# Public Input No. 207-NFPA 70-2019 [ Global Input ]

**"no less than"**
**change to**
**"not less than"**

## Statement of Problem and Substantiation for Public Input

The term "no less than" is used approximately 6 times in the NEC.
The term "not less than" is used approximately 881 times in the NEC.

Reason for the global change is for consistency, and to comply with the style manual. The "no less than's" can be found in:

Definitions, Overcurrent Protective Device, Branch-Circuit.
240.21(B)(4)(9)
430.109(F)
600.32(A)(4) [appears twice in this section]
691.1

## Submitter Information Verification

**Submitter Full Name:** Nick Sasso
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**Street Address:**
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**Submittal Date:** Thu Dec 26 19:34:36 EST 2019
**Committee:** NEC-P01

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# Public Input No. 259-NFPA 70-2020 [ Global Input ]

**"unless permitted by..." or "unless permitted by Article..."**
**change to**
**"unless permitted in..."**

## Statement of Problem and Substantiation for Public Input

Basically this is just clean up language, and to be in accordance with section 4.1.2 of the style manual. Let's pick one or the other. I believe that the correct language should be "unless permitted in..."

The unless permitted by's are located in:

300.13(A)

348.20(A)

356.20(A)

411.5(B)

625.46

626.26

725.136(A)

760.136(A)

The unless permitted in's are located in

225.30

230.2

348.20

356.20

411.5(B)

625.46

626.26

725.136(A)

760.136(A)

## Submitter Information Verification

**Submitter Full Name:** Nick Sasso
**Organization:** Clark County Building and Fire
**Street Address:**
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**State:**
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**Submittal Date:** Wed Jan 08 14:31:09 EST 2020
**Committee:** NEC-P01

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# Public Input No. 276-NFPA 70-2020 [ Global Input ]

**(capable of being) locked in the open position**

**to**

**(capable of being) lockable open**

## Statement of Problem and Substantiation for Public Input

There are approximately 21 references to, "capable of being locked in the open position..."
and
there are approximately 26 references to, "capable of being lockable open..."

Let's pick one. Reason for change is consistency throughout NEC

## Submitter Information Verification

**Submitter Full Name:** Nick Sasso
**Organization:** Clark County Building and Fire
**Street Address:**
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**State:**
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**Submittal Date:** Sat Jan 11 17:27:37 EST 2020
**Committee:** NEC-P01

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# Public Input No. 277-NFPA 70-2020 [ Global Input ]

(capable of being) lockable open

change to

(capable of being) locked in the open position

## Statement of Problem and Substantiation for Public Input

There are approximately 26 references to, "capable of being lockable open..."

and

there are approximately 21 references to, "capable of being locked in the open position..."

Let's pick one. Reason for change is consistency throughout NEC. Personally, I prefer "capable of being locked in the open position."

## Submitter Information Verification

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**Organization:** Clark County Building and Fire
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**Submittal Date:** Sat Jan 11 17:33:21 EST 2020
**Committee:** NEC-P01

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# Public Input No. 368-NFPA 70-2020 [ Global Input ]

**Please provide page headers with the appropriate identifiers to make use of the code less confusing.**

| | |
|---|---|
| Example 1: | Chapter 1 Article 100 - Definitions - PART III - Haz Locs |
| Example 2: | 110.31 Article 110 - Reqs for Electrical Installations -Part III - OVER 1000 VOLTS nom |
| Example 3: | Annex C- Tables Informative Annex C - Table C-3 (FMC) cont. |

## Statement of Problem and Substantiation for Public Input

Earlier versions of the document included shorthand page headers that greatly improved user ease of finding the correct code sections. As written now the document is confusing with important distinctions hard to ferret out. For example the sections that are limited in application to certain voltages or locations may run for pages but the transition to that distinction is hard to find, and any page after the initial distinguishing information is not notated in any way to indicate that a limitation of scope applies.. Identifiers such as Part III Over 1000 volts is not prominently distinguished in the body of the text and is not reflected in the page heading on latter pages, leading to much confusion when using the document in the field. (Earlier versions also had the PART III or similar transitions prominently bold to make finding them easier.) Please accept my apology if this is submitted in the incorrect format or to the incorrect panel or group. This would appear to be a style request more than a code request but I did not find any public input option for style or page headers.

## Submitter Information Verification

**Submitter Full Name:** Joe Kunkel
**Organization:** NU Electric Co
**Street Address:**
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**State:**
**Zip:**
**Submittal Date:** Sun Jan 26 12:24:46 EST 2020
**Committee:** NEC-P01

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# Public Input No. 454-NFPA 70-2020 [ Global Input ]

**Type your content here: I would like to see one of the two things I have listed happen; either put all definitions in article 100 no matter how many times the term is used throughout the NEC or keep the NEC at the current format limiting article 100 for definitions of terms used more than twice in the NEC and using xxx.2 for definitions that are only used in that particular article. Do not use xxx.2 for anything besides definitions. Currently if an article does not contain any definitions, xxx.2 is used for anything. Example; 90.2 SCOPE, 110.2 APPROVAL, 200.2 GENERAL, plus many other articles, although this change would not in essence save lifes, it would add consistincey to the NEC, ...**

## Statement of Problem and Substantiation for Public Input

This would add consistency to the NEC,

## Submitter Information Verification

**Submitter Full Name:** Ray Pritchett
**Organization:** NJATC
**Affiliation:** Evansville Electrical Training Center IBEW Local 16
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**Submittal Date:** Sun Feb 09 22:55:07 EST 2020
**Committee:** NEC-P01

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# Public Input No. 2989-NFPA 70-2020 [ Global Input ]

**Regarding the division of NEC Articles into “Parts”;**

**Where "Parts" are used to sub-divide NEC Articles by topic, it is proposed to amend the Part description text with a set of brackets that enclose the span of paragraph numbers that is encompassed by the respective Part category.**

**For example, NEC Chapter 2, Article 210, Part III.**

**This "Part" text string is represented as;**

**Part III. Over 1000 Volts**

**The proposal is to revise this "Part" text string to;**

**Part III. Over 1000 Volts (210.50-.70)**

**And, to do the same for all "Parts" of all NEC Articles.**

## Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION: to facilitate quicker more efficient code searches by providing a context clue via association of the paragraphs that are correlated to the "Part" sub-category. Page-by-page code searches that miss seeing the keyword "Part" somewhere on the page, could now be less prone to such erroneous mis-associations

## Submitter Information Verification

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**Submittal Date:** Thu Sep 03 19:32:38 EDT 2020
**Committee:** NEC-P01

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# Public Input No. 3013-NFPA 70-2020 [ Global Input ]

**Move all definitions in the code to Article 100, arrange them in alphabetical order and without any subdivisions.**

## Statement of Problem and Substantiation for Public Input

The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The Revisions to the NEC Style require all the definitions to be moved to Article 100.

## Submitter Information Verification

**Submitter Full Name:** David Williams
**Organization:** Delta Charter Township
**Street Address:**
**City:**
**State:**
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**Submittal Date:** Thu Sep 03 21:41:22 EDT 2020
**Committee:** NEC-P01

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# Public Input No. 3141-NFPA 70-2020 [ Global Input ]

**Move all definitions in current (2020) NEC text to Article 100. Insert those definitions in alphabetical order. For definitions that apply in only one article, the article number in parentheses shall follow the definition. The CMP responsible for the definition shall be identified in parentheses at the end of the definition following any extract or article information.**

Type your content here ...

## Statement of Problem and Substantiation for Public Input

This revision provides a more usable code by providing a uniform process to find definitions. Users are currently required to look in multiple locations to determine if a term is defined. Other NFPA codes and standards utilize a single location for all definitions.

## Submitter Information Verification

**Submitter Full Name:** Donald Cook
**Organization:** Shelby County Department of De
**Affiliation:** Self
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Sat Sep 05 15:11:40 EDT 2020
**Committee:** NEC-P01

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# Public Input No. 3327-NFPA 70-2020 [ Global Input ]

**Review the revisions to the new NEC Style Manual and make changes to comply with the Style Manual.**

## Statement of Problem and Substantiation for Public Input

The NEC Style Manual has been revised and every code making panel needs to review the manual and make changes to their code articles to comply with the Style Manual revisions.

## Submitter Information Verification

**Submitter Full Name:** David Williams
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**City:**
**State:**
**Zip:**
**Submittal Date:** Tue Sep 08 07:31:11 EDT 2020
**Committee:** NEC-P01

# Public Input No. 3328-NFPA 70-2020 [ Global Input ]

**Review the Articles with multiple parts to comply with the revisions made to the NEC Style Manual. Make changes based on the Style Manual revisions.**

## Statement of Problem and Substantiation for Public Input

Section 2.1.4 was revised by adding the last two sentences. Where an article contains multiple parts and includes general installation requirements, such requirements shall be located in the first part titled “Part I. General”. Part titles shall be descriptive and as concise as possible.

## Submitter Information Verification

**Submitter Full Name:** David Williams
**Organization:** Delta Charter Township
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Tue Sep 08 07:34:42 EDT 2020
**Committee:** NEC-P01

## Public Input No. 3329-NFPA 70-2020 [ Global Input ]

**Revise the Definition Title Structure to comply with the NEC Style Manual.**

## Statement of Problem and Substantiation for Public Input

Review the Style Manual Revisions in 2.2.2.3 Definition Title Structure. Definitions that have sub-parts shall be listed alphabetically by the base term, with a comma and then the modifying descriptor.

## Submitter Information Verification

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**Organization:** Delta Charter Township
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**Zip:**
**Submittal Date:** Tue Sep 08 07:36:42 EDT 2020
**Committee:** NEC-P01

## Public Input No. 3330-NFPA 70-2020 [ Global Input ]

**Verify that all exceptions are written in completed sentences.**

## Statement of Problem and Substantiation for Public Input

The NEC Style Manual requires that all exceptions are written as complete sentences in accordance with 3.1.4.1.

## Submitter Information Verification

**Submitter Full Name:** David Williams
**Organization:** Delta Charter Township
**Street Address:**
**City:**
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**Zip:**
**Submittal Date:** Tue Sep 08 07:40:56 EDT 2020
**Committee:** NEC-P01

# Public Input No. 3331-NFPA 70-2020 [ Global Input ]

**Revise the definitions in Article 100 to include an acronym, as desired, for subsequent use in the NEC without having to state the term.**

## Statement of Problem and Substantiation for Public Input

The permitted use of acronyms in the NEC has changed with the Style Manual revisions in 3.2.3. When a term is defined in Article 100 and includes an acronym, that acronym is permitted to be used elsewhere through out the code.

## Submitter Information Verification

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**Street Address:**
**City:**
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**Zip:**
**Submittal Date:** Tue Sep 08 07:43:12 EDT 2020
**Committee:** NEC-P01

## Public Input No. 3332-NFPA 70-2020 [ Global Input ]

**Review the structure of all Informational Notes to comply with the revised NEC Style Manual.**

## Statement of Problem and Substantiation for Public Input

Sections 3.1.3.1 and 4.1.3 of the revised NEC Style Manual includes designed structure for references in Informational Notes.

## Submitter Information Verification

**Submitter Full Name:** David Williams
**Organization:** Delta Charter Township
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Tue Sep 08 07:48:58 EDT 2020
**Committee:** NEC-P01

## Public Input No. 3333-NFPA 70-2020 [ Global Input ]

**Review all references to articles or parts of articles to comply with the Style Manual.**

## Statement of Problem and Substantiation for Public Input

Section 4.1.4 References to a Part Within an Article. Except for Article 100, references shall not be made to an entire article. References to parts within articles shall be permitted.

## Submitter Information Verification

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**Submittal Date:** Tue Sep 08 07:50:17 EDT 2020
**Committee:** NEC-P01

# Public Input No. 3335-NFPA 70-2020 [ Global Input ]

**Review the use of Parts within an article and the section number for parts of an article.**

## Statement of Problem and Substantiation for Public Input

The code panels need to review the sections under their purview to comply with the revisions made to the NEC Style Manual. 2.4.2.1 Parts. If an article is subdivided into parts, it is recommended that the section numbering within each part start with the next decade as a minimum to allow for future growth. New or significantly reorganized articles shall follow this numbering convention. Where an article has multiple parts, Part I. shall be titled “General”.

## Submitter Information Verification

**Submitter Full Name:** David Williams
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**State:**
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**Submittal Date:** Tue Sep 08 08:02:00 EDT 2020
**Committee:** NEC-P01

# Public Input No. 3336-NFPA 70-2020 [ Global Input ]

**More than one informational note in a section or subdivision shall be consectutively numbered.**

## Statement of Problem and Substantiation for Public Input

The numbering of informational notes need to comply with the changes made to the revised Style Manual.
2.4.3. Numbering Informational Notes. If there are two or more informational notes in a definition, section or subdivision, consecutive numbering of the informational notes shall only occur in that definition, section or subdivision.

## Submitter Information Verification

**Submitter Full Name:** David Williams
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**Zip:**
**Submittal Date:** Tue Sep 08 08:10:27 EDT 2020
**Committee:** NEC-P01

# Public Input No. 3490-NFPA 70-2020 [ Global Input ]

**100 Definitions**

**Defined terminology associated with Manufacture and Construction activities.**

1. **The term "Construction" shall be defined as the process of deploying product or installation of a device, material, or item of equipment in accordance to its designated purpose. An owner or owner's agent (e.g. contractor) implements construction at a specific worksite location for either a permanent installation, or a temporary application as permitted by code. Installation shall comply with manufacturer terms and ratings unless permitted otherwise in this code. All code delegated responsibilities for testing, marking, labeling, identification, documentation, etc., which are not the clear accomplished responsibility of the manufacture production process, shall be the due diligence responsibility of those involved with the construction process, unless approved otherwise by the authority having jurisdiction.**

**Informational Note: construction applications include, but are not limited to, activities associated with activities involved with: install, field installed, field applied, field tested, field assembled, field evaluation, field wiring, field marking, field conversion, and field labeled.**

2. **The term "Fabricated" shall be defined to apply to equipment or an assembly that is neither necessarily listed nor mass-produced. For example, custom equipment, a custom assembly, or equipment that is altered from its original listing. Fabrication may occur in whole or part onsite or offsite. Component parts and materials may be listed, or may be required to be listed by this code or by the authority having jurisdiction. Generally, where fabricated products are permitted by this code, code compliant product qualification shall be by a Field Evaluation Body, where duties typically include: product testing, marking, labeling, identification, standards compliance, product documentation and instructions sufficient for the safe operation appropriate per the application criteria. Fabricated applications also include reconditioned equipment and retrofit equipment, as permitted by this code, wherever equipment is functionally restored to other than conformance to the original manufacturer's equipment ratings and life cycle projections. Fabricated equipment and systems that encompass, in part or whole, any associated construction activities and elements, shall absorb the associated due diligence responsibilities involved, except as approved otherwise by the authority having jurisdiction.**

**Informational Note: fabrication applications generally include, but are not limited to, activities associated with pre-fabricated equipment and systems: electrical system assemblies, mechanical system assemblies, and modular building assemblies. Where the assembly is listed as a unit, then the manufacture application responsibilities apply.**

3. **The term "Pre-fabricated" shall be defined to apply to those fabricated equipment assembly activities that occur at a site other than the permanent installation location.**

4. **The term "Manufacture" shall be defined as the factory assembly of a product, characteristically mass produced and distributed. Examples include: equipment, wire, devices, material, and compounds. The manufacture process includes production activities including: factory testing, marking, labeling, identification; NRTL Listing where applicable; standards compliance, product document publication for sales and designer specifications including those used for: shipping, install, field**

**testing, owner use, and maintenance. By definition, final assembly or other in-field activites of a product at its permanently installed location will not constitute an aspect of manufacture, unless performed by the manufacturer.**

**Informational Note 1: applications where a product's permanent or temporary installation occurs at a point-of-use location under direct supervision of the manufacturer, the requirement duties of both the manufacture process(es) and associated construction process shall be the responsibility of the manufacturer, except as approved otherwise by the authority having jurisdiction.**

**Informational Note 2: manufacture applications shall include modular equipment, where an assemblage of different products has been hybridized into a singular unit, when the unitized equipment is listed. Where the unitized equipment is not listed as a unit, then the fabricated application responsibilities apply.**

## Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION:
The term "construction" is used throughout NEC in reference to code requirements that are aimed at typically different segments of industry, which only occasionally overlap each other's general task sets. Product construction during manufacture is one application, versus product install during site construction. The code text describes both contexts as construction. Where practicable, it would improve functional clarity in code text requirements to employ distinct construction-like terms wherever reasonable and appropriate. The terms and definitions proposed are suggestions; to serve as a basis to move this discussion and consensus forward.
Where code requirements clearly intend compliance fulfillment to be about the product's activities prior to leaving the factory, distinct terminology can communicate this with added clarity. Similarly, where code compliance fulfillment clearly applies to the implementation of a product, as regards its permanent installation, a distinctly defined term for 'construction' will yield improved comprehension as to intended context. A third distinct category can also be established by definition that encompasses fabrication, to serve to encompass custom fabrication assemblies, reconditioned equipment, and retrofits.
Applications where the code responsibility can fall into gray areas for accountability between the three, can be attended to by a default assignment of responsibility. This explicit clarity helps ensure that enforceable code compliance responsibilities are clearly stated. Allowance for an exception, per AHJ acceptance, provides a mechanism to formally transfer an obligation of responsibility.
Where the code speaks to putting an identifying mark, or information, or color onto a cable or item of equipment, it more often refers to those which would intend to be understood as the responsibility of the manufacturer. The following two sets of code citations illustrate where the manufacturer is to provide a mark or color (first set) versus where the installer is to provide a mark or color. The third set of code citations is where it is intuitively apparent that either the manufacturer or installer could either be involved (or both involved) in providing a mark or color on the electrical equipment.
Example requirements for manufacturer marks or color include but are not necessarily limited to; 110.14(D), 110.28, 200.4(B), 200.6, 200.7, 200.9, 200.10(B), 200.10(D), 215.12(A), 215.12(B), 225.30(A)(7), 230.46, 230.66(A), 230.70(B), 230.77, 240.50(C), 240.81, 240.82, 240.83(A&B), 240.83(D), 240.85, 250.28(B), 250.110 Ex3, 250.119, 250.119(A), 250.119(B), 250.119(C), 250.126, 250.28(B), 250.112, 250.114, 250.119, 250.126, 300.11(B)(1), 300.11(B)(2), 310.3(D), Table 310.4(A), 310.6(ABC), 310.8(C)&(D), 310.10(C), 310.10(D), 311.14, 311.16(A), 311.16(B)(1&2)), 311.16(B4&C), 311.32, 314.16(C)(2), 322.56(B), 322.120(C), 336.120, 338.120, 368.12(E), 386.70, 388.70, 406.3(D), 406.3(E), 406.10(B), 406.13 (A-D), 409.110, 430.52(C)(5), 500.8, 501.5, 501.17, 501.105(B)(1), 501.130(A)(1, 502.6, 502.130(B)(1), 502.130(B)(2), 503.130(A), 504.80(C), 505.8, 505.20(B&C), 505.22, 505.26, 506.9(C)(1), 506.9(C)(2), 506.9(D), 517.18(A), 517.19(A), 517.61(C)(2), 530.21(B), 530.22(B), 545.22(A), 551.77(A), 552.10(B)(3), 552.10(E)(2), 555.8, 555.33(B)(2), 600.23(F), 600.33(A)(3), 600.33(A)(4), 690.12(C), 690.51, 694.22(A), 700.10(A), 705.12(D), 705.20, 706.15(C), 708.10(A)(2), 712.37, 725.3(P), 725.179, 760.3(O), 760.30, 760.176(G), 760.179(G)(1), 770.179, 800.182, 805.179, 820.179, 830.90(A)(2), 830.179(C&D), 840.170(B), and 840.170(E).
Example requirements for the installer to do the marks or color indications include but are not necessarily limited to; 200.4(B), 200.6, 210.5(C)(1), 210.5(C)(2), 210.12, 215.12(A), 215.12(C)(1), 215.12(C)(2), 225.30(B), 225.38(C), 225.52(D&E), 230.72(A), 300.5(D)(3), Table 300.50, 310.6(ABC), 311.14, 406.3(E),

406.10(B), 408.3(E)(2), 408.3(F)(1), 408.3(F)(2), 408.3(F)(3), 408.3(F)(4), 408.3(F)(5), 517.18(A), 517.19(A), 517.160(A)(5), 530.21(B), 530.22(B), 547.9(A)(10, 550.33(A), 552.43(C), 620.53, 620.55, 647.4(C), 647.7(A)(4), 668.21(C), 690.54, 690.55, 700.10(A), 712.25, 712.55, 725.124, 760.30, and 770.179(F).

Example requirements for either the manufacturer and/or the installer to do the marks or color indications include but are not necessarily limited to; 230.56, 250.21(C), 250.167(C), 408.3(E)(1), 409.102(B), 430.97(B), 430.109(A)(6), 430.109(E), 517.31(C)(1), 517.31(E), 517.42(E), 520.44(C)(3), 520.54(C), 520.54(J)(1), 520.54(K), 530.21(B), 530.22(B), 550.10(I), 690.1, 690.31(B)(1), 690.31(D)(2), 770.179(G), 805.90(A)(2), and 805.170(A).

As regards reconditioned equipment and retrofit equipment, the code is in its developing infancy as regards code requirements for marks, as they are few, yet likely to grow in upcoming code cycles. Having distinct groups for manufacture, installation, and fabrication also serves to help make obvious, the places in code that similar code requirements between them may be missing but warranted.

Similar to the topic above for equipment marks between manufacture, installation, and fabrication, are topics for labels and signage which are beyond marks.

In NEC Chapter 3,4 and 7 the term “manufacture specifications” can substituted for “construction specifications”. And in NEC Chapter 5 and 6, where specifications have other terminology variations based on product qualities, “manufacture specifications” can be used with such term descriptors for NEC consistency to augment transparency when a code specification is intended to apply to manufacture apart from installation criterion.

Another example benefit from having a distinction between manufacture, installation, and fabrication are for the code required documentation and whom is to provide it. Such as; instructions for shipping, install, or maintenance, versus installer instructions for operation sequence, equipment ratings guidance or site-specific diagnostic protocols.

Where an entity assumes multiple roles of manufacture, installation, and/or fabrication, they are intended to assume the respective responsibilities. And, what those responsibilities are will have improved certainty, when there are improvements to distinctions of terminology and nomenclature. Inspections and commissioning processes will similarly be improved for the same basis of improved enforceable clarity.

SIDEBAR: a supplemental suggestion, in the earnest of minimizing code text where practicable, is to utilize a letter or symbol icon, for use in NEC margins, that correlates to each of the three definitions for, manufacture, versus fabricated, versus construction. For example, a symbol icon for manufacturer (e.g. Hex Note enclosing an 'M'), versus those affiliated with the product install construction process (e.g. Hex Note with 'C'), versus the symbol for the fabrication process (e.g. Hex Note with 'F'). One example of benefit of deploying a symbolic nomenclature is the topic of labels, signage, and markings; which are often able to be grouped by: manufacturer, fabricated, or installer. Each instance in code for label, mark, or sign can include one or more of these three symbols in the margin alongside the code text without adding pages to the code. A raised bar of label and signage compliance is likely the result, plus an improved ease and capacity for enforcement by way of inspection or commissioning.

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# Public Input No. 4390-NFPA 70-2020 [ Global Input ]

**When an Article has Parts the revised Style Manual requires the following in 2.1.4.**

**Part titles shall be descriptive and as concise as possible.**

**Example:**

**Part I. General**

**Part II. Installation**

**Part III. Construction**

## Statement of Problem and Substantiation for Public Input

The revised Style Manual requires Article Part titles to be descriptive and concise as possible and provides examples for the code panels to use.

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# Public Input No. 4707-NFPA 70-2020 [ Global Input ]

**Globally revise the use of term "Listed", and revise use of the term "Labeled"**

To distinguish the NRTL (testing lab) context for the term "labeled" and "listed" from other NEC context uses of these words in all their forms; label, labels, labeling and labeled, it recommended to apply capitalization to the word "Labeled" and "Listed" when intended for this particular context of a testing organization. Capitalization as proper nouns will make this context more readily recognizable.

For additional distinctive clarity for this context of these terms 'listed' and "labeled", apply them with their "NRTL" modifier; and deploy "NRTL Listed" and "NRTL Labeled" throughout the Code text. Of course, all variants formed for grammatical correctness would also be amended and capitalized, such as "NRTL Listing" and "NRTL Label" etc.

In the definitions, it is appropriate to associate NRTL to "Nationally Recognized Testing Laboratory", which is generally the type of testing agency. Any other testing agency, where approved by an AHJ, is allowed. It is also appropriate to include a reference to the industry standard organization that acknowledged to govern this industry acceptance standard for each NRTL, the Occupational Safety and Health Administration (OSHA). With OSHA acknowledged as the official agency, it becomes a Code-legitimized reference, able to facilitate any follow-up enquiries regarding code compliance. To help facilitate back-checks has never been more suitable than in this age of ever-increasing pirating of product and other pretenders to suitability.

Wherever the term 'Labeled' is used as part of 'NRTL Listed and Labeled', it shall refer to the equipment mounted labeling that is pertinent to all of the equipment item's application-specific Listing(s) and shall include the equipment ratings.

Wherever the term 'Marked' is used as part of 'NRTL Listed and Marked' or 'NRTL Listed and Labeled and Marked', 'marked' shall refer to the marking or labeling that is associated with the Listing and shall include the specific qualification of use mentioned in code. E.g. listed and labeled and marked as being suitable for use as service equipment.

## Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION:

The term 'Listing' and 'Listed' will be capitalized and treated as a proper noun; short for 'NRLT Listing' and 'NRTL Listed'. The term 'Labeled' will also be capitalized as a proper noun when used to indicate 'NRTL Labeled' or 'Manufacturer Labeled' as regards the manufacturer's terms of use for the equipment. NFPA codes does not capitalize these three terms generally so they are indistinguishable from the other contexts for a list or label. Manufacturer terms of use regarding labeling can include ratings, Listing types, or other declarations of compliance to particular industry standards.

There Code text of NEC 110.3, Part (C) may have intended for equipment generally to be Listed, but technically it is not ever stated. All that is stated is the terms for who will do the testing and evaluation as regards a Listing.

The Occupational Safety and Health Administration (OSHA) is the official agency that recognizes qualified testing laboratories, of which there are 23 approved labs to date. OSHA confirms that NEC's "electrical" sub-distinction of labs in NEC 110.3, Part (C) doesn't formally exist as an industry recognized group. The 'electrical' testing laboratory distinction is an obscure reference used in two other places in the NEC [90.7,

490.48(A)], but not in the NEC's other (14) references of a testing laboratory. Underwriter Laboratories (UL) is the only distinct NRTL lab whose standards are cited in the NEC and there are hundreds of UL citations (see. NEC Informative Annex A). One relevant ATS example is cited in NEC; UL1008 for transfer switches up to 600V. And one relevant ATS example is not cited in NEC; UL1008A for 750V-46kV ATSs. Whether another NRTL lab other than UL may qualify NEC's intent as an "electrical lab" is unknown. The NEC requirements are functional without the "electrical" sub-distinction, and so this likely warrants deletion of "electrical" in an upcoming NEC code revision.

Though these code articles infer an expectation that an ATS shall be used, an ATS is not overtly mandated as required. Only when an ATS is used, then definitive code requirements apply, like a Listing for emergency use.

NEC Article 705 applies to Interconnected Power Production Sources that parallel with the normal source, which is typically the utility supplied power source. There is an incongruence of code due to what NEC 705 allows. That is whenever the 705 code language is interpreted as an absolute permission due to the omission of disallowances of use as an essential-class power system. The code requirement variance compared to similar applications is a risk, because it then grants an emergency power distribution topology absolution because the code language allows it. NEC Article 705 has no requirements for equipment to be Listed for any aspect.

NEC 705 applies to distribution gear that interconnects normal power (e.g. utility) with an alternate source of power (e.g. generator). The 705 distribution gear may serve in place of an automatic transfer switch because the code does not disallow that use. Yet code does not require it be listed for emergency use, nor does it even require the automated switching mechanisms to be electrically operated and mechanically held. The NEC 705 gear has latitude to have more than two sources and more than one load. The function of NEC 705 gear may be no less critical but it is more susceptible to dysfunction than an ATS. It is arguably more important even than any single automatic transfer switch as it can perform the duty of multiple transfer switches or be the power source to many ATSs. It is like using a string to support a chain. This example illustrates how language of one NEC article (705) can permit use of a power distribution topology that is inconsistent to all other instances of code text regarding transfer switching of emergency power, which would otherwise be fairly consistent.

Application Specific Code Requirements

A summary of code findings on power source selection for emergency applications is as follows;

1. FOR ALL CODIFIED POWER SYSTEM TYPES OTHER THAN NORMAL: An ATS shall be NRTL Listed for Emergency Use (and also identified for Standby Use). Exceptions are:

A. Optional Standby Power System (NEC 702; other Listing requirements may apply)

B. Fire Pump (NEC 695; other Listing applies)

C. Interconnected Power Production Sources (NEC 705)

D. Medium Voltage (see caveats below)

2. MEDIUM VOLTAGE CAVEATS:

A. NFPA 99 indicates an ATS <600V must be Listed for the purpose. No mention of requirements for other voltages >600V. Allowance for ATS >600V to not be Listed is one logical inference.

B. NFPA 110 states MV transfer of central plant or mechanical equipment is allowed using electrically interlocked medium voltage circuit breakers; but the equipment branch MV transfer switch is not to include life safety (LS), emergency (RE), or critical branch (CR) loads. By mention of critical branch this code regards healthcare but is not correlated by any healthcare code; neither by NFPA 99 nor by NEC 517. Allowance by Listing omission may be logically inferred for power system types not mentioned; SEPSS (NFPA 111), RSPSS (NEC 701), EQ (NEC 517), FPPSS (NEC 695), FCPSS (NEC 692), and EPSS (NFPA 110). Note that an MV transfer equipment is not disallowed for LS, RE, or CR if the MV switch is separated from mechanical loads. Also, there is no disallowance to separate loads if the MV ATS is Listed.

C. NFPA 70 (NEC) does not mandate a Listing requirement specific to distribution gear generally, including medium voltage (MV) equipment. NEC makes no mention of MV ATSs, nor provides any specific exemption for an MV ATS. That paralleling gear has no Listing requirement at all would apparently extend to MV types of paralleling gear.

3. FOR FIRE PUMP APPLICATIONS: A fire pump's local ATS and/or controller shall be NRTL Listed for electric motor-driven fire pump service. Other transfer equipment upstream of a fire pump ATS does not qualify it as a fire pump ATS also; so only the lower level ATS must meet these 'Fire Pump ATS' requirements.

4. GENERAL REQUIREMENTS: NRTL Listing types compound for each condition of use that applies; 'emergency', 'wet location', etc; whenever the NRTL Listed Use is an available product offering. An ATS must be NRTL Listed for all of the load types to be served. Field labeling by a Field Evaluation Body is an alternate compliance path for a Listing requirement generally, except where a Listing is overtly stated as the only compliance path such as for an ATS and select other NEC applications.

5. OPTIONAL STANDBY APPLICATIONS: Transfer equipment shall be NRTL 'Listed as Transfer Equipment' wherever supplemental circuit protection devices (CPD) are integral to the transfer equipment. No other Listing requirements apply for Optional Standby transfer equipment.

6. INTERCONNECTED POWER PRODUCTION SOURCES are a recognized transfer switch application apart from an ATS. NEC 705 scope only applies to multiple sources if the normal source (e.g. utility) is one of the sources. Where field labeling is provided, the NEC does not mandate any requirement for a Listing of any kind. Even if it is Listed, NEC doesn't require the gear to be NRTL 'Listed as Transfer Equipment' (as CPD optional standby transfer equipment must do), nor 'Listed for Emergency Use' (as all other emergency power transfer equipment must do). Where NEC 705 is applied to critical grade topologies, NEC suffers a glaring omission for any code-required NRTL type validation for a failsafe style of integrity, suitable for essential-class loads.

7. PARALLELING GEAR for automatic transfer switching of multiple sources (apart from an Article 705 type system) has no code article that governs its performance requirements. Only if the paralleling gear is connected to a normal (utility) source must it then comply with NEC 705. But even then the 705 requirements are not up to the usual code standards for critical or emergency gear and so it does not impose any failsafe standard for integrity including associated Listings.

Ironically, NEC 110.3(B) does state (by omission) that only the Listed or Labeled equipment needs to be used in accordance with the equipment manufacturer's instructions. Because the NEC makes no similar requirement of equipment that is not Listed nor Labeled, this equipment category escapes the stipulation to comply with the manufacturer's terms of use. This however is recognizable as nonsense, and an intonation of NEC intent must be interpolated.

NEC 110.3, Part (C) fails to identify that multiple Listings may be required for a product, and that one Listing may not be adequate. An individual separate Listing for each specific category of use is required whenever such Listing categories apply to the conditions of the equipment use.

NEC 110.3, Part (C) also fails to identify NEC's own exemptions for its general requirement that everything be Listed, and whether there are terms for when these exceptions are permitted or disallowed. One category is custom fabricated equipment, of which certain field assemblies may qualify as hybrid sub-category. One other category is equipment that has been reconditioned, refurbished or remanufactured. One final category is non-Listed equipment where NEC has outlined the specific terms of permitted use based on application. The problems arising from potential distinctions of allowances for non-Listed equipment is much more pronounced when the inconsistencies of Listing requirements by specific application are attempted to be put into a proper context (more on this in Chapter 8).

A best practice default for equipment selection is to choose a Listed product whenever one is available, and include each Listing application type that applies. Only when a Listed product cannot meet the design requirement should an alternative be considered; such as a custom fabricated product. Even then, such non-Listed applications shall be responsibly managed to best show coherence to all other code intent toward trustworthy integrity of; the components, the assembly work, and the resultant functionality. And where NEC outlines terms for use specific to "non-Listed" equipment (as done in Chapter 8), it shall be considered an acceptable form of compliance.

The NEC variations of terminology for Listed and for Labeled is diverse but the reason for this inconsistency is not always evident. The numeral in parenthesis is the number of occurrences found for each term in the NEC.

SIDEBAR: As the deadline for 2020 Public Comment is impending, the values and citations from here forward were not back-checked to 2020 NEC from the v2017 they were derived from .

1. Listed (1715), Listing (247), List (9)
2. Approved (473), Approving (2), Approval (44)
3. Labeled (65), Labeling (30), Labels (57), Label (55), Field Labeled (3), clearly Labeled (1)
4. Identified (2), Identifying (35), Identify (41)
5. Marked (647), Marking (555), Mark (31), Marks (3)
6. " Listed for" (332)
7. "Listed and Labeled" (21)
8. "Listed and Labeled for" (2)
9. "Listed or Labeled" (6)
10. "Listed, Labeled, and identified" (18)
11. "Listed, Labeled, or identified" (1)
12. "Prominently Labeled" (2)
13. "Listed, Labeled, and marked" (1)
14. "Listed and Labeled or field identified" (1)

Situation specific NEC requirements for equipment to be "Listed" vary case-by-case, whether by code article, or by site application type, or by equipment category. The way the requirements varied indicate that either code intent is not always consistent, or that the manner in which NEC requirements are written are a mixed bag of inconsistencies. In actuality, it is both.

The code citations below are selected to indicate general requirements and the requirements specific to switch transfer of emergency power sources. Other unrelated code citations are included to illustrate how the code may show consistency and how it shows inconsistency.

1. Listing Requirements by NEC Article

Every material item used for Trailer Parks (NEC 552), RVs (NEC 551), and mobile homes (NEC 550) must be Listed. But not a thing is mandated as needing to be Listed for hospitals (NEC 517), floating buildings (NEC 553), and certain other applications in NEC such as; Cablebus (370), Multioutlet Assemblies (380), Underfloor Raceways (390), Concealed Knob and Tube Wiring (394), Open Wiring on Insulators (398), Outdoor Overhead Conductors Over 1000V (399), Flexible Cords and Flexible Cables (400; though only nearly nil), Fixture Wires (402), Industrial Control Panels (409), Fixed Industrial Heating Equipment (455), Capacitors (460), Resistors and Reactors (470), Equipment Over 1000V (490), Integrated Electrical Systems (685), Interconnected Power Production Sources (705; aka paralleling gear), Circuits and Equipment Under 50V (720), and Energy Management Systems (750).

2. Listing Requirements by Equipment Category

For other NEC articles, the requirements for Listed equipment amounts to an honorable mention of oddities in bits and pieces; not because those bits are especially significant, or associated with criticality. NEC will

mention a Listing requirement for the parenthetically consequential 1% and miss the more essential 99%. Switchgear (408) requires that insulated conductors are Listed, but NEC invokes no other requirements of anything else to do with switchgear to be Listed. There are times that NEC chapters or paragraphs only apply technically for any equipment which is Unlisted.

Most all raceways and cabling, but one, are required to be Listed from the 300 series articles of NEC. But at many points amongst the other code articles, only the fittings are indicated as needing to be Listed. The singular 300-series article for cablebus that was inadvertently skipped, is likely an oversight.

3. Listing Requirements by Application Type

Some aspects of Listings are meant to apply categorically, like a Wet Location Listing for any equipment in wet locations; but NEC consistency is sporadic and omissions prolific where they should apply. This inconsistency is similar to the requirements mentioned for sun exposure considerations.

At some points of code there are common applications with common importance factors but they are treated with uncommon requirements.

4. Observations of Inconsistent and Irrelevant Text

The terminologies for similar types of Listings has aspects of inconsistency, such as the five different terms used for an ATS to be Listed for Emergency Use. The verbiage variations could infer that these refined differences in text vary for good reason (with potentially varying requirements), but under scrutiny they do not.

There are code sentences that are superfluous because the Listing requirement for a subcomponent item being mentioned was already imposed generally at some other NEC article prior. Such as for particular conduit fittings to be Listed. To make matters worse, the requirements at one location in code doesn't always match the other location.

Other code text is a waste of language as the statement is redundant unto itself. Such as stating that use of equipment is okay if the Listing says it's okay. Or employing a double-negative to state that equipment is not to be used in a way that the Listing doesn't say is okay. As a side issue, such statements infer that there are "Listing Instructions" to follow for each Listing type. That such instructions exist and are published respective to Listing types is not affirmed to be an industry accepted understanding. How is it proposed that such reference materials are to be captured with consistent integrity by electrical system designers?

At times one or two specifications or features of the Listing itself, are mentioned with the NEC code text. But the exclusion of the other Listing features beckons follow-up questions as to why a partial redundant mention is relevant for some features of the Listing but not the others.

Some NEC text has inferences that a Listing requirement exists without an actual requirement of a Listing ever being stated overtly, only as an inference that the requirement already exists. Conditional statements employing logical grouping sometimes miss clear meaning due to commas missing at relevant points of the sentence.

The benefit that the above comments hope to achieve is in universal applications of Listing requirements as a categorical default wherever practicable, with caveats to follow as to exceptions or specialty additions, such that taken together, the Code edits would amount to less text and simpler forms of clarity. It would be an aide, perhaps suited to Chapter 9 indexes if nowhere else, to have a running list of all potential types of Listings that may be suited to electrical applications governed by NEC. Of course, such a reference list would be subject to on-going updates, but to see them all is perhaps the opportune way to know them.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4586-NFPA 70-2020 [Definition: Labeled.] | similar topic |
| Public Input No. 4591-NFPA 70-2020 [Definition: Listed.] | similar topic |

| | |
|---|---|
| Public Input No. 4619-NFPA 70-2020 [Section No. 110.3(B)] | similar topic |
| Public Input No. 4624-NFPA 70-2020 [Section No. 110.3(C)] | similar topic |

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# Public Input No. 233-NFPA 70-2020 [ Part I. ]

**Part I.** General

**Add definition**

**Emergency disconnect- a disconnecting means that has a Red Lever handle and will disconnect all grounded and ungrounded conductors . This disconnect will meet all lockout standards in NFPA 70e**

## Statement of Problem and Substantiation for Public Input

This will allow all first responders to properly lock out and isolate all energy in system for the team.

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# Public Input No. 2182-NFPA 70-2020 [ New Article after 100 ]

**Health Care Microgrid**

A group of interconnected loads and distributed energy resources within clearly defined boundaries that acts as a single controllable entity with respect to the utility.

## Statement of Problem and Substantiation for Public Input

NFPA 99 has included the concept for a Health Care Microgrid, including its definition. We are submitting a series of PIs to NFPA 70 to correlate with NFPA 99.

This comment is being made by a committee comprised of members of NFPA 99 ELS, NFPA 70 CMP15, and NFPA 110 who has worked over the summer to create a series of proposals to help correlate better with NFPA 99.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2173-NFPA 70-2020 [New Section after 517.30(B)] | |

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# Public Input No. 4318-NFPA 70-2020 [ Chapter 0 [Title Only] ]

**THIS IS A GLOBAL INPUT**

THE TERRAVIEW SOFTWARE WOULD NOT ALLOW THE SUBMISSION OF A GLOBAL INPUT.

PROPOSED GLOBAL INPUT.

Mandate that all alternative energy sources referenced throughout this code comply with the requirements of 230.82(6).

## Statement of Problem and Substantiation for Public Input

This global input is written to address a very serious safety issue that exists abundantly in the NEC. CMP-10 has purview over services and mandates that PV, fuel cells, wind systems, energy storage systems and interconnected power production sources connected on the supply side of the service disconnecting means be done so only with a disconnecting means and overcorrect protection as required for service conductors in Article 230.
The problem here is that 90.3 provides committees dealing with alternative energy sources the ability to completely ignore 230.82(6). They simply claim that "their conductors are output conductors, not service conductors."
Any conductor that taps into or splices to service conductors is a service conductor.
This issue must be dealt with immediately by the NEC Correlating Committee. While this global input may not result in first revisions to correct this very serious safety concern, this concept now exists and is not new in the second draft stage.
We can no longer ignore this issue.

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# Public Input No. 4337-NFPA 70-2020 [ Global Input ]

**Many diverse undefined terminologies are used to invoke some manner of required approval from an AHJ. It may benefit the clarity of intent to either consolidate the use of terminologies or to define their distinctions in respect to each other, or to do some combination of both.**

## Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION
Here are examples of the diverse types of AHJ approval requirements in code;
1. Approved means; 215.12(C)(1), 215.12(C)(2), 230.24, 230.30(A&B), 230.40, 230.50(B), 230.51, 230.53, 240.5(B)(1) , 240.21(B)(2&3), 240.67(A), 250.6(B) 250.68(C)(2), 250.70 (4), 250.94 exception (3), 300.4(H), 300.5, 300.5(F), 300.5(K), 300.6(A)(2), 300.6(A)(2), 300.6(A)(3), 300.6(C)(1), 300.6(C)(2), 300.11(C), 300.15, 300.19(B&C), 300.21, 300.25, 300.50(C).
2. Acceptable to AHJ; 500.8(A), 505.9, 506.9(A).
3. Made available if requested by AHJ; 110.31(A)(3), 110.70, 215.5, 225.56(A) 399.30(A), 399.30(B), 691.6, 691.7, 691.8, 691.9.
4. Made available to AHJ; 110.41, 230.95(C), 240.67(C), 240.87(C) 490.48(A), 517.17(D), 590.6(B)(2), 645.27.
5. Given to AHJ prior to energization; 225.56(B).
6. If Adopted by Local AHJ; 220.12(B), 225.22, 225.36.
7. Preventative Maintenance Plan Required by AHJ; 708.6 (A-E)
8. Initial/Periodic Witness Test by AHJ; 700.3(A), 700.3(D), 708.6 (A-E).

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# Public Input No. 4389-NFPA 70-2020 [ Global Input ]

## COMMENTS ON NEC 705.13 FOR THE 2023 CODE CYCLE

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*September 9, 2020*

## INTRODUCTION

The last two decades has seen the dramatic growth of distributed energy resources (DERs) across the US grid, and this growth is only projected to continue in the years to come. DERs increase the complexity of grid operations, and involve a larger number of active market participants than the traditional model of monopoly utilities who provide power to accounts at the grid-edge from large, centralized plants. Because of this, there is increasing need for control systems that can coordinate both generation and load across discrete busses and circuits from transmission systems down to premises wiring. The adoption of 705.13 in the National Electric Code (NEC or Code) 2020 cycle was a vital recognition of this changing reality. However, this new article, as first adopted, does not adequately reflect the composition, variability, behavior or full capabilities of control systems, and their necessary role in the deployment of DERs.

Control systems can manage all different kinds of equipment, not just electrical equipment; in the electricity sector, they are active at all levels of the electric grid. They can do everything from controlling current in a residential PV system to improving power factor at a high voltage substation. Functionally, we can contemplate the locus of control systems' activity according to the interfaces between major systems in the grid: a) at substations among transmission networks or between transmission and distribution networks; b) at the service point between utility circuits and the premises wiring; and c) at busses or circuits connecting equipment across the premises wiring. Because we are addressing the function of and requirements for control systems as specified in NEC 705.13, our concern will be for the latter, c). However, it should be noted that many of the core considerations discussed here apply equally among distribution and transmission networks, and at the connection of NEC-compliant systems to these networks.

Control systems can manage a wide array of applications, and, indeed, are often central to their design. These applications can operate: a) in time; b) in coordination between different pieces of equipment; c) in reaction to specific monitored conditions; and d) in reaction to signals sent from a higher point of coordination. Electrical equipment can be controlled: a) as a current source; b) as a voltage source; c) if it's an AC system, for its power factor; and/or d) if it's an AC system, for the quality of its power signal against an idealized sine curve. 705.13 specifically deals with limiting current to the busbars or conductors of premises wiring on the basis of monitored conditions for the purpose of protecting this equipment from current overload. This current-limiting function is just one application among many that control systems may be asked to superintend; for example, the same control system which may be limiting current from an energy storage system (ESS) inverter to a sub-panel in a building may also be using the inverter to correct the premises wiring power factor output to the grid across its service point to reduce imaginary power. It is important that the rules and standards required by the NEC are able to grade between this particular application and the broadest set of other control functions, without compromising 705.13's intended safety benefits.

It is not appropriate to think of control systems exclusively as a single, definite type or piece of equipment. Controls can either be ***regulatory***, where they are incorporated into the design and operation of a single device, or ***supervisory***, where they comprise a computing device and its signaling mechanism to one or more

other pieces of equipment with the aim of governing their operations, *together*, as a whole system. In the former, the "control system" is a subordinated feature of a piece of equipment with a specific function, listing requirements, and particularized applicability to different NEC articles. In the latter, the "control system" may have its "brains" associated with a computing device, but it is effectively a set of virtual functions for a *system* embodied by signals coordinating among its constituent parts to govern the behavior of heterogeneous pieces of equipment.

**SCENARIOS FOR LIMITING THE CURRENT OF DERS**

The current-limiting function authorized, alternately, by 705.11, 705.12 and 705.13 can be realized in three different basic scenarios.

SCENARIO #1. A fuse, breaker, or other switching device can be installed at the point of connection for a single circuit, and will trip automatically when the current at that point exceeds some pre-determined, unchangeable limit. This principle is iterative across the premises wiring and can apply to a circuit feeding a single piece of equipment or a circuit serving an enclosure, such as a sub-panel, that combines other circuits for multiple pieces of equipment. This automatic switching operation can happen in milliseconds, if necessary, or longer.

SCENARIO #2. A power source or an energy storage system can be designed and listed to self-limit or modulate its output or intake of power under the governance of its own regulatory controls at pre-defined, but manually changeable, set-points. Alternately, a load control device can limit or modulate current across a single circuit by reacting to a signal under a pre-defined, but manually changeable, function. The input condition, in both cases, could be a current value registered at one or more circuit anywhere across the premises wiring system, or it could be a function of some other measurable value, like time or power factor (though this is unlikely). The modulating action of regulatory controls for many devices can be designed to activate within milliseconds, or longer, as required.

SCENARIO #3. A supervisory control system can orchestrate the output of one or more source, as well as demand from controllable loads, by interfacing with different devices, acquiring relevant real-time information and giving instructions through communication signals. These sources and loads won't necessarily be installed at the same time or be sourced from the "ecosystem" of a single manufacturer. Supervisory controls depend on components that have changeable set-points or alterable functional behavior and that can receive its signals -- similar to those described in Scenario #2. The difference in Scenario #3 is that these inputs to regulatory controls can change dynamically under the guidance of the supervisory controls, and different devices can be coordinated with respect to one another. The supervisory controls, in turn, could be governed by a person, by an algorithm or by machine learning. Supervisory controls are as adaptable and scalable as they need to be. They usually operate, at their fastest, in a second or two, but may be closer to a ten or fifteen second threshold for certain kinds of equipment configurations.

705.11 and 705.12 are both exclusively concerned with Scenario #1. The connections these two articles describe, on both sides of the service point, can only be served by some combination of switch and overcurrent protection device. Scenario #1 is of no particular interest to 705.13, but, as currently written, 705.13 could theoretically apply both to Scenario #2 and Scenario #3.

The requirements that were included in the introduction of 705.13 to the NEC, in the 2020 Code cycle, entail a few items that are germane to its application in Scenario #2 or Scenario #3:

* The text starts by stating: "A power control system (PCS) shall be listed and evaluated to control the output of one or more power production sources, energy storage system (ESS) and other equipment." So the "PCS" must be specifically listed for its control function.
* This sentence also specifically calls for the "PCS" to limit the current from *sources*, but it leaves the door open for loads to be limited as well. "Other equipment" could mean loads, and ESSs are listed as a separate item here because they can behave as loads; also we could interpret the consumption of

power by a piece of equipment under normal operating conditions to be its "output" or at least part of its "output." Current on a bus or a circuit, therefore, can be limited either by curtailing production, or by curtailing load, or both.

* According to 705.13 (A), the "power control system" has to monitor the current of all controlled equipment or circuits, and may monitor uncontrolled equipment or circuits that feed affected busbars or conductors. In most cases, this monitoring function will require an external, automated signal to which the controls must react.
* The text states in 705.13 (C): "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." So the whole scheme of affected busses or circuits must react to current fault conditions that produce an overload condition, not just the switching and curtailment under normal operating conditions enabled by the "PCS" -- whether this be handled by the "PCS" or independently by other devices.
* 705.13 (E) specifies that access to the settings in the controls should be limited to qualified personnel.

Scenario #2 involves equipment whose regulatory controls operate with pre-defined, but manually changeable, set-points. Such equipment can react to a condition on a bus or circuit where the current from multiple sources or to multiple loads exceeds some pre-defined current limit.

Here is a canonical example: let's say in a small commercial building in a strip mall there is a 10 kW inverter for a nominal 12.5 kW DC PV system and it is interconnected at a 200 A main panel with a 200 A main breaker at the service point; if the service and inverter output are single phase, 240 V, the inverter can produce up to ~41.7 A and will need to be protected by a 60 A breaker -- 20 A more than is allowable for this 200 A panel under 705.12 (B) (3) (2) or (4). If the inverter's regulatory controls are able to monitor all of the loads on the main panel, the inverter could proportionally curtail its output when its output and the loads, together, exceed 200 A; under this scheme the PV inverter could still be connected with a 60 A breaker and no modifications would need to be made to the main panel. Presumably, the monitoring scheme would involve devices manufactured by the inverter company and listed for narrow variations of this scenario.

While it is expected that the monitored input signal to these regulatory controls would come from more than one piece of other equipment, there will always be a strong preference to limit the complexity of information meant to serve as input. In other words, Scenario #2 for 705.13 will typically involve measuring simple current values at a single busbar or conductor with power inputs and outputs connected at that point from a manageable number of circuits or pieces of equipment; it is unlikely (though possible) that most regulatory controls would be capable of reacting to situations at more than one busbar or conductor, or under input from some other variable, like time (if equipment utilization is strictly scheduled, for example).

Scenario #3 imagines a "power control system" where the currents of multiple components have to be *coordinated*. Regulatory controls are intrinsic to a single piece of equipment and only will process *input* signals from external (and probably lab tested) devices. In order for a control system to govern more than one piece of equipment, external communication connections are necessary and signals have to be sent, received and acted upon by some equipment that is *extrinsic* to the controls; input signals, moreover, may come from a wide range of sources. Supervisory controls are usually the only option for complex configurations: system with variable inputs, multiple outputs, dynamic information processing. It also may be the only option for certain retrofit projects or where components are sourced from different manufacturers.

In the most straightforward versions of Scenario #3, there will be a computer on site that is connected to different equipment and monitoring devices, and this computer will be the central dispatch for all controlled devices. The computer could be housed in a piece of equipment with some other function, like an inverter, but it is more likely to stand alone as a controller unit. Theoretically, the computing device for the supervisory controls may not necessarily be located on site: supervisory controls could be a software program stored in a remote server or in the cloud, and could retrieve data and issue instructions to equipment over an internet connection or some other secure network connection.

Here is a distinct Scenario #3 example: in the building next door to our previous example, there is a system with a single phase, 240 V service, a 400 A Eaton panel with smart, load control breakers and a 400 A main breaker, a just-installed 500 kWH Li-ion battery ESS with a Sinexcel inverter that outputs up to 100 A, a PV system installed 5 years ago with an SMA inverter that outputs up to 80 A, and an automatic transfer switch that, when the power goes down, connects to a 20 kW Generac generator, installed 10 years ago. The loads from the building, if everything is running all at once could reach as high as 490 A, but curtailment of a Tesla electric vehicle (EV) charger, which draws up to 100 A, should always bring the total possible load drawn from the main panel below 400 A. The PV and ESS systems together output 100 A too much for the size of the main service panel to which they are connected under the limits from 705.12 (B) (3) (2) or (4). Let's say the building is drawing its maximum load and the PV and ESS systems can output their full capacity; the supervisory control system now has several options: it can a) curtail the PV system; b) make sure the ESS isn't charging or discharging; c) curtail the 100 A EV charger; d) curtail several other loads; e) curtail input current from the 400 A main breaker; or f) do more than one of these things at the same time. All six options will accomplish the same safety aim, but the building owner may want to implement a complex scheme for which option is chosen under different conditions. For example, the EV charger might have priority in the evening and morning when the building owner is charging a company car after a day's use so that it has a full battery next morning, while the PV and/or ESS system are prioritized during the afternoon when the building has a high time-of-use electricity rate and would prefer not to consume energy. Furthermore, in a power outage, supervisory controls could manage the loads to match the capabilities of the backup generator, PV system and ESS system (which would vary over time) without electricians needing to segregate only a small bundle of loads in a protected loads panel. This site configuration could only be managed by a supervisory controls system, and there is no practical way to list a single piece of equipment to do all of these things. Nevertheless, this is not an especially challenging control system for an experienced controls engineer to design and implement.

**PROBLEMS WITH 705.13 AS CURRENTLY WRITTEN**

1. Incoherence of Treatment in the NEC. The NEC deals with control systems in various ways, largely in chapters 4 and 7; the responsibility for these articles is scattered among the code-making panels, and it shows. Viewed at some remove, the approach is not very coherent. Here is a summary of articles that deal substantively with control systems that govern electrical equipment; a number of other articles have provisions for the electrical installation of control systems that govern non-electrical equipment, and these aren't our main focus.

*Article 100, Definitions*: This article has several definitions for control components.

*Article 430, Motors, Motor Circuits & Controllers*: This article deals with motors and motor controllers. 430.32, 430.39 and Parts VI, VII and VIII all address some aspects of motor controllers and their use for protecting motor function against overload and failure.

*Article 708, Critical Operation Power Systems (COPS)*: This article covers requirements for backup power systems deemed "critical." The article has a definition for supervisory controls ("SCADA"), but controls functions are only discussed, briefly, in 708.22 (B). The defined term, SCADA, isn't used anywhere else in the text of 708. Its presence here points to Informative Annex G.

*Informative Annex G, Supervisory Control & Data Acquisition (SCADA)*: This is a short informational annotation at the end of the Code which gives some suggested design parameters for the deployment of SCADA in COPS. This Informative Annex is written, syntactically, as though it were a set of Code requirements, but it is explicitly not part of the Code, and its rules are not obligatory.

*Article 725, Class 1, 2 & 3 Remote-Control, Signaling & Power-Limited Circuits*: This article details requirements for control circuits that are part of a supervisory controls system or that are necessary for, but auxiliary to, a regulatory controls system.

*Article 750, Energy Management Systems*: This article gives requirements for "energy management

systems," which it defines as: "A system consisting of any of the following: *[sic]* a monitor(s), communications equipment, a controller(s), a timer(s), or other device(s) that monitors and/or controls an electrical load or a power production or storage source." The intent of this article, basically, is to list systems, such as fire alarms, that should *not* be interfered with by a control system that fits this definition.

There doesn't appear to be a uniform approach to dealing with the design of control systems and their components across the NEC. If a new concept of "power control systems", along with a new set of requirements, are being introduced in article 705, they need to be reconciled to the functions of and stipulations upon control systems elsewhere in the Code.

2. Terminology and Definitions. This incoherence is particularly noticeable in defined terms found in articles that touch about upon control systems. Here are some controls-oriented terms and definitions sprinkled across the NEC; note that "general scope" as used here means that the definition is indicated to apply throughout the Code, while "article specific scope" means that the definition is indicated to only apply to that article:

| Term | Article | Scope |
|---|---|---|
| *controller* | 100 | General |
| *controller* | 430 | Article Specific |
| *controller, motion* | 620 | Article Specific |
| *controller, motor* | 620 | Article Specific |
| *controller, operation* | 620 | Article Specific |
| *diversion load controller* | 694 | Article Specific |
| *diversion charge controller* | 706 | Article Specific |
| *control circuit* | 100 | General |
| *remote control circuit* | 100 | General |
| *signaling circuit* | 100 | General |
| *electronically actuated fuse* | 100 | General |
| *motor control center* | 100 | General |
| *industrial control panel* | 100 | General |
| *supervisory control & data acquisition (SCADA)* | 708 | General |
| *control* | 750 | Article Specific |
| *energy management system* | 750 | General |
| *control system* | 620 | Article Specific |
| *monitor* | 750 | Article Specific |

This terminology, even taken together, is not comprehensive of control systems' components or their modalities as they apply to electrical installations. In some cases, it isn't even consistent. Note, for instance, the redundancy of "controller" in articles 100 and 430, as well as the presence of specific controller types in article 620 that aren't congruent with the basic definition in article 100.

Article 705.13 also doesn't formally define "power control system," nor is any such definition provided elsewhere in article 705 or in article 100. . Even worse, the definition for an "energy management system" in article 750 (which is noted to apply throughout the Code) is functionally indistinguishable from the undefined concept of a "power control system" as 705.13 seems to use it.

The problems with defined terms and their definitions allow the requirements adopted in the 2020 cycle to

elide some of the complexities discussed here. This is a recipe for confusion.

3. Supervisory and Regulatory Controls. There is no acknowledgement in 705.13 of the difference between regulatory and supervisory controls, or between Scenario #2 and Scenario #3. As discussed, this distinction can have substantial implications for the capabilities, reliability and responsiveness of control systems. It stems not only from a difference in the components, but in the conception of what *constitutes* a "control system." A regulatory control system is part of some discrete piece of equipment that has been engineered, evaluated and listed under a standard, and, when applicable, it is transparently regulated by specialized articles of the NEC. Supervisory controls consist in the virtual functions of a system whose components are governed by these functions to achieve some coordinated, emergent outcome. The variability possible under supervisory controls can be managed in a straightforward way by engineering, but is more difficult to regulate from on high, so to speak. Requirements in 705.13 for "power control systems" have to apply themselves, in one fashion or another, to this particular difference.

4. Load and source. The text of 705.13 should be more explicit that both sources AND loads can be controlled to limit current on busbars and conductors. For example, let's say the bus in a sub-panel is rated for 100 A. If there is only 100 A or less of source power on the bus, from the point of view of the bus, there is no safety problem, regardless of potential loads; similarly, if there is only 100 A or less of load on the bus, there is no safety problem, regardless of source potential. It is only when there is more than 100 A possible of BOTH source power AND load that there can be an overload. A controls system can manipulate the sources OR the loads OR both to curtail the total current on a bus or a circuit. Article 705 was written primarily with the idea of controlling DERs as power sources in premises wiring where the overcurrent protection devices on feeders constrain an effectively infinite grid source. As we see more load control devices and ESSs on the market, the ability, and the need, to control loads and sources on equal footing will become more common, and 705.13 should be more explicit about the means by which it can achieve its ends.

To pursue this line of reasoning further, the amount of possible current on a busbar or conductor is determined by the *lowest* possible current value in EITHER the source OR the load. If there is 100 A of source power from a PV inverter and 100 A available from the feeder breaker, again, on a 100 A sub-panel bus, but only 50 A of breakers for loads, the sub-panel will never see more than 100 A of current. The presence of ESSs complicates this picture further, because they can behave either as a source or as a load; in calculating the worst case of maximum current, each ESS presents two different scenarios, one where it behaves as a source and should be counted with other sources, and one where it behaves as a load and should be counted with other loads. In fact, where we have on-site, interconnected power generation, the service of a premises wiring, or circuits connecting back to the service, *also* can behave as a current source or as a load.

The best systematic method for determining the maximum possible current on a busbar or conductor is to enumerate each possible configuration of sources and loads, noting the *lowest* possible current value between source and load in each scenario, and then to choose the *highest* current value among them. Here is an example: there is a 7.6 kW inverter for a 10 kW DC PV system, a second 3.8 kW inverter for a 25 kWH Li-ion battery ESS, and load control breakers on all of the circuits connected to the main panel. The PV inverter has a 40 A breaker connection and the ESS a 20 A breaker connection. The building has a single phase, 240 V service with a 200 A main breaker in a 200 A main panel. The loads from the building, if everything were running all at once, could reach as high as 250 A. Both the ESS and the main breaker can be sources or loads, while the breakers in the panel are always loads and the PV inverter is always a source. From this we get four different scenarios (where L=load and S=source):

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Building loads | L | L | L | L |
| PV inverter | S | S | S | S |
| Main breaker | S | S | L | L |

| | | | | |
|---|---|---|---|---|
| ESS | S | L | S | L |

Based on our set up we can assign a maximum current value to each category of equipment based on its overcurrent protection device(s) (the numbers represent amps):

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Building loads | (L) 250 | (L) 250 | (L) 250 | (L) 250 |
| PV inverter | (S) 40 | (S) 40 | (S) 40 | (S) 40 |
| Main breaker | (S) 200 | (S) 200 | (L) 200 | (L) 200 |
| ESS | (S) 20 | (L) 20 | (S) 20 | (L) 20 |

Next we can determine the maximum possible current on the bus, in each case, by the lowest possible current value between source and load:

| | | | |
|---|---|---|---|
| S = 260 | **S = 240** | **S = 60** | **S = 40** |
| **L = 250** | L = 270 | L = 450 | L = 470 |

The lowest value in each scenario is bolded; only the first and second iterations are above 200 A, with #1 being the highest at 250 A. Clearly the bus is undersized for this system. However, under the common method of 705.12 (B) (3) (2) or (4), we would have assumed that the PV and ESS systems would have overloaded by the bus by up to 60 A, whereas, in fact, the overload where both systems acted as sources would only have been 50 A, and no higher in any other scenario. With this method we can more accurately determine the magnitude of potential overload and what devices it may be associated with.

It has to be mentioned here that neither 705.11 nor 705.12 do a great job of dealing with situations where multiple devices can behave as both source and load. The additions in past cycles of 705.12 (B) (3) (1) & (3) (or their equivalent) were a perfectly adequate means of resolving this conundrum when it was expected, mostly, that only service-facing breakers or feeders would behave as both source and load, but with the growth of ESSs and control systems as regular features in premises wiring in all site types, the NEC needs to adopt more sophisticated rules around this issue.

5. Signaling. All control systems rely on signaling to accomplish their ends. Typically, regulatory controls have the advantage of being compact and more testable in their functionality through a standardized listing process. Nevertheless, for most applications of 705.13, they will rely on external signals from CTs or other monitoring devices.

Supervisory controls rely extensively on signals among multiple pieces of equipment integrated in the field in unique configurations. This may involve multiple regulatory control systems and equipment with different functions. These systems are likely to include equipment produced by different manufacturers. Communications protocols may not be identical among this equipment, and communications signals may have to travel relatively long distances. Wireless or power-line communication devices are an option where hardwiring poses practical installation difficulties. Communication can even be mediated through the internet or another network where some key component (probably the supervisory computing device) could be located off-site.

Because 705.13 is fundamentally a set of safety requirements, it should include some rules on the deployment of signaling systems to ensure their reliability. For example, internet connections are notoriously prone to periodic cutting out, and probably shouldn't be relied upon. Other communications equipment, like some on-site wireless systems or power-line transmitters, may also be less reliable than desired. UL 1741 does disallow off-site connections in the listing of regulatory controls in inverters, but the issue is complicated enough that the NEC should outline some basic parameters for what is allowable, as it does for numerous other engineering issues.

6. Listing requirements. In 2018, UL released a Certification Requirement Decision (CRD) adjunct to the

1741 standard. Among other things, it deals with controllers and DERs. This standard gives us a means of testing and listing regulatory controls under Scenario #2 in our descriptions of control systems. Unfortunately, it does not give us a clear standard for Scenario #3 or engineering guidelines for the wide functionality of supervisory controls. Supervisory controls are often in charge of equipment: a) from different manufacturers: b) that may have been installed at different times under different Code requirements; c) at different distances; d) with signaling systems that require different physical wire and connections (or even wireless signals) and different communications protocols; e) under applications with different response time horizons; and f) under applications with different functional outputs (i.e., current, voltage, power factor, etc.). UL and other standards are written to evaluate the behavior and the safety risks of either: a) individual pieces of manufactured equipment; or b) a limited number of self-contained pieces of equipment that can be tested together in the lab, and that generally operate in the "ecosystem" of the same manufacturer. However, supervisory controls are not a component of a single piece of equipment, nor are they necessarily derived from the limited configurations of a single manufacturer's "ecosystem." They are a set of virtual functions for a multi-component system. They can serve all different kinds of equipment for the special requirements of each site and each system. Their prime virtue is their adaptability and scalability.

If the standards and the Code are written such that only equipment within a single listed "ecosystem," installed together as a project, are acceptable, then there will be little opportunity for retrofit projects or for competitive product development to integrate the many possible configurations of various DERs. As efforts to modernize the grid proceed apace, with considerable economic and environmental consequences, this is not an insignificant consideration.

The proper venue for evaluating supervisory control behavior is electrical engineering for field applications in the construction sector. Compliance should fall under the purview of state-approved professional electrical engineers, with basic requirements articulated in the NEC and adopted by local AHJs. Listing standards are intended to govern the manufacturing of products, not all the details of their on-site installation, the advances represented in the UL 1741 CRD notwithstanding.

There are multiple precedents for this approach. Elsewhere in the construction industry, field engineering is standard for the kind of engineering problems that supervisory controls pose. Consider structural engineering. In order to build a structure or modify a building structurally, contractors don't typically contact an equipment manufacturer and determine that the modification is approved under a listing standard for a manufactured product ("manufactured homes" are a small minority of the building stock in the US, and even then modifications aren't necessarily within the purview of the manufacturer). Instead, they approach a structural engineer who can evaluate the new structure or a modification *in situ* under his or her professional training and relevant parameters of the local building code.

There are also closely related precedents in the NEC itself. Selective coordination, as defined in article 100, is the arrangement of overcurrent protection devices to limit current in different scenarios to busbars and conductors. In articles 620.62, 645.27, 695.3 (C) (3), 700.32, 701.32, and 708.54, a licensed professional must sign off on and document the selective coordination of overcurrent protection devices among relevant circuits. There is no expectation that equipment listing would be the appropriate mode of engineering for limiting current flow. Closer to home, 705.12 (B) (3) (5) allows for configurations that would otherwise violate the rules of 705.12 (B) (3) if a professional engineer has reviewed the particular configuration of equipment in detail and will sign off on it. Similar allowances are certainly possible for control systems to accomplish the same end.

The current policy in 705.13 to push engineering oversight of control systems onto the listing process, rather than professional engineering under local codes, is not a matter of safety: it's a matter of convenience for regulators and well-capitalized manufacturers.

7. Response time frames. For the purposes of 705.13, a crucial safety feature of control systems is how quickly they respond to overload conditions of different magnitudes. All switching and overcurrent protection devices are intended to *react* to specific conditions, and so, necessarily, there is a delay between the onset of

those conditions and the reaction. With breakers and fuses, this can be very, very fast, if necessary, although many overcurrent protection devices are designed to allow for temporary overloads at certain current levels, on the order of seconds, depending on the magnitude and application. Control systems, both regulatory and supervisory, because they rely on external signals, can be designed to meet certain response time thresholds for their reaction to current overload conditions; these response time thresholds have to be indexed for the magnitude of overload, the application (particularly for motors), and the difference between overloads due to faults and those due to excessive, but predictable loads. Where a listing standard, such as the UL 1741 CRD, is applicable, this information can be addressed in the standard, but where a listing standard does not apply, the NEC should articulate some thresholds, indexed, again, according to these variables.

**RECOMMENDATIONS**

Recommendation #1: The material from article 750 should be re-located to 705.13 or an adjacent number within article 705. Under the definition of "energy management systems" from 750, there isn't a coherent argument as to how these systems differ from the "power control systems" referenced in 705.13; it's a distinction without a difference. The intent of Article 750 is very limited -- it restricts what equipment can be controlled by "energy management systems." In fact, it might benefit 705.13 to explicitly restrict what load functions can be manipulated to limit current.

There is a bit of conceptual problem with this shift in that article 705 is labeled, "Interconnected Electric Power Production Sources." "Energy management systems" are focused on load control. However, as we've discussed, with the proliferation of ESSs and load control devices that can do demand response, loads and sources are both of concern when engineering against current overload. 705 should evolve towards addressing both power production and load control on equal terms. The fundamental interest of this article is the safe engineering of power *flow* and power *balancing*. So article 705 probably could be renamed to something like "Power Balancing Across the Premises Wiring."

Recommendation #2: The terminology and definitions for control systems needs a through-going overhaul that reaches across multiple articles. As described earlier, there are definitions relevant to 705.13 scattered in different parts of the Code, as well as other items we've discussed that are not defined or even conceptualized. The term "power control system" should be jettisoned for the specific context of 705.13 and the terminology used in 705.13 should be congruent with material covering control systems elsewhere in the NEC.

Control systems have a number of possible constituent parts; furthermore, supervisory control systems can be recursive in having regulatory controls or subordinate supervisory controls embedded within them. Here is a list of possible control system components:

* Supervisory computing devices
* Communications wiring and connections
* Communications signals and their protocols
* Software that gives instructions under some set of programmed functions
* An operator or technician
* The interface for that person which allows him or her to manipulate the controls.
* Regulatory controls in equipment or subordinate supervisory control systems

Additionally, the conceptual difference between regulatory and supervisory controls should be clearly drawn.

Here are some suggestions for definitions dealing with control systems. It is recommended that most of these be deployed in article 100, for a general scope of use, rather than article 705 or elsewhere. The content here is tentative, and the list by no means exhaustive; the code-making panels are encouraged to contemplate additional terms and alternate wordings in consultation with each other and other stakeholders.

***control system*** — "A system comprised of components designed to control one or more pieces of

equipment. These components could include controllers, other control systems, wires, wireless signaling devices, receivers, monitoring devices, software, and the signals routed along this system to relay information or give instructions. Control systems can have many different functions, only some of which are directly regulated by this Code. A control system does not itself include the equipment that it controls."

The definitions for "control system" in article 620, "control" in article 750, and "energy management system" in article 750 are not necessary if there is a general definition of "control system" in article 100. If the code-making panels feel that control systems governing different functional outputs need to be distinguished, then these could be treated as sub-types. For example, a control system that governs power output in an inverter, ESS or generator could be a "Control System, Power" ("Power Control System"), whereas the control system governing motion in a motor (as the term is used in article 620) could be a "Control System, Motor" or a "Control System, Motion" ("Motor Control System" or "Motion Control System").

***controlled equipment*** — "Equipment which is governed by a control system. Components of controlled equipment, like receivers or regulatory control systems, may be part of a control system, but, as a whole, each piece of controlled equipment is not considered to be part of the control system governing it."

This definition would allow the Code to distinguish between that can and cannot be governed by a given control system. It also makes clear that control systems, as *systems*, ONLY include the mechanisms of control, not their object.

***regulatory control system —*** "A type of control system which is incorporated within a single piece of equipment, which is integral to the design and function of this equipment, and which only governs the behavior of this equipment. Regulatory control systems may utilize information or may respond to instructions from an external signal to carry out its controls; they also may be part of a larger SCADA system."

This definition should be included in article 100.

***SCADA system*** — "A Supervisory Controls And Data Acquisition (SCADA) system is a type of control system which independently coordinates the behavior of one or more piece of controlled equipment. SCADA systems can incorporate other SCADA or regulatory control systems which, in turn, control some subset of equipment within the governance of the larger SCADA system. SCADA systems receive information from different devices and send instructions to controlled equipment."

The presence of SCADA as a definition in article 708 is somewhat strange, given that the term is never actually used in that article, but only referenced in a non-binding Informative Annex at the end of the book. Granted, the Annex does just address the use of SCADA systems in COPS, but the whole arrangement comes across as kind of self-defeating jiu-jitsu. It would make more sense for SCADA systems not to be defined narrowly in terms of COPS and to be placed in article 100 *vis à vis* regulatory control systems. And given the rules articulated in the Informative Annex, perhaps they need their own article with a more general scope (and some specific rules pertaining to COPS SCADA functions)?

***controller*** — "A computing device within a control system that receives data and sends instructions, either according to self-contained functions or according to signals originating from an external device.

The definition in article 100 limits "controller" to only devices that govern the electric power of controlled electrical equipment. The scope of the definition should be expanded to include any kind of functional output, and then the article specific definition from 430 can be eliminated. Specific types of controllers, such as those defined in articles 620, 694 and 706, can remain in those articles

and be article specific in scope.

***signaling system*** — "A system for sending information between components in a control system."

The definition of "control circuit" can stay, if it's useful. A "signaling system" would include not only the control *circuits*, but the signals themselves. It's not clear why there needs to be a definition of "control circuit" *and* "signaling circuit" in article 100. Both definitions describe the same thing -- though they appear to be the provenance of different code-making panels.

***monitoring device*** — "A device that generates information of a specific type, like temperature data or current flow, and reports this information to some other device, either continuously or periodically."

"Monitor" is a definition that only applies to article 750. It should be deleted and a more general term and definition, such as what is suggested here, put in its place in article 100. Note that 705.13 refers to monitoring without defining a "monitor" or "monitoring device."

***control interface*** — "The interface containing set-points and other features of a control system that can be manipulated by qualified personnel."

Having a definition of a control interface makes the locus of 705.13 (E) more concrete and specific.

***off-site*** — "Not located on the same physical property as other equipment associated with a control system and controlled equipment."

This definition would be used if the recommendation of this comment is accepted to restrict signaling systems; it could be article specific in scope to 705.

Recommendation #3: UL and similar standards are designed to test and certify manufactured pieces of equipment, if not strictly alone in their functionality, then with respect to a highly select number of commonly paired components. These standards can insist on *some* limits to the manner of integration for a given piece of equipment, but manufacturing standards are not able to anticipate every possible situation in which listed equipment can be installed and utilized. Critically, for our purpose, they are not meant to evaluate a heterogeneous multi-component system, considered as a gestalt, under a nearly unlimited range of field conditions -- as we have discussed with SCADA systems. Field integration, moreover, is a valid mode of engineering; in fact, it is the whole, entire purpose of the National Electric Code. If too much oversight over equipment behavior is vested in the manufacturing process, the final result isn't necessarily going to enhance safety, but it will hamper innovation and produce anti-competitive product markets.

The testing process within, and, indeed, the inherent purpose of, UL-type standards is not appropriate for evaluating many SCADA systems. The evaluation requirement for control systems in 705.13 should be broken into two separate stipulations:

For the purposes of controlling current in one or more pieces of equipment to prevent overload across a bus or circuit:

A) Regulatory control systems shall be listed for this function;

B) SCADA systems either shall be listed for this function, or they shall be evaluated and approved by a professional electrical engineer or other professional recognized by the AHJ.

Realistically, the company that builds and implements a SCADA system isn't necessarily going to be the company that does the electrical design, and chooses wire sizing, conduit sizing, grounding methods, etc. Controls engineering is a specialized discipline and so it should be allowable that the engineer who signs off on the SCADA system may not be the same engineer or electrician who signs off on the rest of the electrical design, as submitted to the AHJ. Therefore, it would be helpful if an Informational Note were added to stipulation B):

Information Note: The engineer who signs off on the SCADA system may not be the same engineer who signs off on other aspects of the system electrical design and integration, nor will they necessarily be

employed by the same company.

Recommendation #4: Without signaling reliability, most control systems will not be guaranteed to provide the safety protections that are the sole purpose of 705.13. In general, the efficacy and dependability of a signaling system should be something for which an electrical engineer can vouch, having evaluated its performance in the lab, and, if necessary, in the field. The approvals stipulated in Recommendation #2 should include signaling reliability as one of its benchmarks.

However, it is also recommended that the NEC include an additional requirement which cannot be bypassed by an engineer: no off-site control component can be used to implement the safety requirements of the NEC with respect to current overload. An Information Note could be added to clarify this requirement: off-site control components can be used to change set-points and manage equipment function for a variety of purposes, but any *reaction* to an overcurrent condition necessitated in article 705 or elsewhere in the NEC should never rely on off-site components. The code-making panel may also want to better understand the reliability of on-site wireless and power-line technologies for signaling.

Recommendation #5: Where supervisory controls are engineered by a professional and not specifically listed by the manufacturer for compliance with 705.13, the NEC should indicate minimum acceptable response times in which control systems should react. These response times should vary by magnitude (in terms of potential current), by application and by fault condition, and be organized in a table. To illustrate the need for these indices: a fault of 10,000 A over the rating of a conductor or busbar should clear much faster than a controlled overload of 1 A; the peak in-rush current of a motor is intrinsically limited in time in a way that a continuous load is not; a fault can generate near infinite current instantaneously for systems connect to the grid, whereas overload from too many loads will only exceed a predictable value. This comment is not proposing any specific time values, except to note that supervisory controls' signaling typically operates in the range of 1 second to 15 seconds.

Recommendation #6: At the moment, the NEC does not articulate a clear, principled conception of how multiple loads and sources can be balanced within the ampacity limits of busbars and conductors, particularly with equipment that can function, at different times, as either loads or sources. Traditionally, utilities controlled all power generation, so power would flow in one direction from the service point down a hierarchically arranged series of busses, feeders and branch circuits, and the existing rules have worked well where one or two DER sources might intrude on this configuration. However, in the not-too-distant future, there will be not just thousands, but *millions* of DERs and load-control devices connected at the grid edge, often in close proximity and performing many different functions, and so it is imperative that the NEC adopt a view of power balancing that appropriately accounts for this new paradigm.

In an earlier section of this article, we described a method for calculating possible current on a bus or conductor based on a worst balance of load and source. The NEC should adopt some version of this method in determining threshold current values when evaluating possible current overload on busbars or conductors for 705.11, 705.12 and 705.13. It would offer AHJs, engineers and electricians a more accurate assessment of potential overloads than current methods.

## Statement of Problem and Substantiation for Public Input

The version of 705.13 adopted in the 2020 cycle was an important advance in incorporating DERs to the NEC, but its stipulations do not adequately address the composition and capabilities of control systems. This comment gives a background on control systems, critiques some aspects of 705.13 and related issues, and offers some recommendations for code-make panel #4 as they decide how to update the NEC for the next cycle.

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# Public Input No. 4685-NFPA 70-2020 [ Global Input ]

**Align the on-site energy sources into a series of articles as follows:**

**689 On-Site Energy Sources**

**690 Solar Photovoltaic (PV) Systems**

**691 Large-Scale Photovoltaic (PV) Systems**

**692 Fuel Cell Systems**

**693 Generators**

**694 Wind Electric Systems**

**695 Energy Storage Systems**

**696 Storage Batteries**

**Public inputs were made by this task group to accommodate the following:**

1. **Move Article 445 to 693**
2. **Move Article 480 to 696**
3. **Move Article 695 to 703 (This is to make room for 706 Energy Storage Systems)**
4. **Move Article 706 to 695**

**In addition, ARticle 705 should be renumbered to Article 689.**

## Statement of Problem and Substantiation for Public Input

This global input accommodates the work of the Alternative Energy Taskgroup appointed by the corrrelating committee and consisting of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

These actions impact multiple Code Making Panels. Public inputs were made for all of these actions except for the renumbering of ARticle 705. This task group is asking the correlating committee to coordinate these actions to ensure changes align with the new numbering and location of these articles. This will help ensure correlation between eachother and establish their true closer relationship. This task group is not asking that CMP ownership be changed for any of these Articles.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3006-NFPA 70-2020 [Article 706] | |
| Public Input No. 2984-NFPA 70-2020 [Article 445] | |
| Public Input No. 2985-NFPA 70-2020 [Article 480] | |
| Public Input No. 2692-NFPA 70-2020 [Article 705] | |

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# Public Input No. 2766-NFPA 70-2020 [ Global Input ]

**Clarify terminology of power system types and power supply system types.**

For NFPA 70, 99, 110, and 111 taken together, there are seven (7) or more codified power distribution system types and seven (7) or more codified power supply system types that would benefit from a consistently applied pattern in their terminology. It is proposed that wherever there is a particular codified type of power system, apply uniform terminology in the definition.

For distinctive codified types of power distribution, include either "Power System" or "Power Distribution System" in the defining terminology, with examples as follows;

(1) Essential Electrical System of NFPA 70 Article 517 and NFPA 99; revise to "Essential Power System."

(2) Fire pump circuits of Article 695; revise to "Fire Pump Power System."

(3) Emergency Systems of Article 700; revise to "Required Emergency Power System."

(4) Legally Required Standby System of Article 701; revise to "Required Standby Power System."

(5) Optional Standby System of Article 702; revise to "Optional Standby Power System."

(6) Critical Operations Power System of Article 708 remains unchanged.

(7) And for references to normal power; revise code text to "Normal Power System." And, codify it in NEC Article 100 with a proper definition.

For distinctive codified types of a power source, include "Power Supply System" in the defining terminology. Also, preface with the term "Essential" wherever the Power Supply System must comply to an elevated class of resilience due to load criticality, "Essential Power Supply System". Examples are as follows;

(1) Emergency Power Supply System of NFPA 110; revise to "Engine Driven Essential Power Supply System". The "Engine Driven" term is added to distinguish this essential power system distinctly apart from all other types of essential power systems; "Stored Energy Essential Power Supply System" and "Fuel Cell Essential Power Supply System." It used to be that NFPA 110 sources encompassed all those sources that NFPA 111 did not; however, with the advent of fuel cells into the foray of permitted essential power sources, this is no longer the case. *Although at the time of this writing, it is not yet clear what code standard for fuel cells measures up to the system resilience robustness intent of NFPA 110 and 111.*

*SIDEBAR: these three essential power systems together share a unique characterization of supplying emergency, critical, and essential power systems. If another new distinctive definition were to be coined to describe the group of these essential power system sources; it would be dutiful to consider the inclusion or exclusion of unitized batteries with that category, or else derive a more functional other category.*

(1) Stored Energy Emergency Power Supply System (SEPSS) in accordance with NFPA 111; revise to "Stored Energy Essential Power Supply System." Swapping the term 'essential' for 'emergency' accomplishes three things.

(1) By not using the term 'emergency', it affirms that there are more types of code required alternate power system types beyond just the 'emergency' type (of NEC Article 700) that this standard should also apply to.

(2) The term 'essential' can function to associate this as one of the few select sources approved for similar applications.

(3) The importance factor of "essential" can maintain distinction of this power source supply system as an elevated class of resilience apart from the power source supply system of NEC Article 706, Energy Storage Systems.

(1) Solar Photovoltaic (PV) Systems in accordance with Article 690; revise to "Solar Photovoltaic (PV) Power Supply System."

(2) Large-Scale Photovoltaic (PV) Electric Power Production Facility Systems in accordance with Article 691; revise to "Large Scale Solar Photovoltaic (PV) Power Supply System."

(3) Fuel Cell Power Systems in accordance with Article 692; revise to "Fuel Cell Power Supply System."

(a) Where used for supplying required alternate power (e.g. Article 517 and NFPA 99 where permitted to supply the Essential Electrical System), another terminology should be employed to cite whatever code standard is intended to outline compliance with those particular code requirements; "Fuel Cell Essential Power Supply System."

(4) Wind Electric Systems in accordance with Article 694; "Wind Power Supply System."

(5) Energy Storage Systems in accordance with Article 706; " Energy Storage Power Supply System."

## Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION:
1) The word "emergency" is defined as a serious, unexpected, often dangerous situation requiring immediate action. Even within NEC, "emergency" is used in both power and non-power applications; emergency stop, emergency disconnect, emergency conditions, emergency battery-powered lighting (allowable to be used for non-emergency applications), emergency generator (allowable to be used for non-emergency applications), emergency purposes, emergency management, emergency communications, emergency use, emergency operations, emergency room, emergency treatment areas, emergency egress, and other NFPA standards offer other emergency systems that are outside the application of power distribution.
To help mitigate inadvertent misappropriation of the term "emergency" or "emergency systems" by users of the NEC and other NFPA codes, it would be prudent to use discreet terminology to clarify when the application strictly regards power systems. The key to optimal clarity is to uniquely distinguish applications of power from each other. And too, make them more easily distinguishable from all other possible interpretations of "emergency" or "emergency system."
NEC Article 700 use of the term "nonemergency" and "non-emergency" should be standardized to a single term. They are intended to apply to any source other than those of Article 700, but may be construed otherwise due to other types of use for the term "emergency." Refer to the last sentence of 70012(H), where after non-emergency is discussed, the code text juxtaposes "normal supply" with that of the "emergency standby system," which could easily confuse this paragraph's intent and be interpreted as either Article 700 power or Article 701 power or both.
2) Power system type categorization can be accomplished by building upon two base level characterizations, "Power System" types (or "Power Distribution System" types) and "Power Supply System" types. This intuitively functions in two ways;
a. For each individual type, the grouping illustrates their association to each other. The common defining term 'power' shows that one of their principal characteristics is shared with each other.
b. Then to distinguish between the (6) code recognized types of power systems and (7) code recognized types of power supply systems, strategic modifier terminology is selected based on their principal distinctions between each other. To do this with the with the most simply stated yet most

recognizable principal characteristic would help ensure that definitions are understood most clearly and easily.
The intuitive comprehension aide that this yields to NEC would similarly extend as a benefit throughout the other NFPA codes, by readily distinguishing these power terms and applications from other kinds of use of the terms "emergency" and "emergency systems." Thus, also helping improve intuitive understandings for those NFPA references outside of NEC, which are potentially being referenced by disciplines not especially versed in electrical, and could benefit from these intuitive clues.
These two base level characterizations may be suited to get their own defined terminologies for particular power group type categories. This may be implemented to simplify general references in code text meant to address one or another entire category; "Power Systems" (where normal power and optional standby power are encompassed with all others) versus "Essential Power Systems" (only those which are code required alternate power sources). And similarly, "Power Supply Systems" versus "Essential Power Supply Systems".
3) The term "emergency" is used frequently throughout the NFPA (refer to NFPA 2018 Glossary) with many diverse meanings and applications of criticality. Distinctions in the differentiation of the terminology itself are especially important in clarifying intent for matters of code requirements. Without obvious clear distinctions in terminology, unintended cross-correlations of requirements may be inadvertently interpreted. For code reference examples, see;
a. "Emergency" in NFPA: 59A, 130, 424, 450, 502, 1006 & 1221
b. "Emergency Power Supply" and "Emergency Power Supply System" in NFPA: 110 & 111
4) The term "emergency system" is used in multiple instances of NFPA codes and is near identical to the pluralized version of the term "emergency systems" used in Article 700 of the NEC (NFPA 70). Some examples from NFPA outside of NEC are;
• "Emergency Systems" from NFPA: 3 & 4. The set of NFPA 3 & 4 definitions for required alternate power system types is an open-ended generalized approximation that makes reference to; COPS (NEC 708), EPS (NFPA 110), EPSS (NFPA 110), Emergency Systems (NEC 700), and Legally Required Standby Systems (NEC 701). The NFPA: 3 & 4 definition fails to reference the following: NFPA 111; the essential electrical systems of NEC 517 and NFPA 99 with its sub-branches; any power system type that could be derived to strictly serve fire pumps; and fuel cells when used as a required alternate power source.
• "Emergency Alarm System" from NFPA: 318 & 5000
• "Emergency Communication System" from NFPA: 72 & 130
• "Emergency Services System" from NFPA: 1250
• "Emergency Shutdown System" from NFPA: 160
• "Emergency Power Supply System" from NFPA: 110
5) The risk of users inadvertently crossing code requirements inappropriately based on the potential for terminology confusion is twofold.
a. The first is that code text applications which may not intend to correlate, based on the term "emergency", could be interpreted to correlate inappropriately. At least until supplemental review and research of code text is exercised diligently within the time permitted to validate clarification otherwise.
b. The second is that applications meant to apply to Article 700, and reference Article 700, should also be referencing other types of essential, critical, life safety, which are not being stated explicitly because the term "emergency" or "emergency system" was believed adequate to cover intent. The types of other such power system types, depending on the application, may include the following;
i. Emergency Power Supply System circuit in accordance with NFPA 110
ii. Stored Energy Power Supply System circuit in accordance with NFPA 111
iii. Essential Electrical System circuits in accordance with Article 517 and NFPA 99, or any of its sub-system branches as follows;
1. Life Safety Branch
2. Critical Branch
3. Equipment Branch
a. Equipment Branch A
b. Equipment Branch B
iv. Emergency system circuit in accordance with Article 700.
v. Legally required standby system circuit in accordance with Article 701.
vi. Optional standby system circuit in accordance with Article 702.
vii. Critical Operations Power system circuit in accordance with Article 708
viii. Fuel cell power supply system circuit, when used as a power source for power system type (3) through (7) above.
ix. A multi-source power system type derived to strictly serve fire pumps in accordance with Article 695. With its alternate source, as permitted from a power source type (1) through (8) above, or derived

from an alternate normal power service to satisfy the reliability requirements.
6) Examples of potentially misinterpreted terminology within the NEC are:
a. 230.85 Emergency Disconnects.
b. Emergency Lighting [646.16 & 17]; may be interpreted to be unequivocally associated with Article 700. But, such fault resistant lighting requirements may potentially apply also to;
i. Life Safety Branch AND/OR Critical Branch of Essential Electrical System circuits in accordance with Article 517 and NFPA 99.
ii. Critical Operations Power system circuit in accordance with Article 708
c. Emergency shutoff [680.41]; this use of 'emergency' is of a different character to Article 700. Although there could be an "emergency shutoff" system for the source of an "emergency (power) system" where the term 'emergency' in each vernacular has disparate intonations.
7) Terminology revision can also standardize power type definitions and Article titles around the use of pluralization of power system types; where each definition uses the singular version of the word "system" rather than having the varied usage of both plural and no-plural versions; such as the word "systems" as in Article 700. An exception could be developed for titles of NFPA standards 110 and 111, which might perhaps be best suited to the plural version of system, "systems."
8) It may be prudent to clarify in code definitions of power system types, and power supply system types, and any definitions for the groups of such power types, that in practice, users may also use their own terminology. Users may be explicitly permitted describe or label the power system types on their premises. For example, a power system named after an equipment type; e.g. elevator, imaging equipment, etc. However, it should also be explicitly disallowed for a power system to be unclear, as to which of the (7) codified "power system" types or (7) codified "power supply system" types that any power distribution system is being held in compliance to. Nor should it be permitted to be unclear at which points in the power distribution, that one type of power system converts to another. It may behoove any capacity for inspection, commissioning, service, and consistency within a facility to require specific labeling and/or diagramming that details what all types of power systems are present, and at which specific points of named equipment within the power distribution that power system types convert from one type to another type. In other words, make clear the origination point of each power system type. Grammatical protocol for defined power systems types should uniformly reference them as proper nouns by always using the full term and by employing capitalized letters, so to prevent confusion when the same words are used for other purposes.
9) For consistency across NFPA standards, other subsequent edits would also be submitted as Public Input for NFPA revisions that would correlate to those uses of terminology outlined above, so to maximize the benefits that consistency adds to clarity if done similarly throughout the NFPA standards. Examples of such edits include;
a. The revisions to power system terminologies outlined above, which are associated with NEC Article 517, would also to apply to NFPA 99.
b. The title of NFPA 110 "Emergency and Standby Power Systems" revised to "Engine Driven Essential Power Supply Systems."
d. The title of NFPA 111 " Stored Electrical Energy Emergency and Standby Power Systems" revised to "Stored Energy Essential Power Supply Systems."
d. And perhaps some NFPA standard of the same resiliency caliber as NFPA 110 & 111, but instead structured to address fuel cell based essential power supplies, "Fuel Cell Essential Power Supply Systems."

## Submitter Information Verification

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**Submittal Date:** Mon Aug 31 12:15:14 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4289-NFPA 70-2020 [ Global Input ]

Provide a new NFPA standard, "Essential Fuel Cell Power Supply Systems", written to address a level of diligence for load criticality so to be similar and consistent to the reliability standards of the essential-class Power Supply Systems of NFPA 110 and 111. This would serve to unify consistency in requirements for allowed power sources serving the essential-class of codified electrical systems, which include:

(1) Emergency Systems in accordance with Article 700.

(2) Legally Required Standby System in accordance with Article 701.

(3) Essential Electrical System in accordance with Article 517.

(4) Fire pump circuits in accordance with Article 695.

(5) Critical Operations Power System in accordance with Article 708.

## Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION: NEC Article 517 permits Fuel Cells to be used to be the alternate power supply system and source serving the Essential Electrical System, which includes its sub-system branches; Life Safety Branch, Critical Branch, and Equipment Branch. The Equipment Branch having its own two sub-sub branches, Equipment Branch-A and Equipment Branch-B.

The other permitted alternate power source options for serving the Essential Electrical System must comply with an elevated class of resilience due to load criticality, such as the power supply systems of NFPA 110 and 111; the Emergency Power Supply System and the Stored Energy Power Supply System respectively.

Note that NFPA 110 text disallows Fuel Cells as a source for essential-class power supply systems. Code text may need to be revised so to not contradict each other, or revised to acknowledge the terms for this apparent contradiction.

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**Committee:** NEC-P13

# Public Input No. 1820-NFPA 70-2020 [ Definition: Battery System. ]

**Battery System.**

Interconnected battery subsystems consisting of one or more storage batteries and battery chargers, and can include inverters, converters, and associated electrical equipment. (CMP-13)

Informational Note: Inverters, converters, and associated electrical equipment that are part of a dc-coupled multimode system or dc microgrid may not be components of the battery system.

## Statement of Problem and Substantiation for Public Input

A companion PI will seek to remove the definition, but if the definition is to remain is does require clarity.

The informational note will provide clarity to the definition of a battery system. The definition as currently written does an exceptional job of defining what is an ac-coupled battery system, but when applied to a dc-coupled battery system, the definition can define components of a PV or Microgrid system as part of the battery system. There are dc-coupled multimode systems that utilize a single common multimode inverter and use dc to dc optimizers to dc-couple a PV system to the ESS. Without the informational note, the PV system could be considered as "associated electrical equipment" to the battery system which is not the intent of the definition.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2812-NFPA 70-2020 [Definition: Battery System.] | |

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 2812-NFPA 70-2020 [ Definition: Battery System. ]

~~**Battery System.**~~

~~Interconnected battery subsystems consisting of one or more storage batteries and battery chargers, and can include inverters, converters, and associated electrical equipment. (CMP-13)~~

## Statement of Problem and Substantiation for Public Input

The definition of battery system is not required in the NEC. Article 480 defines storage battery and Article 706 defines Energy Storage System. The term battery system is not used throughout the NEC and the Article 100 definition does not correlate with Article 480 and 706.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1820-NFPA 70-2020 [Definition: Battery System.] | Battery system definition |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4326-NFPA 70-2020 [ Definition: Battery System. ]

~~**Battery System.**~~

~~Interconnected battery subsystems consisting of one or more storage batteries and battery chargers, and can include inverters, converters, and associated electrical equipment. (CMP-13)~~

## Statement of Problem and Substantiation for Public Input

This definition continues to sow confusion over what constitutes an electrochemical ESS, and when Article 480 should be used versus Article 706. An electrochemical stationary storage system that includes inverters and converters goes beyond a simple battery installation which is what Article 480 should be focused on. Once this additional equipment is introduced this should be more correctly identified as an ESS or UPS, that already have definitions. If conflicting definitions like this continue to exist it creates opportunities for the circumvention of some important requirements found in Article 706.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel,

First Solar; Jason Smolko, Copperweld;

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4333-NFPA 70-2020 [Section No. 480.10(G)] | |
| Public Input No. 4329-NFPA 70-2020 [Section No. 480.10(C)] | |
| Public Input No. 4321-NFPA 70-2020 [Section No. 480.7(A)] | |
| Public Input No. 4323-NFPA 70-2020 [Section No. 480.7(G)] | |
| Public Input No. 4321-NFPA 70-2020 [Section No. 480.7(A)] | |
| Public Input No. 4329-NFPA 70-2020 [Section No. 480.10(C)] | |
| Public Input No. 4333-NFPA 70-2020 [Section No. 480.10(G)] | |

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**Committee:** NEC-P13

## Public Input No. 2978-NFPA 70-2020 [ Definition: Electric Power Production and Distribution Netw... ]

**Electric Power Production and Distribution Network.**

Power production, distribution, and utilization equipment and facilities, such as electric utility systems that are connected to premises wiring and are external to and not controlled by ~~an interactive system~~ a system that operates in interactive mode . (CMP-13)

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This change aligns with another public input that modifies the definition of "Interactive System". This definition is changing to "Interactive Mode" as part of this task group's focus on aligning the language of alternative energy articles. Should the public input be accepted to modify the definition of interactive system, this definition will have to appropriately reference the new term.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2684-NFPA 70-2020 [Definition: Interactive System.] | Definition / Term change |

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 2687-NFPA 70-2020 [ Definition: Interactive Inverter. ]

**Inverter, Interactive ~~Inverter~~ .**

~~An inverter intended for use in parallel with power source(s) such as an electric utility to supply common loads and capable of delivering power to the utility.~~ Inverter equipment having the capabilities to operate only in interactive mode. (CMP-13)

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

The modification of this definition first will help place this close to other related definitions by switching the words from Interactive Inverter to Inverter, Interactive. Secondly the new definition better aligns with how the term is being used as part of this task groups work. It adds clarity.

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**Committee:** NEC-P13

# Public Input No. 1961-NFPA 70-2020 [ Definition: Switch, Transfer. ]

**Switch, Transfer.**

An automatic or nonautomatic device for transferring one or more load conductor connections from one power source to another. (CMP-13)

Transfer Switch, Meter-Mounted

A transfer switch connected between the utility meter and the meter socket, using the jaws of the meter socket as a means of connection (CMP-13).

## Statement of Problem and Substantiation for Public Input

The term "meter-mounted transfer switch" is used in multiple articles of this code. There is a partial definition for this term given in 702.5(B), but this should be moved to a section dedicated to definitions. Since the term is used in multiple articles and there appears to be no difference in meaning, a definition in Article 100 should be created.

The definition proposed closely aligns with the description of a meter mounted transfer switch provided in UL 1008M, section 1.3.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4171-NFPA 70-2020 [ Definition: Uninterruptible Power Supply. ]

**Uninterruptible Power Supply.**

~~A power supply used to provide alternating current power to a load for some period of time in the event of a power failure. (CMP-13)~~

~~Informational Note: In addition, it may provide a more constant voltage and frequency supply to the load, reducing the effects of voltage and frequency variations~~

device or system that provides quality and continuity of ac power through the use of a stored-energy device as the backup power source during any period when the normal power supply is incapable of performing acceptably .

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.

700.18 – added the word “system” since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2899-NFPA 70-2020 [ New Definition after Definition: Automatic. ]

**TITLE OF NEW CONTENT**

**Availability.** The percentage of time that a system is available to perform its function(s)

## Statement of Problem and Substantiation for Public Input

The availability of a power system is its essential characteristic which supports practical electrical safety for the individual and the public. Everything we do in the power industry is focused on making sure that power is available because of the linkage between public safety and safe and available electrical power.. This definition, coupled with the tern "reliable" should track explicitly in the NEC and should raise awareness that reliability calculations are as essential as short circuit and load flow calculations. We see an expansion of this concept in Annex F.

## Submitter Information Verification

| | |
|---|---|
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| **Submittal Date:** | Thu Sep 03 09:00:07 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 2821-NFPA 70-2020 [ New Definition after Definition: Receptacle Outlet. ]

**TITLE OF NEW CONTENT**

Type your content he

**Reliability.**

Reliability. The probability that a system or component will operate properly for a specified period of time under design operating conditions without failure.

Informational Note: Additional information is available in IEEE 3006.2-2016 Recommended Practice for Evaluating the Reliability of Existing Industrial and Commercial Power Systems

## Statement of Problem and Substantiation for Public Input

This Code will be improved if it recognizes that lack of electrical power is at least as much of a hazard as its presence. The reliability of a power system is its essential characteristic and contributes to the goal of practical safeguarding of persons and property. This proposed definition pairs with the proposed definition of "Availability".

## Submitter Information Verification

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# Public Input No. 1433-NFPA 70-2020 [ Article 445 ]

## Article 445 ~~Generators~~ Generator and Gensets

**445.1** Scope.

This article contains installation and other requirements for generators.

**445.6** Listing.

Stationary generators 600 volts and less shall be listed.

*Exception: One of a kind or custom manufactured generators shall be permitted to be field labeled by a field evaluation body.*

Informational Note: For additional information, see UL 2200, *Standard for Stationary Engine Generator Assemblies*.

**445.10** Location.

Generators shall be of a type suitable for the locations in which they are installed. They shall also meet the requirements for motors in 430.14.

Informational Note: See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, for information on the location of generator exhaust.

**445.11** Marking.

Each generator shall be provided with a nameplate giving the manufacturer's name, the rated frequency, the number of phases if ac, the rating in kilowatts or kilovolt-amperes, the power factor, the normal volts and amperes corresponding to the rating, and the rated ambient temperature.

Nameplates or manufacturer's instructions shall provide the following information for all stationary generators and portable generators rated more than 15 kW:

(1) Subtransient, transient, synchronous, and zero sequence reactances

(2) Power rating category

(3) Temperature rise at rated load and insulation system class

(4) Indication if the generator is protected against overload by inherent design, an overcurrent protective relay, a circuit breaker, or a fuse

(5) Available fault current for inverter-based generators, in lieu of the synchronous, subtransient, and transient reactances

Marking shall be provided by the manufacturer to indicate whether or not the generator neutral is bonded to its frame. Where the bonding is modified in the field, additional marking shall be required to indicate whether the neutral is bonded to the frame.

**445.12** Overcurrent Protection.

**(A)** Constant-Voltage Generators.

Constant-voltage generators, except ac generator exciters, shall be protected from overload by inherent design, circuit breakers, fuses, protective relays, or other identified overcurrent protective means suitable for the conditions of use.

**(B)** Two-Wire Generators.

Two-wire, dc generators shall be permitted to have overcurrent protection in one conductor only if the overcurrent device is actuated by the entire current generated other than the current in the shunt field. The overcurrent device shall not open the shunt field.

**(C)** 65 Volts or Less.

Generators operating at 65 volts or less and driven by individual motors shall be considered as protected by the overcurrent device protecting the motor if these devices will operate when the generators are delivering not more than 150 percent of their full-load rated current.

**(D)** Balancer Sets.

Two-wire, dc generators used in conjunction with balancer sets to obtain neutral points for 3-wire systems shall be equipped with overcurrent devices that disconnect the 3-wire system in case of excessive unbalancing of voltages or currents.

**(E)** Three-Wire, Direct-Current Generators.

Three-wire, dc generators, whether compound or shunt wound, shall be equipped with overcurrent devices, one in each armature lead, and connected so as to be actuated by the entire current from the armature. Such overcurrent devices shall consist either of a double-pole, double-coil circuit breaker or of a 4-pole circuit breaker connected in the main and equalizer leads and tripped by two overcurrent devices, one in each armature lead. Such protective devices shall be interlocked so that no one pole can be opened without simultaneously disconnecting both leads of the armature from the system.

*Exception to (A) through (E): Where deemed by the authority having jurisdiction that a generator is vital to the operation of an electrical system and the generator should operate to failure to prevent a greater hazard to persons, the overload sensing device(s) shall be permitted to be connected to an annunciator or alarm supervised by authorized personnel instead of interrupting the generator circuit.*

**445.13** Ampacity of Conductors.

**(A)** General.

The ampacity of the conductors from the generator output terminals to the first distribution device(s) containing overcurrent protection shall not be less than 115 percent of the nameplate current rating of the generator. It shall be permitted to size the neutral conductors in accordance with 220.61. Conductors that must carry ground-fault currents shall not be smaller than required by 250.30(A). Neutral conductors of dc generators that must carry ground-fault currents shall not be smaller than the minimum required size of the largest conductor.

*Exception: Where the design and operation of the generator prevent overloading, the ampacity of the conductors shall not be less than 100 percent of the nameplate current rating of the generator.*

**(B)** Overcurrent Protection Provided.

Where the generator set is equipped with a listed overcurrent protective device or a combination of a current transformer and overcurrent relay, conductors shall be permitted to be tapped from the load side of the protected terminals in accordance with 240.21(B).

Tapped conductors shall not be permitted for portable generators rated 15 kW or less where field wiring connection terminals are not accessible.

**445.14** Protection of Live Parts.

Live parts of generators operated at more than 50 volts ac or 60 volts dc to ground shall not be exposed to accidental contact where accessible to unqualified persons.

**445.15** Guards for Attendants.

Where necessary for the safety of attendants, the requirements of 430.233 shall apply.

**445.16** Bushings.

Where field-installed wiring passes through an opening in an enclosure, a conduit box, or a barrier, a bushing shall be used to protect the conductors from the edges of an opening having sharp edges. The bushing shall have smooth, well-rounded surfaces where it may be in contact with the conductors. If used where oils, grease, or other contaminants may be present, the bushing shall be made of a material not deleteriously affected.

**445.17** Generator Terminal Housings.

Generator terminal housings shall comply with 430.12. Where a horsepower rating is required to determine the required minimum size of the generator terminal housing, the full-load current of the generator shall be compared with comparable motors in Table 430.247 through Table 430.250. The higher horsepower rating of Table 430.247 and Table 430.250 shall be used whenever the generator selection is between two ratings.

*Exception: This section shall not apply to generators rated over 600 volts.*

**445.18** Disconnecting Means and Emergency Shutdown.

**(A)** Disconnecting Means.

Generators other than cord-and-plug-connected portable generators shall have one or more disconnecting means. Each disconnecting means shall simultaneously open all associated ungrounded conductors. Each disconnecting means shall be lockable open in accordance with 110.25.

**(B)** Emergency Shutdown of Prime Mover.

Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

(1) Be equipped with provisions to disable all prime mover start control circuits to render the prime mover incapable of starting

(2) Initiate a shutdown mechanism that requires a mechanical reset

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of 445.18(A) where it is capable of being locked in the open position in accordance with 110.25.

**(C)** Remote Emergency Shutdown.

Generators with greater than 15 kW rating shall be provided with a remote emergency stop switch to shut down the prime mover. The remote emergency stop switch shall be located outside the equipment room or generator enclosure and shall also meet the requirements of 445.18(B)(1) and (B)(2).

**(D)** Emergency Shutdown in One- and Two-Family Dwelling Units.

For other than cord-and-plug-connected portable generators, an emergency shutdown device shall be located outside the dwelling unit at a readily accessible location.

**(E)** Generators Installed in Parallel.

Where a generator is installed in parallel with other generators, the provisions of 445.18(A) shall be capable of isolating the generator output terminals from the paralleling equipment. The disconnecting means shall not be required to be located at the generator.

**445.20** Ground-Fault Circuit-Interrupter Protection for Receptacles on 15-kW or Smaller Portable Generators.

Receptacle outlets that are a part of a 15-kW or smaller portable generator shall have listed ground-fault circuit-interrupter protection (GFCI) for personnel integral to the generator or receptacle as indicated in either (A) or (B):

**(A)** Unbonded (Floating Neutral) Generators.

Unbonded generators with both 125-volt and 125/250-volt receptacle outlets shall have listed GFCI protection for personnel integral to the generator or receptacle on all 125-volt, 15- and 20-ampere receptacle outlets.

*Exception: GFCI protection shall not be required where the 125-volt receptacle outlets(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use.*

**(B)** Bonded Neutral Generators.

Bonded generators shall be provided with GFCI protection on all 125-volt, 15- and 20-ampere receptacle outlets.

Informational Note: Refer to 590.6(A)(3) for GFCI requirements for 15-kW or smaller portable generators used for temporary electric power and lighting.

*Exception to (A) and (B): If the generator was manufactured or remanufactured prior to January 1, 2015, listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted.*

## Statement of Problem and Substantiation for Public Input

prime mover are also addressed, a prime mover and generator are combine it is call a genset

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1432-NFPA 70-2020 [Section No. 445.1] | |

## Submitter Information Verification

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**Submittal Date:** Wed Jun 03 15:30:19 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2984-NFPA 70-2020 [ Article 445 ]

~~**Article 445**~~ Article 693 Generators

**~~445~~ 693 .1** Scope.

This article contains installation and other requirements for generators.

**~~445~~ 693 .6** Listing.

Stationary generators 600 volts and less shall be listed.

*Exception: One of a kind or custom manufactured generators shall be permitted to be field labeled by a field evaluation body.*

Informational Note: For additional information, see UL 2200, *Standard for Stationary Engine Generator Assemblies*.

**~~445~~ 693 .10** Location.

Generators shall be of a type suitable for the locations in which they are installed. They shall also meet the requirements for motors in 430.14.

Informational Note: See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, for information on the location of generator exhaust.

**~~445~~ 693 .11** Marking.

Each generator shall be provided with a nameplate giving the manufacturer's name, the rated frequency, the number of phases if ac, the rating in kilowatts or kilovolt-amperes, the power factor, the normal volts and amperes corresponding to the rating, and the rated ambient temperature.

Nameplates or manufacturer's instructions shall provide the following information for all stationary generators and portable generators rated more than 15 kW:

(1) Subtransient, transient, synchronous, and zero sequence reactances

(2) Power rating category

(3) Temperature rise at rated load and insulation system class

(4) Indication if the generator is protected against overload by inherent design, an overcurrent protective relay, a circuit breaker, or a fuse

(5) Available fault current for inverter-based generators, in lieu of the synchronous, subtransient, and transient reactances

Marking shall be provided by the manufacturer to indicate whether or not the generator neutral is bonded to its frame. Where the bonding is modified in the field, additional marking shall be required to indicate whether the neutral is bonded to the frame.

**~~445~~ 693 .12** Overcurrent Protection.

**(A)** Constant-Voltage Generators.

Constant-voltage generators, except ac generator exciters, shall be protected from overload by inherent design, circuit breakers, fuses, protective relays, or other identified overcurrent protective means suitable for the conditions of use.

**(B)** Two-Wire Generators.

Two-wire, dc generators shall be permitted to have overcurrent protection in one conductor only if the overcurrent device is actuated by the entire current generated other than the current in the shunt field. The overcurrent device shall not open the shunt field.

**(C)** 65 Volts or Less.

Generators operating at 65 volts or less and driven by individual motors shall be considered as protected by the overcurrent device protecting the motor if these devices will operate when the generators are delivering not more than 150 percent of their full-load rated current.

**(D)** Balancer Sets.

Two-wire, dc generators used in conjunction with balancer sets to obtain neutral points for 3-wire systems shall be equipped with overcurrent devices that disconnect the 3-wire system in case of excessive unbalancing of voltages or currents.

**(E)** Three-Wire, Direct-Current Generators.

Three-wire, dc generators, whether compound or shunt wound, shall be equipped with overcurrent devices, one in each armature lead, and connected so as to be actuated by the entire current from the armature. Such overcurrent devices shall consist either of a double-pole, double-coil circuit breaker or of a 4-pole circuit breaker connected in the main and equalizer leads and tripped by two overcurrent devices, one in each armature lead. Such protective devices shall be interlocked so that no one pole can be opened without simultaneously disconnecting both leads of the armature from the system.

*Exception to (A) through (E): Where deemed by the authority having jurisdiction that a generator is vital to the operation of an electrical system and the generator should operate to failure to prevent a greater hazard to persons, the overload sensing device(s) shall be permitted to be connected to an annunciator or alarm supervised by authorized personnel instead of interrupting the generator circuit.*

**~~445~~ 693 .13** Ampacity of Conductors.

**(A)** General.

The ampacity of the conductors from the generator output terminals to the first distribution device(s) containing overcurrent protection shall not be less than 115 percent of the nameplate current rating of the generator. It shall be permitted to size the neutral conductors in accordance with 220.61. Conductors that must carry ground-fault currents shall not be smaller than required by 250.30(A). Neutral conductors of dc generators that must carry ground-fault currents shall not be smaller than the minimum required size of the largest conductor.

*Exception: Where the design and operation of the generator prevent overloading, the ampacity of the conductors shall not be less than 100 percent of the nameplate current rating of the generator.*

**(B)** Overcurrent Protection Provided.

Where the generator set is equipped with a listed overcurrent protective device or a combination of a current transformer and overcurrent relay, conductors shall be permitted to be tapped from the load side of the protected terminals in accordance with 240.21(B).

Tapped conductors shall not be permitted for portable generators rated 15 kW or less where field wiring connection terminals are not accessible.

**~~445~~ 693 .14** Protection of Live Parts.

Live parts of generators operated at more than 50 volts ac or 60 volts dc to ground shall not be exposed to accidental contact where accessible to unqualified persons.

**~~445~~ 693 .15** Guards for Attendants.

Where necessary for the safety of attendants, the requirements of 430.233 shall apply.

**~~445~~ 693 .16** Bushings.

Where field-installed wiring passes through an opening in an enclosure, a conduit box, or a barrier, a bushing shall be used to protect the conductors from the edges of an opening having sharp edges. The bushing shall have smooth, well-rounded surfaces where it may be in contact with the conductors. If used where oils, grease, or other contaminants may be present, the bushing shall be made of a material not deleteriously affected.

**~~445~~ 693 .17** Generator Terminal Housings.

Generator terminal housings shall comply with 430.12. Where a horsepower rating is required to determine the required minimum size of the generator terminal housing, the full-load current of the generator shall be compared with comparable motors in Table 430.247 through Table 430.250. The higher horsepower rating of Table 430.247 and Table 430.250 shall be used whenever the generator selection is between two ratings.

*Exception: This section shall not apply to generators rated over 600 volts.*

**~~445~~ 693 .18** Disconnecting Means and Emergency Shutdown.

**(A)** Disconnecting Means.

Generators other than cord-and-plug-connected portable generators shall have one or more disconnecting means. Each disconnecting means shall simultaneously open all associated ungrounded conductors. Each disconnecting means shall be lockable open in accordance with 110.25.

**(B)** Emergency Shutdown of Prime Mover.

Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

(1) Be equipped with provisions to disable all prime mover start control circuits to render the prime mover incapable of starting

(2) Initiate a shutdown mechanism that requires a mechanical reset

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of ~~445~~ 693 .18(A) where it is capable of being locked in the open position in accordance with 110.25.

**(C)** Remote Emergency Shutdown.

Generators with greater than 15 kW rating shall be provided with a remote emergency stop switch to shut down the prime mover. The remote emergency stop switch shall be located outside the equipment room or generator enclosure and shall also meet the requirements of ~~445~~ 693 .18(B)(1) and (B)(2).

**(D)** Emergency Shutdown in One- and Two-Family Dwelling Units.

For other than cord-and-plug-connected portable generators, an emergency shutdown device shall be located outside the dwelling unit at a readily accessible location.

**(E)** Generators Installed in Parallel.

Where a generator is installed in parallel with other generators, the provisions of ~~445~~ 693 .18(A) shall be capable of isolating the generator output terminals from the paralleling equipment. The disconnecting means shall not be required to be located at the generator.

**~~445~~ 693 .20** Ground-Fault Circuit-Interrupter Protection for Receptacles on 15-kW or Smaller Portable Generators.

Receptacle outlets that are a part of a 15-kW or smaller portable generator shall have listed ground-fault circuit-interrupter protection (GFCI) for personnel integral to the generator or receptacle as indicated in either (A) or (B):

**(A)** Unbonded (Floating Neutral) Generators.

Unbonded generators with both 125-volt and 125/250-volt receptacle outlets shall have listed GFCI protection for personnel integral to the generator or receptacle on all 125-volt, 15- and 20-ampere receptacle outlets.

*Exception: GFCI protection shall not be required where the 125-volt receptacle outlets(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use.*

**(B)** Bonded Neutral Generators.

Bonded generators shall be provided with GFCI protection on all 125-volt, 15- and 20-ampere receptacle outlets.

Informational Note: Refer to 590.6(A)(3) for GFCI requirements for 15-kW or smaller portable generators used for temporary electric power and lighting.

*Exception to (A) and (B): If the generator was manufactured or remanufactured prior to January 1, 2015, listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted.*

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This change aligns with an effort to re-organize the alternative energy sources NEC Articles into a series of articles closely located together. This reorganization places all sources alternate sources as follows:

689 On-Site Energy Sources
690 Solar Photovoltaic (PV) Systems
691 Large-Scale Photovoltaic (PV) Systems
692 Fuel Cell Systems
693 Generators
694 Wind Electric Systems
695 Energy Storage Systems
696 Storage Batteries

This public input simply changes 445 to 693 to support this effort. These articles are closely related to each other and this change is in alignment with the direction by the correlating committee to review alternative energy sources for conflicts and usability. This new alignment will create a similar structure as that found for hazardous locations. The new Article 689 is the a combination of Articles 705, 710 and 712 and will act to be the new general requirements for this series of alternative energy sources.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3009-NFPA 70-2020 [Section No. 708.20(F)(5)] | |
| Public Input No. 3011-NFPA 70-2020 [Definition: ] | |
| Public Input No. 4685-NFPA 70-2020 [Global Input] | |

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 2628-NFPA 70-2020 [ New Section after 445.1 ]

**TITLE OF NEW CONTENT**

Type your content here ...

**445.3 Reconditioning of Generators.** The reconditioning and marking of generators shall be performed in accordance with instructions provided by a generator manufacturer and/or in accordance with a nationally recognized standard. Generators are reconditioned when they are rebuilt or serviced and then placed in commerce. Generators shall not be considered reconditioned when they are repaired, rewound or repaired and not placed in commerce.

Exception: Classified (Hazardous) Generators identified for use in Class I, Division 1 (or Zone 0 or 1) areas shall not be reconditioned. Classified Generators Class I, Division 1 (Zone 0 or 1) shall be permitted to repaired or rewound in accordance with instructions provided by a motor manufacturer and in accordance with a nationally recognized standard.

Informational Note: For information pertaining to the reconditioning, repair or rewinding of motors see ANSI/EASA AR100-2020, *Recommended Practice for the Repair of Rotating Electrical Apparatus.*

## Statement of Problem and Substantiation for Public Input

It is a normal practice for generators to be repaired and rewound by established refurbishing companies in accordance to a nationally recognized standard (ANSI/EASA AR100). Reconditioned generators are necessary to keep facilities running without long downtimes. Reconditioned generators are also reconditioned by established refurbishing companies in accordance to the same nationally recognized standard (ANSI/EASA AR100). The nameplate information supplied on a generator is required to ensure the proper application and should not be removed unless the original ratings or characteristics are modified. This program has been successfully in place for many years.

It is not acceptable to recondition generators for Classified for Class 1, Division 1, Zone 0 and Zone 1 locations.

The proposed language is similar to the language found in 408.8 and 490.49 for Switchgear.

Free download of ANSI/EASA AR100-2020, Recommended Practice for the Repair of Rotating Electrical Apparatus is available at the following link: https://easa.com/DesktopModules/DnnSharp/SearchBoost/FileDownload.ashx?file=2125&sb-bhvr=1

This Public Input was developed by EASA, ABB Inc., and Nidec Motors.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3215-NFPA 70-2020 [ New Section after 445.1 ]

**445.3 Reconditioned Generators.** The reconditioning of generators shall be in accordance with instructions provided by a generator manufacturer. The generator nameplate shall not be required to be removed.

Reconditioned, rewound or repaired Classified (Hazardous) Generators identified for use in Class I, Division 1 (or Zone 0 or 1) locations shall be listed as reconditioned (or certified as reconditioned).

Rewound or repaired generators shall not be defined as reconditioned and any listing mark shall not be required to be removed or made permanently illegible.

Informational Note: For information pertaining to the rewinding and repair of generators see ANSI/EASA AR100-2015, Recommended Practice for the Repair of Rotating Electrical Apparatus.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed in accordance with the direction of the NFPA Standards Council in Decision D#19-11. This task group was appointed to identify potential proposed changes to the 2020 edition of the NEC in the form of proposed Tentative Interim Amendments (TIAs) or to the 2023 edition of the NEC in the form of Public Inputs (PIs) that are within the Task Group's scope of activity as specified by the Standards Council.

These proposed Public Inputs relate to requirements covering the use of reconditioned electrical equipment throughout the NEC as a coordinated set of new or revised requirements. These Public Inputs should not be misconstrued by the CMPs as precluding equal consideration of other Public Inputs, with supporting information, submitted now or in the future by individuals.

The task group members are: G. Scott Harding (Chair), Tom Bishop, Casey Blevins, John Catlett, Dave Dagenais, James Dollard, Robert Fahey, Paul Grein, Howard Herndon, David Hittinger, Christel Hunter, Bob Jordan, David Kendall, Dave King, Jack Lyons, Ryan McClarnon, Robert Osborne, Chris Paxton, David Rosenfield, Michael Savage, Bill Schofield and Ron Widup. This task group of balanced interests provided the expertise to develop these public inputs. Multiple sub task groups were set up during the process with the results of the sub task group work shared with and voted on by the full task group.

Public Inputs are being submitted as follows:
- Revised to Article 100 definition of Reconditioned
- Revisions to Sections 110.21(A)(2), 240.88 and 210.15(3)
- New requirements/Sections 110.17, 110.20, 430.3 and 445.3

New Section 445.3

It is a normal practice for generators to be repaired and rewound by established service centers. Said repairs are accomplished in accordance with manufacturer's instructions and/or to the nationally recognized standard (ANSI/EASA AR100). Rewound or repaired generators are necessary to keep facilities running without long downtimes. The original nameplate information supplied on a generator is required to ensure the proper application and should not be removed unless the original ratings or characteristics are modified. This process for repairs has been successfully in place for many years.

Classified generators used in Class I, Division 1 (Zone 0 and Zone 1) locations are permitted to be reconditioned when recertified.

A free download of ANSI/EASA AR100-2015, Recommended Practice for the Repair of Rotating Electrical Apparatus is available to the public at the following link:

https://easa.com/Resources/Resource-library/ansieasa-standard-ar100-2015-recommended-practice-for-the-repair-of-rotating-electrical-apparatus-1

Note to NFPA Staff: ANSI/EASA AR100-2015 is the current edition of this standard. EASA is finalizing the ANSI procedure for AR100 and it will be published as ANSI/EASA AR100-2020 in 2020, prior to the publication of the 2023 NEC and will be confirmed in the comment period.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 1432-NFPA 70-2020 [ Section No. 445.1 ]

**445.1** Scope.

This article contains installation and other requirements for generators and their prime mover .

## Statement of Problem and Substantiation for Public Input

This Article also cover prime mover requirements see Section 445.18 (B). Prime movers are not generators.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1433-NFPA 70-2020 [Article 445] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3257-NFPA 70-2020 [ Section No. 445.1 ]

**445.1** Scope.

This article contains installation and other requirements for generators.

Informational Note: See IEEE 3002.2 Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems for additional information.

## Statement of Problem and Substantiation for Public Input

Generator manufacturers and electricians are sensitive to the specifics of running generators in parallel but it may be wise to direct users of the NEC toward reactive power (circulating current) issues; among others. From the 3002.2 prospectus:

"Activities related to load flow analysis, including design considerations for new systems, analytical studies for existing systems, as well as operational and model validation considerations for industrial and commercial power systems are addressed. Load flow analysis includes steadystate power flow and voltage analysis along with considerations for optimal power flow calculations. The use of computer-aided analysis software, with a list of desirable capabilities recommended to conduct a modern load-flow study, is emphasized. Examples of system data requirements and result analysis techniques are presented."

https://standards.ieee.org/standard/3002_2-2018.html

## Submitter Information Verification

| | |
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| **Committee:** | NEC-P13 |

# Public Input No. 3869-NFPA 70-2020 [ Section No. 445.6 ]

**445.6** Listing.

Stationary generators ~~600 volts and less~~ shall be listed.

*Exception: One of a kind or custom manufactured generators shall be permitted to be field labeled by a field evaluation body.*

Informational Note: For additional information, see UL 2200, *Standard for Stationary Engine Generator Assemblies*.

## Statement of Problem and Substantiation for Public Input

Substantiation – STATIONARY ENGINE GENERATOR ASSEMBLIES - UL 2200, is the UL ANSI standard
for engine generators and it addresses safety concerns for both the electrical and fuel control for electrical
generating equipment. Engine generators need to operate safely under normal and foreseeable abnormal
conditions to prevent a risk of electric shock, fire and mechanical hazards especially considering they are
often exposed to general public access in residential, commercial and industrial applications.
Dozens of manufactures have certified hundreds of generator models in accordance with UL2200 since it
was published in 1998 and it has been significantly revised and expanded to address to align with installation codes and incorporated input from the generator industry. The 3rd edition of UL 2200 was revised through the ANSI consensus process to address the needs of both the USA and Canada. The expanded UL/ULC2200 standard additionally includes
requirements for medium voltage (MV) generators which is critical to properly address the hazards and safety concerns related to combining medium voltage, low voltage and combustible fuels within the same product that are often installed in general access locations.

These generators may be driven by gasoline, LP-gas, natural gas, diesel or bio fueled internal combustion engines. Additionally UL2200 certified engine generator assemblies are intended for installation and use in ordinary locations in accordance with the National Electrical Code NFPA 70; the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37, the Standard for Health Care Facilities, NFPA 99, and the Standard for Emergency and Standby Power Systems, NFPA 110. UL2200 includes numerous NEC references and requirements to facilitate a Code compliant engine generator electrical installation. The UL2200 3rd edition which includes requirements for medium voltage generators recently passed ballot and is scheduled for publication in September of 2020.

This proposed revision removes the 600v limitation and requires all stationary generators to be listed.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 14:28:14 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4154-NFPA 70-2020 [ Section No. 445.6 ]

**445.6** Listing.

Stationary generators 600 volts and less shall be listed.

*Exception: One of a kind or custom manufactured generators shall be permitted to be field labeled ~~by a field evaluation body~~ .*

Informational Note: For additional information, see UL 2200, *Standard for Stationary Engine Generator Assemblies*.

## Statement of Problem and Substantiation for Public Input

The phrase "by a field evaluation body" is unnecessary. The term "field labeled" is used in several places in the Code and in no other instance is it followed by the phrase "by a field evaluation body."

The definition of Field Labeled in part states "Equipment or materials to which has been attached a label, symbol, or other identifying mark of an FEB (Field Evaluation Body)... This infers field labeling is accomplished by a field evaluation body.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 930-NFPA 70-2020 [ Section No. 445.6 ]

**445.6** Listing.

Stationary generators 600 volts or less, and portable generators 15 KW or less, 250 volts or less, shall be listed.

*Exception: One of a kind or custom manufactured generators shall be permitted to be field labeled by a field evaluation body.*

Informational Note: For additional information, see UL 2200, *Standard for Stationary Engine Generator Assemblies*.

## Statement of Problem and Substantiation for Public Input

Portable generator are being install for the same purpose and should be held to the same standards and code requirements. there are plenty of manufactures that have listed portable units Ul has standard for this equipment as well

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 929-NFPA 70-2020 [Section No. 702.12(B)] | |
| Public Input No. 929-NFPA 70-2020 [Section No. 702.12(B)] | |

## Submitter Information Verification

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## Public Input No. 2379-NFPA 70-2020 [ Section No. 445.10 ]

**445.10** Location.

Generators shall be of a type suitable for the locations in which they are installed. ~~They shall also meet the requirements for motors in 430.14~~ . The installation shall comply with equipment manufacturer(s) requirements for the installation and maintenance of the generator set.

Informational Note: See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, for information on the location of generator exhaust.

## Statement of Problem and Substantiation for Public Input

The previous text requires the user to go to Article 430.14 to simply be directed to install the generator set correctly. This is an unnecessary complication for the user because the text describing the requirement is very short and does not duplicate any lengthy requirements.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 945-NFPA 70-2020 [ Section No. 445.10 ]

**445.10** Location.

Generators shall be of a type suitable for the locations in which they are installed. They shall also meet the requirements for motors in 430.14.

Informational Note: See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, for information on the location of ~~generator exhaust~~ generators .

## Statement of Problem and Substantiation for Public Input

The scope of NFPA 37 is the following "This standard establishes criteria for minimizing the hazards of fire during the installation and operation of stationary combustion engines and gas turbines." The location of the generator exhaust is out of scope as it applies to NFPA 37 except as it applies to protecting structures from fire due to the temperature of generator exhaust. The Information Note is misleading since NFPA 37 does not dictate minimum distance requirements from engine exhaust as it applies to CO. NFPA 37 does have some useful information as it applies to generator placement as it pertains to minimizing the fire hazards to the structure or adjacent structures.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 1607-NFPA 70-2020 [ Section No. 445.11 ]

**445.11** Marking.

Each generator shall be provided with a nameplate giving the manufacturer's name, the rated frequency, the number of phases if ac, the rating in kilowatts or kilovolt-amperes, the power factor, the normal volts and amperes corresponding to the rating, and the rated ambient temperature.

Nameplates or manufacturer's instructions shall provide the following information for all stationary generators and portable generators rated more than 15 kW:

(1) Subtransient, transient, synchronous, and zero sequence reactances

(2) Power rating category

(3) Temperature rise at rated load and insulation system class

(4) Indication if the generator is protected against overload by inherent design, an overcurrent protective relay, a circuit breaker, or a fuse

(5) Available fault current for inverter-based generators, in lieu of the synchronous, subtransient, and transient reactances

Marking shall be provided by the manufacturer to indicate whether or not the generator neutral is bonded to its ~~frame~~ equipment grounding conductor . Where the bonding is modified in the field, additional marking shall be required to indicate whether the neutral is bonded to ~~the frame~~ it's equipment grounding conductor .

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Generator_email_about_bonding.png | Generator Email about Floating Neutral | |
| Portable_Generator_3.jpg | Wirng diagram of a portable generator with N/G bond made. | |

## Statement of Problem and Substantiation for Public Input

The key to understanding how to ground and bond a generator is a function of whether the generator windings are bonded or not bonded to the equipment grounding conductor of the generator. Generator manufactures (see email attachment) identify the generator as a floating neutral system if the "frame" of the generator is not bonded to the neutral conductor, but the equiptment grounding conductor is bonded to the neutral conductor. My edits are to make it clear that it is the neutral of the generator bonding to the equipment grounding conductor that determines if the system has a bonded or floating neutral; not if the frame is or is not bonded to the neutral.

## Submitter Information Verification

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**Submittal Date:** Wed Jun 24 10:54:39 EDT 2020
**Committee:** NEC-P13

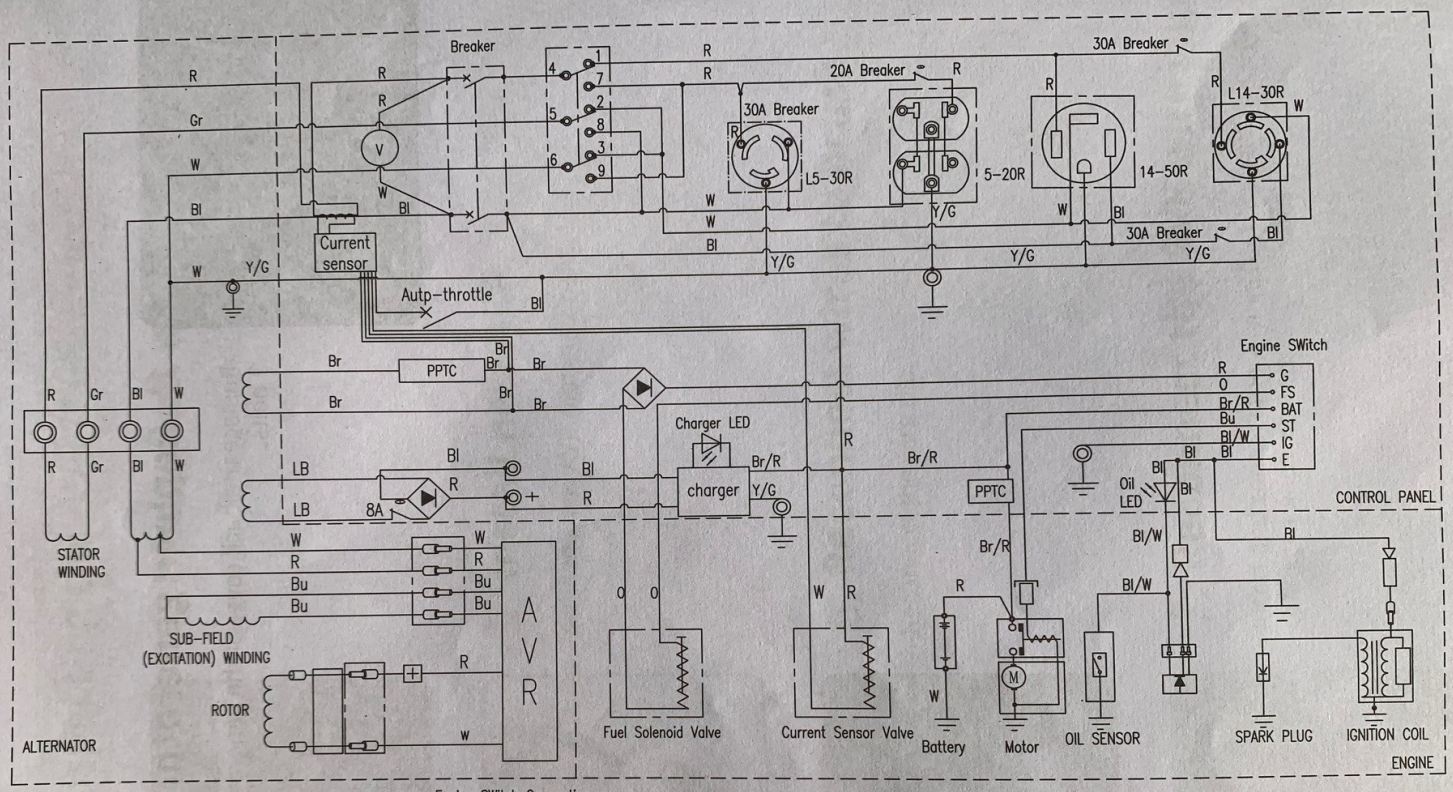
**From:** [redacted] <support@duromaxpowerequipment.com>
**Date:** June 23, 2020 at 12:42:37 PM EDT
**To:** [redacted]
**Subject: Re: DuroMax Power Equipment just answered your question about DuroMax XP12000EH 12000-Watt 18 HP Portable Dual Fuel Gas Propane Generator [3844030:793995]**

Hello Todd,

We apologize for the confusion. The jumper of the generator head is bonded to the stator housing, but the stator housing is set up on rubber motor mounts causing the stator system to be isolated from the generator frame, and because there is no path to ground until the generator is grounded and the generator will be still considered a floating neutral. We always mention to physically ground the generator for safety because of this set up.

Please feel free to contact us if you have any further questions or concerns. Thank you for choosing us.

# WIRING DIAGRAM




| | | | | | |
|---|---|---|---|---|---|
| Bl | Black | Br | Brown | Y/G | Yellow/Green |
| O | Orange | Br/R | Brown/Red | Bl/W | Black/White |
| Bu | Blue | LB | Light Blue | G | Green |
| Gr | Gray | Bl | Black | - | |
| R | Red | W | White | | |

Engine SWitch Connecting

| | IG | E | BAT | ST | FS | G |
|---|---|---|---|---|---|---|
| OFF | o | o | | | o | o |
| ON | | | | | | |
| Start | | | o | o | | |

WIRING DIAGRAM OF 120/240V GENERATOR SET

## Public Input No. 2360-NFPA 70-2020 [ Section No. 445.11 ]

**445.11** Marking.

Each generator shall be provided with a nameplate giving the manufacturer's name, the rated frequency, the number of phases if ac, the rating in kilowatts or kilovolt-amperes, the power factor, the normal volts and amperes corresponding to the rating, and the rated ambient temperature.

Nameplates or manufacturer's instructions shall provide the following information for all stationary generators and portable generators rated more than 15 kW:

(1) Subtransient, transient, synchronous, and zero sequence reactances

(2) Power rating category

(3) Temperature rise at rated load and insulation system class

(4) Indication if the generator is protected against overload by inherent design, an overcurrent protective relay, a circuit breaker, or a fuse

(5) Available fault current for inverter-based generators, in lieu of the synchronous, subtransient, and transient reactances

Marking shall be provided by the manufacturer to indicate whether or not the generator neutral is bonded to its frame. Where the bonding is modified in the field, additional marking shall be required to indicate whether the neutral is bonded to the frame.

Factory mounted disconnect switch(es), optional accessories, or other supplemental equipment mounted to the generator assembly shall not conceal or obscure the generator nameplate, unless another unconcealed generator nameplate is provided at an accessible and readily identifiable location.

## Statement of Problem and Substantiation for Public Input

Oftentimes, factory-mounted disconnect switches either conceal the generator nameplate, or prevent access to the generator nameplate due to enclosure constraints. The generator nameplate should be readily accessible no matter the factory alterations that occur.

## Submitter Information Verification

**Submitter Full Name:** John Blissett
**Organization:** Bernhard TME
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Mon Aug 17 17:06:53 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2555-NFPA 70-2020 [ Section No. 445.11 ]

**445.11** Marking.

Each generator shall be provided with a nameplate giving the manufacturer's name, the rated frequency, the number of phases if ac, the rating in kilowatts or kilovolt-amperes, the power factor, the normal volts and amperes corresponding to the rating, and the rated ambient temperature.

Nameplates or manufacturer's instructions shall provide the following information for all stationary generators and portable generators rated more than 15 kW:

(1) ~~Subtransient,~~ Generator set power rating category (prime, standby, or continuous)

(2) Alternator subtransient, transient, synchronous, and zero sequence reactances

(3) ~~Power and the rating category~~ basis

(4) ~~Temperature~~ Alternator temperature ~~rise at rated load and insulation system class~~

(5) ~~Indication if the generator is protected against overload by inherent design, an overcurrent protective relay, a circuit breaker, or a fuse~~

(6) ~~Available fault current for inverter-based generators, in lieu of the synchronous, subtransient, and transient reactances~~

Marking shall be provided by the manufacturer to indicate whether or not the generator neutral is bonded to its frame. Where the bonding is modified in the field, additional marking shall be required to indicate whether the neutral is bonded to the frame.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| MS_Word_text_for_445.11_suggested_change.docx | Not sure the text change was clear based on what was displayed | |

## Statement of Problem and Substantiation for Public Input

Changes suggested are to clarify the requirements necessary for a designer/user to identify the basic performance requirements necessary for design of a generator set for a critical application. The information is also required for situations where an owner or system designer is attempting to validate the ability of installed equipment to accept additional loads.

Also reworded some of the text to add common terms for generator set power ratings based on NFPA 110 terminology.

Alternator reactances are of no value if the basis of the rating is not stated, so that is added to the text

Reordered the text for readability, with the most general requirements first, and component requirements following.

## Submitter Information Verification

**Submitter Full Name:** Gary Olson

| | |
|---|---|
| **Organization:** | kWRx LLC |
| **Street Address:** | |
| **City:** | |
| **State:** | |
| **Zip:** | |
| **Submittal Date:** | Mon Aug 24 16:15:37 EDT 2020 |
| **Committee:** | NEC-P13 |

Nameplates or manufacturer's instructions shall provide the following information for all stationary generators and portable generators rated more than 15 kW:

1. Generator set power rating category (prime, standby, or continuous)
2. Alternator subtransient, transient, synchronous, and zero sequence reactances and the rating basis
3. Alternator temperature rise at rated load and insulation system class
4. Indication if the generator is protected against overload by inherent design, an overcurrent protective relay, a circuit breaker, or a fuse
5. Available fault current for inverter-based generators, in lieu of the synchronous, subtransient, and transient reactances

# Public Input No. 2593-NFPA 70-2020 [ Section No. 445.13 ]

**445.13** Ampacity of Conductors.

**(A)** ~~– General.~~

~~The~~

**Overcurrent Protection Not Provided.** Where an overcurrent protection device is not provided within the generator set, the ampacity of the conductors

~~from the generator output terminals~~

to the first distribution device(s) containing overcurrent protection for the generator shall not be less than

~~115 percent~~

115% of the nameplate current rating of the generator.

~~It~~

Neutral conductors shall be permitted to

~~size the neutral conductors~~

be sized in accordance with

~~220~~

250 .61 . Conductors that must carry ground-fault currents shall not be smaller than required by 250.

~~30~~

35.

~~(~~

~~A~~

**B ) Overcurrent Protection Provided .**

~~Neutral conductors of dc generators~~

Where overcurrent protection device(s) in accordance with 445.12 are provided within the generator set, the ampacity of the conductors shall be sized in accordance to the ampere rating of the overcurrent protection device(s). Neutral conductors shall be permitted to be sized in accordance with 250.61. Conductors that must carry ground-fault currents shall not be smaller than

~~the minimum required size of the largest conductor.~~

required by 250.35.

*Exception: Where the design and operation of the generator prevent overloading, the ampacity of the feeder conductors shall be permitted to be sized to not*

~~be~~

*less than*

~~100 percent~~

*100 percent of the nameplate current rating of the generator.*

~~(~~

~~B) Overcurrent Protection Provided.~~

**~~C) Tapped Conductors.~~** ~~- Where the generator set is equipped with~~

~~a listed overcurrent protective device~~

overcurrent protection in accordance with 445.13(B), or a combination of a current transformer and overcurrent relay, conductors shall be permitted to be tapped from the load side of the protected terminals in accordance with 240.21(B) .

~~— Tapped conductors shall not be permitted for portable generators rated~~

~~15 kW~~

~~15 kW or less where field wiring connection terminals are not accessible.~~

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 2023_NEC_445.13.docx | Word doc version of the proposed PI | |

## Statement of Problem and Substantiation for Public Input

Article 445.13 has been revised to provide clarity to the code user on how generators are manufactured, with or without overcurrent protection. Generators are designed and manufactured to be equipped with either integral overcurrent protection devices, or are equipped with power distribution blocks. The revised code will provide clarity on how the generator feeder conductors are to be sized in the field based on the location of the generator OCPD(s). The exception to 445.13(A) has been relocated to (B) since the inherent design of the generator is a permitted type of overcurrent protection in 445.12. The requirements for tap conductors are moved to a new (C).

## Submitter Information Verification

**Submitter Full Name:** Brian Baughman
**Organization:** Generac Power Systems Inc.
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Tue Aug 25 10:07:07 EDT 2020
**Committee:** NEC-P13

**445.13 Ampacity of Conductors.**

**(A) Overcurrent Protection Not Provided.** Where an overcurrent protection device is not provided within the generator set, the ampacity of the conductors to the first distribution device(s) containing overcurrent protection for the generator shall not be less than 115% of the nameplate current rating of the generator. Neutral conductors shall be permitted to be sized in accordance with 250.61. Conductors that must carry ground-fault currents shall not be smaller than required by 250.35.

**(B) Overcurrent Protection Provided**. Where overcurrent protection device(s) in accordance with 445.12 are provided within the generator set, the ampacity of the conductors shall be sized in accordance to the ampere rating of the overcurrent protection device(s). Neutral conductors shall be permitted to be sized in accordance with 250.61. Conductors that must carry ground-fault currents shall not be smaller than required by 250.35.

*Exception: Where the design and operation of the generator prevent overloading, the ampacity of the feeder conductors shall be permitted to be sized to not less than 100 percent of the nameplate current rating of the generator.*

**(C) Tapped Conductors.** Where the generator set is equipped with overcurrent protection in accordance with 445.13(B) or a combination of a current transformer and overcurrent relay, conductors shall be permitted to be tapped from the load side of the protected terminals in accordance with 240.21(B).

Tapped conductors shall not be permitted for portable generators rated 15 kW or less where field wiring connection terminals are not accessible.

**Technical Substantiation:** Article 445.13 has been revised to provide clarity to the code user on how generators are manufactured, with or without overcurrent protection. Generators are designed and manufactured to be equipped with either integral overcurrent protection devices, or are equipped with power distribution blocks. The revised code will provide clarity on how the generator feeder conductors are to be sized in the field based on the location of the generator OCPD(s). The exception to 445.13(A) has been relocated to (B) since the inherent design of the generator is a permitted type of overcurrent protection in 445.12. The requirements for tap conductors are moved to a new (C).

## Public Input No. 2389-NFPA 70-2020 [ Section No. 445.13(A) ]

**(A)** General.

The ampacity of the conductors from the generator output terminals to the first distribution device(s) containing overcurrent protection shall not be less than 115 percent of the nameplate current rating of the generator. It shall be permitted to size the neutral conductors in accordance with 220.61. Conductors that must carry ground-fault currents shall not be smaller than required by 250.30(A). Neutral conductors of dc generators that must carry ground-fault currents shall not be smaller than the minimum required size of the largest conductor.

*Exception: Where the design and operation of the generator prevent overloading by use of listed protective equipment , the ampacity of the conductors shall not be less than 100 percent of the nameplate current rating of the generator.*

## Statement of Problem and Substantiation for Public Input

The current text of the document does not provide any guidance as to technical requirements for a protective device that would prevent overloading of the generator set, or a means for authorities to verify that the protection provided is effective in preventing an overload of the generator set. By requiring a listed protective device there is 3rd party verification of the capabilities of the protective device in preventing an overload when the protective device is properly applied based on the alternator capability.

## Submitter Information Verification

**Submitter Full Name:** Gary Olson
**Organization:** kWRx LLC
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Tue Aug 18 15:21:06 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2594-NFPA 70-2020 [ Section No. 445.18 ]

**445.18** Disconnecting ~~Means and Emergency Shutdown.~~ Means

**(A)**

~~Disconnecting Means~~
**General .**

~~Generators other than cord-and-plug-connected portable generators shall have one or more disconnecting means. Each disconnecting means shall~~

Generators shall be provided with means to simultaneously open all associated ungrounded conductors.

~~Each~~ The provisions to shut down the prime mover shall be permitted to satisfy the

The disconnecting means shall comply with the following:

(1) The disconnecting means shall be comprised of a circuit breaker, molded case switch, general-use switch, snap switch, or other approved means.

(2) The disconnecting means shall be readily accessible.

(3) The disconnecting means shall be lockable open in accordance with 110.25 .

~~**(B)** Emergency Shutdown of Prime Mover.~~

~~Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:~~

(1) ~~Be equipped with provisions to disable all prime mover start control circuits to render the prime mover incapable of starting~~

(2) ~~Initiate a shutdown mechanism that requires a mechanical reset~~

(1) Where multiple disconnecting means are installed, the disconnecting means shall be grouped.

(2) The disconnecting means shall be labeled “Generator Disconnect” and the label shall not be handwritten and shall be of sufficient durability to withstand the environment involved. Where multiple generators are present, the labeling shall clearly indicate the disconnecting means for each generator.

*Exception: The requirements of 445.18(A)*

~~where it is capable of being locked in the open position in accordance with 110.25 .~~

~~**(C)** Remote Emergency Shutdown.~~

~~Generators with greater than 15 kW rating shall be provided with a remote emergency stop switch to shut down the prime mover. The remote emergency stop switch shall be located outside the equipment room or generator enclosure and shall also meet the~~

*shall not apply to the generator control wiring.*

**(B) Outdoor Generator Sets and Portable Generators Greater Than 15 kW.** Where an outdoor housed generator set is equipped with an integral disconnecting means in accordance with 445.18(A), and the generator set is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. The generator disconnecting means shall be permitted to be located within the generator enclosure.

Where the generator set with an integral disconnecting means or the disconnecting means required by 445.18(A) is not within sight of building or structure supplied, an additional disconnecting means

meeting the requirements of 445.18(

~~B)(1) and (B)(2).~~

~~**(D)** Emergency Shutdown in One- and Two-Family Dwelling Units.~~

~~For other than cord-and-plug-connected portable generators, an emergency shutdown device shall be located outside the dwelling unit at a readily accessible location.~~

~~**(E)** Generators Installed in Parallel.~~

~~Where~~

A) shall be installed.

Exception: For installations under single management, where conditions of maintenance and supervision ensure that only qualified persons will monitor and service the installation and where documented safe switching procedures are established and maintained for disconnection, the generator set disconnecting means shall not be required to be located within sight of the building or structure served.

**(C) Portable Generators 15 kW or Less.** Where a portable generator, rated 15 kW or less, is connected to a premise wiring system using a flanged inlet or other cord-and plug-type connection, the disconnecting means in 445.18(A) shall not be required where ungrounded conductors serve or pass through a building or structure.

**(D) Generators installed in Parallel.** Where a generator is installed in parallel with other generators, the provisions of 445.18(A) shall

~~be capable of isolating~~

apply to each generator and shall isolate the generator output

~~terminals~~

from the paralleling equipment. The disconnecting means shall not be required to be located at the generator.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 2023_NEC_445.18.docx | Word doc version of the revised text | |

## Statement of Problem and Substantiation for Public Input

The code arrangement in 90.3 states that Chapters 1-4 apply generally to all installations and Chapters 5-7 can supplement or modify Chapters 1-7. Generator disconnecting means requirements currently appear in Articles 445.18, 700.12(D)(5), 701.12(D)(5), 702.12, and 708.20(F)(5). For code clarity and improved usability, the current generator disconnect means requirements throughout the Code are combined into a new 445.18 Disconnecting Means. The requirements in 445.18 will apply to any type of generator installation under the purview of the NEC and will make the disconnecting means requirements in Chapter 7 redundant unnecessary language.
The revisions also provides clarity that generator sets can be factory equipped with disconnecting means within the generator assembly enclosure and if the generator is within sight of the building or structure supplied, an additional disconnecting means should not be required. Some AHJ's have taken a literal interpretation that the actual physical handle of the generator disconnecting means has to be within sight of the building or structure supplied, and required addition safety switches where a breaker disconnecting means is within the generator assembly.
A field labeling requirement is added to provide clarity on the purpose of the disconnecting means for first responders.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2595-NFPA 70-2020 [New Section after 445.18(E)] | |
| Public Input No. 2598-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 2600-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 2601-NFPA 70-2020 [Section No. 702.12] | |
| Public Input No. 2603-NFPA 70-2020 [Section No. 708.20(F)] | |

## Submitter Information Verification

**Submitter Full Name:** Brian Baughman
**Organization:** Generac Power Systems Inc.
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Tue Aug 25 10:14:43 EDT 2020
**Committee:** NEC-P13

**445.18 Disconnecting Means**

**(A) General.** Generators shall be provided with means to simultaneously open all associated ungrounded conductors.

The disconnecting means shall comply with the following:

1) The disconnecting means shall be comprised of a circuit breaker, molded case switch, general-use switch, snap switch, or other approved means.
2) The disconnecting means shall be readily accessible.
3) The disconnecting means shall be lockable open in accordance with 110.25.
4) Where multiple disconnecting means are installed, the disconnecting means shall be grouped.
5) The disconnecting means shall be labeled "Generator Disconnect" and the label shall not be handwritten and shall be of sufficient durability to withstand the environment involved. Where multiple generators are present, the labeling shall clearly indicate the disconnecting means for each generator.

*Exception: The requirements of 445.18(A) shall not apply to the generator control wiring.*

**(B) Outdoor Generator Sets and Portable Generators Greater Than 15 kW.** Where an outdoor housed generator set is equipped with an integral disconnecting means in accordance with 445.18(A), and the generator set is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. The generator disconnecting means shall be permitted to be located within the generator enclosure.

Where the generator set with an integral disconnecting means or the disconnecting means required by 445.18(A) is not within sight of building or structure supplied, an additional disconnecting means meeting the requirements of 445.18(A) shall be installed.

*Exception: For installations under single management, where conditions of maintenance and supervision ensure that only qualified persons will monitor and service the installation and where documented safe switching procedures are established and maintained for disconnection, the generator set disconnecting means shall not be required to be located within sight of the building or structure served.*

**(C) Portable Generators 15 kW or Less.** Where a portable generator, rated 15 kW or less, is connected to a premise wiring system using a flanged inlet or other cord-and plug-type connection, the disconnecting means in 445.18(A) shall not be required where ungrounded conductors serve or pass through a building or structure.

**(D) Generators installed in Parallel.** Where a generator is installed in parallel with other generators, the provisions of 445.18(A) shall apply to each generator and shall isolate the generator output from the paralleling equipment. The disconnecting means shall not be required to be located at the generator.

**Technical Substantiation:** The code arrangement in 90.3 states that Chapters 1-4 apply generally to all installations and Chapters 5-7 can supplement or modify Chapters 1-7. Generator disconnecting means requirements currently appear in Articles 445.18, 700.12(D)(5), 701.12(D)(5), 702.12, and 708.20(F)(5). For code clarity and improved usability, the current generator disconnect means requirements throughout the Code are combined into a new 445.18 Disconnecting Means. The requirements in 445.18 will apply to any type of generator installation under the purview of the NEC and will make the disconnecting means requirements in Chapter 7 redundant unnecessary language.

The revisions also provides clarity that generator sets can be factory equipped with disconnecting means within the generator assembly enclosure and if the generator is within sight of the building or structure supplied, an additional disconnecting means should not be required. Some AHJ's have taken a literal interpretation that the actual physical handle of the generator disconnecting means has to be within sight of the building or structure supplied, and required addition safety switches where a breaker disconnecting means is within the generator assembly.

A field labeling requirement is added to provide clarity on the purpose of the disconnecting means for first responders.

## Public Input No. 1301-NFPA 70-2020 [ Section No. 445.18(B) ]

**(B)** Emergency Shutdown of Prime Mover.

Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

(1) Be equipped with provisions to disable all prime mover start control circuits to render the prime mover incapable of starting

(2) Initiate a shutdown mechanism that requires a ~~mechanical reset~~ manual restart

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of 445.18(A) where it is capable of being locked in the open position in accordance with 110.25.

## Statement of Problem and Substantiation for Public Input

The current language is confusing, Several AHJ's have expressed that they are unsure what mechanical reset means or how they are to inspect it. Looking at the PI's and PC's for this 2017 change, manual restart seems to have been what was being suggested. Revising the text seems to maintain the intent of the 2017 change while using terms that are more common and understandable by those that enforce the NEC.

## Submitter Information Verification

**Submitter Full Name:** Jeffrey Fecteau
**Organization:** UL LLC
**Affiliation:** UL LLC
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Thu May 28 18:29:30 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2719-NFPA 70-2020 [ Section No. 445.18(B) ]

**(B)** Emergency Shutdown of Prime Mover.

Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

(1) Be equipped with provisions to disable all prime mover start control circuits to render the prime mover incapable of starting

(2) Initiate a shutdown mechanism that requires a mechanical reset

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of 445.18(A) ~~where it is capable of being locked in the open position in accordance with 110.25~~ . and 445.18(D) when the prime mover shut down device complies with 445.18(B) and a label shall be applied at the service equipment location outside of the structure with the location of the prime mover shut down device for the first responders. Markings shall comply with 110.21(B).

## Statement of Problem and Substantiation for Public Input

This new language will help clear up a lot of the confusion that is occurring with both the inspectors and the installers alike as to whether or not a disconnect is required in addition to the prime mover shut down device which disables the prime mover from operating, and a label will need to be located at the service equipment outside of the dwelling unit for the first res-ponders. Markings shall comply with 110.21(b)

## Submitter Information Verification

**Submitter Full Name:** Paul J Kennedy Jr
**Organization:** Kennedy Seminars
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Sat Aug 29 14:24:49 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2625-NFPA 70-2020 [ Section No. 445.18(C) ]

**(C)** Remote Emergency Shutdown.

Generators with greater than 15 kW rating shall be provided with a remote emergency stop switch to shut down the prime mover when located in a building . The remote emergency stop switch shall be located on the exterior of the building, or outside of the equipment room or generator enclosure located outside the building, and shall also meet the requirements of 445.18(B)(1) and (B)(2).

Exception: Generators located outside of the building and 22 kW or less are not required to have a remote shutdown.

## Statement of Problem and Substantiation for Public Input

This input is being submitted on behalf of the Minnesota Department of Labor and Industry. The Department's 15 office/field staff, and 65 plus contract electrical inspectors complete over 150,000 electrical inspections annually and are involved in the daily enforcement and interpretation of the National Electrical Code.
To be consistent with other emergency responder disconnects in the NEC, this generator disconnect should be located exterior of the building or structure.
The exception to the requirement was added because 22KW and under generators are commonly installed at dwelling units. Generally, a disconnect switch is located under a hinged cover and an additional emergency stop located on the exterior of the enclosure or mounted on the exterior of the home is not necessary. A plaque located on the enclosure cover near the access to the on/off switch and feeder breaker should be adequate as required by section 702.7. The NEC also allows for a use of keys as a common alternative to the ready access requirements as found in the definition of "Readily Accessible".

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2626-NFPA 70-2020 [Section No. 445.18(D)] | |
| Public Input No. 2626-NFPA 70-2020 [Section No. 445.18(D)] | |

## Submitter Information Verification

**Submitter Full Name:** Dean Hunter
**Organization:** Minnesota Department of Labor
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Wed Aug 26 08:46:03 EDT 2020
**Committee:** NEC-P13

## Public Input No. 595-NFPA 70-2020 [ Section No. 445.18(C) ]

**(C)** Remote Emergency Shutdown.

~~Generators with greater than 15 kW rating shall~~ Generators shall be provided with a remote emergency stop switch to shut down the prime mover. The remote emergency stop switch shall be located outside the equipment room or generator enclosure and shall also meet the requirements of 445.18(B)(1) and (B)(2).

## Statement of Problem and Substantiation for Public Input

445.18b is confusing with the requirements. By editing 445.18c this eliminates confusion and creates a safer environment for first responders and Service personnel

## Submitter Information Verification

**Submitter Full Name:** Brian Leary
**Organization:** Town of Walpole
**Affiliation:** Electrical inspector and still currently working in the trade
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Wed Mar 04 09:24:34 EST 2020
**Committee:** NEC-P13

## Public Input No. 2626-NFPA 70-2020 [ Section No. 445.18(D) ]

~~(D) Emergency Shutdown in One- and Two-Family Dwelling Units.~~

~~For other than cord-and-plug-connected portable generators, an emergency shutdown device shall be located outside the dwelling unit at a readily accessible location.~~

## Statement of Problem and Substantiation for Public Input

This input is being submitted on behalf of the Minnesota Department of Labor and Industry. The Department's 15 office/field staff, and 65 plus contract electrical inspectors complete over 150,000 electrical inspections annually and are involved in the daily enforcement and interpretation of the National Electrical Code.
22KW and under generators are commonly installed at dwelling units. Generally, a disconnect switch is located under a hinged cover and an additional emergency stop located on the exterior of the enclosure or mounted on the exterior of the home is not necessary. A plaque located on the enclosure cover near the access to the on/off switch and feeder breaker should be adequate as required by section 702.7. The NEC also allows for a use of keys as a common alternative to the ready access requirements as found in the definition of "Readily Accessible".

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2625-NFPA 70-2020 [Section No. 445.18(C)] | |
| Public Input No. 2625-NFPA 70-2020 [Section No. 445.18(C)] | |

## Submitter Information Verification

**Submitter Full Name:** Dean Hunter
**Organization:** Minnesota Department of Labor
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Wed Aug 26 08:57:25 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2595-NFPA 70-2020 [ New Section after 445.18(E) ]

**445.19 Emergency Shutdown of the Generator Prime Mover.**

**(A) General.** Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

(1) Be equipped with provisions to disable all prime mover start control circuits to shut down the prime mover.

(2) Initiate a shutdown mechanism that requires a mechanical reset.

(3) The means of shut down shall be labeled “Generator Emergency Shutdown” and the label shall not be handwritten and shall be of sufficient durability to withstand the environment involved.

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of 445.18(A) where it is capable of being lockable open in accordance with 110.25.

**(B) Remote Emergency Shutdown.** Generators with a greater than 25 kW rating shall be provided with a remote emergency stop switch to shutdown the prime mover. The remote emergency stop switch shall be located at a readily accessible location outside of the generator equipment room or generator enclosure. and shall also meet the requirements of 445.19(A)(1), (A)(2), and (A)(3). The remote emergency stop switch shall be permitted to be installed on the exterior of the generator enclosure where the generator is located outdoors.

*Exception: The requirement in 445.19(B) shall not apply to generators installed on one- or two-family dwelling units.*

**(C) Emergency Shutdown in One- and Two-Family Dwelling Units** . For other than cord-and-plug connected portable generators, a single generator prime mover shutdown device in accordance with 445.19(A)(1) and (A)(2) and shall be installed at a readily accessible location, outside the dwelling unit. The generator prime mover shutdown device shall be permitted to be installed on the exterior of the generator enclosure. The generator prime mover shutdown device shall be labeled "Generator Shutdown" and the label shall not be handwritten and shall be of sufficient durability to withstand the environment involved.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 2023_NEC_445.19.docx | Word doc of the proposed PI | |

## Statement of Problem and Substantiation for Public Input

The requirements for the emergency shutdown of a prime mover should be broken out of Article 445.18 and be provided with their own code section for clarity. The proposed language takes the current requirements from 445.18(B), (C), and (D) and moves them to 445.19. A field labeling requirement is added for the generator emergency shutdown switches installed with each generator. In addition, permissive language was added to (B) and (C) and allows the emergency shutdown switch or emergency shutdown device to be installed on the exterior of the generator enclosure. This new language will provide correlation with the change in code language in Section 5.6.5.6.1 in the 2019 edition of NFPA 110.

An exception was added to (B) to provide clarity that generators installed on one- and two-family dwelling units only have to comply with the provisions of (A) and (C). The kW threshold in (B) has been increased to 25 kW to provide some installation relief due to the presence of listed optional standby air-cooled generators rated at 24 kW in the field.

The language in (C) will provide clarity that emergency stop switches or “red mushroom style E-stops” are not required on generators installed on one-or two-family dwelling units, and only a device that disables the prime mover is required. A separate labeling requirement has been provided for the shutdown device on residential generators.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2594-NFPA 70-2020 [Section No. 445.18] | moves prime mover shutdown to a new article |

## Submitter Information Verification

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**Submittal Date:** Tue Aug 25 10:43:41 EDT 2020
**Committee:** NEC-P13

**445.19 Emergency Shutdown of the Generator Prime Mover.**

**A) General.** Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

(1) Be equipped with provisions to disable all prime mover start control circuits to shut down the prime mover.

(2) Initiate a shutdown mechanism that requires a mechanical reset.

(3) The means of shut down shall be labeled “Generator Emergency Shutdown” and the label shall not be handwritten and shall be of sufficient durability to withstand the environment involved.

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of 445.18(A) where it is capable of being lockable open in accordance with 110.25.

**B) Remote Emergency Shutdown.** Generators with a greater than 25 kW rating shall be provided with a remote emergency stop switch to shutdown the prime mover. The remote emergency stop switch shall be located at a readily accessible location outside of the generator equipment room or generator enclosure and shall also meet the requirements of 445.19(A)(1), (A)(2), and (A)(3). The remote emergency stop switch shall be permitted to be installed on the exterior of the generator enclosure where the generator is located outdoors.

*Exception: The requirement in 445.19(B) shall not apply to generators installed on one- or two-family dwelling units.*

**C) Emergency Shutdown in One- and Two-Family Dwelling Units**. For other than cord-and-plug connected portable generators, a single generator prime mover shutdown device in accordance with 445.19(A)(1) and (A)(2) shall be installed at a readily accessible location outside the dwelling unit. The generator prime mover shutdown device shall be permitted to be installed on the exterior of the generator enclosure. The generator prime mover shutdown device shall be labeled "Generator Shutdown" and the label shall not be handwritten and shall be of sufficient durability to withstand the environment involved.

**Technical Substantiation:** The requirements for the emergency shutdown of a prime mover should be broken out of Article 445.18 and be provided with their own code section for clarity. The proposed language takes the current requirements from 445.18(B), (C), and (D) and moves them to 445.19. A field labeling requirement is added for the generator emergency shutdown switches installed with each generator. In addition, permissive language was added to (B) and (C) and allows the emergency shutdown switch or emergency shutdown device to be installed on the exterior of the generator

enclosure. This new language will provide correlation with the change in code language in Section 5.6.5.6.1 in the 2019 edition of NFPA 110.

An exception was added to (B) to provide clarity that generators installed on one- and two-family dwelling units only have to comply with the provisions of (A) and (C). The kW threshold in (B) has been increased to 25 kW to provide some installation relief due to the presence of listed optional standby air-cooled generators rated at 24 kW in the field.

The language in (C) will provide clarity that emergency stop switches or “red mushroom style E-stops” are not required on generators installed on one-or two-family dwelling units, and only a device that disables the prime mover is required. A separate labeling requirement has been provided for the shutdown device on residential generators.

## Public Input No. 1321-NFPA 70-2020 [ Section No. 445.18(E) ]

**(E)** Generators Installed in Parallel.

Where a generator is installed in parallel with other generators, the provisions of 445.18(A) shall be capable of isolating the generator output terminals from the paralleling ~~equipment~~ system bus . The disconnecting means shall not be required to be located at the generator. Barriers shall be provided to prevent accidental access to any point on the generator assembly that is energized by the system bus.

## Statement of Problem and Substantiation for Public Input

The term "paralleling equipment" is not sufficient to identify the requirement. The paralleling breaker or other disconnecting means may be located at the paralleling switchboard/switchgear, at the generator set location or any place between the system bus and the generator terminals. In any case, opening the paralleling breaker and preventing it from closing provides the intended isolation of the generator set from a potentially live paralleling bus so that an alternator can be safely serviced or maintained. However, if the paralleling breaker is located on the generator set, the bus side of the paralleling breaker could be energized from the bus, so should be provided with barriers that protect a technician from accidental contact with energized hardware.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4497-NFPA 70-2020 [ Section No. 445.20 ]

**445.20** Ground-Fault Circuit-Interrupter Protection for Receptacles on 15-kW or Smaller Portable Generators.

Receptacle outlets that are a part of a 15-kW or smaller portable or vehicle-mounted generator shall have listed ground-fault circuit-interrupter protection (GFCI) for personnel integral to the generator or receptacle as indicated in either (A) or (B):

**(A)** Unbonded (Floating Neutral) Generators.

~~Unbonded generators with both 125-volt and 125/250-volt receptacle outlets shall have listed GFCI protection for personnel integral to the generator or receptacle on all 125-volt, 15- and 20-ampere receptacle outlets.~~

~~Exception: GFCI protection shall not be required where the 125-volt receptacle outlets(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use.~~

GFCI-type receptacles shall not be a part of a 15-kW or smaller portable or vehicle-mounted generator.

**(B)** Bonded Neutral Generators.

~~Bonded generators~~

GFCI protection shall be provided

~~with GFCI protection on all~~

for all 125-volt, 15- and 20-ampere receptacle outlets.

Informational Note: Refer to 590.6(A)(3) for GFCI requirements for 15-kW or smaller portable generators used for temporary electric power and lighting.

~~*Exception to (A) and (B): If the generator was manufactured or remanufactured prior to January 1, 2015, listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted.*~~

## Statement of Problem and Substantiation for Public Input

Changes to this section are really needed for safety.
GFCI protection cannot function if the neutral is floating because there is no complete circuit provided.
We all know that current cannot flow if a complete circuit does not exist.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 766-NFPA 70-2020 [ New Section after 445.20(B) ]

**TITLE OF NEW CONTENT**

Type your content here ...

**445.22 Electromagnetic Pulse (EMP) Protection.** Protection for generators against the effects of electromagnetic pulses shall be provided at a minimum of Level 2. See 709.7 for levels of electromagnetic pulse protection.

*Exception: The requirements of 709.7(A)(5) and 709.7(B)(3) shall not apply.*

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

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## Public Input No. 3635-NFPA 70-2020 [ Section No. 455.2 ]

(Relocate all definitions in the 455. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**455. 2** Definitions.

**Manufactured Phase.**

This definition shall apply within this article and throughout the *Code*.

The phase that originates at the phase converter and is not solidly connected to either of the single-phase input conductors.

**Phase Converter.**

This definition shall apply within this article and throughout the *Code*.

An electrical device that converts single-phase power to 3-phase electric power.

Informational Note: Phase converters have characteristics that modify the starting torque and locked-rotor current of motors served, and consideration is required in selecting a phase converter for a specific load.

**Rotary-Phase Converter.**

This definition shall apply only within this article.

A device that consists of a rotary transformer and capacitor panel(s) that permits the operation of 3-phase loads from a single-phase supply.

**Static-Phase Converter.**

This definition shall apply only within this article.

A device without rotating parts, sized for a given 3-phase load to permit operation from a single-phase supply.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

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**Committee:** NEC-P13

# Public Input No. 2368-NFPA 70-2020 [ Section No. 455.6(B) ]

**(B)** Manufactured Phase Marking.

The manufactured phase conductors shall be identified in all accessible locations with a distinctive marking. The marking shall be consistent throughout the system and premises.

Informational Note: see 200.6, 210.5, 215.12, 250.119, and 517.160(A)(5) for conductor identification and posting requirements that may apply.

## Statement of Problem and Substantiation for Public Input

The code has other conductor identification and posting requirements on the topic of facility-wide consistency of conductor marking by voltage system and by phase. A portion of these other codes likely always apply to this application of 455.6(B). And, each of the separate code requirements on this topic should correlate each other to facilitate consistency across a facility; 200.6 [grounded phase conductors], 210.5 [branch conductors], 215.12 [feeder conductors], 250.119 [equipment grounding conductors], 517.160(A)(5) [Isolated Power Systems], along with 455.6(B) for conductors of manufactured phases.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2370-NFPA 70-2020 [Section No. 200.6] | similar issue and edit |
| Public Input No. 2371-NFPA 70-2020 [Section No. 210.5] | similar issue and edit |
| Public Input No. 2372-NFPA 70-2020 [Section No. 215.12] | similar issue and edit |
| Public Input No. 2373-NFPA 70-2020 [Section No. 250.119] | similar issue and edit |
| Public Input No. 2374-NFPA 70-2020 [Section No. 517.160(A)(5)] | similar issue and edit |
| Public Input No. 2370-NFPA 70-2020 [Section No. 200.6] | |
| Public Input No. 2371-NFPA 70-2020 [Section No. 210.5] | |
| Public Input No. 2372-NFPA 70-2020 [Section No. 215.12] | |
| Public Input No. 2373-NFPA 70-2020 [Section No. 250.119] | |
| Public Input No. 2374-NFPA 70-2020 [Section No. 517.160(A)(5)] | |

## Submitter Information Verification

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# Public Input No. 2985-NFPA 70-2020 [ Article 480 ]

~~**Article 480**~~ Article 696 Storage Batteries

**~~480~~ 696 .1** Scope.

This article applies to all stationary installations of storage batteries.

Informational Note: The following standards are frequently referenced for the installation of stationary batteries:

(1) IEEE 484, *Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*

(2) IEEE 485, *Recommended Practice for Sizing Vented Lead-Acid Storage Batteries for Stationary Applications*

(3) IEEE 1145, *Recommended Practice for Installation and Maintenance of Nickel-Cadmium Batteries for Photovoltaic (PV) Systems*

(4) IEEE 1187, *Recommended Practice for Installation Design, and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications*

(5) IEEE 1375, *IEEE Guide for the Protection of Stationary Battery Systems*

(6) IEEE 1578, *Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management*

(7) IEEE 1635/ASHRAE 21, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*

(8) UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*

(9) UL Subject 2436, *Outline of Investigation for Spill Containment for Stationary Lead Acid Battery Systems*

(10) UL 1989, *Standard for Standby Batteries*

(11) UL Subject 1974, *Standard for Evaluation of Repurposed Batteries*

**~~480~~ 696 .2** Definitions.

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

**Cell.**

The basic electrochemical unit, characterized by an anode and a cathode, used to receive, store, and deliver electrical energy.

**Container.**

A vessel that holds the plates, electrolyte, and other elements of a single unit in a battery.

Informational Note: A container may be single-cell or multi-cell and is sometimes referred to in the industry as a “jar.”

**Electrolyte.**

The medium that provides the ion transport mechanism between the positive and negative electrodes of a cell.

**Intercell Connector.**

An electrically conductive bar or cable used to connect adjacent cells.

**Intertier Connector.**

An electrical conductor used to connect two cells on different tiers of the same rack or different shelves of the same rack.

**Nominal Voltage (Battery or Cell).**

The value assigned to a cell or battery of a given voltage class for the purpose of convenient designation. The operating voltage of the cell or battery may vary above or below this value.

Informational Note: The most common nominal cell voltages are 2 volts per cell for the lead-acid systems, 1.2 volts per cell for alkali systems, and 3.6 to 3.8 volts per cell for Li-ion systems. Nominal voltages might vary with different chemistries.

**Sealed Cell or Battery.**

A cell or battery that has no provision for the routine addition of water or electrolyte or for external measurement of electrolyte specific gravity and might contain pressure relief venting.

**Storage Battery (Battery).**

A single or group of rechargeable cells connected together electrically in series, in parallel, or a combination of both, and comprised of lead-acid, nickel-cadmium, or other rechargeable electrochemical types.

**Terminal.**

That part of a cell, container, or battery to which an external connection is made (commonly identified as post, pillar, pole, or terminal post).

**~~480~~ 696 .3** Equipment.

Storage batteries and battery management equipment shall be listed. This requirement shall not apply to lead-acid batteries.

**~~480~~ 696 .4** Battery and Cell Terminations.

**(A)** Corrosion Prevention.

Where mating dissimilar metals, antioxidant material suitable for the battery connection shall be used where recommended by the battery manufacturer.

Informational Note: The battery manufacturer's installation and instruction manual can be used for guidance for acceptable materials.

**(B)** Intercell and Intertier Conductors and Connections.

The ampacity of field-assembled intercell and intertier connectors and conductors shall be of such cross-sectional area that the temperature rise under maximum load conditions and at maximum ambient temperature shall not exceed the safe operating temperature of the conductor insulation or of the material of the conductor supports.

Informational Note: Conductors sized to prevent a voltage drop exceeding 3 percent of maximum anticipated load, and where the maximum total voltage drop to the furthest point of connection does not exceed 5 percent, may not be appropriate for all battery applications. IEEE 1375-2003, *Guide for the Protection of Stationary Battery Systems,* provides guidance for overcurrent protection and associated cable sizing.

**(C)** Battery Terminals.

Electrical connections to the battery, and the cable(s) between cells on separate levels or racks, shall not put mechanical strain on the battery terminals. Terminal plates shall be used where practicable.

Informational Note: Conductors are commonly pre-formed to eliminate stress on battery terminations. Fine stranded cables may also eliminate the stress on battery terminations. See the manufacturer's instructions for guidance.

**(D)** Accessibility.

The terminals of all cells or multicell units shall be readily accessible for readings, inspections, and cleaning where required by the equipment design. One side of transparent battery containers shall be readily accessible for inspection of the internal components.

**~~480~~ 696 .5** Wiring and Equipment Supplied from Batteries.

Wiring and equipment supplied from storage batteries shall be subject to the applicable provisions of this *Code* applying to wiring and equipment operating at the same voltage, unless otherwise permitted by ~~480~~ 696 .6.

**~~480~~ 696 .6** Overcurrent Protection for Prime Movers.

Overcurrent protection shall not be required for conductors from a battery with a voltage of 60 volts dc or less if the battery provides power for starting, ignition, or control of prime movers. Section 300.3 shall not apply to these conductors.

**~~480~~ 696 .7** DC Disconnect Methods.

**(A)** Disconnecting Means.

A disconnecting means shall be provided for all ungrounded conductors derived from a stationary battery system with a voltage over 60 volts dc. A disconnecting means shall be readily accessible and located within sight of the battery system.

> Informational Note: See 240.21(H) for information on the location of the overcurrent device for battery conductors.

**(B)** Emergency Disconnect.

For one-family and two-family dwellings, a disconnecting means or its remote control for a stationary battery system shall be located at a readily accessible location outside the building for emergency use. The disconnect shall be labeled “EMERGENCY DISCONNECT”.

**(C)** Disconnection of Series Battery Circuits.

Battery circuits exceeding 240 volts dc nominal between conductors or to ground and subject to field servicing shall have provisions to disconnect the series-connected strings into segments not exceeding 240 volts dc nominal for maintenance by qualified persons. Non-load-break bolted or plug-in disconnects shall be permitted.

**(D)** Remote Actuation.

Where a disconnecting means, located in accordance with ~~480~~ 696 .7(A), is provided with remote controls to activate the disconnecting means and the controls for the disconnecting means are not located within sight of the stationary battery system, the disconnecting means shall be capable of being locked in the open position, in accordance with 110.25, and the location of the controls shall be field marked on the disconnecting means.

**(E)** Busway.

Where a dc busway system is installed, the disconnecting means shall be permitted to be incorporated into the busway.

**(F)** Notification.

The disconnecting means shall be legibly marked in the field. A label with the marking shall be placed in a conspicuous location near the battery if a disconnecting means is not provided. The marking shall be of sufficient durability to withstand the environment involved and shall include the following:

(1) Nominal battery voltage

(2) Available fault current derived from the stationary battery system

Informational Note: Battery equipment suppliers can provide information about available fault current on any particular battery model.

(3) An arc flash label in accordance with acceptable industry practice

Informational Note: *NFPA 70E*-2018, *Standard for Electrical Safety in the Workplace*, provides assistance in determining the severity of potential exposure, planning safe work practices, arc flash labeling, and selecting personal protective equipment.

(4) Date the calculation was performed

*Exception: List items (2), (3), and (4) shall not apply to one- and two-family dwellings.*

**(G)** Identification of Power Sources.

Battery systems shall be indicated by ~~480~~ 696 .7(G)(1) and (G)(2).

**(1)** Facilities with Utility Services and Battery Systems.

Plaques or directories shall be installed in accordance with 705.10 and 712.10.

*Exception: This requirement does not apply where a disconnect in 480.7(A) is not required.*

**(2)** Facilities with Stand-Alone Systems.

A permanent plaque or directory shall be installed in accordance with 710.10.

**~~480~~ 696 .8** Insulation of Batteries.

Batteries constructed of an electrically conductive container shall have insulating support if a voltage is present between the container and ground.

**~~480~~ 696 .9** Battery Support Systems.

For battery chemistries with corrosive electrolyte, the structure that supports the battery shall be resistant to deteriorating action by the electrolyte. Metallic structures shall be provided with nonconducting support members for the cells, or shall be constructed with a continuous insulating material. Paint alone shall not be considered as an insulating material.

**~~480~~ 696 .10** Battery Locations.

Battery locations shall conform to ~~480~~ 696 .10(A) through (G).

**(A)** Ventilation.

Provisions appropriate to the battery technology shall be made for sufficient diffusion and ventilation of gases from the battery, if present, to prevent the accumulation of an explosive mixture.

Informational Note No. 1: See NFPA 1-2018, *Fire Code*, Chapter 52, for ventilation considerations for specific battery chemistries.

Informational Note No. 2: Some battery technologies do not require ventilation.

Informational Note No. 3: For additional information on the ventilation of stationary battery systems, see *IEEE Std 1635-2012/ASHRAE Guideline 21-2012 Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*.

**(B)** Live Parts.

Guarding of live parts shall comply with 110.27.

**(C)** Spaces About Battery Systems.

Spaces about battery systems shall comply with 110.26 and 110.34. Working space shall be measured from the edge of the battery cabinet, racks, or trays.

For battery racks, there shall be a minimum clearance of 25 mm (1 in.) between a cell container and any wall or structure on the side not requiring access for maintenance. Battery stands shall be permitted to contact adjacent walls or structures, provided that the battery shelf has a free air space for not less than 90 percent of its length.

Informational Note: Additional space is often needed to accommodate battery hoisting equipment, tray removal, or spill containment.

**(D)** Top Terminal Batteries.

Where top terminal batteries are installed on tiered racks or on shelves of battery cabinets, working space in accordance with the battery manufacturer's instructions shall be provided between the highest point on a cell and the row, shelf, or ceiling above that point.

Informational Note: IEEE 1187-2013, *IEEE Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications*, provides guidance for top clearance of valve-regulated lead-acid batteries, which are commonly used in battery cabinets.

**(E)** Egress.

Personnel doors intended for entrance to, and egress from, rooms designated as battery rooms shall open in the direction of egress and shall be equipped with listed panic or listed fire exit hardware.

**(F)** Piping in Battery Rooms.

Gas piping shall not be permitted in dedicated battery rooms.

**(G)** Illumination.

Illumination shall be provided for working spaces containing battery systems. The lighting outlets shall not be controlled by automatic means only. Additional lighting outlets shall not be required where the work space is illuminated by an adjacent light source. The location of luminaires shall not:

(1) Expose personnel to energized battery components while performing maintenance on the luminaires in the battery space; or

(2) Create a hazard to the battery upon failure of the luminaire.

**~~480~~ 696 .11** Vents.

**(A)** Vented Cells.

Each vented cell shall be equipped with a flame arrester.

Informational Note: A flame arrester prevents destruction of the cell due to ignition of gases within the cell by an external spark or flame.

**(B)** Sealed Cells.

Where the battery is constructed such that an excessive accumulation of pressure could occur within the cell during operation, a pressure-release vent shall be provided.

**~~480~~ 696 .12** Battery Interconnections.

Flexible cables, as identified in Article 400, in sizes 2/0 AWG and larger shall be permitted within the battery enclosure from battery terminals to a nearby junction box where they shall be connected to an approved wiring method. Flexible battery cables shall also be permitted between batteries and cells within the battery enclosure. Such cables shall be listed and identified for the environmental conditions. Flexible, fine-stranded cables shall only be used with terminals, lugs, devices, or connectors in accordance with 110.14.

**~~480~~ 696 .13** Ground-Fault Detection.

Battery circuits exceeding 100 volts between the conductors or to ground shall be permitted to operate with ungrounded conductors, provided a ground-fault detector and indicator is installed to monitor for ground faults.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This change aligns with an effort to re-organize the alternative energy sources NEC Articles into a series of articles closely located together. This reorganization places all sources alternate sources as follows:

689 On-Site Energy Sources
690 Solar Photovoltaic (PV) Systems
691 Large-Scale Photovoltaic (PV) Systems
692 Fuel Cell Systems
693 Generators
694 Wind Electric Systems
695 Energy Storage Systems
696 Storage Batteries

This public input simply changes 480 to 696 to support this effort. These articles are closely related to each other and this change is in alignment with the direction by the correlating committee to review alternative energy sources for conflicts and usability. This new alignment will create a similar structure as that found for hazardous locations. The new Article 689 is the a combination of Articles 705, 710 and 712 and will act to be the new general requirements for this series of alternative energy sources

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3011-NFPA 70-2020 [Definition: ] | |
| Public Input No. 4685-NFPA 70-2020 [Global Input] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3879-NFPA 70-2020 [ Section No. 480.1 ]

**480.1** Scope.

This article applies to all stationary installations of storage batteries.

Informational Note: The following standards are frequently referenced for the installation of stationary batteries:

(1) IEEE 484, *Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*

(2) *NFPA 855-2020, Standard for the Installation of Stationary Energy Storage Stystems*

(3) IEEE 485, *Recommended Practice for Sizing Vented Lead-Acid Storage Batteries for Stationary Applications*

(4) IEEE 1145, *Recommended Practice for Installation and Maintenance of Nickel-Cadmium Batteries for Photovoltaic (PV) Systems*

(5) IEEE 1187, *Recommended Practice for Installation Design, and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications*

(6) IEEE 1375, *IEEE Guide for the Protection of Stationary Battery Systems*

(7) IEEE 1578, *Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management*

(8) IEEE 1635/ASHRAE 21, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*

(9) UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*

(10) UL Subject 2436, *Outline of Investigation for Spill Containment for Stationary Lead Acid Battery Systems*

(11) UL 1989, *Standard for Standby Batteries*

(12) UL Subject 1974, *Standard for Evaluation of Repurposed Batteries*

## Statement of Problem and Substantiation for Public Input

NFPA 855-2020 Standard for the Installation of Stationary Energy Storage Systems should be included in the list items for referenced standards in this Informational Note under the Scope of Article 480. This standard is in its first edition and was approved as an American National Standard on August 25, 2019. According to the purpose of this standard it provides the minimum requirements for mitigating the hazards associated with ESS's. This would include storage batteries mentioned in Article 480. NFPA 855 also references NFPA 70 as a referenced standard and shall be considered part of the requirements for NFPA 855. Therefore NFPA 855 should also be referenced here in Article 480 for ESS to comply with both standards when installing these systems using batteries that would fall under the scope of Article 480.

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| **Committee:** | NEC-P13 |

# Public Input No. 4085-NFPA 70-2020 [ Section No. 480.1 ]

**480.1** Scope.

This article applies to ~~all~~ stationary installations of storage batteries ~~.~~

~~Informational Note: The following standards are frequently referenced for the installation of stationary batteries:~~

(1) ~~IEEE 484, *Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*~~

(2) ~~IEEE 485, *Recommended Practice for Sizing Vented Lead-Acid Storage Batteries for Stationary Applications*~~

(3) ~~IEEE 1145, *Recommended Practice for Installation and Maintenance of Nickel-Cadmium Batteries for Photovoltaic (PV) Systems*~~

(4) ~~IEEE 1187, *Recommended Practice for Installation Design, and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications*~~

(5) ~~IEEE 1375, *IEEE Guide for the Protection of Stationary Battery Systems*~~

(6) ~~IEEE 1578, *Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management*~~

(7) ~~IEEE 1635/ASHRAE 21, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*~~

(8) ~~UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*~~

(9) ~~UL Subject 2436, *Outline of Investigation for Spill Containment for Stationary Lead Acid Battery Systems*~~

(10) ~~UL 1989, *Standard for Standby Batteries*~~

(11) ~~UL Subject 1974, *Standard for Evaluation of Repurposed Batteries*~~

supplying dc energy to a distinct utilization load .

## Statement of Problem and Substantiation for Public Input

The correlating committee created a problem with the application of this Code when Article 480 was retained during the development of Article 706. The original thoughts in the development of Article 706 is that Article 480 would be removed as unnecessary. Consequently, these two articles have heavily overlapping scopes that cause a serious disservice to those applying this code. To help resolve this problem, the scope of Article 480 must be constrained to only cover applications that are dedicating dc power to specific utilization equipment. All cycling applications and applications for power supply in interactive or multiple-load stand alone applications must fall under Article 706. Essentially, the current scope of Article 480 allows for the installer to apply the rules of Article 480, instead of Article 706 (which requires listing to UL9540) whenever it is inconvenient to meet the requirements of Article 706. Whether intended or not, this Code cannot survive with such large loopholes.

The laundry list of IEEE and UL standards may be informative to the uninitiated, but it makes this article read like a design manual that the NEC is clearly not. These references belong in the Annex and the Handbook where relevant.

## Submitter Information Verification

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## Public Input No. 3638-NFPA 70-2020 [ Section No. 480.2 ]

(Relocate all definitions in the 480. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**480. 2** Definitions.

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

**Cell.**

The basic electrochemical unit, characterized by an anode and a cathode, used to receive, store, and deliver electrical energy.

**Container.**

A vessel that holds the plates, electrolyte, and other elements of a single unit in a battery.

Informational Note: A container may be single-cell or multi-cell and is sometimes referred to in the industry as a “jar.”

**Electrolyte.**

The medium that provides the ion transport mechanism between the positive and negative electrodes of a cell.

**Intercell Connector.**

An electrically conductive bar or cable used to connect adjacent cells.

**Intertier Connector.**

An electrical conductor used to connect two cells on different tiers of the same rack or different shelves of the same rack.

**Nominal Voltage (Battery or Cell).**

The value assigned to a cell or battery of a given voltage class for the purpose of convenient designation. The operating voltage of the cell or battery may vary above or below this value.

Informational Note: The most common nominal cell voltages are 2 volts per cell for the lead-acid systems, 1.2 volts per cell for alkali systems, and 3.6 to 3.8 volts per cell for Li-ion systems. Nominal voltages might vary with different chemistries.

**Sealed Cell or Battery.**

A cell or battery that has no provision for the routine addition of water or electrolyte or for external measurement of electrolyte specific gravity and might contain pressure relief venting.

**Storage Battery (Battery).**

A single or group of rechargeable cells connected together electrically in series, in parallel, or a combination of both, and comprised of lead-acid, nickel-cadmium, or other rechargeable electrochemical types.

**Terminal.**

That part of a cell, container, or battery to which an external connection is made (commonly identified as post, pillar, pole, or terminal post).

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the

NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4636-NFPA 70-2020 [ Definition: Nominal Voltage (Battery or Cell). ]

**Nominal Voltage (Battery or Cell).**

The value assigned to a cell or battery of a given voltage class for the purpose of convenient designation. The operating voltage of the cell or battery may vary above or below this value.

~~Informational Note: The most common nominal cell voltages are 2 volts per cell for the lead-acid systems, 1.2 volts per cell for alkali systems, and 3.6 to 3.8 volts per cell for Li-ion systems. Nominal voltages might vary with different chemistries.~~

## Statement of Problem and Substantiation for Public Input

The educational value and technical accuracy of this informational note has expired. The list of viable chemistries and form factors continues to grow and this list will no longer be technically accurate or comprehensive by the time this code is published.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
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Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

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**Submittal Date:** Thu Sep 10 16:06:50 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4169-NFPA 70-2020 [ Definition: Storage Battery (Battery). ]

**Storage Battery (Battery).**

A single cell or group of ~~rechargeable~~ cells connected together electrically in series, in parallel, or a combination of both~~, and comprised of lead-acid, nickel-cadmium, or other rechargeable electrochemical types~~ .

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per

the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 4316-NFPA 70-2020 [ Definition: Storage Battery (Battery). ]

**Storage Battery (Battery).**

A single or group of rechargeable cells connected together electrically in series, in parallel, or a combination of both, that supplies dc power to a distinct utilization load, and comprised of lead-acid, nickel-cadmium, or other rechargeable electrochemical types.

## Statement of Problem and Substantiation for Public Input

This suggested change clarifies that, unlike energy storage systems that are covered in Article 706, that may have either dc or ac outputs, and are used to supply “electrical energy into the premises wiring system or an electric power production and distribution network” (see 706.2), Article 480 covers storage batteries that only supply dc energy and are dedicated to specific equipment for the purposes of providing either primary power (i.e. to a motor starter) or standby power (i.e. emergency lighting). It is important that such clarification be made in NFPA-70 in order to eliminate the confusion currently faced by users of the Code when determining how to apply these two articles to installations that include battery storage

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF’s effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI’s as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI’s submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy

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**Committee:** NEC-P13

## Public Input No. 4321-NFPA 70-2020 [ Section No. 480.7(A) ]

**(A)** Disconnecting Means.

A disconnecting means shall be provided for all ungrounded conductors derived from a stationary battery ~~system with~~ , or group of series or parallel connected batteries, with a voltage over 60 volts dc. A disconnecting means shall be readily accessible and located within sight of the battery system.

Informational Note: See 240.21(H) for information on the location of the overcurrent device for battery conductors.

## Statement of Problem and Substantiation for Public Input

This use of the term “battery system” continues to sow confusion over what constitutes an electrochemical ESS, and when Article 480 should be used versus Article 706. An electrochemical stationary storage system that includes inverters and converters goes beyond a simple battery installation which is what Article 480 should be focused on. Once this additional equipment is introduced this should be more correctly identified as an ESS or UPS, that already have definitions. If conflicting definitions like this continue to exist it creates opportunities for the circumvention of some important requirements found in Article 706.This proposal is part of a broader effort to clarify the scoping of Articles 480 and 706 and the defined terms used. Where better terms should be used, related PIs have been submitted.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF’s effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI’s as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI’s submitted.
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Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4326-NFPA 70-2020 [Definition: Battery System.] | |
| Public Input No. 4326-NFPA 70-2020 [Definition: Battery System.] | |

## Submitter Information Verification

**Submitter Full Name:** Evelyn Butler
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**Submittal Date:** Thu Sep 10 10:04:44 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1785-NFPA 70-2020 [ Section No. 480.7(B) ]

~~**(B)** Emergency Disconnect.~~

~~For one-family and two-family dwellings, a disconnecting means or its remote control for a stationary battery system shall be located at a readily accessible location outside the building for emergency use. The disconnect shall be labeled "EMERGENCY DISCONNECT".~~

## Statement of Problem and Substantiation for Public Input

Stationary batteries are not used for dwellings and there is no need to require an emergency disconnect marking for these type systems. Stationary batteries are used in UPS and Telecom industries. Markings are needed for Energy Storage Systems but these are covered in Article 706.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4052-NFPA 70-2020 [ Section No. 480.7(B) ]

**(B)**

–

**Emergency Disconnect.**

~~For~~

For one - ~~family~~

~~and~~

and two-family dwellings, a

~~disconnecting means~~

n emergency disconnecting means ~~or its remote control for a stationary battery system shall be located~~

~~at~~

~~in~~ ~~a readily accessible location outside the building for emergency use.~~

~~The~~

~~The~~ ~~disconnect shall be labeled "EMERGENCY~~ ~~DISCONNECT~~ ". shall comply with (B)(1) through (B)(4).

(1) Be located in a readily accessible location outside the building

(2) Be located within 1 m (3 ft) of any required emergency service disconnect or where there is no required emergency service disconnect, shall be located within 1 m (3 ft) of any other power source emergency disconnect or any PV rapid shutdown initiator

(3) If remotely controlled, the remote-control system shall be "fail safe" where the disconnect automatically opens on loss of control signal or control power

(4) Be labeled "EMERGENCY BATTERY DISCONNECT" and comply with 110 . 21(B).

## Statement of Problem and Substantiation for Public Input

This proposal is one of several related, but separate proposals involving the 2020 NEC requirements for external (outside the building) emergency disconnects on one- and two-family dwellings for energy sources such as the utility service, batteries, energy storage systems (ESS), wind systems and also stand-alone PV systems plus PV rapid shutdown systems. The intent of these proposals is to require multiple emergency disconnects to be grouped in one location to increase safety for Fire Service responders.

Also, when remote activation of these disconnects is allowed, the proposal establishes an additional safety requirement that the remote controls be "fail safe" and in the event of loss of control power or control signal, the emergency disconnect shall automatically be opened.

It has been determined that some inverter manufacturers are already starting to put inputs on their products to allow an external remote shutdown control system that is fail safe. Also, it has been determined that adding such a fail-safe remotely controlled emergency disconnect system is relatively inexpensive using voltage-trip circuit breakers and a relay on large battery banks or ESS.

## Submitter Information Verification

| | |
|---|---|
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| **Committee:** | NEC-P13 |

## Public Input No. 2994-NFPA 70-2020 [ Section No. 480.7(G) ]

**(G)** Identification of Power Sources.

Battery systems shall be indicated by ~~480.7(G)(1) and (G)(2).~~

~~**(1)** Facilities with Utility Services and Battery Systems.~~

~~Plaques or directories shall be~~

p laques or directories installed in accordance with

~~705~~

689 .10

~~and 712~~

~~.~~

~~10.~~

*Exception: This requirement does not apply where a disconnect in 480.7(A) is not required.*

~~**(2)** Facilities with Stand-Alone Systems.~~

~~A permanent plaque or directory shall be installed in accordance with 710.10 .~~

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This modification is necessary as 710, 712 and 689 are combined as part of this task group effort into a new Article 689. The proper reference for plaques and directories is found in 689.10 only. In addition, this section was simplified as only one reference section exists. Changes simplify and add clarity.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2535-NFPA 70-2020 [Section No. 705.10] | |
| Public Input No. 2692-NFPA 70-2020 [Article 705] | |

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**Submittal Date:** Thu Sep 03 20:01:43 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4323-NFPA 70-2020 [ Section No. 480.7(G) ]

**(G)** Identification of Power Sources.

~~Battery systems shall~~ Installations of storage batteries shall be indicated by 480.7(G)(1) and (G)(2).

**(1)** Facilities with Utility Services and ~~Battery Systems~~ Storage Batteries .

Plaques or directories shall be installed in accordance with 705.10 and 712.10.

*Exception: This requirement does not apply where a disconnect in 480.7(A) is not required.*

**(2)** Facilities with Stand-Alone Systems.

A permanent plaque or directory shall be installed in accordance with 710.10.

## Statement of Problem and Substantiation for Public Input

This use of the term “battery system” continues to sow confusion over what constitutes an electrochemical ESS, and when Article 480 should be used versus Article 706. An electrochemical stationary storage system that includes inverters and converters goes beyond a simple battery installation which is what Article 480 should be focused on. Once this additional equipment is introduced this should be more correctly identified as an ESS or UPS, that already have definitions. If conflicting definitions like this continue to exist it creates opportunities for the circumvention of some important requirements found in Article 706.This proposal is part of a broader effort to clarify the scoping of Articles 480 and 706 and the defined terms used. Where better terms should be used, related PIs have been submitted.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
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Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4326-NFPA 70-2020 [Definition: Battery System.] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 802-NFPA 70-2020 [ Section No. 480.10 ]

**480.10** Battery Locations.

Battery locations shall conform to 480.10(A) through (G).

**(A)** Ventilation.

Provisions appropriate to the battery technology shall be made for sufficient diffusion and ventilation of gases from the battery, if present, to prevent the accumulation of an explosive mixture.

Informational Note No. 1: See NFPA 1-2018, *Fire Code*, Chapter 52, for ventilation considerations for specific battery chemistries.

Informational Note No. 2: Some battery technologies do not require ventilation.

Informational Note No. 3: For additional information on the ventilation of stationary battery systems, see *IEEE Std 1635-2012/ASHRAE Guideline 21-2012 Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*.

**(B)** Live Parts.

Guarding of live parts shall comply with 110.27.

**(C)** Spaces About Battery Systems.

Spaces about battery systems shall comply with 110.26 and 110.34. Working space shall be measured from the edge of the battery cabinet, racks, or trays.

For battery racks, there shall be a minimum clearance of 25 mm (1 in.) between a cell container and any wall or structure on the side not requiring access for maintenance. Battery stands shall be permitted to contact adjacent walls or structures, provided that the battery shelf has a free air space for not less than 90 percent of its length.

Informational Note: Additional space is often needed to accommodate battery hoisting equipment, tray removal, or spill containment.

**(D)** Top Terminal Batteries.

Where top terminal batteries are installed on tiered racks or on shelves of battery cabinets, working space in accordance with the battery manufacturer's instructions shall be provided between the highest point on a cell and the row, shelf, or ceiling above that point.

Informational Note: IEEE 1187-2013, *IEEE Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications*, provides guidance for top clearance of valve-regulated lead-acid batteries, which are commonly used in battery cabinets.

**(E)** Egress.

~~Personnel~~ In other than one- and two family dwelling units, personnel doors intended for entrance to, and egress from, rooms designated as battery rooms shall open in the direction of egress and shall be equipped with listed panic or listed fire exit hardware.

**(F)** Piping in Battery Rooms.

~~Gas~~ In other than one- and two family dwelling units, gas piping shall not be permitted in dedicated battery rooms.

**(G)** Illumination.

Illumination shall be provided for working spaces containing battery systems. The lighting outlets shall not be controlled by automatic means only. Additional lighting outlets shall not be required where the work space is illuminated by an adjacent light source. The location of luminaires shall not:

(1) Expose personnel to energized battery components while performing maintenance on the luminaires in the battery space; or

(2) Create a hazard to the battery upon failure of the luminaire.

## Statement of Problem and Substantiation for Public Input

Article 480 is commonly enforced by AHJ's on residential battery energy storage systems that contain storage batteries even with the language in 706.8 stating that Article 480 does not apply. Installation relief should be provided to installations in one-and two-family dwelling units as it applies to the egress doors and gas piping in areas where battery energy storage systems are installed. Chapter 15 of NFPA 855 and the IRC do not contain restrictions on gas piping being is the same room or space and do not require doors to be equipped with listed panic hardware.

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**Submittal Date:** Mon Mar 30 09:14:31 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4329-NFPA 70-2020 [ Section No. 480.10(C) ]

**(C)** Spaces About Battery Systems.

Spaces about ~~battery systems~~ storage batteries shall comply with 110.26 and 110.34. Working space shall be measured from the edge of the battery cabinet, racks, or trays.

For battery racks, there shall be a minimum clearance of 25 mm (1 in.) between a cell container and any wall or structure on the side not requiring access for maintenance. Battery stands shall be permitted to contact adjacent walls or structures, provided that the battery shelf has a free air space for not less than 90 percent of its length.

Informational Note: Additional space is often needed to accommodate battery hoisting equipment, tray removal, or spill containment.

## Statement of Problem and Substantiation for Public Input

This use of the term “battery system” continues to sow confusion over what constitutes an electrochemical ESS, and when Article 480 should be used versus Article 706. An electrochemical stationary storage system that includes inverters and converters goes beyond a simple battery installation which is what Article 480 should be focused on. Once this additional equipment is introduced this should be more correctly identified as an ESS or UPS, that already have definitions. If conflicting definitions like this continue to exist it creates opportunities for the circumvention of some important requirements found in Article 706.This proposal is part of a broader effort to clarify the scoping of Articles 480 and 706 and the defined terms used. Where better terms should be used, related PIs have been submitted.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
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Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4326-NFPA 70-2020 [Definition: Battery System.] | deletion of old definition |
| Public Input No. 4326-NFPA 70-2020 [Definition: Battery System.] | |

## Submitter Information Verification

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**Submittal Date:** Thu Sep 10 10:16:20 EDT 2020
**Committee:** NEC-P13

# Public Input No. 3568-NFPA 70-2020 [ Section No. 480.10(E) ]

**(E)** Egress.

Personnel doors intended for entrance to, and egress from, rooms designated as battery rooms shall open at least 90 degrees in the direction of egress and shall be equipped with listed panic or listed fire exit hardware.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Door_obstruction.jpg | sprinkler pipe preventing electric room door from fully opening | |

## Statement of Problem and Substantiation for Public Input

Doors must be able to open at least 90 degrees in order for people to escape danger in an emergency situation such as an electrical explosion or arc flash event. If the door were to come to a sudden stop at only 30 degrees open due to an obstruction, people rushing through the door could be hindered or even injured during their escape. I have actually been "stunned" and even disoriented by doors not opening fully and coming to an unexpected and sudden early stop. Now imagine that scenario during an panic situation! It could result in injuries or even death.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3563-NFPA 70-2020 [Section No. 110.26(C)(3)] | unobstructed door swings |
| Public Input No. 3566-NFPA 70-2020 [Section No. 110.33(A)(3)] | unobstructed door swings |
| Public Input No. 3570-NFPA 70-2020 [Section No. 450.43(C)] | |
| Public Input No. 3575-NFPA 70-2020 [Section No. 646.19 [Excluding any Sub-Sections]] | |
| Public Input No. 3582-NFPA 70-2020 [Section No. 110.31(A)(4)] | |

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 08:04:00 EDT 2020
**Committee:** NEC-P13


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## Public Input No. 4333-NFPA 70-2020 [ Section No. 480.10(G) ]

**(G)** Illumination.

Illumination shall be provided for working spaces containing ~~battery systems~~ storage batteries . The lighting outlets shall not be controlled by automatic means only. Additional lighting outlets shall not be required where the work space is illuminated by an adjacent light source. The location of luminaires shall not:

(1) Expose personnel to energized battery components while performing maintenance on the luminaires in the battery space; or

(2) Create a hazard to the battery upon failure of the luminaire.

## Statement of Problem and Substantiation for Public Input

This use of the term “battery system” continues to sow confusion over what constitutes an electrochemical ESS, and when Article 480 should be used versus Article 706. An electrochemical stationary storage system that includes inverters and converters goes beyond a simple battery installation which is what Article 480 should be focused on. Once this additional equipment is introduced this should be more correctly identified as an ESS or UPS, that already have definitions. If conflicting definitions like this continue to exist it creates opportunities for the circumvention of some important requirements found in Article 706.This proposal is part of a broader effort to clarify the scoping of Articles 480 and 706 and the defined terms used. Where better terms should be used, related PIs have been submitted.

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esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4326-NFPA 70-2020 [Definition: Battery System.] | deletion of old definition |
| Public Input No. 4326-NFPA 70-2020 [Definition: Battery System.] | |

## Submitter Information Verification

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**Submittal Date:** Thu Sep 10 10:26:36 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4356-NFPA 70-2020 [ Section No. 480.12 ]

**480.12** Battery Interconnections.

Flexible cables, as identified in ~~Article~~ Table 400.4 , in sizes 2/0 AWG and larger shall be permitted within the battery enclosure from battery terminals to a nearby junction box where they shall be connected to an approved wiring method. Flexible battery cables shall also be permitted between batteries and cells within the battery enclosure. Such cables shall be listed and identified for the environmental conditions. Flexible, fine-stranded cables shall only be used with terminals, lugs, devices, or connectors in accordance with 110.14.

## Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As the flexible cable types are identified in Table 400.4, reference to this specific table will correct the problem while complying with the style manual, without changing the intent of the section.

## Submitter Information Verification

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**Submittal Date:** Thu Sep 10 11:11:05 EDT 2020
**Committee:** NEC-P13

# Public Input No. 778-NFPA 70-2020 [ New Section after 480.13 ]

**TITLE OF NEW CONTENT**

Type your content here ...

**480.15 Electromagnetic Pulse (EMP) Protection.** Where storage batteries are utilized to supply manufacturing, production, transportation, distribution, sales, and business systems in facilities that are required to be EMP-protected, EMP protection for storage batteries against the effects of electromagnetic pulses shall be provided. See 709.7 for levels of electromagnetic pulse protection.

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

## Submitter Information Verification

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## Public Input No. 2987-NFPA 70-2020 [ Article 695 ]

~~**Article 695**~~ Article 703 Fire Pumps

~~**695**~~ **703 .1** Scope.

**(A)** Covered.

This article covers the installation of the following:

(1) Electric power sources and interconnecting circuits

(2) Switching and control equipment dedicated to fire pump drivers

Informational Note: Text that is followed by a reference in brackets has been extracted from NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*. Only editorial changes were made to the extracted text to make it consistent with this *Code*.

**(B)** Not Covered.

This article does not cover the following:

(1) The performance, maintenance, and acceptance testing of the fire pump system, and the internal wiring of the components of the system

(2) The installation of pressure maintenance (jockey or makeup) pumps

Informational Note: For the installation of pressure maintenance (jockey or makeup) pumps supplied by the fire pump circuit or another source, see Article 430.

(3) Transfer equipment upstream of the fire pump transfer switch(es)

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, for further information.

~~**695**~~ **703 .2** Definitions.

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

**Fault-Tolerant External Control Circuits.**

Those control circuits either entering or leaving the fire pump controller enclosure, which if broken, disconnected, or shorted will not prevent the controller from starting the fire pump from all other internal or external means and may cause the controller to start the pump under these conditions.

**On-Site Power Production Facility.**

The normal supply of electric power for the site that is expected to be constantly producing power.

**On-Site Standby Generator.**

A facility producing electric power on site as the alternate supply of electric power. It differs from an on-site power production facility in that it is not constantly producing power.

~~**695**~~ **703** .3 Power Source(s) for Electric Motor-Driven Fire Pumps.

Electric motor-driven fire pumps shall have a reliable source of power.

Informational Note: See Sections 9.3.2 and A.9.3.2 from NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, for guidance on the determination of power source reliability.

**(A)** Individual Sources.

Where reliable, and where capable of carrying indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment when connected to this power supply, the power source for an electric motor driven fire pump shall be one or more of the following.

**(1)** Electric Utility Service Connection.

A fire pump shall be permitted to be supplied by a separate service, or from a connection located ahead of and not within the same cabinet, enclosure, vertical switchgear section, or vertical switchboard section as the service disconnecting means. The connection shall be located and arranged so as to minimize the possibility of damage by fire from within the premises and from exposing hazards. A tap ahead of the service disconnecting means shall comply with 230.82(5). The service equipment shall comply with the labeling requirements in 230.2 and the location requirements in 230.72(B). [**20:**9.2.2(1)]

**(2)** On-Site Power Production Facility.

A fire pump shall be permitted to be supplied by an on-site power production facility. The source facility shall be located and protected to minimize the possibility of damage by fire. [**20:**9.2.2(3)]

**(3)** Dedicated Feeder.

A dedicated feeder shall be permitted where it is derived from a service connection as described in 695.3(A)(1). [**20:**9.2.2(3)]

**(B)** Multiple Sources.

If reliable power cannot be obtained from a source described in ~~695~~ 703 .3(A), power shall be supplied by one of the following: [**20:**9.3.2]

**(1)** Individual Sources.

An approved combination of two or more of the sources from ~~695~~ 703 .3(A).

**(2)** Individual Source and On-site Standby Generator.

An approved combination of one or more of the sources in ~~695~~ 703 .3(A) and an on-site standby generator complying with ~~695~~ 703 .3(D). [**20:**9.3.4]

*Exception to ~~695~~ 703 .3(B)(1) and (B)(2): An alternate source of power shall not be required where a back-up engine-driven fire pump, back-up steam turbine-driven fire pump , or back-up electric motor-driven fire pump with an independent power source in accordance with ~~695~~ 703 .3(A) or (C) is installed.*

**(C)** Multibuilding Campus-Style Complexes.

If the sources in ~~695~~ 703 .3(A) are not practicable and the installation is part of a multibuilding campus-style complex, feeder sources shall be permitted if approved by the authority having jurisdiction and installed in accordance with either ~~695~~ 703 .3(C)(1) and (C)(3) or (C)(2) and (C)(3).

**(1)** Feeder Sources.

Two or more feeders shall be permitted as more than one power source if such feeders are connected to, or derived from, separate utility services. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of ~~695~~ 703 .4(B)(1)(b).

**(2)** Feeder and Alternate Source.

A feeder shall be permitted as a normal source of power if an alternate source of power independent from the feeder is provided. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of ~~695~~ 703 .4(B)(1)(b).

**(3)** Selective Coordination.

Overcurrent protective device(s) shall be selectively coordinated with all supply-side overcurrent protective device(s).

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

**(D)** On-Site Standby Generator as Alternate Source.

An on-site standby generator(s) used as an alternate source of power shall comply with ~~695~~ 703 .3(D)(1) through (D)(3). [**20:**9.6.2.1]

**(1)** Capacity.

The generator shall have sufficient capacity to allow normal starting and running of the motor(s) driving the fire pump(s) while supplying all other simultaneously operated load(s). [**20:**9.6.1.1]

Automatic shedding of one or more optional standby loads in order to comply with this capacity requirement shall be permitted.

**(2)** Connection.

A tap ahead of the generator disconnecting means shall not be required. [**20:**9.6.1.2]

**(3)** Adjacent Disconnects.

The requirements of 430.113 shall not apply.

**(E)** Arrangement.

All power supplies shall be located and arranged to protect against damage by fire from within the premises and exposing hazards. [**20:**9.1.4]

Multiple power sources shall be arranged so that a fire at one source does not cause an interruption at the other source.

**(F)** Transfer of Power.

Transfer of power to the fire pump controller between the individual source and one alternate source shall take place within the pump room. [**20:**9.6.4]

**(G)** Power Source Selection.

Selection of power source shall be performed by a transfer switch listed for fire pump service. [**20:**10.8.1.3.1]

**(H)** Overcurrent Device Selection.

An instantaneous trip circuit breaker shall be permitted in lieu of the overcurrent devices specified in 695.4(B)(2)(a)(1), provided that it is part of a transfer switch assembly listed for fire pump service that complies with ~~695~~ 703 .4(B)(2)(a)(2).

**(I)** Phase Converters.

Phase converters shall not be permitted to be used for fire pump service. [**20:**9.1.7]

**~~695~~ 703** .4 Continuity of Power.

Circuits that supply electric motor–driven fire pumps shall be supervised from inadvertent disconnection as covered in 695.4(A) or (B).

**(A)** Direct Connection.

The supply conductors shall directly connect the power source to a listed fire pump controller, a listed combination fire pump controller and power transfer switch, or a listed fire pump power transfer switch.

**(B)** Connection Through Disconnecting Means and Overcurrent Device.

**(1)** Number of Disconnecting Means.

(a) *General.* A single disconnecting means and associated overcurrent protective device(s) shall be permitted to be installed between the fire pump power source(s) and one of the following: [**20:**9.1.2]

(2) A listed fire pump controller

(3) A listed fire pump power transfer switch

(4) A listed combination fire pump controller and power transfer switch

(e) *Feeder Sources.* For systems installed under the provisions of 695.3(C) only, additional disconnecting means and the associated overcurrent protective device(s) shall be permitted.

(f) *On-Site Standby Generator.* Where an on-site standby generator is used to supply a fire pump, an additional disconnecting means and an associated overcurrent protective device(s) shall be permitted.

**(2)** Overcurrent Device Selection.

Overcurrent devices shall comply with ~~695~~ 703 .4(B)(2)(a) or (B)(2)(b).

(a) *Individual Sources.* Overcurrent protection for individual sources shall comply with the following:

(2) Overcurrent protective device(s) shall be rated to carry indefinitely the sum of the locked-rotor current of the largest fire pump motor and the full-load current of all of the other pump motors and accessory equipment. [ **20:** 9.2.3.4] Where the locked-rotor current value does not correspond to a standard overcurrent device size, the next standard overcurrent device size shall be used in accordance with 240.6 . The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

*Exception: The requirement to carry the locked-rotor currents indefinitely shall not apply to feeder overcurrent protective devices installed in accordance with 695.3(C) .*

(3) Overcurrent protection shall be provided by an assembly listed for fire pump service and complying with the following:

(4) The overcurrent protective device shall not open within 2 minutes at 600 percent of the full-load current of the fire pump motor(s).

(5) The overcurrent protective device shall not open with a re-start transient of 24 times the full-load current of the fire pump motor(s).

(6) The overcurrent protective device shall not open within 10 minutes at 300 percent of the full-load current of the fire pump motor(s).

(7) The trip point for circuit breakers shall not be field adjustable. [ **20:** 9.2.3.4.1]

(h) *On-Site Standby Generators.* Overcurrent protective devices between an on-site standby generator and a fire pump controller shall be selected and sized to allow for instantaneous pickup of the full pump room load, but shall not be larger than the value selected to comply with 430.62 to provide short-circuit protection only. [**20:**9.6.1.1]

**(3)** Disconnecting Means.

All disconnecting devices that are unique to the fire pump loads shall comply with items ~~695~~ 703 .4(B)(3)(a) through (B)(3)(e).

(a) *Features and Location — Normal Power Source.* The disconnecting means for the normal power source shall comply with all of the following: [**20:**9.2.3.1]

(2) Be identified as suitable for use as service equipment.

(3) Be lockable in the closed position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed.

(4) Not be located within the same enclosure, panelboard, switchboard, switchgear, or motor control center, with or without common bus, that supplies loads other than the fire pump.

(5) Be located sufficiently remote from other building or other fire pump source disconnecting means such that inadvertent operation at the same time would be unlikely.

*Exception to*

~~695~~

(1)

*703 .4(B)(3)(a): For a multibuilding campus-style complex(s) installed under the provisions of*

~~695~~

(1)

*703 .3(C) , only the requirements in*

~~695~~

(1)

*703 .4(B)(3) (a)(2) shall apply for normal power source disconnects.*

(f) *Features and Location — On-Site Standby Generator.* The disconnecting means for an on-site standby generator(s) used as the alternate power source shall be installed in accordance with 700.10(B)(5) for emergency circuits and shall be lockable in the closed position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed.

(g) *Disconnect Marking.* The disconnecting means shall be marked “Fire Pump Disconnecting Means.” The letters shall be at least 25 mm (1 in.) in height, and they shall be visible without opening enclosure doors or covers. [**20:**9.2.3.1(5)]

(h) *Controller Marking.* A placard shall be placed adjacent to the fire pump controller, stating the location of this disconnecting means and the location of the key (if the disconnecting means is locked). [**20:**9.2.3.2]

(i) *Supervision.* The disconnecting means shall be supervised in the closed position by one of the following methods:

(10) Central station, proprietary, or remote station signal device

(11) Local signaling service that causes the sounding of an audible signal at a constantly attended point

(12) Locking the disconnecting means in the closed position

(m) Sealing of disconnecting means and approved weekly recorded inspections when the disconnecting means are located within fenced enclosures or in buildings under the control of the owner [**20:**9.2.3.3]

~~**695**~~ **703** .5 Transformers.

Where the service or system voltage is different from the utilization voltage of the fire pump motor, transformer(s) protected by disconnecting means and overcurrent protective devices shall be permitted to be installed between the system supply and the fire pump controller in accordance with 695.5(A) and (B), or with (C). Only transformers covered in 695.5(C) shall be permitted to supply loads not directly associated with the fire pump system.

**(A)** Size.

Where a transformer supplies an electric motor driven fire pump, it shall be rated at a minimum of 125 percent of the sum of the fire pump motor(s) and pressure maintenance pump(s) motor loads, and 100 percent of the associated fire pump accessory equipment supplied by the transformer.

**(B)** Overcurrent Protection.

The primary overcurrent protective device(s) shall be selected or set to carry indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment when connected to this power supply. Secondary overcurrent protection shall not be permitted. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

**(C)** Feeder Source.

Where a feeder source is provided in accordance with 695.3(C), transformers supplying the fire pump system shall be permitted to supply other loads. All other loads shall be calculated in accordance with Article 220, including demand factors as applicable.

**(1)** Size.

Transformers shall be rated at a minimum of 125 percent of the sum of the fire pump motor(s) and pressure maintenance pump(s) motor loads, and 100 percent of the remaining load supplied by the transformer.

**(2)** Overcurrent Protection.

The transformer size, the feeder size, and the overcurrent protective device(s) shall be coordinated such that overcurrent protection is provided for the transformer in accordance with 450.3 and for the feeder in accordance with 215.3, and such that the overcurrent protective device(s) is selected or set to carry indefinitely the sum of the locked-rotor current of the fire pump motor(s), the pressure maintenance pump motor(s), the full-load current of the associated fire pump accessory equipment, and 100 percent of the remaining loads supplied by the transformer. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

~~**695**~~ **703** .6 Power Wiring.

Power circuits and wiring methods shall comply with the requirements in 695.6(A) through (J), and as permitted in 230.90(A), Exception No. 4; 230.94, Exception No. 4; 240.13; 230.208; 240.4(A); and 430.31.

**(A)** Supply Conductors.

**(1)** Services and On-Site Power Production Facilities.

Service conductors and conductors supplied by on-site power production facilities shall be physically routed outside a building(s) and shall be installed as service-entrance conductors in accordance with 230.6, 230.9, and Parts III and IV of Article 230. Where supply conductors cannot be physically routed outside of buildings, the conductors shall be permitted to be routed through the building(s) where installed in accordance with 230.6(1) or (2).

*Exception: The supply conductors within the fire pump room shall not be required to meet 230.6(1) or (2).*

Informational Note: See 250.24(C) for routing the grounded conductor to the service equipment.

**(2)** Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.4(B), or conductors that connect directly to an on-site standby generator, shall comply with all of the following:

(1) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(2) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(3) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(4) *Inside of a Building.* Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

a. The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

b. The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

c. The cable or raceway is a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

*Exception to ~~695~~ 703.6(A)(2)(4): The supply conductors located in the electrical equipment room where they originate and in the fire pump room shall not be required to have the minimum 2-hour fire separation or fire-resistance rating unless otherwise required by 700.10(D) of this Code.*

**(B)** Conductor Size.

**(1)** Fire Pump Motors and Other Equipment.

Conductors supplying a fire pump motor(s), pressure maintenance pumps, and associated fire pump accessory equipment shall have a rating not less than 125 percent of the sum of the fire pump motor(s) and pressure maintenance motor(s) full-load current(s), and 100 percent of the associated fire pump accessory equipment.

**(2)** Fire Pump Motors Only.

Conductors supplying only a fire pump motor shall have a minimum ampacity in accordance with 430.22 and shall comply with the voltage drop requirements in 695.7.

**(C)** Overload Protection.

Power circuits shall not have automatic protection against overloads. Except for protection of transformer primaries provided in ~~695~~ 703 .5(C)(2), branch-circuit and feeder conductors shall be protected against short circuit only. Where a tap is made to supply a fire pump, the wiring shall be treated as service conductors in accordance with 230.6. The applicable distance and size restrictions in 240.21 shall not apply.

*Exception No. 1: Conductors between storage batteries and the engine shall not require overcurrent protection or disconnecting means.*

*Exception No. 2: For an on-site standby generator(s) rated to produce continuous current in excess of 225 percent of the full-load amperes of the fire pump motor, the conductors between the on-site generator(s) and the combination fire pump transfer switch controller or separately mounted transfer switch shall be installed in accordance with ~~695~~ 703 .6(A)(2).*

*The protection provided shall be in accordance with the short-circuit current rating of the combination fire pump transfer switch controller or separately mounted transfer switch.*

**(D)** Pump Wiring.

All wiring from the controllers to the pump motors shall be in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable. Electrical connections at motor terminal boxes shall be made with a listed means of connection. Twist-on, insulation-piercing–type, and soldered wire connectors shall not be permitted to be used for this purpose.

**(E)** Loads Supplied by Controllers and Transfer Switches.

A fire pump controller and fire pump power transfer switch, if provided, shall not serve any load other than the fire pump for which it is intended.

**(F)** Mechanical Protection.

All wiring from engine controllers and batteries shall be protected against physical damage and shall be installed in accordance with the controller and engine manufacturer's instructions.

**(G)** Ground-Fault Protection of Equipment.

Ground-fault protection of equipment shall not be installed in any fire pump power circuit. [**20:**9.1.8.1]

**(H)** Listed Electrical Circuit Protective System to Controller Wiring.

Electrical circuit protective system installation shall comply with any restrictions provided in the listing of the electrical circuit protective system used, and the following also shall apply:

(1) A junction box shall be installed ahead of the fire pump controller a minimum of 300 mm (12 in.) beyond the fire-rated wall or floor bounding the fire zone.

(2) Where required by the manufacturer of a listed electrical circuit protective system or by the listing, or as required elsewhere in this *Code*, the raceway between a junction box and the fire pump controller shall be sealed at the junction box end as required and in accordance with the instructions of the manufacturer. [**20:**9.8.2]

(3) Standard wiring between the junction box and the controller shall be permitted. [**20:**9.8.3]

**(I)** Junction Boxes.

Where fire pump wiring to or from a fire pump controller is routed through a junction box, the following requirements shall be met:

(1) The junction box shall be securely mounted. [**20:**9.7(1)]

(2) Mounting and installing of a junction box shall not violate the enclosure type rating of the fire pump controller(s). [**20:**9.7(2)]

(3) Mounting and installing of a junction box shall not violate the integrity of the fire pump controller(s) and shall not affect the short-circuit current rating of the controller(s).

(4) As a minimum, a Type 2, drip-proof enclosure (junction box) shall be used where installed in the fire pump room. The enclosure shall be listed to match the fire pump controller enclosure type rating. [**20:**9.7(4)]

(5) Terminals, junction blocks, wire connectors, and splices, where used, shall be listed. [**20:**9.7(5)]

(6) A fire pump controller or fire pump power transfer switch, where provided, shall not be used as a junction box to supply other equipment, including a pressure maintenance (jockey) pump(s).

**(J)** Terminations.

Where raceways or cable are terminated at a fire pump controller, the following requirements shall be met:

(1) Raceway or cable fittings listed and identified for use in wet locations shall be used.

(2) The type rating of the raceway or cable fittings shall be at least equal to that of the fire pump controller.

(3) The installation instructions of the manufacturer of the fire pump controller shall be followed.

(4) Alterations to the fire pump controller, other than raceway or cable terminations as allowed elsewhere in this *Code*, shall be approved by the authority having jurisdiction.

**~~695~~ 703** .7 Voltage Drop.

**(A)** Starting.

The voltage at the fire pump controller line terminals shall not drop more than 15 percent below normal (controller-rated voltage) under motor starting conditions.

*Exception: This limitation shall not apply for emergency run mechanical starting. [**20:**9.4.2]*

**(B)** Running.

The voltage at the load terminals of the fire pump controller shall not drop more than 5 percent below the voltage rating of the motor connected to those terminals when the motor is operating at 115 percent of the full-load current rating of the motor.

**~~695~~ 703** .10 Listed Equipment.

Diesel engine fire pump controllers, electric fire pump controllers, electric motors, fire pump power transfer switches, foam pump controllers, and limited service controllers shall be listed for fire pump service. [**20:**9.5.1.1, 10.1.2.1, 12.1.3.1]

Fire pump controllers and transfer switches shall not be permitted to be reconditioned.

**~~695~~ 703** .12 Equipment Location.

**(A)** Controllers and Transfer Switches.

Electric motor-driven fire pump controllers and power transfer switches shall be located as close as practicable to, and within sight of, the motors that they control.

**(B)** Engine-Drive Controllers.

Engine-drive fire pump controllers shall be located as close as is practical to, and within sight of, the engines that they control.

**(C)** Storage Batteries.

Storage batteries for fire pump engine drives shall be supported above the floor, secured against displacement, and located where they are not subject to physical damage, flooding with water, excessive temperature, or excessive vibration.

**(D)** Energized Equipment.

All energized equipment parts shall be located at least 300 mm (12 in.) above the floor level.

**(E)** Protection Against Pump Water.

Fire pump controller and power transfer switches shall be located or protected so that they are not damaged by water escaping from pumps or pump connections.

**(F)** Mounting.

All fire pump control equipment shall be mounted in a substantial manner on noncombustible supporting structures.

**~~695~~ 703** .14 Control Wiring.

**(A)** Control Circuit Failures.

External control circuits that extend outside the fire pump room shall be arranged so that failure of any external circuit (open or short circuit) shall not prevent the operation of a pump(s) from all other internal or external means. Breakage, disconnecting, shorting of the wires, or loss of power to these circuits could cause continuous running of the fire pump but shall not prevent the controller(s) from starting the fire pump(s) due to causes other than these external control circuits. All control conductors within the fire pump room that are not fault tolerant shall be protected against physical damage. [**20:**10.5.2.6, 12.5.2.5]

**(B)** Sensor Functioning.

No undervoltage, phase-loss, frequency-sensitive, or other sensor(s) shall be installed that automatically or manually prohibits actuation of the motor contactor. [**20:**10.4.5.6]

*Exception: A phase-loss sensor(s) shall be permitted only as a part of a listed fire pump controller.*

**(C)** Remote Device(s).

No remote device(s) shall be installed that will prevent automatic operation of the transfer switch. [**20:**10.8.1.3]

**(D)** Engine-Drive Control Wiring.

All wiring between the controller and the diesel engine shall be stranded and sized to continuously carry the charging or control currents as required by the controller manufacturer. Such wiring shall be protected against physical damage. Controller manufacturer's specifications for distance and wire size shall be followed. [**20:**12.3.5.1]

**(E)** Electric Fire Pump Control Wiring Methods.

All electric motor–driven fire pump control wiring shall be in rigid metal conduit, intermediate metal conduit, liquidtight flexible metal conduit, electrical metallic tubing, liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable.

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

(2) The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

**~~695~~ 703** .15 Surge Protection.

A listed surge protection device shall be installed in or on the fire pump controller.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This change aligns with an effort to re-organize the alternative energy sources NEC Articles into a series of articles closely located together. This reorganization places all sources alternate sources as follows:
689 On-Site Energy Sources
690 Solar Photovoltaic (PV) Systems
691 Large-Scale Photovoltaic (PV) Systems
692 Fuel Cell Systems
693 Generators
694 Wind Electric Systems
695 Energy Storage Systems
696 Storage Batteries

This public input changes 695 to 703 to support this effort and to better align with the fact that this Article is closely related to emergency systems. The requirements of this new 703 focus on more than just a fire pump and arguably more so focuses on fire pump systems which is closely aligned with Chapter 7 of the NEC.

This moves makes way for alignment of alternative energy sources article arrangement. These articles are closely related to each other and this change is in alignment with the direction by the correlating committee to review alternative energy sources for conflicts and usability. This new alignment will create a similar structure as that found for hazardous locations. The new Article 689 is the a combination of Articles 705, 710 and 712 and will act to be the new general requirements for this series of alternative energy sources.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2988-NFPA 70-2020 [Section No. 240.101(A)] | |
| Public Input No. 2990-NFPA 70-2020 [Section No. 242.3] | |
| Public Input No. 2991-NFPA 70-2020 [Section No. 430.5] | |
| Public Input No. 2992-NFPA 70-2020 [Section No. 430.31] | |
| Public Input No. 2993-NFPA 70-2020 [Section No. 450.1] | |

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 4573-NFPA 70-2020 [ Article 695 ]

**Article 695** Fire ~~Pumps~~ Pumps (SEE WORD DOC WITH ALL LEGISLATIVE TEXT AND FORMATTING)

**695.1** Scope.

**(A)** Covered.

This article covers the installation of the following:

(1) Electric power sources and interconnecting circuits

(2) Switching and control equipment dedicated to fire pump drivers

Informational Note: Text that is followed by a reference in brackets has been extracted from NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*. Only editorial changes were made to the extracted text to make it consistent with this *Code*.

**(B)** Not Covered.

This article does not cover the following:

(1) The performance, maintenance, and acceptance testing of the fire pump system, and the internal wiring of the components of the system

(2) The installation of pressure maintenance (jockey or makeup) pumps

Informational Note: For the installation of pressure maintenance (jockey or makeup) pumps supplied by the fire pump circuit or another source, see Article 430.

(3) Transfer equipment upstream of the fire pump transfer switch(es)

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, for further information.

**695.2** Definitions.

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

**Fault-Tolerant External Control Circuits.**

Those control circuits either entering or leaving the fire pump controller enclosure, which if broken, disconnected, or shorted will not prevent the controller from starting the fire pump from all other internal or external means and may cause the controller to start the pump under these conditions.

**On-Site Power Production Facility.**

The normal supply of electric power for the site that is expected to be constantly producing power.

**On-Site Standby Generator.**

A facility producing electric power on site as the alternate supply of electric power. It differs from an on-site power production facility in that it is not constantly producing power.

**695.3** Power Source(s) for Electric Motor-Driven Fire Pumps.

Electric motor-driven fire pumps shall have a reliable source of power.

Informational Note: See Sections 9.3.2 and A.9.3.2 from NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, for guidance on the determination of power source reliability.

**(A)** Individual Sources.

Where reliable, and where capable of carrying indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment when connected to this power supply, the power source for an electric motor driven fire pump shall be one or more of the following.

**(1)** Electric Utility Service Connection.

A fire pump shall be permitted to be supplied by a separate service, or from a connection located ahead of and not within the same cabinet, enclosure, vertical switchgear section, or vertical switchboard section as the service disconnecting means. The connection shall be located and arranged so as to minimize the possibility of damage by fire from within the premises and from exposing hazards. A tap ahead of the service disconnecting means shall comply with 230.82(5). The service equipment shall comply with the labeling requirements in 230.2 and the location requirements in 230.72(B). [**20:**9.2.2(1)]

**(2)** On-Site Power Production Facility.

A fire pump shall be permitted to be supplied by an on-site power production facility. The source facility shall be located and protected to minimize the possibility of damage by fire. [**20:**9.2.2(3)]

**(3)** Dedicated Feeder.

A dedicated feeder shall be permitted where it is derived from a service connection as described in 695.3(A)(1). [**20:**9.2.2(3)]

**(B)** Multiple Sources.

If reliable power cannot be obtained from a source described in 695.3(A), power shall be supplied by one of the following: [**20:**9.3.2]

**(1)** Individual Sources.

An approved combination of two or more of the sources from 695.3(A).

**(2)** Individual Source and On-site Standby Generator.

An approved combination of one or more of the sources in 695.3(A) and an on-site standby generator complying with 695.3(D). [**20:**9.3.4]

*Exception to 695.3(B)(1) and (B)(2): An alternate source of power shall not be required where a back-up engine-driven fire pump, back-up steam turbine-driven fire pump , or back-up electric motor-driven fire pump with an independent power source in accordance with 695.3(A) or (C) is installed.*

**(C)** Multibuilding Campus-Style Complexes.

If the sources in 695.3(A) are not practicable and the installation is part of a multibuilding campus-style complex, feeder sources shall be permitted if approved by the authority having jurisdiction and installed in accordance with either 695.3(C)(1) and (C)(3) or (C)(2) and (C)(3).

**(1)** Feeder Sources.

Two or more feeders shall be permitted as more than one power source if such feeders are connected to, or derived from, separate utility services. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).

**(2)** Feeder and Alternate Source.

A feeder shall be permitted as a normal source of power if an alternate source of power independent from the feeder is provided. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).

**(3)** Selective Coordination.

Overcurrent protective device(s) shall be selectively coordinated with all supply-side overcurrent protective device(s).

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

**(D)** On-Site Standby Generator as Alternate Source.

An on-site standby generator(s) used as an alternate source of power shall comply with 695.3(D)(1) through (D)(3). [**20:**9.6.2.1]

**(1)** Capacity.

The generator shall have sufficient capacity to allow normal starting and running of the motor(s) driving the fire pump(s) while supplying all other simultaneously operated load(s). [**20:**9.6.1.1]

Automatic shedding of one or more optional standby loads in order to comply with this capacity requirement shall be permitted.

**(2)** Connection.

A tap ahead of the generator disconnecting means shall not be required. [**20:**9.6.1.2]

**(3)** Adjacent Disconnects.

The requirements of 430.113 shall not apply.

**(E)** Arrangement.

All power supplies shall be located and arranged to protect against damage by fire from within the premises and exposing hazards. [**20:**9.1.4]

Multiple power sources shall be arranged so that a fire at one source does not cause an interruption at the other source.

**(F)** Transfer of Power.

Transfer of power to the fire pump controller between the individual source and one alternate source shall take place within the pump room. [**20:**9.6.4]

**(G)** Power Source Selection.

Selection of power source shall be performed by a transfer switch listed for fire pump service. [**20:**10.8.1.3.1]

**(H)** Overcurrent Device Selection.

An instantaneous trip circuit breaker shall be permitted in lieu of the overcurrent devices specified in 695.4(B)(2)(a)(1), provided that it is part of a transfer switch assembly listed for fire pump service that complies with 695.4(B)(2)(a)(2).

**(I)** Phase Converters.

Phase converters shall not be permitted to be used for fire pump service. [**20:**9.1.7]

**695.4** Continuity of Power.

Circuits that supply electric motor–driven fire pumps shall be supervised from inadvertent disconnection as covered in 695.4(A) or (B).

**(A)** Direct Connection.

The supply conductors shall directly connect the power source to a listed fire pump controller, a listed combination fire pump controller and power transfer switch, or a listed fire pump power transfer switch.

**(B)** Connection Through Disconnecting Means and Overcurrent Device.

**(1)** Number of Disconnecting Means.

(a) *General.* A single disconnecting means and associated overcurrent protective device(s) shall be permitted to be installed between the fire pump power source(s) and one of the following: [**20:**9.1.2]

(2) A listed fire pump controller

(3) A listed fire pump power transfer switch

(4) A listed combination fire pump controller and power transfer switch

(e) *Feeder Sources.* For systems installed under the provisions of 695.3(C) only, additional disconnecting means and the associated overcurrent protective device(s) shall be permitted.

(f) *On-Site Standby Generator.* Where an on-site standby generator is used to supply a fire pump, an additional disconnecting means and an associated overcurrent protective device(s) shall be permitted.

**(2)** Overcurrent Device Selection.

Overcurrent devices shall comply with 695.4(B)(2)(a) or (B)(2)(b).

(a) *Individual Sources.* Overcurrent protection for individual sources shall comply with the following:

(2) Overcurrent protective device(s) shall be rated to carry indefinitely the sum of the locked-rotor current of the largest fire pump motor and the full-load current of all of the other pump motors and accessory equipment. [ **20:** 9.2.3.4] Where the locked-rotor current value does not correspond to a standard overcurrent device size, the next standard overcurrent device size shall be used in accordance with 240.6 . The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

*Exception: The requirement to carry the locked-rotor currents indefinitely shall not apply to feeder overcurrent protective devices installed in accordance with 695.3(C) .*

(3) Overcurrent protection shall be provided by an assembly listed for fire pump service and complying with the following:

(4) The overcurrent protective device shall not open within 2 minutes at 600 percent of the full-load current of the fire pump motor(s).

(5) The overcurrent protective device shall not open with a re-start transient of 24 times the full-load current of the fire pump motor(s).

(6) The overcurrent protective device shall not open within 10 minutes at 300 percent of the full-load current of the fire pump motor(s).

(7) The trip point for circuit breakers shall not be field adjustable. [ **20:** 9.2.3.4.1]

(h) *On-Site Standby Generators.* Overcurrent protective devices between an on-site standby generator and a fire pump controller shall be selected and sized to allow for instantaneous pickup of the full pump room load, but shall not be larger than the value selected to comply with 430.62 to provide short-circuit protection only. [**20:**9.6.1.1]

**(3)** Disconnecting Means.

All disconnecting devices that are unique to the fire pump loads shall comply with items 695.4(B)(3)(a) through (B)(3)(e).

(a) *Features and Location — Normal Power Source.* The disconnecting means for the normal power source shall comply with all of the following: [**20:**9.2.3.1]

(2) Be identified as suitable for use as service equipment.

(3) Be lockable in the closed position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed.

(4) Not be located within the same enclosure, panelboard, switchboard, switchgear, or motor control center, with or without common bus, that supplies loads other than the fire pump.

(5) Be located sufficiently remote from other building or other fire pump source disconnecting means such that inadvertent operation at the same time would be unlikely.

*Exception to 695.4(B)(3)(a): For a multibuilding campus-style complex(s) installed under the provisions of 695.3(C) , only the requirements in 695.4(B)(3) (a)(2) shall apply for normal power source disconnects.*

(f) *Features and Location — On-Site Standby Generator.* The disconnecting means for an on-site standby generator(s) used as the alternate power source shall be installed in accordance with 700.10(B)(5) for emergency circuits and shall be lockable in the closed position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed.

(g) *Disconnect Marking.* The disconnecting means shall be marked “Fire Pump Disconnecting Means.” The letters shall be at least 25 mm (1 in.) in height, and they shall be visible without opening enclosure doors or covers. [**20:**9.2.3.1(5)]

(h) *Controller Marking.* A placard shall be placed adjacent to the fire pump controller, stating the location of this disconnecting means and the location of the key (if the disconnecting means is locked). [**20:**9.2.3.2]

(i) *Supervision.* The disconnecting means shall be supervised in the closed position by one of the following methods:

(10) Central station, proprietary, or remote station signal device

(11) Local signaling service that causes the sounding of an audible signal at a constantly attended point

(12) Locking the disconnecting means in the closed position

(m) Sealing of disconnecting means and approved weekly recorded inspections when the disconnecting means are located within fenced enclosures or in buildings under the control of the owner [**20:**9.2.3.3]

**695.5** Transformers.

Where the service or system voltage is different from the utilization voltage of the fire pump motor, transformer(s) protected by disconnecting means and overcurrent protective devices shall be permitted to be installed between the system supply and the fire pump controller in accordance with 695.5(A) and (B), or with (C). Only transformers covered in 695.5(C) shall be permitted to supply loads not directly associated with the fire pump system.

**(A)** Size.

Where a transformer supplies an electric motor driven fire pump, it shall be rated at a minimum of 125 percent of the sum of the fire pump motor(s) and pressure maintenance pump(s) motor loads, and 100 percent of the associated fire pump accessory equipment supplied by the transformer.

**(B)** Overcurrent Protection.

The primary overcurrent protective device(s) shall be selected or set to carry indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment when connected to this power supply. Secondary overcurrent protection shall not be permitted. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

**(C)** Feeder Source.

Where a feeder source is provided in accordance with 695.3(C), transformers supplying the fire pump system shall be permitted to supply other loads. All other loads shall be calculated in accordance with Article 220, including demand factors as applicable.

**(1)** Size.

Transformers shall be rated at a minimum of 125 percent of the sum of the fire pump motor(s) and pressure maintenance pump(s) motor loads, and 100 percent of the remaining load supplied by the transformer.

**(2)** Overcurrent Protection.

The transformer size, the feeder size, and the overcurrent protective device(s) shall be coordinated such that overcurrent protection is provided for the transformer in accordance with 450.3 and for the feeder in accordance with 215.3, and such that the overcurrent protective device(s) is selected or set to carry indefinitely the sum of the locked-rotor current of the fire pump motor(s), the pressure maintenance pump motor(s), the full-load current of the associated fire pump accessory equipment, and 100 percent of the remaining loads supplied by the transformer. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

**695.6** Power Wiring.

Power circuits and wiring methods shall comply with the requirements in 695.6(A) through (J), and as permitted in 230.90(A), Exception No. 4; 230.94, Exception No. 4; 240.13; 230.208; 240.4(A); and 430.31.

**(A)** Supply Conductors.

**(1)** Services and On-Site Power Production Facilities.

Service conductors and conductors supplied by on-site power production facilities shall be physically routed outside a building(s) and shall be installed as service-entrance conductors in accordance with 230.6, 230.9, and Parts III and IV of Article 230. Where supply conductors cannot be physically routed outside of buildings, the conductors shall be permitted to be routed through the building(s) where installed in accordance with 230.6(1) or (2).

*Exception: The supply conductors within the fire pump room shall not be required to meet 230.6(1) or (2).*

Informational Note: See 250.24(C) for routing the grounded conductor to the service equipment.

**(2)** Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.4(B), or conductors that connect directly to an on-site standby generator, shall comply with all of the following:

(1) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(2) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(3) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(4) *Inside of a Building.* Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

a. The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

b. The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

c. The cable or raceway is a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

*Exception to 695.6(A)(2)(4): The supply conductors located in the electrical equipment room where they originate and in the fire pump room shall not be required to have the minimum 2-hour fire separation or fire-resistance rating unless otherwise required by 700.10(D) of this Code.*

**(B)** Conductor Size.

**(1)** Fire Pump Motors and Other Equipment.

Conductors supplying a fire pump motor(s), pressure maintenance pumps, and associated fire pump accessory equipment shall have a rating not less than 125 percent of the sum of the fire pump motor(s) and pressure maintenance motor(s) full-load current(s), and 100 percent of the associated fire pump accessory equipment.

**(2)** Fire Pump Motors Only.

Conductors supplying only a fire pump motor shall have a minimum ampacity in accordance with 430.22 and shall comply with the voltage drop requirements in 695.7.

**(C)** Overload Protection.

Power circuits shall not have automatic protection against overloads. Except for protection of transformer primaries provided in 695.5(C)(2), branch-circuit and feeder conductors shall be protected against short circuit only. Where a tap is made to supply a fire pump, the wiring shall be treated as service conductors in accordance with 230.6. The applicable distance and size restrictions in 240.21 shall not apply.

*Exception No. 1: Conductors between storage batteries and the engine shall not require overcurrent protection or disconnecting means.*

*Exception No. 2: For an on-site standby generator(s) rated to produce continuous current in excess of 225 percent of the full-load amperes of the fire pump motor, the conductors between the on-site generator(s) and the combination fire pump transfer switch controller or separately mounted transfer switch shall be installed in accordance with 695.6(A)(2).*

*The protection provided shall be in accordance with the short-circuit current rating of the combination fire pump transfer switch controller or separately mounted transfer switch.*

**(D)** Pump Wiring.

All wiring from the controllers to the pump motors shall be in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable. Electrical connections at motor terminal boxes shall be made with a listed means of connection. Twist-on, insulation-piercing–type, and soldered wire connectors shall not be permitted to be used for this purpose.

**(E)** Loads Supplied by Controllers and Transfer Switches.

A fire pump controller and fire pump power transfer switch, if provided, shall not serve any load other than the fire pump for which it is intended.

**(F)** Mechanical Protection.

All wiring from engine controllers and batteries shall be protected against physical damage and shall be installed in accordance with the controller and engine manufacturer's instructions.

**(G)** Ground-Fault Protection of Equipment.

Ground-fault protection of equipment shall not be installed in any fire pump power circuit. [**20:**9.1.8.1]

**(H)** Listed Electrical Circuit Protective System to Controller Wiring.

Electrical circuit protective system installation shall comply with any restrictions provided in the listing of the electrical circuit protective system used, and the following also shall apply:

(1) A junction box shall be installed ahead of the fire pump controller a minimum of 300 mm (12 in.) beyond the fire-rated wall or floor bounding the fire zone.

(2) Where required by the manufacturer of a listed electrical circuit protective system or by the listing, or as required elsewhere in this *Code*, the raceway between a junction box and the fire pump controller shall be sealed at the junction box end as required and in accordance with the instructions of the manufacturer. [**20:**9.8.2]

(3) Standard wiring between the junction box and the controller shall be permitted. [**20:**9.8.3]

**(I)** Junction Boxes.

Where fire pump wiring to or from a fire pump controller is routed through a junction box, the following requirements shall be met:

(1) The junction box shall be securely mounted. [**20:**9.7(1)]

(2) Mounting and installing of a junction box shall not violate the enclosure type rating of the fire pump controller(s). [**20:**9.7(2)]

(3) Mounting and installing of a junction box shall not violate the integrity of the fire pump controller(s) and shall not affect the short-circuit current rating of the controller(s).

(4) As a minimum, a Type 2, drip-proof enclosure (junction box) shall be used where installed in the fire pump room. The enclosure shall be listed to match the fire pump controller enclosure type rating. [**20:**9.7(4)]

(5) Terminals, junction blocks, wire connectors, and splices, where used, shall be listed. [**20:**9.7(5)]

(6) A fire pump controller or fire pump power transfer switch, where provided, shall not be used as a junction box to supply other equipment, including a pressure maintenance (jockey) pump(s).

**(J)** Terminations.

Where raceways or cable are terminated at a fire pump controller, the following requirements shall be met:

(1) Raceway or cable fittings listed and identified for use in wet locations shall be used.

(2) The type rating of the raceway or cable fittings shall be at least equal to that of the fire pump controller.

(3) The installation instructions of the manufacturer of the fire pump controller shall be followed.

(4) Alterations to the fire pump controller, other than raceway or cable terminations as allowed elsewhere in this *Code*, shall be approved by the authority having jurisdiction.

**695.7** Voltage Drop.

**(A)** Starting.

The voltage at the fire pump controller line terminals shall not drop more than 15 percent below normal (controller-rated voltage) under motor starting conditions.

*Exception: This limitation shall not apply for emergency run mechanical starting. [**20:**9.4.2]*

**(B)** Running.

The voltage at the load terminals of the fire pump controller shall not drop more than 5 percent below the voltage rating of the motor connected to those terminals when the motor is operating at 115 percent of the full-load current rating of the motor.

**695.10** Listed Equipment.

Diesel engine fire pump controllers, electric fire pump controllers, electric motors, fire pump power transfer switches, foam pump controllers, and limited service controllers shall be listed for fire pump service. [**20:**9.5.1.1, 10.1.2.1, 12.1.3.1]

Fire pump controllers and transfer switches shall not be permitted to be reconditioned.

**695.12** Equipment Location.

**(A)** Controllers and Transfer Switches.

Electric motor-driven fire pump controllers and power transfer switches shall be located as close as practicable to, and within sight of, the motors that they control.

**(B)** Engine-Drive Controllers.

Engine-drive fire pump controllers shall be located as close as is practical to, and within sight of, the engines that they control.

**(C)** Storage Batteries.

Storage batteries for fire pump engine drives shall be supported above the floor, secured against displacement, and located where they are not subject to physical damage, flooding with water, excessive temperature, or excessive vibration.

**(D)** Energized Equipment.

All energized equipment parts shall be located at least 300 mm (12 in.) above the floor level.

**(E)** Protection Against Pump Water.

Fire pump controller and power transfer switches shall be located or protected so that they are not damaged by water escaping from pumps or pump connections.

**(F)** Mounting.

All fire pump control equipment shall be mounted in a substantial manner on noncombustible supporting structures.

**695.14** Control Wiring.

**(A)** Control Circuit Failures.

External control circuits that extend outside the fire pump room shall be arranged so that failure of any external circuit (open or short circuit) shall not prevent the operation of a pump(s) from all other internal or external means. Breakage, disconnecting, shorting of the wires, or loss of power to these circuits could cause continuous running of the fire pump but shall not prevent the controller(s) from starting the fire pump(s) due to causes other than these external control circuits. All control conductors within the fire pump room that are not fault tolerant shall be protected against physical damage. [**20:**10.5.2.6, 12.5.2.5]

**(B)** Sensor Functioning.

No undervoltage, phase-loss, frequency-sensitive, or other sensor(s) shall be installed that automatically or manually prohibits actuation of the motor contactor. [**20:**10.4.5.6]

*Exception: A phase-loss sensor(s) shall be permitted only as a part of a listed fire pump controller.*

**(C)** Remote Device(s).

No remote device(s) shall be installed that will prevent automatic operation of the transfer switch. [**20:**10.8.1.3]

**(D)** Engine-Drive Control Wiring.

All wiring between the controller and the diesel engine shall be stranded and sized to continuously carry the charging or control currents as required by the controller manufacturer. Such wiring shall be protected against physical damage. Controller manufacturer's specifications for distance and wire size shall be followed. [**20:**12.3.5.1]

**(E)** Electric Fire Pump Control Wiring Methods.

All electric motor–driven fire pump control wiring shall be in rigid metal conduit, intermediate metal conduit, liquidtight flexible metal conduit, electrical metallic tubing, liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable.

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

(2) The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

**695.15** Surge Protection.

A listed surge protection device shall be installed in or on the fire pump controller.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Article_695_-_Fire_Pump.docx | | |

## Statement of Problem and Substantiation for Public Input

Section 695.3 does not correspond with NFPA 20 in the intent of how fire pumps are wired. These changes better align with NFPA 20 and provide additional clarity and usability for Fire Pump Installations. Campus-style arrangements are allowed per NFPA 20. NFPA 70 Article 695 indicates that campus-style arrangements are only permitted if the individual sources in 695.3 are exhausted. That is misleading and not accurate and does not correlate with NFPA 20.

## Submitter Information Verification

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| **Zip:** | |
| **Submittal Date:** | Thu Sep 10 15:17:19 EDT 2020 |
| **Committee:** | NEC-P13 |

Article 695 Fire Pumps

695.1 Scope.

(A) Covered.

This article covers the installation of the following:

1. Electric power sources and interconnecting circuits
2. Switching and control equipment dedicated to fire pump drivers

Informational Note: Text that is followed by a reference in brackets has been extracted from NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*. Only editorial changes were made to the extracted text to make it consistent with this *Code*.

(B) Not Covered.

This article does not cover the following:

1. The performance, maintenance, and acceptance testing of the fire pump system, and the internal wiring of the components of the system
2. The installation of pressure maintenance (jockey or makeup) pumps

Informational Note: For the installation of pressure maintenance (jockey or makeup) pumps supplied by the fire pump circuit or another source, see Article 430.

3. Transfer equipment upstream of the fire pump transfer switch(es)

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, for further information.

695.2 Definitions.

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

Fault-Tolerant External Control Circuits.

Those control circuits either entering or leaving the fire pump controller enclosure, which if broken, disconnected, or shorted will not prevent the controller from starting the fire pump from all other internal or external means and may cause the controller to start the pump under these conditions.

On-Site Power Production Facility.

The normal supply of electric power for the site that is expected to be constantly producing power.

On-Site Standby Generator.

A facility producing electric power on site as the alternate supply of electric power. It differs from an on-site power production facility in that it is not constantly producing power.

695.3 Power Source(s) for Electric Motor-Driven Fire Pumps.

Electric motor-driven fire pumps shall have a reliable source of power.

Informational Note: See Sections 9.3.2 and A.9.3.2 from NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, for guidance on the determination of power source reliability.

(A) Individual Sources.

Where reliable, and where capable of carrying indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment when connected to this power supply, the power source for an electric motor driven fire pump shall be one or more of the following.

(1) Electric Utility Service Connection.

A fire pump shall be permitted to be supplied by a separate service, or from a connection located ahead of and not within the same cabinet, enclosure, vertical switchgear section, or vertical switchboard section as the service disconnecting means. The connection shall be located and arranged so as to minimize the possibility of damage by fire from within the premises and from exposing hazards. A tap ahead of the service disconnecting means shall comply with 230.82(5). The service equipment shall comply with the labeling requirements in 230.2 and the location requirements in 230.72(B). [**20:**9.2.2(1)]

(2) On-Site Power Production Facility.

A fire pump shall be permitted to be supplied by an on-site power production facility. The source facility shall be located and protected to minimize the possibility of damage by fire. [**20:**9.2.2(3)]

(3) Dedicated Feeder.

A dedicated feeder shall be permitted where it is derived from a service connection as described in 695.3(A)(1). [**20:**9.2.2(3)]

(4) Dedicated Transformer Connection.

Where the service or system voltage is different from the utilization voltage of the fire pump motor, transformer(s) protected by disconnecting means and overcurrent protective devices shall be permitted to be installed between the system supply and the fire pump controller in accordance with 695.5(A) and (B), or with (C). Only transformers covered in 695.5(C) shall be permitted to supply loads not directly associated with the fire pump system.

(5) Feeder from Multibuilding Campus-Style Complexes.

If the sources in 695.3(A) are not practicable and the installation is part of a multibuilding campus-style complex, feeder sources shall be permitted if approved by the authority having jurisdiction and installed in accordance with either 695.3(C)(1) and (C)(3) or (C)(2) and (C)(3).

(1) Feeder Sources.

Two or more feeders shall be permitted as more than one power source if such feeders are connected to, or derived from, separate utility services. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).

(2) Feeder and Alternate Source.

A feeder shall be permitted as a normal source of power if an alternate source of power independent from the feeder is provided. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).

(3) Selective Coordination.

Overcurrent protective device(s) shall be selectively coordinated with all supply-side overcurrent protective device(s).

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, maintain, and operate the system.

Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

(B) Multiple Sources.

If reliable power cannot be obtained from a source described in 695.3(A), power shall be supplied by one of the following: [**20:**9.3.2]

(1) Individual Sources.

An approved combination of two or more of the sources from 695.3(A).

(2) Individual Source and On-site Standby Generator.

An approved combination of one or more of the sources in 695.3(A) and an on-site standby generator complying with 695.3(D). [**20:**9.3.4]

Exception to 695.3(B)(1) and (B)(2): An alternate source of power shall not be required where a back-up engine-driven fire pump, back-up steam turbine-driven fire pump , or back-up electric motor-driven fire pump with an independent power source in accordance with 695.3(A) or (C) is installed.

~~(C) Multibuilding Campus-Style Complexes.~~

~~If the sources in 695.3(A) are not practicable and the installation is part of a multibuilding campus-style complex, feeder sources shall be permitted if approved by the authority having jurisdiction and installed in accordance with either 695.3(C)(1) and (C)(3) or (C)(2) and (C)(3).~~

~~(1) Feeder Sources.~~

~~Two or more feeders shall be permitted as more than one power source if such feeders are connected to, or derived from, separate utility services. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).~~

~~(2) Feeder and Alternate Source.~~

~~A feeder shall be permitted as a normal source of power if an alternate source of power independent from the feeder is provided. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).~~

~~(3) Selective Coordination.~~

~~Overcurrent protective device(s) shall be selectively coordinated with all supply-side overcurrent protective device(s).~~

~~Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, maintain, and operate the system.~~

~~Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.~~

(C)~~(D)~~ On-Site Standby Generator as Alternate Source.

An on-site standby generator(s) used as an alternate source of power shall comply with 695.3(D)(1) through (D)(3). [**20:**9.6.2.1]

(1) Capacity.

The generator shall have sufficient capacity to allow normal starting and running of the motor(s) driving the fire pump(s) while supplying all other simultaneously operated load(s). [**20:**9.6.1.1]

Automatic shedding of one or more optional standby loads in order to comply with this capacity requirement shall be permitted.

(2) Connection.

A tap ahead of the generator disconnecting means shall not be required. [**20:**9.6.1.2]

(3) Adjacent Disconnects.

The requirements of 430.113 shall not apply.

(E) Arrangement.

All power supplies shall be located and arranged to protect against damage by fire from within the premises and exposing hazards. [**20:**9.1.4]

Multiple power sources shall be arranged so that a fire at one source does not cause an interruption at the other source.

(F) Transfer of Power.

Transfer of power to the fire pump controller between the individual source and one alternate source shall take place within the pump room. [**20:**9.6.4]

(G) Power Source Selection.

Selection of power source shall be performed by a transfer switch listed for fire pump service. [**20:**10.8.1.3.1]

(H) Overcurrent Device Selection.

An instantaneous trip circuit breaker shall be permitted in lieu of the overcurrent devices specified in 695.4(B)(2)(a)(1), provided that it is part of a transfer switch assembly listed for fire pump service that complies with 695.4(B)(2)(a)(2).

(I) Phase Converters.

Phase converters shall not be permitted to be used for fire pump service. [**20:**9.1.7]

695.4 Continuity of Power.

Circuits that supply electric motor–driven fire pumps shall be supervised from inadvertent disconnection as covered in 695.4(A) or (B).

(A) Direct Connection.

The supply conductors shall directly connect the power source to a listed fire pump controller, a listed combination fire pump controller and power transfer switch, or a listed fire pump power transfer switch.

(B) Connection Through Disconnecting Means and Overcurrent Device.

(1) Number of Disconnecting Means.

1. *General.* A single disconnecting means and associated overcurrent protective device(s) shall be permitted to be installed between the fire pump power source(s) and one of the following: [**20:**9.1.2]
    1. A listed fire pump controller
    2. A listed fire pump power transfer switch
    3. A listed combination fire pump controller and power transfer switch
2. *Feeder Sources.* For systems installed under the provisions of 695.3(C) only, additional disconnecting means and the associated overcurrent protective device(s) shall be permitted.
3. *On-Site Standby Generator.* Where an on-site standby generator is used to supply a fire pump, an additional disconnecting means and an associated overcurrent protective device(s) shall be permitted.

(2) Overcurrent Device Selection.

Overcurrent devices shall comply with 695.4(B)(2)(a) or (B)(2)(b).

1. *Individual Sources.* Overcurrent protection for individual sources shall comply with the following:
    1. Overcurrent protective device(s) shall be rated to carry indefinitely the sum of the locked-rotor current of the largest fire pump motor and the full-load current of all of the

other pump motors and accessory equipment. [**20:**9.2.3.4] Where the locked-rotor current value does not correspond to a standard overcurrent device size, the next standard overcurrent device size shall be used in accordance with 240.6. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

Exception: The requirement to carry the locked-rotor currents indefinitely shall not apply to feeder overcurrent protective devices installed in accordance with 695.3(C).

2. Overcurrent protection shall be provided by an assembly listed for fire pump service and complying with the following:

    1. The overcurrent protective device shall not open within 2 minutes at 600 percent of the full-load current of the fire pump motor(s).

    2. The overcurrent protective device shall not open with a re-start transient of 24 times the full-load current of the fire pump motor(s).

    3. The overcurrent protective device shall not open within 10 minutes at 300 percent of the full-load current of the fire pump motor(s).

    4. The trip point for circuit breakers shall not be field adjustable. [**20:**9.2.3.4.1]

2. *On-Site Standby Generators.* Overcurrent protective devices between an on-site standby generator and a fire pump controller shall be selected and sized to allow for instantaneous pickup of the full pump room load, but shall not be larger than the value selected to comply with 430.62 to provide short-circuit protection only. [**20:**9.6.1.1]

(3) Disconnecting Means.

All disconnecting devices that are unique to the fire pump loads shall comply with items 695.4(B)(3)(a) through (B)(3)(e).

1. *Features and Location — Normal Power Source.* The disconnecting means for the normal power source shall comply with all of the following: [**20:**9.2.3.1]

    1. Be identified as suitable for use as service equipment.

    2. Be lockable in the closed position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed.

    3. Not be located within the same enclosure, panelboard, switchboard, switchgear, or motor control center, with or without common bus, that supplies loads other than the fire pump.

    4. Be located sufficiently remote from other building or other fire pump source disconnecting means such that inadvertent operation at the same time would be unlikely.

Exception to 695.4(B)(3)(a): For a multibuilding campus-style complex(s) installed under the provisions of 695.3(C), only the requirements in 695.4(B)(3)(a)(2) shall apply for normal power source disconnects.

2. *Features and Location — On-Site Standby Generator.* The disconnecting means for an on-site standby generator(s) used as the alternate power source shall be installed in accordance with 700.10(B)(5) for emergency circuits and shall be lockable in the closed position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed.

3. *Disconnect Marking.* The disconnecting means shall be marked "Fire Pump Disconnecting Means." The letters shall be at least 25 mm (1 in.) in height, and they shall be visible without opening enclosure doors or covers. [**20:**9.2.3.1(5)]

4. *Controller Marking.* A placard shall be placed adjacent to the fire pump controller, stating the location of this disconnecting means and the location of the key (if the disconnecting means is locked). [**20:**9.2.3.2]

5. *Supervision.* The disconnecting means shall be supervised in the closed position by one of the following methods:

    1. Central station, proprietary, or remote station signal device

    2. Local signaling service that causes the sounding of an audible signal at a constantly attended point

    3. Locking the disconnecting means in the closed position

6. Sealing of disconnecting means and approved weekly recorded inspections when the disconnecting means are located within fenced enclosures or in buildings under the control of the owner [**20:**9.2.3.3]

695.5 Transformers.

~~Where the service or system voltage is different from the utilization voltage of the fire pump motor, transformer(s) protected by disconnecting means and overcurrent protective devices shall be permitted to be installed between the system supply and the fire pump controller in accordance with 695.5(A) and (B), or with (C). Only transformers covered in 695.5(C) shall be permitted to supply loads not directly associated with the fire pump system.~~

(A) Size.

Where a transformer supplies an electric motor driven fire pump, it shall be rated at a minimum of 125 percent of the sum of the fire pump motor(s) and pressure maintenance pump(s) motor loads, and 100 percent of the associated fire pump accessory equipment supplied by the transformer.

(B) Overcurrent Protection.

The primary overcurrent protective device(s) shall be selected or set to carry indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment when connected to this power supply.

Secondary overcurrent protection shall not be permitted. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

(C) Feeder Source.

Where a feeder source is provided in accordance with 695.3(C), transformers supplying the fire pump system shall be permitted to supply other loads. All other loads shall be calculated in accordance with Article 220, including demand factors as applicable.

(1) Size.

Transformers shall be rated at a minimum of 125 percent of the sum of the fire pump motor(s) and pressure maintenance pump(s) motor loads, and 100 percent of the remaining load supplied by the transformer.

(2) Overcurrent Protection.

The transformer size, the feeder size, and the overcurrent protective device(s) shall be coordinated such that overcurrent protection is provided for the transformer in accordance with 450.3 and for the feeder in accordance with 215.3, and such that the overcurrent protective device(s) is selected or set to carry indefinitely the sum of the locked-rotor current of the fire pump motor(s), the pressure maintenance pump motor(s), the full-load current of the associated fire pump accessory equipment, and 100 percent of the remaining loads supplied by the transformer. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

695.6 Power Wiring.

Power circuits and wiring methods shall comply with the requirements in 695.6(A) through (J), and as permitted in 230.90(A), Exception No. 4; 230.94, Exception No. 4; 240.13; 230.208; 240.4(A); and 430.31.

(A) Supply Conductors.

(1) Services and On-Site Power Production Facilities.

Service conductors and conductors supplied by on-site power production facilities shall be physically routed outside a building(s) and shall be installed as service-entrance conductors in accordance with 230.6, 230.9, and Parts III and IV of Article 230. Where supply conductors cannot be physically routed outside of buildings, the conductors shall be permitted to be routed through the building(s) where installed in accordance with 230.6(1) or (2).

Exception: The supply conductors within the fire pump room shall not be required to meet 230.6(1) or (2).

Informational Note: See 250.24(C) for routing the grounded conductor to the service equipment.

(2) Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.4(B), or conductors that connect directly to an on-site standby generator, shall comply with all of the following:

1. *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.
2. *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.
3. *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.
4. *Inside of a Building.* Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:
    1. The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.
    2. The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

3. The cable or raceway is a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

Exception to 695.6(A)(2)(4): The supply conductors located in the electrical equipment room where they originate and in the fire pump room shall not be required to have the minimum 2-hour fire separation or fire-resistance rating unless otherwise required by 700.10(D) of this *Code*.

(B) Conductor Size.

(1) Fire Pump Motors and Other Equipment.

Conductors supplying a fire pump motor(s), pressure maintenance pumps, and associated fire pump accessory equipment shall have a rating not less than 125 percent of the sum of the fire pump motor(s) and pressure maintenance motor(s) full-load current(s), and 100 percent of the associated fire pump accessory equipment.

(2) Fire Pump Motors Only.

Conductors supplying only a fire pump motor shall have a minimum ampacity in accordance with 430.22 and shall comply with the voltage drop requirements in 695.7.

(C) Overload Protection.

Power circuits shall not have automatic protection against overloads. Except for protection of transformer primaries provided in 695.5(C)(2), branch-circuit and feeder conductors shall be protected against short circuit only. Where a tap is made to supply a fire pump, the wiring shall be treated as service conductors in accordance with 230.6. The applicable distance and size restrictions in 240.21 shall not apply.

Exception No. 1: Conductors between storage batteries and the engine shall not require overcurrent protection or disconnecting means.

Exception No. 2: For an on-site standby generator(s) rated to produce continuous current in excess of 225 percent of the full-load amperes of the fire pump motor, the conductors between the on-site generator(s) and the combination fire pump transfer switch controller or separately mounted transfer switch shall be installed in accordance with 695.6(A)(2).

The protection provided shall be in accordance with the short-circuit current rating of the combination fire pump transfer switch controller or separately mounted transfer switch.

(D) Pump Wiring.

All wiring from the controllers to the pump motors shall be in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable. Electrical connections at motor terminal boxes shall be made with a listed means of connection. Twist-on, insulation-piercing–type, and soldered wire connectors shall not be permitted to be used for this purpose.

(E) Loads Supplied by Controllers and Transfer Switches.

A fire pump controller and fire pump power transfer switch, if provided, shall not serve any load other than the fire pump for which it is intended.

(F) Mechanical Protection.

All wiring from engine controllers and batteries shall be protected against physical damage and shall be installed in accordance with the controller and engine manufacturer's instructions.

(G) Ground-Fault Protection of Equipment.

Ground-fault protection of equipment shall not be installed in any fire pump power circuit. [**20:**9.1.8.1]

(H) Listed Electrical Circuit Protective System to Controller Wiring.

Electrical circuit protective system installation shall comply with any restrictions provided in the listing of the electrical circuit protective system used, and the following also shall apply:

1. A junction box shall be installed ahead of the fire pump controller a minimum of 300 mm (12 in.) beyond the fire-rated wall or floor bounding the fire zone.
2. Where required by the manufacturer of a listed electrical circuit protective system or by the listing, or as required elsewhere in this *Code*, the raceway between a junction box and the fire

pump controller shall be sealed at the junction box end as required and in accordance with the instructions of the manufacturer. [**20:**9.8.2]

3. Standard wiring between the junction box and the controller shall be permitted. [**20:**9.8.3]

(I) Junction Boxes.

Where fire pump wiring to or from a fire pump controller is routed through a junction box, the following requirements shall be met:

1. The junction box shall be securely mounted. [**20:**9.7(1)]
2. Mounting and installing of a junction box shall not violate the enclosure type rating of the fire pump controller(s). [**20:**9.7(2)]
3. Mounting and installing of a junction box shall not violate the integrity of the fire pump controller(s) and shall not affect the short-circuit current rating of the controller(s).
4. As a minimum, a Type 2, drip-proof enclosure (junction box) shall be used where installed in the fire pump room. The enclosure shall be listed to match the fire pump controller enclosure type rating. [**20:**9.7(4)]
5. Terminals, junction blocks, wire connectors, and splices, where used, shall be listed. [**20:**9.7(5)]
6. A fire pump controller or fire pump power transfer switch, where provided, shall not be used as a junction box to supply other equipment, including a pressure maintenance (jockey) pump(s).

(J) Terminations.

Where raceways or cable are terminated at a fire pump controller, the following requirements shall be met:

1. Raceway or cable fittings listed and identified for use in wet locations shall be used.
2. The type rating of the raceway or cable fittings shall be at least equal to that of the fire pump controller.
3. The installation instructions of the manufacturer of the fire pump controller shall be followed.
4. Alterations to the fire pump controller, other than raceway or cable terminations as allowed elsewhere in this *Code*, shall be approved by the authority having jurisdiction.

695.7 Voltage Drop.

(A) Starting.

The voltage at the fire pump controller line terminals shall not drop more than 15 percent below normal (controller-rated voltage) under motor starting conditions.

Exception: This limitation shall not apply for emergency run mechanical starting. [***20:***9.4.2]

(B) Running.

The voltage at the load terminals of the fire pump controller shall not drop more than 5 percent below the voltage rating of the motor connected to those terminals when the motor is operating at 115 percent of the full-load current rating of the motor.

695.10 Listed Equipment.

Diesel engine fire pump controllers, electric fire pump controllers, electric motors, fire pump power transfer switches, foam pump controllers, and limited service controllers shall be listed for fire pump service. [**20:**9.5.1.1, 10.1.2.1, 12.1.3.1]

Fire pump controllers and transfer switches shall not be permitted to be reconditioned.

695.12 Equipment Location.

(A) Controllers and Transfer Switches.

Electric motor-driven fire pump controllers and power transfer switches shall be located as close as practicable to, and within sight of, the motors that they control.

(B) Engine-Drive Controllers.

Engine-drive fire pump controllers shall be located as close as is practical to, and within sight of, the engines that they control.

(C) Storage Batteries.

Storage batteries for fire pump engine drives shall be supported above the floor, secured against displacement, and located where they are not subject to physical damage, flooding with water, excessive temperature, or excessive vibration.

(D) Energized Equipment.

All energized equipment parts shall be located at least 300 mm (12 in.) above the floor level.

(E) Protection Against Pump Water.

Fire pump controller and power transfer switches shall be located or protected so that they are not damaged by water escaping from pumps or pump connections.

(F) Mounting.

All fire pump control equipment shall be mounted in a substantial manner on noncombustible supporting structures.

695.14 Control Wiring.

(A) Control Circuit Failures.

External control circuits that extend outside the fire pump room shall be arranged so that failure of any external circuit (open or short circuit) shall not prevent the operation of a pump(s) from all other internal or external means. Breakage, disconnecting, shorting of the wires, or loss of power to these circuits could cause continuous running of the fire pump but shall not prevent the controller(s) from starting the fire pump(s) due to causes other than these external control circuits. All control conductors

within the fire pump room that are not fault tolerant shall be protected against physical damage. [**20:**10.5.2.6, 12.5.2.5]

(B) Sensor Functioning.

No undervoltage, phase-loss, frequency-sensitive, or other sensor(s) shall be installed that automatically or manually prohibits actuation of the motor contactor. [**20:**10.4.5.6]

Exception: A phase-loss sensor(s) shall be permitted only as a part of a listed fire pump controller.

(C) Remote Device(s).

No remote device(s) shall be installed that will prevent automatic operation of the transfer switch. [**20:**10.8.1.3]

(D) Engine-Drive Control Wiring.

All wiring between the controller and the diesel engine shall be stranded and sized to continuously carry the charging or control currents as required by the controller manufacturer. Such wiring shall be protected against physical damage. Controller manufacturer's specifications for distance and wire size shall be followed. [**20:**12.3.5.1]

(E) Electric Fire Pump Control Wiring Methods.

All electric motor–driven fire pump control wiring shall be in rigid metal conduit, intermediate metal conduit, liquidtight flexible metal conduit, electrical metallic tubing, liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable.

(F) Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

1. The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.
2. The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

3. The cable or raceway is protected by a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

695.15 Surge Protection.

A listed surge protection device shall be installed in or on the fire pump controller.

## Public Input No. 1158-NFPA 70-2020 [ Section No. 695.1(B) ]

**(B)** Not Covered.

This article does not cover the following:

(1) The performance, maintenance, and acceptance testing of the fire pump system, and the internal wiring of the components of the system

(2) The installation of pressure maintenance (jockey or makeup) pumps

Informational Note: For the installation of pressure maintenance (jockey or makeup) pumps supplied by the fire pump circuit or another source, see Article 430.

(3) Transfer equipment upstream of the fire pump transfer switch(es)

(4) Installation of fire pump equipment used to supply sprinkler systems in one and two family dwellings.

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection* , for further information.

## Statement of Problem and Substantiation for Public Input

This is stated already in the NEC Handbook blue text under 695.1(B)(3). Acting on this or enforcing this requires the passage be placed in the mandatory NEC70 text.

## Submitter Information Verification

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**State:**
**Zip:**
**Submittal Date:** Tue May 19 08:18:16 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3945-NFPA 70-2020 [ Section No. 695.2 ]

(Relocate all definitions in the 695. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**695. 2** Definitions.

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

**Fault-Tolerant External Control Circuits.**

Those control circuits either entering or leaving the fire pump controller enclosure, which if broken, disconnected, or shorted will not prevent the controller from starting the fire pump from all other internal or external means and may cause the controller to start the pump under these conditions.

**On-Site Power Production Facility.**

The normal supply of electric power for the site that is expected to be constantly producing power.

**On-Site Standby Generator.**

A facility producing electric power on site as the alternate supply of electric power. It differs from an on-site power production facility in that it is not constantly producing power.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

## Submitter Information Verification

**Submitter Full Name:** David Williams
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**Submittal Date:** Wed Sep 09 16:04:36 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3165-NFPA 70-2020 [ Section No. 695.3(B)(2) ]

**(2)** Individual Source and On-site Standby Generator.

An approved combination of one or more of the sources in 695.3(A) and an on-site standby generator complying with 695.3(D). [**20:**9.3.4]

*Exception to 695.3(B)(1) and (B)(2): An alternate source of power shall not be required where a back-up engine-driven fire pump, back-up steam turbine-driven fire pump , or back-up electric motor-driven fire pump with an independent power source in accordance with 695.3(A) or (C) is installed.*

*Informational Note: When system uses a transfer switch without a neutral, On-site Standby Generator is a separately derived system.*

## Statement of Problem and Substantiation for Public Input

Most fire pump manufacturers have transfer switches with no neutral. In generator mode the fault current path would be broken if the system was non-separately derived. This issue is magnified if a separate solidly switched neutral transfer switch is added to the system as the only path for fault current would be through the neutral of a different circuit which would cause a 300.3 B violation.

## Submitter Information Verification

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**Submittal Date:** Sun Sep 06 07:24:20 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4167-NFPA 70-2020 [ Section No. 695.3(C)(2) ]

**(2)** Feeder and Alternate Source.

A feeder shall be permitted as a ~~normal~~ normal power source ~~of power~~ if an alternate power source ~~of power~~ independent from the feeder is provided. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.

701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 23:29:04 EDT 2020
**Committee:** NEC-P13

## Public Input No. 923-NFPA 70-2020 [ Section No. 695.4(B)(1) ]

**(1)** Number of Disconnecting Means.

(a) *General.* A single disconnecting means and associated overcurrent protective device(s) shall be permitted to be installed between the fire pump power source(s) and one of the following: [**20:9.** ~~1~~ **2 .** ~~2~~ **3** ]

(2) A listed fire pump controller

(3) A listed fire pump power transfer switch

(4) A listed combination fire pump controller and power transfer switch

(e) *Feeder Sources.* For systems installed under the provisions of 695.3(C) only, additional disconnecting means and the associated overcurrent protective device(s) shall be permitted.

(f) *On-Site Standby Generator.* Where an on-site standby generator is used to supply a fire pump, an additional disconnecting means and an associated overcurrent protective device(s) shall be permitted.

## Statement of Problem and Substantiation for Public Input

The correct extract reference to NFPA 20 should be 9.2.3.

## Submitter Information Verification

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**Submittal Date:** Thu Apr 30 23:51:59 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3163-NFPA 70-2020 [ Section No. 695.5(A) ]

**(A)** Size.

Where a transformer supplies an electric motor driven fire pump, it shall be rated to provide the maximum voltage drop indicated at ~~a minimum of~~ the fire pump controller line terminals upon starting permitted by 695.7 but at a no case be smaller then 125 percent of the sum of the fire pump motor(s) and pressure maintenance pump(s) motor loads, and 100 percent of the associated fire pump accessory equipment supplied by the transformer.

## Statement of Problem and Substantiation for Public Input

Based on the type of starting utilized by the fire pump controller the controller can cause a large voltage drop which would exceed 15% VD permitted by 695.7

## Submitter Information Verification

**Submitter Full Name:** Kyle Mackenzie
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**Submittal Date:** Sun Sep 06 07:01:26 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1016-NFPA 70-2020 [ New Section after 695.6 ]

**TITLE OF NEW CONTENT**

Type your content here ...Wiring in Fire Pump room spaces.

Uses permitted. Only wiring, raceways, cables directly associated with fire pump power and control including wiring for signals, for communication, lighting, heating, ventilation, sump pumps, maintenance receptacles, for fire detection systems are allowed in the fire pump room space.

Informational note: see NFPA 20 4.13.1.1.5 Standard for the Installation of Stationary Pumps for Fire Protection

### Statement of Problem and Substantiation for Public Input

Most Electricians are not familiar with NFPA 20 and unknowingly run unassociated conduits through the fire Pump room. Also this input will more closely correlate the NEC with NFPA 20

### Submitter Information Verification

**Submitter Full Name:** Kelly Wofford
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**Submittal Date:** Sat May 09 11:47:10 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3697-NFPA 70-2020 [ Section No. 695.6(A) ]

**(A)** Supply Conductors.

**(1)** Services and On-Site Power Production Facilities.

Service conductors and conductors supplied by on-site power production facilities shall be physically routed outside a building(s) and shall be installed as service-entrance conductors in accordance with 230.6, 230.9, and Parts III and IV of Article 230. Where supply conductors cannot be physically routed outside of buildings, the conductors shall be permitted to be routed through the building(s) where installed in accordance with 230.6(1) or (2) or a listed 2-hour electrical circuit integrity system employing cable permitted for use in service installations in accordance with 230 .43.

*Exception: The supply conductors within the fire pump room shall not be required to meet 230.6(1) or (2).*

Informational Note: See 250.24(C) for routing the grounded conductor to the service equipment.

**(2)** Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.4(B), or conductors that connect directly to an on-site standby generator, shall comply with all of the following:

(1) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(2) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(3) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(4) *Inside of a Building.* Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

a. The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

b. The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

c. The cable or raceway is a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

*Exception to 695.6(A)(2)(4): The supply conductors located in the electrical equipment room where they originate and in the fire pump room shall not be required to have the minimum 2-hour fire separation or fire-resistance rating unless otherwise required by 700.10(D) of this Code.*

## Statement of Problem and Substantiation for Public Input

Listed Electrical Circuit Integrity Systems are intended to ensure that the complete electrical circuit integrity system will survive during fire and hose stream exposure. The 2-hour rating was chosen to be equal to the requirements in 230.6(1) and 230.6(2). As an example, Type MI cable can be selected since it is allowed in Article 230 and 332 for use in service installations. See the following definition for listed Electrical Circuit Integrity Systems:

Electrical Circuit Integrity Systems (UL category FHIT)

GENERAL

This category covers electrical circuit integrity systems consisting of components and materials intended for installation as protection for specific electrical wiring systems, with respect to the disruption of electrical circuit integrity upon exterior fire exposure.
Ratings apply only to the entire system assembly, constructed using the combination of components and materials specified in the individual system. Components and materials are designated for use in a specific individual system for which corresponding ratings have been developed and are not intended to be interchanged between systems. Ratings are not assigned to individual system components or materials.

Electrical circuit integrity systems are intended to be fastened to a concrete or masonry wall or a concrete floor-ceiling assembly. The fire rating of the wall or floor-ceiling assembly is intended to be equal to or greater than the rating of the electrical circuit integrity system. This is to ensure that the complete electrical circuit integrity system will survive during fire and hose stream exposure.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 11:01:46 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4178-NFPA 70-2020 [ Section No. 695.6(A)(1) ]

**(1)** Services and On-Site Power Production Facilities.

Service conductors and conductors supplied by on-site power production facilities shall be physically routed outside a building(s) and shall be installed as service-entrance conductors in accordance with 230.6, 230.9, and Parts III and IV of Article 230. Where supply conductors cannot be physically routed outside of buildings, the conductors shall be permitted to be routed through the building(s) where installed in accordance with 230.6(1) or (2).

~~*Exception: The supply conductors within the fire pump room shall not be required to meet 230.6(1) or (2).*~~

Informational Note: See 250.24(C) for routing the grounded conductor to the service equipment.

## Statement of Problem and Substantiation for Public Input

1. Service Conductors are required to be outside or inside nearest the pointof entry.
The Service Disconnecting Means SHALL BE INSTALLED IN A READILY ACCESSIBLE LOCATION EITHER Outside or Inside Nearest The Point Of Entrance per 230.71 (A) (1). Permitting Service Entrance Conductors to enter without a Service Disconnection Means ignores all rules for Service Entrance Conductors.
2. The Committee Statement references the word, Typically, this is not an application the the Committee can define, use, infer or suggest! All Fire Pump Rooms are not Typical. All areas and jurisdictions cannot not be assumed to be Typical. Suggesting a Fire Pump Room could be addressed as Typical presumes too much.
3. A Fire Pump Room could have 4 walls and a floor that are Fire Rated but not all roof systems are fire rated. The roof system may not create a full fire rated assembly.
4. Fire Pump rooms could be located very close to transformers or transformer vaults and there could be Very High Fault Currents entering into a Fire Pump Room.
5. This will be confusing for Design Professionals, keeping Service Conductors uniformly in accordance with 230 abates the varied problems of Unfused Service Entrance Conductors in the Fire Pump Room

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 23:49:02 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1035-NFPA 70-2020 [ Section No. 695.6(A)(2) ]

**(2)** Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.4(B), or conductors that connect directly to an on-site standby generator, shall comply with all of the following:

(1) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(2) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(3) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(4) *Inside of a Building.* Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

a. The cable or raceway is encased in a minimum ~~50 mm~~ 127 mm (~~2 in~~ 5 in .) of concrete.

b. The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

c. The cable or raceway is a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

*Exception to 695.6(A)(2)(4): The supply conductors located in the electrical equipment room where they originate and in the fire pump room shall not be required to have the minimum 2-hour fire separation or fire-resistance rating unless otherwise required by 700.10(D) of this Code.*

## Statement of Problem and Substantiation for Public Input

In December of 2018 the NFPA Fire Research Foundation published their findings on the fire resistance ratings of concrete protecting electrical conductors. The summary of this report illustrates that in order to provide the minimum required 2 hour fire rating, the minimum concrete encasement without specifying the type of concrete should be 127 mm or 5 inches.

https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Electrical/RFFireResistanceOfConcreteForElectricalConductors.pdf

## Related Public Inputs for This Document

| Related Input | Relationship |
| --- | --- |
| Public Input No. 1034-NFPA 70-2020 [Section No. 695.14(F)] | |
| Public Input No. 1036-NFPA 70-2020 [Section No. 700.10(D)(2)] | |
| Public Input No. 1037-NFPA 70-2020 [Section No. 708.10(C)(2)] | |

## Submitter Information Verification

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**Submittal Date:** Tue May 12 14:20:09 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2099-NFPA 70-2020 [ Section No. 695.6(A)(2) ]

**(2)** Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.4(B), or conductors that connect directly to an on-site standby generator, shall comply with all of the following:

(1) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(2) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(3) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(4) *Inside of a Building.* Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

a. The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

b. The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 1: ~~Fire-resistive cables are tested to ANSI/UL 2196-2017, Standard for~~ One method of defining a fire-resistive cable system is by establishing a rating when tested in accordance with UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power , Instrumentation, Control and Data* ~~Cables.~~ *cables* . UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

c. The cable or raceway is part of a listed electrical circuit protective system.

Informational Note No. 1: ~~Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are~~ One method of defining an electrical circuit protective system is by establishing a rating when tested in accordance with ~~UL 1724~~ UL 1724 , *Fire Tests for Electrical Circuit* ~~Protection Systems.~~ *Protective Systems* . UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

*Exception to 695.6(A)(2)(4): The supply conductors located in the electrical equipment room where they originate and in the fire pump room shall not be required to have the minimum 2-hour fire separation or fire-resistance rating unless otherwise required by 700.10(D) of this Code.*

## Statement of Problem and Substantiation for Public Input

The language is revised to reflect the proper title of the standard, deleting the reference to ANSI at UL's request, and revising to show the allowable methods to protect the cables. This public input is a result of the Correlating Committee Task Group for Circuit Integrity Cable efforts to correlate

information on Circuit Integrity (-CI) cable throughout the NEC®. Members of the task group included Blake Shugarman from UL – Principal Engineer for Circuit Integrity Systems, Larry Shudak from UL - Principal Engineer for Life Safety Technologies and member of NFPA 72, Anthony Tassone from UL – Principal Engineer Seasonal and Holiday Decorative Products and Telecommunications Cables - CMP16, Jim Conrad from Marmon Innovation and Technology Group – CMP13, George Straniero from AFC Cable Systems – CMP6, CMP3, and CC, Paul Casparro from IBEW – CMP3, and Rich Holub from DuPont – CMP14 and CC.

## Submitter Information Verification

**Submitter Full Name:** Richard Holub
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**Submittal Date:** Thu Jul 30 11:25:26 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3685-NFPA 70-2020 [ Section No. 695.6(A)(2) ]

**(2)** Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.4(B), or conductors that connect directly to an on-site standby generator, shall comply with all of the following:

(1) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(2) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(3) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(4) *Inside of a Building.* Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

a. The cable or raceway is encased in a minimum ~~50 mm (2 in.) of~~ 125 mm (5") of concrete.

b. The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

c. The cable or raceway is a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

*Exception to 695.6(A)(2)(4): The supply conductors located in the electrical equipment room where they originate and in the fire pump room shall not be required to have the minimum 2-hour fire separation or fire-resistance rating unless otherwise required by 700.10(D) of this Code.*

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 695-6.docx | Detailed substantiation for proposed change to 695-6 | |

## Statement of Problem and Substantiation for Public Input

Following the NFPA Research Foundation report “Fire Resistance of Concrete for Electrical Conductors” review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada (NBCC), using the terminology “Fire Resistance Rating” where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on aggregate types (table included in attached documentation.

While not exactly the same between these two reports, both detail the same general information that 2” (50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3707-NFPA 70-2020 [Section No. 695.14(F)] | |
| Public Input No. 3710-NFPA 70-2020 [Section No. 700.10(D)(2)] | |
| Public Input No. 3717-NFPA 70-2020 [Section No. 708.10(C)(2)] | |

## Submitter Information Verification

**Submitter Full Name:** Ryan Drury
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**State:**
**Zip:**
**Submittal Date:** Wed Sep 09 10:50:55 EDT 2020
**Committee:** NEC-P13

695.6 Power Wiring

(A) Supply Conductors

(2) Feeders

(4) Inside a building. Where routed through a building, the conductors shall be protected from the fire for 2 hours using one of the following methods:

a. The cable or raceway is encased in ~~50 mm (2 in)~~ 125 mm (5 in) of concrete.

**Substantiation:**

Following the NFPA Research Foundation report "Fire Resistance of Concrete for Electrical Conductors" review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada 2015 Volume 1 (NBCC), using the terminology "Fire Resistance Rating" where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on aggregate types:

**Table D-2.1.1.**
**Minimum Equivalent Thicknesses(1) of Unit Masonry and Monolithic Concrete Walls Loadbearing and Non-Loadbearing, mm**

| Type of Wall | Fire-Resistance Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 min | 45 min | 1 h | 1.5 h | 2 h | 3 h | 4 h |
| Solid brick units (80% solid and over), actual overall thickness | 63 | 76 | 90 | 108 | 128 | 152 | 178 |
| Cored brick units and hollow tile units (less than 80% solid), equivalent thickness | 50 | 60 | 72 | 86 | 102 | 122 | 142 |
| Solid and hollow concrete masonry units, equivalent thickness | | | | | | | |
| Type S or N concrete(2) | 44 | 59 | 73 | 95 | 113 | 142 | 167 |
| Type $L_1$20S concrete | 42 | 54 | 66 | 87 | 102 | 129 | 152 |
| Type $L_1$ concrete | 42 | 54 | 64 | 82 | 97 | 122 | 143 |
| Type $L_2$20S concrete | 42 | 54 | 64 | 81 | 94 | 116 | 134 |
| Type $L_2$ concrete | 42 | 54 | 63 | 79 | 91 | 111 | 127 |
| Monolithic concrete and concrete panels, equivalent thickness | | | | | | | |
| Type S concrete | 60 | 77 | 90 | 112 | 130 | 158 | 180 |
| Type N concrete | 59 | 74 | 87 | 108 | 124 | 150 | 171 |
| Type L40S or Type L concrete | 49 | 62 | 72 | 89 | 103 | 124 | 140 |

While not exactly the same between these two reports, both detail the same general information that 2" (50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different

aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

## Public Input No. 1391-NFPA 70-2020 [ Section No. 695.6(B)(1) ]

**(1)** Fire Pump Motors and Other Equipment.

Conductors supplying a fire pump motor(s), pressure maintenance pumps, and associated fire pump accessory equipment shall have ~~a rating~~ an ampacity of not less than the sum of the following:

(1) 125 percent of the sum of the fire pump motor(s) and pressure maintenance motor(s) full-load current(s), ~~and~~ as determined by 430.6(A)

(2) 100 percent of the associated fire pump accessory equipment ~~,~~ full-load current(s)

## Statement of Problem and Substantiation for Public Input

Edits were made so the rule is more complete and to identify that the rule is about “ampacity.” In addition, text was revised to have it follow a format similar to that of 430.24 (list format).

## Submitter Information Verification

**Submitter Full Name:** Mike Holt
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**Submittal Date:** Tue Jun 02 10:36:50 EDT 2020
**Committee:** NEC-P13

## Public Input No. 950-NFPA 70-2020 [ New Section after 695.6(B)(2) ]

**695.6(B)(3) Equipment Grounding Conductor**

The minimum size equipment grounding conductor run with the fire pump conductors shall be calculated according to Article 250.66, after applying the requirements in 695.6(B)(2). Larger sizes shall be permitted for any reason or where necessary to comply with 250.4(A)(5) or 250.4(B)(4).

## Statement of Problem and Substantiation for Public Input

Current NEC does not provide instruction for sizing the equipment grounding conductor (EGC) run to a fire pump motor. We should provide this.

As we all know, fire pumps are an animal unto themselves, and the normal NEC rules do not always apply. Overcurrent protection for fire pumps must be sized larger. This could trigger a much larger EGC if Table 250.122 is used (EGC based on the size of overcurrent device). For normal wiring, the minimum size EGC required for equipment is based on the rating or setting of the overcurrent device protecting the circuit. These rules simply don't work for Article 695 due to the larger overcurrent protection that is sometimes integral to the overall design.

Table 250.66 provides a valid and sound basis for sizing the EGC, based upon the size of the conductors AFTER applying the requirements of 695.6(B)(2). Table 250.102(C)(1) could also be used - it is identical to 250.66, save for the last row. But I see no reason to complicate the issue, as I cannot fathom an instance where the ECG to a fire pump would ever need to be larger than 3/0 (I cannot even imagine this scenario). So I'm voting for Table 250.66 to keep things simple.

This problem actually came up on the NFPA X-change and the person who posted it was confused at the fact that 695 is silent on size of EGC. We can (and should) correct this.
I believe that the proposed language will accomplish this.

## Submitter Information Verification

**Submitter Full Name:** Nick Sasso
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**Submittal Date:** Tue May 05 16:04:34 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3700-NFPA 70-2020 [ Section No. 695.6(D) ]

**(D)** Pump Wiring.

All wiring from the controllers to the pump motors shall be in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable. Electrical connections at motor terminal boxes shall be made with a listed means of connection. Twist-on, insulation-piercing–type, and soldered wire connectors shall not be permitted to be used for this purpose. [20:9.4.4.1, 9.4.4.2, 9.4.4.3]

## Statement of Problem and Substantiation for Public Input

The requirements in 695.6(D) are extracted from NFPA 20, Sections 9.4.4.1, 9.4.4.2, and 9.4.4.3.

## Submitter Information Verification

**Submitter Full Name:** Megan Hayes
**Organization:** Nema
**Street Address:**
**City:**
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**Submittal Date:** Wed Sep 09 11:05:34 EDT 2020
**Committee:** NEC-P13

## Public Input No. 884-NFPA 70-2020 [ Section No. 695.6(D) ]

**(D)** Pump Wiring.

All wiring from the controllers to the pump motors shall be in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable. Electrical connections at motor terminal boxes shall be made with a listed means of connection. Twist-on, insulation-piercing–type, and soldered wire connectors shall not be permitted to be used for this purpose.

*Exception:* Type PVC conduit, Type RTRC conduit, and Type HDPE conduit shall be permitted where buried under not less than

600 mm (2 ft) of cover. Where Type PVC conduit, Type RTRC conduit, or Type HDPE conduit is used, one of the wiring methods in section 695.6 (D) shall be used for the last 600 mm (2 ft) of the underground run to emergence or to the point of connection to the aboveground raceway, and an equipment grounding conductor shall be included to provide electrical continuity of the raceway system and for grounding of non–current-carrying metal parts.

## Statement of Problem and Substantiation for Public Input

This is common to see PVC from the fire pump controller run underground to the fire pump. however this section would not permit this. no additional hazard is increased by this type of installation and where possible gives another method to supply the motor. The language comes from section 514.8 and would require one of the general rule wiring methods to stub up for termination

## Submitter Information Verification

**Submitter Full Name:** Alfio Torrisi
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**Submittal Date:** Tue Apr 21 11:59:16 EDT 2020
**Committee:** NEC-P13

## Public Input No. 889-NFPA 70-2020 [ Section No. 695.6(D) ]

**(D)** Pump Wiring.

**(1) Wiring Methods,**

All wiring from the controllers to the pump motors shall be in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable.

**(2) Conductors** ,

Electrical connections at motor terminal boxes shall be made with a listed means of connection. Twist-on, insulation-piercing–type, and soldered wire connectors shall not be permitted to be used for this purpose.

## Statement of Problem and Substantiation for Public Input

the conductor termination gets lost in the requirement, splitting the two in a line format makes it clear the are two requirements in this section, one for wiring methods and on for conductor termination both have to do with the pump motor

## Submitter Information Verification

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**Submittal Date:** Tue Apr 21 12:19:15 EDT 2020
**Committee:** NEC-P13

## Public Input No. 428-NFPA 70-2020 [ Section No. 695.6(H) ]

**(H)** Listed Electrical Circuit Protective System to Controller Wiring.

Electrical circuit protective system installation shall comply with any restrictions provided in the listing of the electrical circuit protective system used, and the following also shall apply:

(1) A junction box shall be installed ahead of the fire pump controller a minimum of 300 mm (12 in.) beyond the fire-rated ceiling, wall or floor bounding the fire zone.

(2) Where required by the manufacturer of a listed electrical circuit protective system or by the listing, or as required elsewhere in this *Code*, the raceway between a junction box and the fire pump controller shall be sealed at the junction box end as required and in accordance with the instructions of the manufacturer. [**20:**9.8.2]

(3) Standard wiring between the junction box and the controller shall be permitted. [**20:**9.8.3]

## Statement of Problem and Substantiation for Public Input

the current language does not allow a ceiling entry, the addition of the word ceiling would address this entry

## Submitter Information Verification

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**Submittal Date:** Wed Feb 05 12:28:35 EST 2020
**Committee:** NEC-P13

# Public Input No. 3704-NFPA 70-2020 [ Section No. 695.7 ]

**695.7** Voltage Drop.

**(A)** ~~Starting.~~

~~The~~

Unless the requirements of (B) or (C) are met, the voltage at the fire pump controller line terminals shall not drop more than 15 percent below normal (controller-rated voltage) under motor starting conditions.

~~Exception:~~ ~~This limitation~~

~~[20: 9.4.1]~~

~~**(B) The requirements of (A) shall not apply**~~

~~for~~

~~**to emergency run mechanical starting , provided successful start can be demonstrated on the standby generator system . [ 20: 9.4.2]**~~

~~**(**~~

~~B)~~ ~~Running.~~

~~The voltage at the load terminals of the fire pump controller shall~~

~~**1) The requirements of (A) shall apply to the emergency-run mechanical control of the self-regulating variable speed fire pump unit. [20: 9.4.2.1]**~~

~~**(C) The requirements of (A) shall not apply to the bypass mode of a variable speed pressure limiting control, provided a successful start can be demonstrated on the standby gen-set. [20: 9.4.3]**~~

~~(D) The voltage at the contractor(s) the load terminals to which the motor is connected shall not drop more than 5 percent below the voltage rating of the~~

~~motor connected to those terminals~~

~~motor when the motor is operating at 115 percent of the full-load current rating of the motor. [20: 9.4.4]~~

## Statement of Problem and Substantiation for Public Input

The voltage drop criteria for fire pump controllers should align with the performance criteria from NFPA 20. This proposal extracts material from NFPA 20-2019, paragraph 9.4.

## Submitter Information Verification

**Submitter Full Name:** Megan Hayes
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**Submittal Date:** Wed Sep 09 11:08:54 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4524-NFPA 70-2020 [ Section No. 695.10 ]

**695.10** Listed Equipment.

Diesel engine fire pump controllers, electric fire pump controllers, electric motors, fire pump power transfer switches, foam pump controllers, and limited service controllers shall be listed for fire pump service. [**20:**9.5.1.1, 10.1.2.1, 12.1.3.1]

Fire pump controllers and transfer switches shall not be permitted to be reconditioned, unless specifically permitted by another section of this code .

## Statement of Problem and Substantiation for Public Input

Added language for addition to 110.21(A)(2) and new section 517.2

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4496-NFPA 70-2020 [Section No. 110.21(A)(2)] | |
| Public Input No. 4518-NFPA 70-2020 [New Section after 517.1] | |

## Submitter Information Verification

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**Submittal Date:** Thu Sep 10 14:40:05 EDT 2020
**Committee:** NEC-P13

## Public Input No. 882-NFPA 70-2020 [ Section No. 695.14(E) ]

**(E)** Electric Fire Pump Control Wiring Methods.

All electric motor–driven fire pump control wiring shall be in rigid metal conduit, intermediate metal conduit, liquidtight flexible metal conduit, electrical metallic tubing, liquidtight flexible nonmetallic conduit, listed Type MC cable with an impervious covering, or Type MI cable.

Exception No. 1: Type PVC conduit, Type RTRC conduit, andType HDPE conduit shall be permitted where buried under not less than

600 mm (2 ft) of cover. Where Type PVC conduit, Type RTRC conduit, or Type HDPE conduit is used, threaded rigid metal conduit or threaded

steel intermediate metal conduit shall be used for the last 600 mm (2 ft) of the underground run to emergence or to the point of connection

to the aboveground raceway, and an equipment grounding conductor shall be included to provide electrical continuity of the raceway system

and for grounding of non–current-carrying metal parts.

## Statement of Problem and Substantiation for Public Input

There is no allowance for PVC (nonmetallic conduit) installed underground . PVC installed in this manner is protected from hazards and should be allowed

## Submitter Information Verification

**Submitter Full Name:** Alfio Torrisi
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**Submittal Date:** Tue Apr 21 11:46:36 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1034-NFPA 70-2020 [ Section No. 695.14(F) ]

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum ~~50 mm~~ 127 mm (~~2 in~~ 5 in .) of concrete.

(2) The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

## Statement of Problem and Substantiation for Public Input

In December of 2018 the NFPA Fire Research Foundation published their findings on the fire resistance ratings of concrete protecting electrical conductors. The summary of this report illustrates that in order to provide the minimum required 2 hour fire rating, the minimum concrete encasement without specifying the type of concrete should be 127 mm or 5 inches.

https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Electrical/RFFireResistanceOfConcreteForElectricalConductors.pdf

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1035-NFPA 70-2020 [Section No. 695.6(A)(2)] | fire rating of concrete |
| Public Input No. 1036-NFPA 70-2020 [Section No. 700.10(D)(2)] | |
| Public Input No. 1037-NFPA 70-2020 [Section No. 708.10(C)(2)] | |

## Submitter Information Verification

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**Submittal Date:** Tue May 12 14:18:14 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2100-NFPA 70-2020 [ Section No. 695.14(F) ]

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note ~~No. 1~~ : ~~Fire-resistive cables are tested to ANSI/UL 2196-2017, Standard for~~ One method of defining a fire-resistive cable system is by establishing a rating when tested in accordance with UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables* . ~~Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.~~

(3) The cable or raceway is

~~protected by~~

- part of a listed electrical circuit protective system.

Informational Note

~~No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are~~

- : One method of defining an electrical circuit protective system is by establishing a rating when tested in accordance with

~~UL 1724~~

- UL 1724 , *Fire Tests for Electrical Circuit*

~~Protection Systems. Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire~~

- *Protective Systems* . UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| PI2100_-_without_track_changes.JPG | Terra is striking out the last sentence of the Informational Note to #2, for some reason. If I view it and turn off the changes, this displays, which is what is intended. Not sure how to correct this in Terra. | |

## Statement of Problem and Substantiation for Public Input

The language is revised to reflect the proper title of the standards, deleting the reference to ANSI at UL's request, and revising to show some allowable methods to protect the cables. This public input is a result of the Correlating Committee Task Group for Circuit Integrity Cable efforts to correlate information on Circuit Integrity (-CI) cable throughout the NEC®. Members of the task group included Blake Shugarman from UL – Principal Engineer for Circuit Integrity Systems, Larry Shudak from UL - Principal Engineer for Life Safety Technologies and member of NFPA 72, Anthony Tassone from UL – Principal Engineer Seasonal and Holiday Decorative Products and Telecommunications Cables - CMP16, Jim Conrad from Marmon Innovation and Technology Group – CMP13, George Straniero from AFC Cable Systems – CMP6, CMP3, and CC, Paul Casparro from IBEW – CMP3, and Rich Holub from DuPont – CMP14 and CC.

## Submitter Information Verification

**Submitter Full Name:** Richard Holub
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**City:**
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**Submittal Date:** Thu Jul 30 11:44:07 EDT 2020
**Committee:** NEC-P13

**Review Comment**

Edit | Preview | Add'l Chgs | Substantiation | Links | Verification | Signature

Please make your proposed changes below. On the next screen you will see your changes highlighted in legislative text (i.e., track changes).
**Note:** Some changes such as graphics, charts, tables, equations, or complex text may be difficult to accomplish on this screen. If that is the case, you will be given the opportunity on a later screen to upload these changes as text or graphics files.

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note: One method of defining a fire-resistive cable system is by establishing a rating when tested in accordance with UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*. UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

(3) The cable or raceway is part of a listed electrical circuit protective system.

Informational Note: One method of defining an electrical circuit protective system is by establishing a rating when tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protective Systems*. UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

## Public Input No. 3164-NFPA 70-2020 [ Section No. 695.14(F) ]

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring, *series wiring of control conductors between multiple transfer switches shall not be permitted* . The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

(2) The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

## Statement of Problem and Substantiation for Public Input

Code presently only requires wiring between the between the fire pump power transfer switch and the standby generator to be separate, so there is no code language that prohibits daisy chaining of the start stop signal.

## Submitter Information Verification

**Submitter Full Name:** Kyle Mackenzie
**Organization:** Polise Consulting Engineer
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Sun Sep 06 07:06:18 EDT 2020

**Committee:** NEC-P13

## Public Input No. 3492-NFPA 70-2020 [ Section No. 695.14(F) ]

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s). Loss of integrity shall also initiate local audible and visual annunciation and facility remote annunciation, or local audible and visual annunciation and network remote annunciation.

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

Informational Note: See NFPA 110-2013, Standard for Emergency and Standby Power Systems, Section 5.6.6. for more information on Remote Controls and Alarms.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum 50 mm (2 in.) of concrete.

(2) The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

## Statement of Problem and Substantiation for Public Input

Throughout the NFPA standards where monitoring of failure, performance or derangement of equipment is required. Monitoring requires a description of the "act of announcing" the event by visual and or audible means and the location of the announcement to alert personnel. The added text paraphrases NFPA 110 A.5.6.6 as to the minimum "remote alarm annunciation" that would be acceptable to alert personnel at a constantly attended station on site and offsite for a Level 1 system.

## Submitter Information Verification

**Submitter Full Name:** Lawrence Forshner
**Organization:** Bard Rao Athanas Consulting
**Affiliation:** self
**Street Address:**

| | |
|---|---|
| **City:** | |
| **State:** | |
| **Zip:** | |
| **Submittal Date:** | Tue Sep 08 17:20:22 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 3707-NFPA 70-2020 [ Section No. 695.14(F) ]

**(F)** Generator Control Wiring Methods.

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, Section 3.3.7.2, for more information on fault-tolerant external control circuits.

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in a minimum ~~50 mm (2 in.~~ 125 mm (5" ) of concrete.

(2) The cable or raceway is a listed fire-resistive cable system.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed electrical circuit protective system.

Informational Note No. 1: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft and are tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 695-14.docx | Detailed Substantiation for proposed changes to 695-14 | |

## Statement of Problem and Substantiation for Public Input

Following the NFPA Research Foundation report “Fire Resistance of Concrete for Electrical Conductors” review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada (NBCC), using the terminology “Fire Resistance Rating” where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on

aggregate types (table included in attached documentation).

While not exactly the same between these two reports, both detail the same general information that 2" (50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3685-NFPA 70-2020 [Section No. 695.6(A)(2)] | Same changes to similar section |

## Submitter Information Verification

**Submitter Full Name:** Ryan Drury
**Organization:** nVent Thermal Management
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Wed Sep 09 11:09:32 EDT 2020
**Committee:** NEC-P13

695.14 Control Wiring

(F) Generator Control Wiring Methods

The control conductors shall be protected to resist potential damage by fire or structural failure. Where routed through a building, the conductors shall be protected from the fire for 2 hours using one of the following methods:

(1) The cable or raceway is encased in ~~50 mm (2 in)~~ 125 mm (5 in)of concrete.

**Substantiation:**

Following the NFPA Research Foundation report "Fire Resistance of Concrete for Electrical Conductors" review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada 2015 Volume 1 (NBCC), using the terminology "Fire Resistance Rating" where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on aggregate types:

**Table D-2.1.1.**
**Minimum Equivalent Thicknesses(1) of Unit Masonry and Monolithic Concrete Walls Loadbearing and Non-Loadbearing, mm**

| Type of Wall | Fire-Resistance Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 min | 45 min | 1 h | 1.5 h | 2 h | 3 h | 4 h |
| Solid brick units (80% solid and over), actual overall thickness | 63 | 76 | 90 | 108 | 128 | 152 | 178 |
| Cored brick units and hollow tile units (less than 80% solid), equivalent thickness | 50 | 60 | 72 | 86 | 102 | 122 | 142 |
| Solid and hollow concrete masonry units, equivalent thickness | | | | | | | |
| Type S or N concrete(2) | 44 | 59 | 73 | 95 | 113 | 142 | 167 |
| Type $L_1$20S concrete | 42 | 54 | 66 | 87 | 102 | 129 | 152 |
| Type $L_1$ concrete | 42 | 54 | 64 | 82 | 97 | 122 | 143 |
| Type $L_2$20S concrete | 42 | 54 | 64 | 81 | 94 | 116 | 134 |
| Type $L_2$ concrete | 42 | 54 | 63 | 79 | 91 | 111 | 127 |
| Monolithic concrete and concrete panels, equivalent thickness | | | | | | | |
| Type S concrete | 60 | 77 | 90 | 112 | 130 | 158 | 180 |
| Type N concrete | 59 | 74 | 87 | 108 | 124 | 150 | 171 |
| Type L40S or Type L concrete | 49 | 62 | 72 | 89 | 103 | 124 | 140 |

While not exactly the same between these two reports, both detail the same general information that 2" (50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different

aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

# Public Input No. 1566-NFPA 70-2020 [ New Section after 695.15 ]

**TITLE OF NEW CONTENT**

Type your content here ...

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| June_19_to_NEC.docx | Add a section 696 to cover 480V 60Hz to 400V 50Hz converters | |

## Statement of Problem and Substantiation for Public Input

It would resolve the electrical installation of an equipment category that isn't covered by the current code. With more international trade, the requirement for converters will increase. Converters are also used in avionics and electronics. A new section would provide instructions on primary and load side protection, disconnects, conductor sizing, etc.

## Submitter Information Verification

**Submitter Full Name:** Paul Levy
**Organization:** MCS
**Affiliation:** None
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Fri Jun 19 05:54:02 EDT 2020
**Committee:** NEC-P13

To: NFPA NEC 2021

Re: Add a new section 696

I have a 480V 60Hz to 400V 50Hz 80KVA Converter. I cannot locate a section that covers this type of equipment. Therefore, I am proposing that NEC consider creating a new section 696 to cover the sizing of the conductors, primary line side CB, disconnect, OLP, required information that the manufacturer must provide on the equipment name tag, etc.

Thank you for your consideration.

Cordially,



Paul Levy, PE, CCP

# Public Input No. 764-NFPA 70-2020 [ New Section after 695.15 ]

**TITLE OF NEW CONTENT**

Type your content here ...

**695.16 Electromagnetic Pulse (EMP) Protection.** Protection for fire pumps against the effects of electromagnetic pulses shall be provided at a minimum of Level 2. See 709.7 for levels of electromagnetic pulse protection.

*Exception: The requirements of 709.7(A)(5) and 709.7(B)(3) shall not apply.*

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

## Submitter Information Verification

**Submitter Full Name:** Vincent Saporita
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**Submittal Date:** Mon Mar 23 13:36:32 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1450-NFPA 70-2020 [ Section No. 695.15 ]

**695.15** Surge Protection.

A listed surge protection device shall be installed in or on the fire pump controller.

Exception: Surge protection devices shall not be required in or on a fire pump controller for diesel fire pumps.

Informational Note: Surge protection is required in or on the fire pump controller whether the fire pump is diesel or electric.

## Statement of Problem and Substantiation for Public Input

I am asking for the Exception, or the Informational Note, but not both.

This code article is unclear in that it requires the surge protection for "controllers." While doing a plan review, I wrote a correction requiring the surge protection on a diesel fire pump controller. I'm being told by the general contractor that "FM approval" will not allow for surge protection on a controller for a diesel fire pump, and that this would void the FM approval. I was not able to discern if this was in fact true or not. We need some guidance from the code panel on this.

## Submitter Information Verification

**Submitter Full Name:** Nick Sasso
**Organization:** Clark County Building and Fire
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**City:**
**State:**
**Zip:**
**Submittal Date:** Fri Jun 05 12:10:48 EDT 2020
**Committee:** NEC-P13

# Public Input No. 3217-NFPA 70-2020 [ Section No. 695.15 ]

**695.~~15~~ ~~Surge~~ 15 Overvoltage Protection.**

~~A listed surge~~ Overvoltage protection ~~device~~ shall be installed ~~in or on~~ to protect the fire pump controller.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Code_Input.docx | input to improve overvoltage protection | |

## Statement of Problem and Substantiation for Public Input

In the 2020 NEC cycle, ARTICLES 280 and 285 were combined to make ARTICLE 242. This was a positive change that began to address the issue of OVERVOLTAGE as a technical subject apart from particular product methods (SPDs and Surge Arresters). There are other technologies and products to address the issue of OVERVOLTAGE. This input attempts to add one such technology as well as correlate the other code references to the subject of OVERVOLTAGE, surge protective devices, and surge arresters to be consistent. This is important to allow for other technologies to be utilized without prejudice to certain products promoted by manufacturers.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3200-NFPA 70-2020 [Section No. 242.1] | |
| Public Input No. 3202-NFPA 70-2020 [New Article after 100] | |
| Public Input No. 3203-NFPA 70-2020 [New Article after 242] | |
| Public Input No. 3205-NFPA 70-2020 [Section No. 501.35] | |
| Public Input No. 3206-NFPA 70-2020 [Section No. 502.35] | |
| Public Input No. 3208-NFPA 70-2020 [Section No. 551.72(E)] | |
| Public Input No. 3209-NFPA 70-2020 [Section No. 490.24] | |
| Public Input No. 3210-NFPA 70-2020 [Section No. 490.48(A)] | |
| Public Input No. 3211-NFPA 70-2020 [Section No. 620.51(E)] | |
| Public Input No. 3212-NFPA 70-2020 [Section No. 645.18] | |
| Public Input No. 3214-NFPA 70-2020 [Section No. 670.6] | |
| Public Input No. 3216-NFPA 70-2020 [Section No. 694.7(D)] | |
| Public Input No. 3218-NFPA 70-2020 [Section No. 700.8] | |
| Public Input No. 3219-NFPA 70-2020 [Section No. 708.20(D)] | |

## Submitter Information Verification

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| | |
|---|---|
| **Zip:** | |
| **Submittal Date:** | Sun Sep 06 19:05:23 EDT 2020 |
| **Committee:** | NEC-P13 |

**Substantiation for Changes: In the 2020 NEC cycle, ARTICLES 280 and 285 were combined to make ARTICLE 242. This was a positive change that began to address the issue of OVERVOLTAGE as a technical subject apart from particular product methods (SPDs and Surge Arresters). There are other technologies and products to address the issue of OVERVOLTAGE. This input attempts to add one such technology as well as correlate the other code references to the subject of OVERVOLTAGE, surge protective devices, and surge arresters to be consistent. This is important to allow for other technologies to be utilized without prejudice to certain products promoted by manufacturers.**

**ARTICLE 100 - DEFINITIONS**

**Voltage Stabilizing Ground Reference (VSGR) System** – an engineered assembly of interconnected passive inductive devices that utilize mutual counter electro-magnetic inductance to stabilize phase voltages of a connected supply system with respect to each other and to ground.

**ARTICLE 242 Overvoltage Protection**

**Part I. General**

**242.1 Scope.**
This article provides the general requirements, installation requirements, and connection requirements for overvoltage protection and overvoltage protective devices. Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal, while Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal. Part IV covers Voltage Stabilizing Ground Reference (VSGR) systems permanently installed on premises wiring systems for any voltage.

Informational Note: Article 242 combines and replaces Articles 280 and 285 in *NFPA 70*-2017.

**242.3 Other Articles.**
Equipment shall be protected against overvoltage in accordance with the article in this *Code* that covers the type of equipment or location specified in Table 242.3.

## Table 242.3 Other Articles

| Equipment | Article |
|---|---|
| Class I locations | 501 |
| Class II locations | 502 |
| Community antenna television and radio distribution systems | 820 |
| Critical operations power systems | 708 |

## Table 242.3 Other Articles

| Equipment | Article |
|---|---|
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | 620 |
| Emergency systems | 700 |
| Equipment over 1000 volts, nominal | 490 |
| Fire pumps | 695 |
| Industrial machinery | 670 |
| Information technology equipment | 645 |
| Modular data centers | 646 |
| Outdoor overhead conductors over 1000 volts | 399 |
| Radio and television equipment | 810 |
| Receptacles, cord connectors, and attachment plugs (caps) | 406 |
| Wind electric systems | 694 |

### Part II. Surge-Protective Devices (SPDs), 1000 Volts or Less

Informational Note: Surge arresters 1000 volts or less are also known as Type 1 SPDs.

### 242.6 Uses Not Permitted.

An SPD device shall not be installed in the following:

1. (1)

   Circuits over 1000 volts

2. (2)

   On ungrounded systems, impedance grounded systems, or corner grounded delta systems unless listed specifically for use on these systems

3. (3)

   Where the rating of the SPD is less than the maximum continuous phase-to-ground voltage at the power frequency available at the point of application

### 242.8 Listing.
An SPD shall be a listed device.

### 242.10 Short-Circuit Current Rating.
The SPD shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating. This marking requirement shall not apply to receptacles.

### 242.12 Type 1 SPDs.
Type 1 SPDs shall be installed in accordance with 242.12(A) and (B).

### 242.12(A) Installation.
Type 1 SPDs shall be permitted to be connected in accordance with one of the following:

1. (1)

   To the supply side of the service disconnect as permitted in 230.82(4)

2. (2)

   As specified in 242.14

### 242.12(B) At the Service.
When installed at services, Type 1 SPDs shall be connected to one of the following:

1. (1)

   Grounded service conductor

2. (2)

   Grounding electrode conductor

3. (3)

   Grounding electrode for the service

4. (4)

   Equipment grounding terminal in the service equipment

### 242.14 Type 2 SPDs.
Type 2 SPDs shall be installed in accordance with 242.14(A) through (C).

### 242.14(A) Service-Supplied Building or Structure.
Type 2 SPDs shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91 unless installed in accordance with 230.82(8).

### 242.14(B) Feeder-Supplied Building or Structure.
Type 2 SPDs shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.

### 242.14(C) Separately Derived System.
The SPD shall be connected on the load side of the first overcurrent device in a separately derived system.

### 242.16 Type 3 SPDs.
Type 3 SPDs shall be permitted to be installed on the load side of branch-circuit overcurrent protection up to the equipment served. If included in the manufacturer's instructions, the Type 3 SPD connection shall be a minimum 10 m (30 ft) of conductor distance from the service or separately derived system disconnect.

### 242.18 Type 4 and Other Component Type SPDs.
Type 4 component assemblies and other component type SPDs shall only be installed by the equipment manufacturer.

### 242.20 Number Required.
Where used at a point on a circuit, the SPD shall be connected to each ungrounded conductor.

### 242.22 Location.
SPDs shall be permitted to be located indoors or outdoors and shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

### 242.24 Routing of Connections.
The conductors used to connect the SPD to the line or bus and to ground shall not be any longer than necessary and shall avoid unnecessary bends.

### 242.26 Connection.
Where an SPD device is installed, it shall comply with 242.12, 242.14, 242.16, 242.28. and 242.30.

### 242.28 Conductor Size.
Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

### 242.30 Connection Between Conductors.
An SPD shall be permitted to be connected between any two conductors — ungrounded conductor(s), grounded conductor, equipment grounding conductor, or grounding electrode conductor. The grounded conductor and the equipment grounding conductor shall be interconnected only by the normal operation of the SPD during a surge.

### 242.32 Grounding Electrode Conductor Connections and Enclosures.
Except as indicated in this article, SPD grounding connections shall be made as specified in Article 250, Part III. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

## Part III. Surge Arresters, Over 1000 Volts

### 242.40 Uses Not Permitted.
A surge arrester shall not be installed where the rating of the surge arrester is less than the maximum continuous phase-to-ground voltage at the power frequency available at the point of application.

### 242.42 Surge Arrester Selection.
The surge arresters shall comply with 242.42(A) and (B).

### 242.42(A) Rating.
The rating of a surge arrester shall be equal to or greater than the maximum continuous operating voltage available at the point of application.

### 242.42(A)(1) Solidly Grounded Systems.
The maximum continuous operating voltage shall be the phase-to-ground voltage of the system.

### 242.42(A)(2) Impedance or Ungrounded System.

The maximum continuous operating voltage shall be the phase-to-phase voltage of the system.

### 242.42(B) Silicon Carbide Types.

The rating of a silicon carbide-type surge arrester shall be not less than 125 percent of the rating specified in 242.42(A).

Informational Note No. 1: For further information on surge arresters, see IEEE C62.11-2012, *Standard for Metal-Oxide Surge Arresters for Alternating-Current Power Circuits (>1 kV)*, and IEEE C62.22-2009, *Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems*.

Informational Note No. 2: The selection of a properly rated metal oxide arrester is based on considerations of maximum continuous operating voltage and the magnitude and duration of overvoltages at the arrester location as affected by phase-to-ground faults, system grounding techniques, switching surges, and other causes. See the manufacturer's application rules for selection of the specific arrester to be used at a particular location.

### 242.44 Number Required.

Where used at a point on a circuit, a surge arrester shall be connected to each ungrounded conductor. A single installation of such surge arresters shall be permitted to protect a number of interconnected circuits if no circuit is exposed to surges while disconnected from the surge arresters.

### 242.46 Location.

Surge arresters shall be permitted to be located indoors or outdoors. Surge arresters shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

### 242.48 Routing of Surge Arrester Equipment Grounding Conductors.

The conductor used to connect the surge arrester to line, bus, or equipment and to an equipment grounding conductor or grounding electrode connection point as provided in 242.50 shall not be any longer than necessary and shall avoid unnecessary bends.

### 242.50 Connection.

The arrester shall be connected to one of the following:

1. (1)

   Grounded service conductor

2. (2)

   Grounding electrode conductor

3. (3)

   Grounding electrode for the service

4. (4)

   Equipment grounding terminal in the service equipment

### 242.52 Surge-Arrester Conductors.

The conductor between the surge arrester and the line, and the surge arrester and the grounding connection, shall not be smaller than 6 AWG copper or aluminum.

### 242.54 Interconnections.

The surge arrester protecting a transformer that supplies a secondary distribution system shall be interconnected as specified in 242.54(A), (B), or (C).

### 242.54(A) Metal Interconnections.
A metal interconnection shall be made to the secondary grounded circuit conductor or the secondary circuit grounding electrode conductor, if, in addition to the direct grounding connection at the surge arrester, the connection complies with 242.54(A)(1) or (A)(2).

### 242.54(A)(1) Additional Grounding Connection.
The grounded conductor of the secondary has a grounding connection elsewhere to a continuous metal underground water piping system. In urban water-pipe areas where there are at least four water-pipe connections on the neutral conductor and not fewer than four such connections in each mile of neutral conductor, the metal interconnection shall be permitted to be made to the secondary neutral conductor with omission of the direct grounding connection at the surge arrester.

### 242.54(A)(2) Multigrounded Neutral System Connection.
The grounded conductor of the secondary system is part of a multigrounded neutral system or static wire of which the primary neutral conductor or static wire has at least four grounding connections in each 1.6 km (1 mile) of line in addition to a grounding connection at each service.

### 242.54(B) Through Spark Gap or Device.
Where the surge arrester grounding electrode conductor is not connected as in 242.54(A), or where the secondary is not grounded as in 242.54(A) but is otherwise grounded as in 250.52, an interconnection shall be made through a spark gap or listed device as required by 242.54(B)(1) or (B)(2).

### 242.54(B)(1) Ungrounded or Unigrounded Primary System.
For ungrounded or unigrounded primary systems, the spark gap for a listed device shall have a 60-Hz breakdown voltage of at least twice the primary circuit voltage but not necessarily more than 10 kV, and there shall be at least one other ground on the grounded conductor of the secondary that is not less than 6.0 m (20 ft) distant from the surge-arrester grounding electrode.

### 242.54(B)(2) Multigrounded Neutral Primary System.
For multigrounded neutral primary systems, the spark gap or listed device shall have a 60-Hz breakdown of not more than 3 kV, and there shall be at least one other ground on the grounded conductor of the secondary that is not less than 6.0 m (20 ft) distant from the surge-arrester grounding electrode.

### 242.54(C) By Special Permission.
An interconnection of the surge-arrester ground and the secondary neutral conductor, other than as provided in 242.54(A) or (B), shall be permitted to be made only by special permission.

### 242.56 Grounding Electrode Conductor Connections and Enclosures.
Except as indicated in this article, surge-arrester grounding electrode conductor connections shall be made as specified in Article 250, Parts III and X. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

## Part IV. Voltage Stabilizing Ground Reference (VSGR) systems.

### 242.68 Listing.
A VSGR shall be a listed device or system composed of listed components.

### 242.70 Short-Circuit Current Rating.
The VSGR shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating.

### 242.71 Voltage Rating.
The rating of the VSGR shall be equal to or greater than the maximum system continuous operating voltage at the point of application.

**242.72 Installation.**
VSGRs shall be installed in accordance with 242.72(A) through (C).

**242.72(A) Service-Supplied Building or Structure.**
VSGR shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91 unless installed in accordance with 230.82(8).

**242.72(B) Feeder-Supplied Building or Structure.**
VSGR shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.

**242.72(C) Separately Derived System.**
VSGR shall be connected on the load side of the first overcurrent device in a separately derived system.

**242.82 Location.**
VSGRs shall be permitted to be located indoors or outdoors and shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

**242.84 Conductor Size.**
Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

**242.90 Connection Between Conductors.**
VSGR connections shall follow the manufacturer's instructions for the system connections.

**242.92 Grounding Electrode Conductor Connections and Enclosures.**
Except as indicated in this article, VSGR grounding connections shall be made as specified in Article 250, Part III. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

**501.35 Overvoltage ~~Surge~~ Protection.**

**501.35(A) Class I, Division 1.**
Overvoltage protection devices, surge arresters, surge-protective devices, and capacitors shall be installed in enclosures identified for Class I, Division 1 locations. Surge-protective capacitors shall be of a type designed for specific duty.

**501.35(B) Class I, Division 2.**
Overvoltage protection devices, surge arresters and surge-protective devices shall be nonarcing, such as metal-oxide varistor (MOV) sealed type, and surge-protective capacitors shall be of a type designed for specific duty. Enclosures shall be permitted to be of the general-purpose type. Overvoltage ~~Surge~~ protection of types other than described in this paragraph shall be installed in enclosures identified for Class I, Division 1 locations.

**502.35 Overvoltage ~~Surge~~ Protection — Class II, Divisions 1 and 2.**
Overvoltage protection devices, surge arresters and surge-protective devices installed in a Class II, Division 1 location shall be in suitable enclosures. Surge-protective capacitors shall be of a type designed for specific duty.

**551.72(E) Connected Devices.**
The use of autotransformers shall not be permitted. The use of listed overvoltage and surge protective devices shall be permitted.

**Table 490.24 Minimum Clearance of Live Parts**

Note: The values given are the minimum clearance for rigid parts and bare conductors under favorable service conditions. They shall be increased for conductor movement or under unfavorable service conditions or wherever space limitations permit. The selection of the associated impulse withstand voltage for a particular system voltage is determined by the characteristics of the overvoltage ~~surge~~ protective equipment.

## 490.48(A) Design and Documentation.

(12) Overvoltage ~~Surge~~ arresters

**620.51(E) Overvoltage ~~Surge~~ Protection.**
Overvoltage protection shall be provided where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, a legally required system load, or a critical operation power system load, ~~listed surge protection shall be provided.~~

**645.18 Overvoltage ~~Surge~~ Protection for Critical Operations Data Systems.**
Overvoltage ~~Listed surge~~ protection shall be provided for critical operations data systems.

**670.6 Surge Protection.**
Industrial machinery with safety interlock control devices not effectively protected from voltage surges on the incoming supply circuit shall have overvoltage ~~surge~~ protection installed.

**694.7(D) Overvoltage Protection ~~Surge Protective Devices (SPD).~~**
Overvoltage protection ~~A surge protective device~~ shall be installed between a wind electric system and any loads served by the premises electrical system. The ~~surge~~ protective device shall be permitted to be a VSGR, or a Type 3 SPD on the circuit serving a wind electric system, or a Type 2 SPD located anywhere on the load side of the service disconnect. Overvoltage ~~Surge~~ protective devices shall be installed in accordance with Part II of Article 242.

**695.15 Overvoltage ~~Surge~~ Protection.**
Overvoltage ~~A listed surge~~ protection ~~device~~ shall be provided for ~~installed in or on~~ the fire pump controller.

**700.8 Overvoltage ~~Surge~~ Protection.**
Overvoltage protection ~~A listed SPD~~ shall be provided ~~installed in or on~~ for all emergency systems switchboards and panelboards.

**708.20(D) Overvoltage ~~Surge~~ Protection ~~Devices~~.**

Surge protection devices shall be provided at all facility distribution voltage levels

## Public Input No. 3721-NFPA 70-2020 [ Section No. 695.15 ]

**695.~~15~~** ~~Surge Protection~~ 15 Overvoltage Protection .

A listed surge~~-protection device~~ -protective device (SPD) shall be installed in accordance with Part II of Article 242 in or on the fire pump controller.

## Statement of Problem and Substantiation for Public Input

The purpose of this public input is to correlate and harmonize all of the current sections of the code where “overvoltage protection” is required by:

1. Changing the section titles to “Overvoltage Protection” to properly correlate with Article 242.

2. Correcting the product description to “listed surge-protective device (SPD)” which is defined in Article 100 and correlates with Article 242.

3. Adding a pointer to “Part II. of Article 242” to ensure compliance with all of the requirements for SPDs are met when complying with the rule.

This public input is one of eleven correlating public inputs covering Sections 230.67, 501.35, 502.35, 620.51(E), 645.18, 670.6, 694.7(D), 695.15, 700.8, 708.20(D), and Informative Annex G

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**Committee:** NEC-P13

## Public Input No. 1794-NFPA 70-2020 [ Section No. 700.1 ]

**700.1** Scope.

This article applies to the electrical safety of the installation, operation, and maintenance of emergency systems consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination, power, or both, to required facilities when the normal electrical supply or system is interrupted.

Informational Note No. 1: For further information regarding wiring and installation of emergency systems in health care facilities, see Article 517.

Informational Note No. 2: For further information regarding performance and maintenance of emergency systems in health care facilities, see NFPA 99-2018, *Health Care Facilities Code*.

Informational Note No. 3: For specification of locations where emergency lighting is considered essential to life safety, see NFPA *101*-2018, *Life Safety Code*.

Informational Note No. 4: For further information regarding performance of emergency and standby power systems, see NFPA 110-2019, *Standard for Emergency and Standby Power Systems* and NFPA 111 Standard on Stored Electrical Energy Emergency and Standby Power Systems .

## Statement of Problem and Substantiation for Public Input

Just like the generator the UPS is an important emergency systems with additional requirements the designer needs to be aware of, this informational note will help remind them.

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**Committee:** NEC-P13

## Public Input No. 3286-NFPA 70-2020 [ Section No. 700.1 ]

**700.1** Scope.

This article applies to the electrical safety of the installation, operation, and maintenance of emergency systems consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination, power, or both, to required facilities when the normal electrical supply or system is interrupted.

Informational Note No. 1: For further information regarding wiring and installation of emergency systems in health care facilities, see Article 517.

Informational Note No. 2: For further information regarding performance and maintenance of emergency systems in health care facilities, see NFPA 99-2018, *Health Care Facilities Code*.

Informational Note No. 3: For specification of locations where emergency lighting is considered essential to life safety, see NFPA *101*-2018, *Life Safety Code*.

Informational Note No. 4: For further information regarding performance of emergency and standby power systems, see NFPA 110-2019, *Standard for Emergency and Standby Power Systems*.

**Informational Note No. 5: For further information regarding power system reliability, see IEEE 3006.2 Recommended Practice for Evaluating the Reliability of Existing Industrial& Commercial Power Systems**

**Informational Note No. 6: For further information, see IEEE 3005.4 Recommended Practice for Design and Operational Considerations for Improving the Reliability of Emergency and Stand-By Power Systems**

## Statement of Problem and Substantiation for Public Input

These are more slices of updated content from the legacy "Red Book" IEEE 141, "Gray Book": IEEE 241 and "Orange Book" IEEE 446 which are now being mapped into the IEEE 3000 Standards Collection. From the project prospectuses:

3006.2: Data supporting the reliability evaluation of existing industrial and commercial power systems are described. This recommended practice is likely to be of greatest value to the power-oriented engineer with limited experience in the area of reliability. It can also be an aid to all engineers responsible for the electrical design of industrial and commercial power systems.

https://standards-stg.ieee.org/standard/3006_2-2016.html

3005.4 This recommended practice describes how to improve the reliabiity of emergency and stand-by power systems. Some of the factors examined include the specific application of the emergency or standby equipment, environmental concerns, specification and acceptance testing of the equipment, and the operations and maintenance of the equipment. (Note that this title has been approved and it near formal release; which should happen before the Public Comment period)

https://standards.ieee.org/standard/3005_4-2020.html

## Submitter Information Verification

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## Public Input No. 2788-NFPA 70-2020 [ Section No. 700.2 ]

**700.2** Definitions.

**Branch-Circuit Emergency Lighting Transfer Switch.**

This definition shall apply only within this article.

A device connected on the load side of a branch-circuit overcurrent protective device that transfers only emergency lighting loads from the normal supply to an emergency supply.

Informational Note: See ANSI/UL 1008, *Transfer Switch Equipment*, for information covering branch-circuit emergency lighting transfer switches.

**Emergency Luminaire, Directly Controlled.**

An emergency luminaire that has a control input for an integral dimming or switching function that drives the luminaire to the required illumination level upon loss of normal power.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for information covering directly controlled luminaires.

**Emergency Power Supply System (EPSS).**

This definition shall apply within this article and throughout the code.

A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power. [ **110** :3.3.4]

**Stored-Energy Power Supply System (SEPSS).**

This definition shall apply within this article and throughout the code.

A complete functioning EPSS powered by a stored-energy electrical source.

**Emergency Systems.**

This definition shall apply within this article and throughout the *Code*.

Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

Informational Note: Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions. Emergency systems may also provide power for such functions as ventilation where essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems, industrial processes where current interruption would produce serious life safety or health hazards, and similar functions.

**Relay, Automatic Load Control.**

A device used to set normally dimmed or normally-off switched emergency lighting equipment to full power illumination levels in the event of a loss of the normal supply by bypassing the dimming/switching controls, and to return the emergency lighting equipment to normal status when the device senses the normal supply has been restored.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for the requirements covering automatic load control relays.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 200830_NEC_700_Revisions_Cases_1-5.docx | NEC CC Emergency Sources TG | |

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy, Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The definition of an Emergency Power Supply System (EPSS) should be included in Article 700 for alignment with NFPA 110. This definition is useful to describe emergency systems consisting of multiple sources to collectively supply loads when the normal supply is interrupted.

The term Stored-Energy Power Supply System (SEPSS) is being introduced to address the unique requirements for these sources to serve within an EPSS.

## Related Public Inputs for This Document

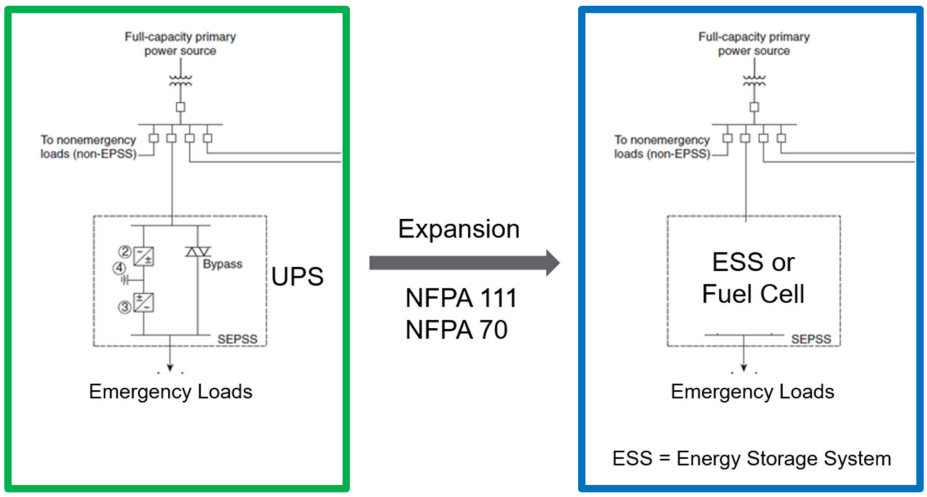
| Related Input | Relationship |
|---|---|
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |

Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)]
Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

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## Emergency Sources TG – Case 1, Emergency Only




**700.2 Definitions.**

**Emergency Power Supply System (EPSS).**

This definition shall apply within this article and throughout the Code.

A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power.[**110**:3.3.4]

**Stored-Energy Power Supply System (SEPSS).**

This definition shall apply within this article and throughout the Code.

A complete functioning EPSS powered by a stored-energy electrical source.

**700.4(B) Capacity.**

An emergency system shall have adequate capacity in accordance with Article 220 or by another approved method. The system capacity shall be sufficient for the rapid load changes and transient power and energy requirements associated with any expected loads.

**Commented [CK1]: PI 2788**
Rationale: The definition of an Emergency Power Supply System (EPSS) should be included in Article 700 for alignment with NFPA 110. This definition is useful to describe emergency systems consisting of multiple sources to collectively supply loads when the normal supply is interrupted.

The term Stored-Energy Power Supply System (SEPSS) is being introduced to address the unique requirements for these sources to serve within an EPSS.

**Commented [CK2]: PI 2789**
Jason
The addition of this new language addresses the common condition where facilities relying on emergency systems have variable loads that can also have significant transient high-power conditions such as motor starting. This language makes it clear that these conditions must be taken into account when sizing the minimum capacity of these systems.

**700.4(C) Selective Load Pickup~~,~~ and Load Shedding~~, and Peak Load Shaving.~~**

The alternate power source shall be permitted to supply emergency, legally required standby, and optional standby system loads where the source has adequate capacity or where automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the emergency circuits, (2) the legally required standby circuits, and (3) the optional standby circuits, in that order of priority. ~~The alternate power source shall be permitted to be used for peak load shaving, provided these conditions are met.~~

~~Peak load shaving operation shall be permitted for satisfying the test requirement of 700.3(B), provided all other conditions of 700.3 are met.~~

**700.4(D) Parallel Operation.**

Parallel operation of the emergency source(s) shall consist of the following:

(1) Normal Source. The emergency source shall be permitted to operate in parallel with the normal source in compliance with Part I or Part II of Article 705 where the capacity required to supply the emergency load is maintained at all times. Any operating condition that results in less than the required emergency source capacity shall initiate a system malfunction signal per 700.6(A).

Parallel operation shall be permitted for satisfying the test requirements of 700.3(B), provided all other conditions of 700.3 are met.

Informational Note: Peak load shaving is one application for parallel source operation.

(2) Emergency Source. Emergency sources shall be permitted to operate in parallel where the necessary equipment to establish and maintain a synchronous condition is provided.

Rationale: This new section is being added to aid users of this Code to more easily identify the requirements unique to power sources used in emergency systems that can operate in parallel with a normal source. The application of parallel connected power sources is becoming increasingly popular, both for economics and resiliency. This new language clarifies that there are two distinctly different types of parallel operation. 700.4(D)(1) identifies requirements specific to applications where emergency source(s) operate in parallel with a normal source whereas 700.4(D)(2) identifies requirements for conditions where emergency sources operate in parallel only with each other. Some systems may utilize both conditions, so the charging sentence allows both to be applied. For applications where an emergency source is used in parallel with a normal source, a statement that the required capacity to supply the emergency load be maintained at all times is included. To clarify these applications further with regards to other sections in article 700, a reference to 700.6(A) is included to ensure that any reduction in the minimum capacity trigger a malfunction signal. Since systems that operate in parallel with a normal source are generally always functioning, a recognition that this operation meets the requirements for periodic testing is also included. All other requirements in 700.3 continue to apply so that is made clear in this new language. The sentences struck from previous 700.4(C) have been moved here (modified) into 700.4(D)(1). A reference to article 705 has been added to point users to this article where requirements for interconnected sources are located. The addition of

**Commented [CK3]: PI 2793**
Jason
Removing this text as this issue is now addressed in new section 700.4(D) titled "Parallel Operation". The application of peak load shaving is just one use case for these systems while operating in parallel with a normal source.

**Commented [CK4]:**
**PI 2794**
Jason

700.4(D)(2) clarifies that emergency sources can be paralleled together provided they are suitable for this application. This was not prohibited before, but it is important to state this here to distinguish between sources operated in parallel with each other and those that operate in parallel with a normal source.

**700.5(D) Use.**

Transfer equipment shall supply only emergency loads.

Informational Note: Transfer equipment that supplies emergency loads provides separation of this load type from any others and is independent of any equipment used to combine or parallel sources.

**Commented [CK5]: PI 2799**
This informational note helps users understand that systems with multiple power sources often have transfer equipment associated with source interconnection pr paralleling. Transfer equipment installed for these purposes is not used to separate emergency loads fron other load types as required by this section..

**700.6 Signals.**

Audible and visual signal devices shall be provided, where practicable, for the purpose described in 700.6(A) through (D).

...

**700.6(C) ~~Not Functioning.~~ Storage Battery Charging Malfunction.**

To indicate ~~that the battery charger is not functioning~~ a charging malfunction where a battery charger is required for source readiness, including engine starting.

**Commented [CK6]: PI 2800**
Rationale: The title of this section should be revised to better describe the functional area of the alarm signal. Additionally, the requirement was changed to align with the focus on battery charging and potential impact to source readiness.

**700.10(D) Fire Protection.**

**700.10(D)(4) ~~Generator Control Wiring.~~ Source Control Wiring**

~~Control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring and shall meet the conditions of 700.10(D)(2). The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).~~ Control conductors installed between the EPSS/SEPSS and the transfer equipment or control system that initiate the operation of emergency sources or initiate the automatic connection to emergency loads shall be kept entirely independent of all other wiring and shall meet the conditions of 700.10(D)(2). The integrity of the control wiring shall be continuously monitored for broken, disconnected, or shorted wires. Loss of integrity shall be considered a system malfunction, initiate the designated signal(s) in 700.6(A), and shall start the emergency source.

**Commented [CK7]: PI 2801**
Brian
Substantiation: The requirements of 700.10(D)(4) have been revised to provide clarity that the control conductors from all approved emergency power sources have to meet the requirements of 700.10(D)(2) and be kept entirely independent of all other wiring. The loss of integrity of the control wiring for all emergency power sources shall also be monitored for any malfunctions, and losses in integrity should single a system malfunction and start the associated emergency source.

**Part III. Sources of Power**

**700.12 General Requirements.** (no changes)

**700.12(A) Power Source Considerations.** (no changes)

**700.12(B) Equipment Design and Location.** (no changes)

**700.12(C) ~~Storage Battery.~~ Supply Duration**

~~Storage batteries shall be of suitable rating and capacity to supply and maintain the total load for a minimum period of 11⁄2 hours, without the voltage applied to the load falling below 871⁄2 percent of normal. Automotive-type batteries shall not be used.~~

~~An automatic battery charging means shall be provided.~~

The emergency power source shall be of suitable rating and capacity to supply and maintain the total load for the duration determined by the system design. In no case shall the duration be less than 2 hours of system operation unless used for emergency illumination in 700.12(C)(4) or unit equipment in 700.12(I). Additionally, the power source shall comply with the following requirements as applicable.

(1) *On-Site Fuel Supply.* An on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours operation of the system.

(2) *Fuel Transfer Pumps.* Where power is needed for the operation of the fuel transfer pumps to deliver fuel to the source, these pumps shall be connected to the emergency power system.

(3) *Public Gas System, Municipal Water Supply.* Sources shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.

*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.*

(4) Storage batteries and Uninterruptable Power Supply systems used to supply emergency illumination shall meet the capacity and performance required by 700.12(I)(2)(1).

(5) Automatic Fuel Source Transfer. Where dual fuel sources are used, means shall be provided for automatically transferring from one fuel source to another.

This requirement was moved to 700.12(C)(4).

**Commented [CK8]: PI 2802**
Rationale: The existing requirements for storage batteries are being moved to 700.12(C)(4) with this revision. The title was revised in order to have a common section for the emergency source duration required regardless of the source type(s). Additionally, the fuel supply, storage, and transfer pump requirements included are moved from 700.12(D)(2) since these should apply to any applicable sources and not just generators.

**700.12(D) Generator Set.**

**700.12(D)(1) Prime Mover-Driven.** (no changes)

**~~700.12(D)(2) Internal Combustion Engines as Prime Movers.~~**

**PI 2803**

This requirement was moved to 700.12(C) since it applies to more than generators.

~~(a) On-Site Fuel Supply. Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours' operation of the system.~~

~~(b) Fuel Transfer Pumps. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the emergency power system.~~

~~(c) Public Gas System, Municipal Water Supply. Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.~~

~~Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.~~

~~(d) Automatic Fuel Transfer. Where dual fuel supplies are used, means shall be provided for automatically transferring from one fuel supply to another.~~

**700.12(D)(3) Battery Power and Dampers.** (no changes)

**700.12(D)(4) Auxiliary Power Supply.** (no changes)

**700.12(D)(5) Outdoor Generator Sets.** (no changes)

**700.12(E) ~~Uninterruptible Power Supplies~~ Stored-Energy Power Supply Systems (SEPSS).** ~~Uninterruptible power supplies used to provide power for emergency systems shall comply with the applicable provisions of 700.12(B) and (C).~~ Stored Energy Power Supply Systems shall comply with all of the following:

1. Systems shall consist of one or more of the following system types
    a) Uninterruptible Power Supply (UPS).
        Informational Note: For further information, see UL 1778, *Uninterruptable Power Systems*.

    b) Fuel Cell System. Fuel cell systems used as a source of power shall also meet the requirements of Article 692.

    c) Energy Storage System (ESS). The installation of an energy storage system shall also meet the requirements of Article 706.

    d) Storage Battery. A storage battery used as a source of power for dc loads shall also comply with Article 480.

    e) Other approved equivalent stored energy sources that comply with 700.12.

**Commented [CK9]: PI 2804**
Laurie - These changes are intended to expand what can be utilized for the newly defined stored-energy power supply systems (SEPSS) to include a number of different technologies that are currently available and can be used for this application including UPS, fuel cell systems, ESS, storage batteries for DC loads and an "other" option since these technologies may not represent an all-inclusive list.

2. Systems shall be Installed with the fire protection and suppression, ventilation and separation requirements specified in the manufacturer's instructions or equipment listing.

Informational Note: Additional information on fire protection installation requirements can be found in NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems;* NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems.*

~~**700.12(G) Fuel Cell System.**~~ (This was moved to 700.12(E), **PI 2806**)

~~Fuel cell systems used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.~~

~~Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.~~

**700.12(H) ~~DC~~ Microgrid Systems. (PI 2808)**

~~Sources connected to a dc microgrid system shall be permitted where the system is capable of being isolated from all non-emergency sources.~~

~~DC microgrid systems used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total emergency load for not less than 2 hours of full-demand operation.~~

~~Where a dc microgrid system source serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the emergency standby system.~~

On-site sources, designated as emergency sources, shall be permitted to be connected to a microgrid system.

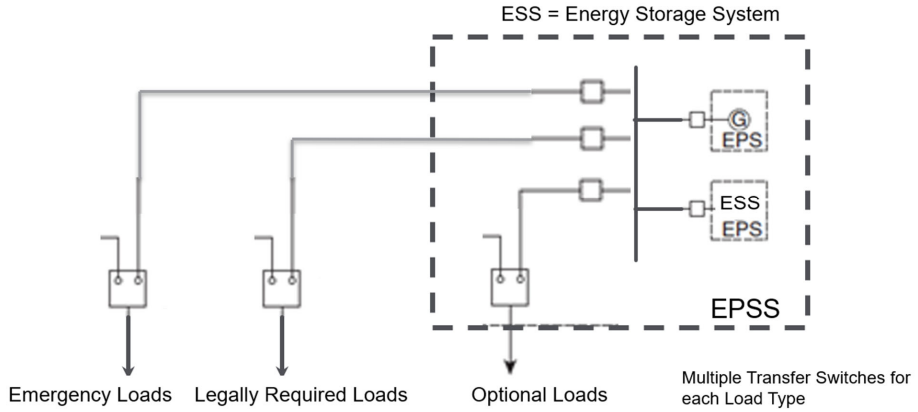
The system shall isolate the emergency system from all non-emergency loads when the normal electric supply is interrupted or shall meet the requirements of 700.4(C). Interruption, partial or complete failure of the normal or non-emergency source(s) shall not impact the availability, capacity and duration provided by the designated emergency sources.

Designated stored-energy electrical emergency power source(s) of a microgrid system shall be permitted to remain interconnected to any available power production source during the emergency source(s) operation where the lack of, or failure, of the interconnected power production source(s), or related controls, does not impact system operation. Interconnected power production sources, other than the designated stored

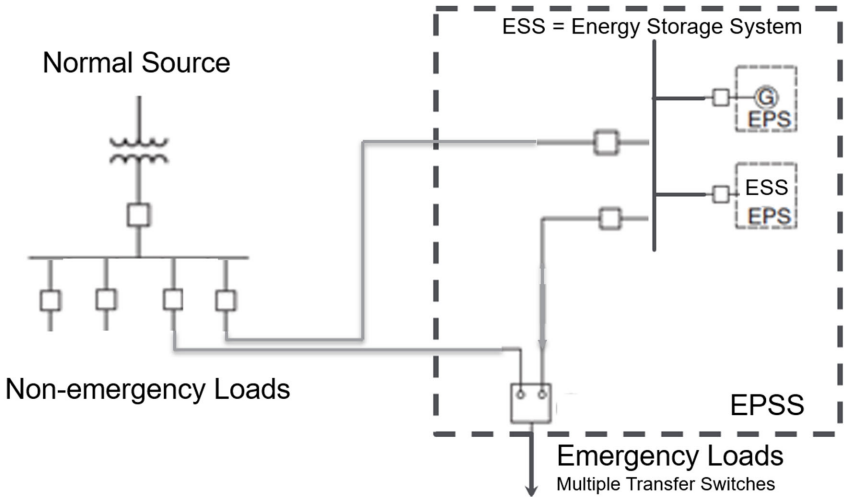
emergency power source(s) shall not be required to meet the requirements of Article 700.

Rationale: [8/24/2020 10:22 AM] Jason Fisher:
SUBSTANTIATION:
Modifying this section to recognize that there are different types of microgrids, in addition to any that might be categorized as dc only. The first sentence is similar to the 2020 language but modified to include other microgrid configurations. New second sentence clarifies that, similar to optional standby systems, non-emergency loads are permitted to be supplied by the emergency sources within the microgrid but these shall be isolated from the emergency sources during emergency operation, or shall be controlled per 700.4(C). Language to address the condition where there is a failure of one or more interconnected sources not categorized as emergency sources is addressed in the third sentence. Failures with emergency sources require a malfunction signal in 700.6 however other sources are not included so this language has been added. This language would require that an analysis of these conditions is considered in the installation of such a system.
The final paragraph provides and allowance that where a stored-energy emergency source, such as a battery or ESS, is used as part of the emergency power system, it shall be permitted to be charged by other sources, not just those categorized as emergency sources. This is not a blanket allowance however, since an analysis must be performed to ensure that the lack of any of these sources, or any failure within them, will not impact the ability of the emergency system to supply the emergency loads.

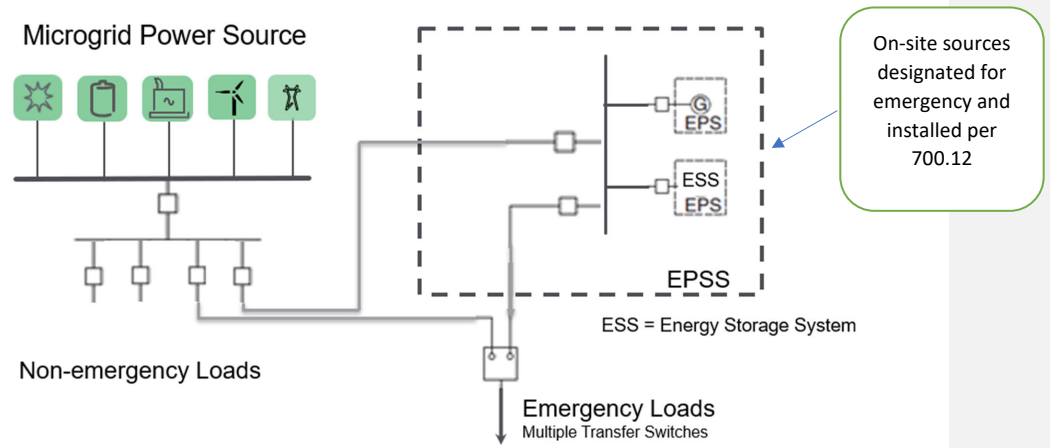
## Emergency Sources TG – Case 2, Emergency and other load



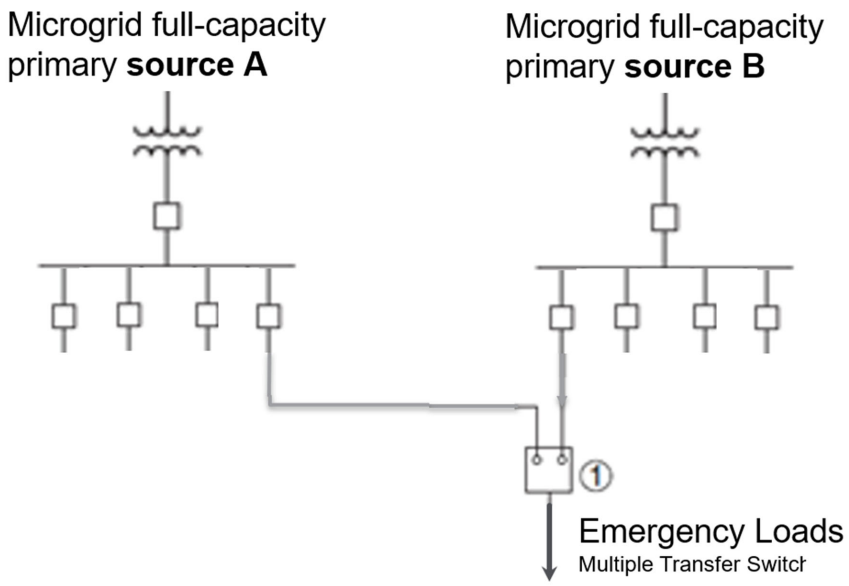
**Emergency Sources TG – Case 3, Parallel with Emergency and other load**




**Emergency Sources TG – Case 4, Microgrid Source, Local EPSS**



**Emergency Sources TG – Case 5, Microgrid Source, Multiple Feeders**




Aspects to consider:

1. Same source for A & B?
    a. Does it matter is the sources are local/onsite versus remote?
    b. Bus A and B supply all load types?
    c. Feeder B and Bus B dedicated to emergency loads?
    d. Other?
2. Different sources for A & B?
    a. Similar rules as permitted in 700.12(F) for a separate service?
    b. Should one group of sources (A or B) comply with 700.12(B) or should this only apply to local/on-site sources?

**The task group did not find sufficient information to support Case 5 and therefore decided to revisit in future code cycles.**

## Public Input No. 3950-NFPA 70-2020 [ Section No. 700.2 ]

(Relocate all definitions in the 700. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**700. 2** Definitions.

**Branch-Circuit Emergency Lighting Transfer Switch.**

This definition shall apply only within this article.

A device connected on the load side of a branch-circuit overcurrent protective device that transfers only emergency lighting loads from the normal supply to an emergency supply.

Informational Note: See ANSI/UL 1008, *Transfer Switch Equipment*, for information covering branch-circuit emergency lighting transfer switches.

**Emergency Luminaire, Directly Controlled.**

An emergency luminaire that has a control input for an integral dimming or switching function that drives the luminaire to the required illumination level upon loss of normal power.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for information covering directly controlled luminaires.

**Emergency Systems.**

This definition shall apply within this article and throughout the *Code*.

Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

Informational Note: Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions. Emergency systems may also provide power for such functions as ventilation where essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems, industrial processes where current interruption would produce serious life safety or health hazards, and similar functions.

**Relay, Automatic Load Control.**

A device used to set normally dimmed or normally-off switched emergency lighting equipment to full power illumination levels in the event of a loss of the normal supply by bypassing the dimming/switching controls, and to return the emergency lighting equipment to normal status when the device senses the normal supply has been restored.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for the requirements covering automatic load control relays.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

## Submitter Information Verification

**Submitter Full Name:** David Williams
**Organization:** Delta Charter Township
**Street Address:**
**City:**
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**Zip:**
**Submittal Date:** Wed Sep 09 16:12:55 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4164-NFPA 70-2020 [ Definition: Branch-Circuit Emergency Lighting Transfer Swit... ]

**Branch-Circuit Emergency Lighting Transfer Switch.**

This definition shall apply only within this article.

A device connected on the load side of a branch-circuit overcurrent protective device that transfers only emergency lighting loads from the normal ~~supply~~ power source to an emergency ~~supply~~ power source .

Informational Note: See ANSI/UL 1008, *Transfer Switch Equipment*, for information covering branch-circuit emergency lighting transfer switches.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term

701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

**Submitter Full Name:** Todd Lottmann
**Organization:** Eaton Corporation
**Street Address:**
**City:**
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**Zip:**
**Submittal Date:** Wed Sep 09 23:20:24 EDT 2020
**Committee:** NEC-P13

## Public Input No. 667-NFPA 70-2020 [ Definition: Emergency Luminaire, Directly Controlled. ]

**Emergency Luminaire, Directly Controlled.**

An emergency luminaire that has a control input for an integral dimming or switching function that drives the luminaire to the required illumination level upon loss of normal power.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for information covering directly controlled emergency luminaires.

## Statement of Problem and Substantiation for Public Input

When this definition was revised in the 2020 edition, the informational note was missed. The word "emergency" needs to be added.

## Submitter Information Verification

**Submitter Full Name:** Steven Terry
**Organization:** Electronic Theatre Controls In
**Affiliation:** USITT
**Street Address:**
**City:**
**State:**
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**Submittal Date:** Tue Mar 17 10:15:33 EDT 2020
**Committee:** NEC-P13

# Public Input No. 4162-NFPA 70-2020 [ Definition: Emergency Systems. ]

**Emergency Systems.**

This definition shall apply within this article and throughout the *Code*.

Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

Informational Note No 1 : Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions. Emergency systems may also provide power for such functions as ventilation where essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems, industrial processes where current interruption would produce serious life safety or health hazards, and similar functions.

Informational Note No 2: Emergency power supply (EPS) and Emergency Power Supply System (EPSS) as defined in NFPA110 and NFPA111 may be subsets of an Emergency System

Informational Note No 3: Emergency systems are considered level one systems when applying NFPA110-2019. Standard for Emergency and Standby Power Systems.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
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517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111

517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word “system” since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 23:14:47 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2202-NFPA 70-2020 [ Definition: Relay, Automatic Load Control. ]

**Relay, Automatic Load Control.**

~~A~~ An emergency lighting control device used to set normally dimmed or normally-off switched emergency lighting equipment to ~~full power illumination levels in the~~ the required illumination level in the event of a loss of the normal supply ~~by bypassing the dimming/switching controls,~~ and to return the emergency lighting equipment to normal status when the device senses the normal supply has been restored.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for the requirements covering automatic load control relays.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| NEC_2023_PI_700.2_ALCR_Shulman_8-10-2020.docx | PI 700.2 ALCR definition Shulman | |

## Statement of Problem and Substantiation for Public Input

This PI adjusts the Automatic Load Control Relay (ALCR) definition to recognize their ability to energize their controlled loads at less than full illumination, where such illumination levels are sufficient for the emergency illumination needs associated with those luminaires. This allowance was recognized in the 2017 Code for directly-controlled emergency luminaires and it should apply equally to other emergency luminaires controlled by an ALCR. The UL 924 emergency lighting control functionality test specifically addresses this feature, when provided.

The PI also identifies an ALCR as a type of emergency lighting control device (ELCD). This was recently recognized within UL 924, to acknowledge that there are now a range of discrete devices playing various control roles within the emergency lighting system, and these devices warrant common treatment and evaluation. A separate PI has been submitted with a definition for ELCD, aligned with that of UL 924.

The phrase “by bypassing the dimming/switching controls” can be deleted. This describes the internal functionality of some ALCRs but electronic versions can instead modify (rather than bypass) the control settings. Function performance is established by the UL 924 evaluation program; the means by which that performance is achieved does not need to be limited by the NEC.

## Submitter Information Verification

**Submitter Full Name:** Michael Shulman
**Organization:** UL LLC
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Mon Aug 10 11:53:10 EDT 2020
**Committee:** NEC-P13

**700.2**

**Relay, Automatic Load Control.** An emergency lighting control device used to set normally dimmed or normally-off switched emergency lighting equipment to the requiredfull power illumination levels in the event of a loss of the normal supply by bypassing the dimming/switching controls, and to return the emergency lighting equipment to normal status when the device senses the normal supply has been restored.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for the requirements covering automatic load control relays.

**Substantiation:**

This PI adjusts the Automatic Load Control Relay (ALCR) definition to recognize their ability to energize their controlled loads at less than full illumination, where such illumination levels are sufficient for the emergency illumination needs associated with those luminaires. This allowance was recognized in the 2017 Code for directly-controlled emergency luminaires and it should apply equally to other emergency luminaires controlled by an ALCR. The UL 924 emergency lighting control functionality test specifically addresses this feature, when provided.

The PI also identifies an ALCR as a type of emergency lighting control device (ELCD). This was recently recognized within UL 924, to acknowledge that there are now a range of discrete devices playing various control roles within the emergency lighting system, and these devices warrant common treatment and evaluation. A separate PI has been submitted with a definition for ELCD, aligned with that of UL 924.

The phrase “by bypassing the dimming/switching controls” can be deleted. This describes the internal functionality of some ALCRs but electronic versions can instead modify (rather than bypass) the control settings. Function performance is established by the UL 924 evaluation program; the means by which that performance is achieved does not need to be limited by the NEC.

# Public Input No. 2849-NFPA 70-2020 [ New Definition after Definition: Branch-Circuit Emergency L... ]

**TITLE OF NEW CONTENT**

**Control Device, Emergency Lighting.** This definition shall apply only within this article.

A separate or integral device intended to perform one or more emergency lighting control functions.

Informational Note: See ANSI/UL 924, *Emergency Lighting and Power Equipment* , for information covering emergency lighting control devices.

## Statement of Problem and Substantiation for Public Input

This PI was developed by a correlating committee task group consisting of:
Joe Schomaker, Eaton, MO [M] CMP-11
Steve Terry, Electronic Theater Controls Inc., NY, US Institute for Theater Technology [M] CMP-15
Fred Carpenter, Acuity Brand Lighting, NEMA [M] CMP-18
Michael Shulman, UL LLC
Chad Jones, Cisco Systems, OH [M] CMP-3
George Zimmerman, CME Consulting, Inc., CA, Ethernet Alliance [SE] CMP-3
Mike O'Boyle, Signify, American Lighting Association [M] CMP-18
Steve Froemming, City of Franklin, WI, IAEI [E] CMP-13
Dan Caron, Bard, Rao + Athanas Consulting Engineers, LLC [SE], CMP-13

700.16(B) uses the term "control devices in the emergency lighting system." There has been some confusion in the industry as to what qualifies as an emergency lighting control device as the term is used, but not defined in the Code. A definition of an emergency lighting control device and informational note pointer to UL924 is required for clarity. This definition will provide users with a consistent understanding of the types of devices that are considered emergency lighting control devices.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2851-NFPA 70-2020 [New Section after 700.26] | |

## Submitter Information Verification

**Submitter Full Name:** Joe Schomaker
**Organization:** Eaton
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Wed Sep 02 15:00:10 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2203-NFPA 70-2020 [ New Definition after Definition: Emergency Luminaire, Direc... ]

**Emergency Luminaire, Battery- Equipped . A luminaire with a rechargeable battery, a battery charging means, and an a utomatic load control relay .**

**Unit Equipment. A battery- equipped emergency luminaire that illuminates only as part of the emergency illumination system and is not illuminated when the normal supply is available .**

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| NEC_2023_PI_700.2_and_700.12_emergency_battery-equipped_luminaires_and_unit_equipment_Shulman_8-10-2020.docx | Definitions for battery-equipped emergency luminaires and unit equipment; adjustments to 700.12(I) | |

## Statement of Problem and Substantiation for Public Input

This PI defines battery-equipped emergency luminaires and then defines unit equipment as a type of battery-equipped emergency luminaire. Most of the existing content of 700.12(I) applies to all battery-equipped emergency luminaires. This PI shifts some of the existing 700.12(I) text to the definitions; the related PI 2204 then revises the remaining 700.12(I) content to address the installation requirements applicable to battery-equipped emergency luminaires.

The definition for unit equipment identifies its functional difference from other battery-supplied emergency luminaires. The existing text in 700.12(I)(1)(4) that refers to unit equipment including “a relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment” is not needed, because this text describes an automatic load control relay (ALCR), and ALCRs are noted as a required element within the battery-equipped emergency luminaire definition.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2204-NFPA 70-2020 [Section No. 700.12(I)] | PI 2204 uses these definitions |
| Public Input No. 2204-NFPA 70-2020 [Section No. 700.12(I)] | |

## Submitter Information Verification

**Submitter Full Name:** Michael Shulman
**Organization:** UL LLC
**Street Address:**
**City:**

| | |
|---|---|
| **State:** | |
| **Zip:** | |
| **Submittal Date:** | Mon Aug 10 14:48:11 EDT 2020 |
| **Committee:** | NEC-P13 |

**700.2**

**Emergency Luminaire, Battery-Equipped**. A luminaire with a rechargeable battery, a battery charging means, and an automatic load control relay.

**Unit Equipment.** A battery-equipped emergency luminaire that illuminates only as part of the emergency illumination system and is not illuminated when the normal supply is available.

**700.12 General Requirements.** Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, emergency lighting, emergency power, or both shall be available within the time required for the application but not to exceed 10 seconds. The supply system for emergency purposes, in addition to the normal services to the building and meeting the general requirements of this section, shall be one or more of the types of systems described in 700.12(C) through H. ~~Unit equipment~~Battery-equipped emergency luminaires in accordance with 700.12(I) shall satisfy the applicable requirements of this article.

**(I) ~~Unit Equipment.~~ Battery-Equipped Emergency Luminaires**
**(1) Listing Required. All battery-equipped emergency luminaires shall be listed.**

Informational Note No. 1: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for the requirements covering battery-equipped emergency luminaires and emergency battery packs. A listed emergency battery pack installed in a listed luminaire will provide similar functionality as a listed battery-equipped emergency luminaire.

~~**(1) Components of Unit Equipment.** Individual unit equipment for emergency illumination shall consist of the following:~~
~~(1) A rechargeable battery~~
~~(2) A battery charging means~~
~~(3) Provisions for one or more lamps mounted on the equipment, or shall be permitted to have terminals for remote lamps, or both~~
~~(4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment~~
~~**(2) Installation of Unit Equipment.** Unit equipment shall be installed in accordance with the following:~~
~~(1) The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:~~
~~(a) For a period of at least 1-1/2 hours without the voltage falling below 87-1/2 percent of normal battery voltage below~~
~~(b) The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1 1/2 hours~~
**(2) Installation.** Battery-equipped emergency luminaires shall be installed in accordance with the following:
~~(2)~~(1) ~~Unit equipment~~Battery-equipped emergency luminaires shall be permanently fixed ~~(i.e., not portable)~~ in place (i.e., not portable) ~~and shall have all w~~
(2) Wiring to each ~~unit~~luminaire shall be installed in accordance with the requirements of any of the wiring methods in Chapter 3 unless otherwise specified in this Article. Flexible cord-and-plug connection shall be permitted for unit equipment, provided that the cord does not exceed 900 mm (3 ft) in length. Flexible cord, with or without a plug, shall also be permitted for battery-equipped emergency luminaires installed in accordance with 410.62(C)(1).
(3) The branch circuit feeding the battery-equipped emergency luminaire ~~unit equipment~~ shall be one of the following:
    a. The same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches.

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b. The same or a different branch circuit as that serving the normal lighting in the area but with means to monitor the status of that area's normal lighting branch circuit ahead of any local switches.

c~~b~~. Where the normal lighting circuit is served by one or more branch circuits, a separate branch circuit, provided with a lock-on feature, that originates from the same panelboard as the normal lighting circuits. The branch circuit disconnecting means for this branch circuit shall be provided with a lock-on feature.

(4) The branch circuit that feeds battery-equipped emergency luminaires ~~unit equipment~~ shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a battery-equipped emergency luminaire ~~unit equipment and are not part of the unit equipment~~ shall be wired to the battery-equipped emergency luminaire as elsewhere required in this Article~~unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3~~.

(6) Remote luminaires~~heads~~ providing lighting for the exterior of an exit door shall be permitted to be supplied by the battery-equipped emergency luminaire ~~unit equipment~~ serving the area immediately inside the exit door.

**Substantiation:**

This PI re-organizes and expands some of the Article 700 text associated with battery-equipped emergency lighting.

The PI defines battery-equipped emergency luminaires and then defines unit equipment as a type of battery-equipped emergency luminaire. Most of the existing content of 700.12(I) applies to all battery-equipped emergency luminaires. The PI shifts some of the existing 700.12(I) text to the definitions and then revises the remaining 700.12(I) content to address the installation requirements applicable to battery-equipped emergency luminaires.

The definition for unit equipment identifies its functional difference from other battery-supplied emergency luminaires. The existing text in 700.12(I)(1)(4) that refers to unit equipment including "a relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment" is not needed, because this text describes an automatic load control relay (ALCR), and ALCRs are noted as a required element within the battery-equipped emergency luminaire definition.

This PI retitles 700.12(I) to reflect its application to the broader class of battery-equipped emergency luminaires. The content of existing subsection 1 (Components of Unit Equipment) has been shifted to the definition, as described earlier. The first portion of existing subsection 2 (Installation of Unit Equipment) actually describes the intended performance of unit equipment (minimum 90 minutes of operation without excess battery discharge or light level reduction) but this is directly addressed by the listing requirements of UL 924. So this PI replaces this subsection with such a listing requirement. An informational note is provided to clarify that comparable functionality can be achieved by adding a (UL 924) listed emergency battery pack to a listed luminaire. This practice has been accepted for many years; with fluorescent luminaires, the emergency battery packs were commonly referred to as "inverter/charger packs." UL 924 requires emergency battery packs to include markings and/or instructions to identify suitably compatible luminaires and/or lamps for the purpose of meeting required emergency illumination performance.

The remaining existing content under 700.12(I) addresses installation issues. This PI replaces "unit equipment" with "battery-equipped emergency luminaire", and makes the following supplemental revisions:

1) Subsection (2) addresses the fixed in place (versus portable) requirement and the supply wiring requirement. For the supply wiring requirements, the PI proposes expanding the allowance to use flexible cord to include any battery-equipped luminaire otherwise permitted to use flexible cord per 410.62(C)(1) (i.e., high bays and pendants); these designs are permitted under UL 924. An additional exemption to Chapter 3 wiring is added, through the phrase “unless otherwise specified in this Article”, to support alternatives that may be separately adopted during this Code revision cycle (such as for class 2 luminaires).
2) Subsection (3) adds an allowance for the battery-equipped emergency luminaire to be connected after (and thus be controlled by) a local switch, or on a different branch circuit than the other local (normal power only) luminaires, provided that the emergency luminaire has means to monitor the status of the normal lighting branch circuit ahead of that local switch. This feature was/is not needed for unit equipment since it is never controlled by a local switch. But it is a common application for other types of battery-equipped emergency luminaires and it is evaluated by the UL 924 listing program.
3) Subsection (5) removes the requirement for luminaires remote from and supplied by the battery-equipped emergency luminaire to be wired exclusively using Chapter 3 methods. Many (if not all) of these remote-installed luminaires will be supplied within class 2 power levels. By referring more broadly to wiring “…as elsewhere required in this Article” this subclause anticipates and avoids conflict with existing or to-be-developed wiring requirements.

## Public Input No. 669-NFPA 70-2020 [ New Definition after Definition: Emergency Systems. ]

**Normal/Emergency Power Source.**

This definition shall apply only within this article.

A power source on the output side of a transfer switch or uninterruptable power supply that is automatically available upon loss of normal power.

## Statement of Problem and Substantiation for Public Input

700.23 already uses this term. As emergency control systems increase in complexity to adapt to new technologies, this term needs a clear definition.

## Submitter Information Verification

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**Submittal Date:** Tue Mar 17 10:27:16 EDT 2020
**Committee:** NEC-P13

## Public Input No. 670-NFPA 70-2020 [ New Definition after Definition: Emergency Systems. ]

**Normal-Only Power Source.**

This definition shall apply only within this article.

A normal power source upstream of a transfer switch or uninterruptable power supply.

## Statement of Problem and Substantiation for Public Input

700.23 already uses this term. As emergency control systems increase in complexity to adapt to new technologies, this term needs a clear definition.

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**Committee:** NEC-P13

## Public Input No. 2880-NFPA 70-2020 [ Section No. 700.3 ]

**700.3** ~~Tests~~ Commissioning and Maintenance.

**(A)** ~~Conduct or~~ Commissioning Witness Test.

The authority having jurisdiction shall conduct or witness ~~a test~~ the commissioning and testing of the complete system upon installation ~~and periodically afterward.~~ in compliance with 110.17.

**(B)** Tested Periodically.

Systems shall be tested periodically on a schedule approved by the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

**(C)** Maintenance.

Emergency system equipment shall be maintained in accordance with manufacturer instructions and industry standards.

**(D)** Written Record.

A written record shall be kept of such tests and maintenance.

**(E)** Testing Under Load.

Means for testing all emergency lighting and power systems during maximum anticipated load conditions shall be provided.

> Informational Note: For information on testing and maintenance of emergency power supply systems (EPSSs), see NFPA 110-2019, *Standard for Emergency and Standby Power Systems*.

**(F)** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

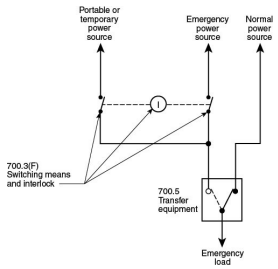
(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Statement of Problem and Substantiation for Public Input

Common requirements for device and system commissioning are being proposed to Article 110 in PI 2844 that will help drive consistency in the actions necessary prior to devices and systems being placed into service. This public input is part of a series of revisions proposed throughout the code to include commissioning where the existing requirements only mention testing.

Confirming the installation, setup, and initial performance for devices and equipment necessary for proper system operation and safety extend well beyond a simple testing requirement. Existing requirements for specific tests are not focused on how the device or equipment fits within the overall system. In addition to verifying operational controls and sequence of operation, this revision also adds clarity that overcurrent and protective devices must have settings that have been adjusted and verified when inspected by the AHJ. The requirement to include as-built documentation and a record of the actions taken to correct any shortcomings will enhance the safety of those who will operate, maintain, and service the equipment.

The text "periodically afterward" is removed from 700.3(A) since this requirement exists in 700.3(B). The term commissioning is defined in 708.2 and applies throughout the code.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2844-NFPA 70-2020 [New Section after 110.16] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |
| Public Input No. 2885-NFPA 70-2020 [Section No. 706.7] | |
| Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.] | |
| Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |
| Public Input No. 2885-NFPA 70-2020 [Section No. 706.7] | |
| Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.] | |
| Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)] | |

## Submitter Information Verification

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**Submittal Date:** Thu Sep 03 07:58:53 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1538-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

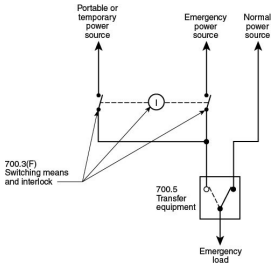
(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists. Informational note; examples of exceptions 1 and 3 are .....*

## Statement of Problem and Substantiation for Public Input

There has been much discussion about what the exceptions are really meaning. Some kind of examples to 1 and 3 would be really helpful as this is not understood in the field. The whole point is to have the switch if needed. What could exception 3 relate to if the point is to have the switch to connect to the temporary source?

## Submitter Information Verification

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**Submittal Date:** Mon Jun 15 22:57:42 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1793-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)** Temporary ~~Source~~ connection of Power for Maintenance or Repair of the Generator Set Alternate Source of Power.

If the emergency system relies on a single ~~alternate source of power~~ generator set driven by an internal combustion engine , which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

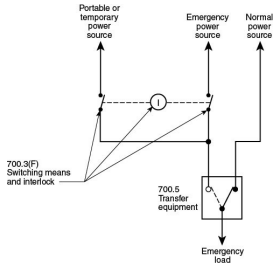
(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Statement of Problem and Substantiation for Public Input

The original concern was for the maintenance of large generator set were the maintenance of the combustion engine would take the stand by power out of commission for long periods of time and did

not take into consideration all the other allowable sources of power not needing similar maintenance. This section should applies only to Generator set with combustion engine's. It should not be required for storage battery systems, unit equipment, fuel cell or UPS. the new language make it clear this section only applies to combustion engine prime movers

## Submitter Information Verification

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**Submittal Date:** Sun Jul 05 17:55:30 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1830-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring. Temporary power and control conductors from the switching means to and including the temporary source of power equipment shall only be required to meet the requirements of Article 590.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

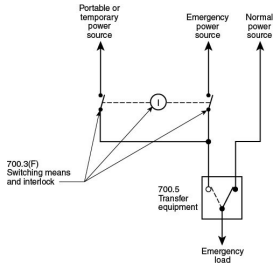
(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Statement of Problem and Substantiation for Public Input

The added text adds clarity to the requirements and intent of the rule. Distributors of temporary power equipment refer to this code rule as the "docking station requirement" not the "switching requirement".

This marketing approach has resulted in added expense for building owners. Electrical designers include a cam lock style docking station with 100's of feet of temporary feeders permanently installed in 2 hour chases, shafts, 2 hour wiring methods etc. adding thousands of dollars to the total cost of the electrical installation. Building owners are rarely made aware of the exceptions in 700.3(F) that are available, appropriate, and should be their choice as to how they want to implement this code rule.

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**Submittal Date:** Fri Jul 10 08:11:00 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2061-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

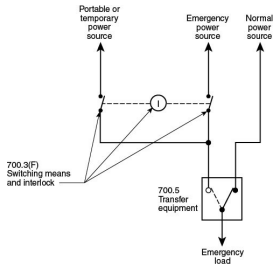
(4) ~~Mechanical~~ The switching means shall be listed, and shall be provided with mechanical or electrical interlocking ~~shall~~ to prevent inadvertent interconnection of power sources. Mechanical interlocks shall be Listed for use with the specific switching device.

(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Statement of Problem and Substantiation for Public Input

SUBSTANTIATION:
The switching device and interlocking required in 700.3(F)(4) are critical to operator safety and to the integrity of the emergency system. Unless a mechanical interlock is designed for the specific switching device, and the interlock has been tested and shown to be effective, safety of the system may be compromised. As such, the switching device should be listed, and the interlock should be listed for use with the specific switching device.

## Submitter Information Verification

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**Submittal Date:** Mon Jul 27 09:19:54 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2457-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

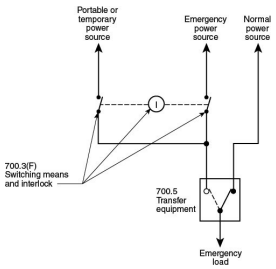
(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

(6) The connection point for the temporary generator shall be located as to not have cables, from the connection point to the temporary generator, installed thru window, doors or similar openings.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or ~~structure is unoccupied and fire~~ structures fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Statement of Problem and Substantiation for Public Input

I am proposing to add a new subparagraph (6) to 700.3(F) to make it clear the temporary cables

installed from the temporary generator cannot be installed thru doors, windows and similar openings where the cables or cords could become pinched or damaged. This additional language in the proposed (6) would typically require the connection point for the temporary generator to be located on the exterior of the building.
The second part of of this public input it proposing to eliminate a portion of exception No 2 due to the fact this portion of the exception is unenforceable. The exception has good intentions but is difficult for the enforcement Community to gain compliance. The issue is that when this is a school, hi rise, business or a medical clinic, the designer will advise that the building will be unoccupied when the generator is down for maintenance, which may be true and easy to schedule. The problem with enforcement of the unoccupied portion of exception #2 arises when a generator has a failure, and there is a time delay in receiving parts or service, then it becomes very difficult to advise a business, clinic, school or other establishment the building must be vacated until the generator is repaired and is operational. I have had designers indicate that they will advise the owner of the building will be vacated or unoccupied when this breakdown occurs, but in reality, the occupants of the building will not take steps to close the school, hi rise, business or medical clinic if the generator is out of service due to a breakdown, they will typically keep the building or occupancy operating and occupied. With this portion of the exception removed, it will be more assured the building is always supplied with emergency power, due to the fact the temporary connection is available to the building occupants. This change will eliminate this unenforceable section of this exception.

## Submitter Information Verification

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**Submittal Date:** Sun Aug 23 08:26:21 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2637-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring. The connections of the portable or temporary power source shall be made with power inlets or terminals and not require terminations within enclosures.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

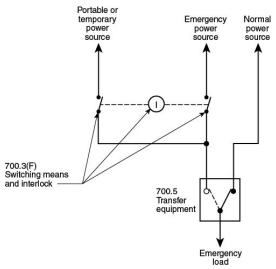
(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Statement of Problem and Substantiation for Public Input

This input is being submitted on behalf of the Minnesota Department of Labor and Industry. The Department's 15 office/field staff, and 65 plus contract electrical inspectors complete over 150,000 electrical inspections annually and are involved in the daily enforcement and interpretation of the

National Electrical Code.
Installations that require field terminations to connect temporary sources within equipment, may expose individuals to energized parts. Requiring connections to be made by permanently installed inlets, cam lock connectors, or other approved receptacles would enhance electrical safety.

## Submitter Information Verification

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**City:**
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**Submittal Date:** Wed Aug 26 10:19:09 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4021-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

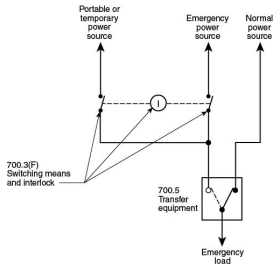
(5) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

(6) The switching mean shall disconnect the grounded conductors connected to the emergency power source in accordance with 230.75 or other approved means that will isolate the emergency power system from the grounded conductors of the portable or temporary power source during maintenance or repair.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Statement of Problem and Substantiation for Public Input

To eliminate any current feedback over the grounded conductors (neutral current), a provision must be provided to safe guard the workers performing maintenance or repair of the emergency power system. This problem is present when the portable or temporary power source is not a separately derived system and connected to the premises electrical system neutral point or conductors.
In NYC we require a poles switching mean in order to address this hazard. Other means are available such as installing the power sources as separately derived system.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 17:49:36 EDT 2020
**Committee:** NEC-P13

## Public Input No. 806-NFPA 70-2020 [ Section No. 700.3(F) ]

**(F)_** Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for maintenance or repair, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power, which shall be available for the duration of the maintenance or repair. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

(1) Connection to the portable or temporary alternate source of power shall not require modification of the permanent system wiring.

(2) Transfer of power between the normal power source and the emergency power source shall be in accordance with 700.12.

(3) Name and Location of Load side Equipment from this connection point.

(4) Connection point shall be identified per 210.5 for branch circuit identification, Voltage requirements, maximum amperage, KAIC of load side equipment and signage per 700.7.

(5) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements.

(6) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

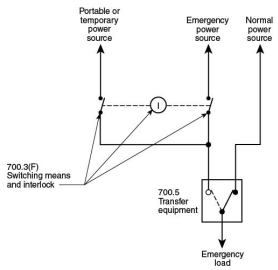
(7) Diagram or Operating instructions labeled on connection point, to safely utilize the alternate power source.

(8) The switching means shall include a contact point that shall annunciate at a location remote from the generator or at another facility monitoring system to indicate that the permanent emergency source is disconnected from the emergency system.

It shall be permissible to utilize manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to utilize the switching means for connection of a load bank.

Informational Note: There are many possible methods to achieve the requirements of 700.3(F). See Informational Note Figure 700.3(F) for one example.

**Figure Informational Note Figure 700.3(F)**




*Exception: The permanent switching means to connect a portable or temporary alternate source of power, for the duration of the maintenance or repair, shall not be required where any of the following conditions exists:*

*(1) All processes that rely on the emergency system source are capable of being disabled during maintenance or repair of the emergency source of power.*

*(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.*

*(3) Other temporary means can be substituted for the emergency system.*

*(4) A permanent alternate emergency source, such as, but not limited to, a second on-site standby generator or separate electric utility service connection, capable of supporting the emergency system, exists.*

## Additional Proposed Changes

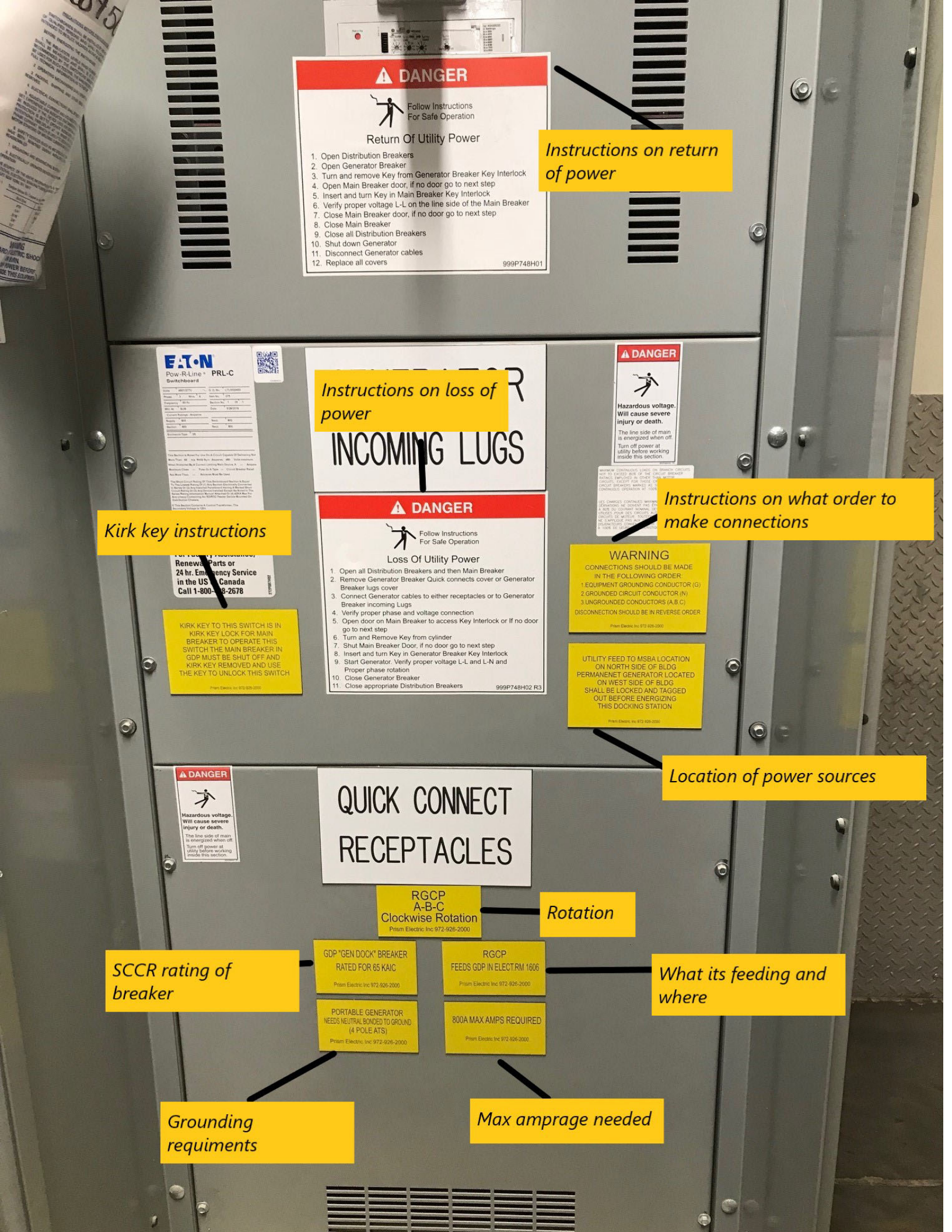
| File Name | Description | Approved |
|---|---|---|
| Temp._Generator_Docking_Station_Labeling.pdf | Temp. Generator Docking Station Labeling example | |

## Statement of Problem and Substantiation for Public Input

When Generators are needed to temporarily run the emergency load of a building. They are rented and taken to the building and need that information posted on the docking Station to be able to safely configure the new power source the Electrician or generator Techs may not be familiar with the building requirements needed. With this info posted on the docking Station, they should be able to do the installation correctly.

## Submitter Information Verification

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**Affiliation:** Prism Electric
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**Zip:**
**Submittal Date:** Mon Mar 30 11:15:17 EDT 2020
**Committee:** NEC-P13


DANGER
Follow Instructions For Safe Operation
Return Of Utility Power
1. Open Distribution Breakers
2. Open Generator Breaker
3. Turn and remove Key from Generator Breaker Key Interlock
4. Open Main Breaker door, if no door go to next step
5. Insert and turn Key in Main Breaker Key Interlock
6. Verify proper voltage L-L on the line side of the Main Breaker
7. Close Main Breaker door, if no door go to next step
8. Close Main Breaker
9. Close all Distribution Breakers
10. Shut down Generator
11. Disconnect Generator cables
12. Replace all covers
999P748H01
Instructions on return of power
EATON
Pow-R-Line PRL-C
Switchboard
Instructions on loss of power
INCOMING LUGS
DANGER
Follow Instructions For Safe Operation
Loss Of Utility Power
1. Open all Distribution Breakers and then Main Breaker
2. Remove Generator Breaker Quick connects cover or Generator Breaker lugs cover
3. Connect Generator cables to either receptacles or to Generator Breaker incoming Lugs
4. Verify proper phase and voltage connection
5. Open door on Main Breaker to access Key Interlock or If no door go to next step
6. Turn and Remove Key from cylinder
7. Shut Main Breaker Door, if no door go to next step
8. Insert and turn Key in Generator Breaker Key Interlock
9. Start Generator. Verify proper voltage L-L and L-N and Proper phase rotation
10. Close Generator Breaker
11. Close appropriate Distribution Breakers
999P748H02 R3
DANGER
Hazardous voltage. Will cause severe injury or death.
The line side of main is energized when off.
Turn off power at utility before working inside this section.
Kirk key instructions
Instructions on what order to make connections
Renewal Parts or
24 hr. Emergency Service
in the US & Canada
Call 1-800-[illegible]-2678
KIRK KEY TO THIS SWITCH IS IN KIRK KEY LOCK FOR MAIN BREAKER TO OPERATE THIS SWITCH THE MAIN BREAKER IN GDP MUST BE SHUT OFF AND KIRK KEY REMOVED AND USE THE KEY TO UNLOCK THIS SWITCH
WARNING
CONNECTIONS SHOULD BE MADE IN THE FOLLOWING ORDER:
1 EQUIPMENT GROUNDING CONDUCTOR (G)
2 GROUNDED CIRCUIT CONDUCTOR (N)
3 UNGROUNDED CONDUCTORS (A,B,C)
DISCONNECTION SHOULD BE IN REVERSE ORDER
UTILITY FEED TO MSBA LOCATION ON NORTH SIDE OF BLDG
PERMANENET GENERATOR LOCATED ON WEST SIDE OF BLDG
SHALL BE LOCKED AND TAGGED OUT BEFORE ENERGIZING THIS DOCKING STATION
Location of power sources
DANGER
Hazardous voltage. Will cause severe injury or death.
The line side of main is energized when off.
Turn off power at utility before working inside this section.
QUICK CONNECT RECEPTACLES
RGCP
A-B-C
Clockwise Rotation
Prism Electric Inc 972-926-2000
Rotation
SCCR rating of breaker
GDP "GEN DOCK" BREAKER RATED FOR 65 KAIC
Prism Electric Inc 972-926-2000
RGCP
FEEDS GDP IN ELECT RM 1606
Prism Electric Inc 972-926-2000
What its feeding and where
PORTABLE GENERATOR NEEDS NEUTRAL BONDED TO GROUND (4 POLE ATS)
Prism Electric Inc 972-926-2000
800A MAX AMPS REQUIRED
Prism Electric Inc 972-926-2000
Grounding requiments
Max amprage needed

## Public Input No. 3783-NFPA 70-2020 [ Section No. 700.4 ]

**700.4** Capacity and Rating.

**(A) Application**

Under engineering supervision microgrid systems identified in Article 705 shall be permitted to be used as emergency systems subject to all other criteria indentified in this Article.

**(B)** Rating.

The emergency system equipment shall be suitable for the available fault current at its terminals.

**(~~B~~ C )** Capacity.

An emergency system shall have adequate capacity in accordance with Article 220 or by another approved method.

**(~~C~~ D )** Selective Load Pickup, Load Shedding, and Peak Load Shaving.

The alternate power source shall be permitted to supply emergency, legally required standby, and optional standby system loads where the source has adequate capacity or where automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the emergency circuits, (2) the legally required standby circuits, and (3) the optional standby circuits, in that order of priority. The alternate power source shall be permitted to be used for peak load shaving, provided these conditions are met.

Peak load shaving operation shall be permitted for satisfying the test requirement of 700.3(B), provided all other conditions of 700.3 are met.

## Statement of Problem and Substantiation for Public Input

Many colleges and universities have district energy plants identified as the primary source of power but run in parallel with a regulated utility. NFPA 110 permits use of a utility as an emergency source where approved by the Authority Having Jurisdiction. Independence of fuel supply may be a site specific criteria.

A selection of research supporting this proposal is listed below:

1. Microgrid Reliability Evaluation Using Distributed Energy Storage Systems | https://ieeexplore.ieee.org/document/8881068

Abstract: Reliability assessment of power systems is a very important factor to judge utilities and suppliers. Many suppliers lose millions of dollars because of the failure happening in their systems. Although these failures are out of control and cannot be avoided strictly, there are methods developed to enhance the reliability of power systems to minimize the number of failures and they work very efficiently. Integrating an energy storage system (ESS) with the power system is one of these methods to enhance the reliability. This paper presents the effects of integrating an ESS with a microgrid on the reliability evaluation and compares between the reliability indices of the microgrid without the ESS and with it. Also, dynamic programming is used to solve the unit commitment problem in both cases to calculate the production cost in both cases. The simulation results and numerical analysis depict the effectiveness of the proposed approach.

2. Economic and Environmental Advantages of Renewable-based Microgrids over Conventional Microgrids | https://ieeexplore.ieee.org/document/8767146

Distributed generation is one of the best and most practical ways to achieve power supply reliability. Yet, the best method to maximize this benefit is by utilizing the distributed energy resources within

smart microgrids, where these resources, and nearby loads are efficiently controlled via the “Microgrid Controller,” which consists the heart of a microgrid. Distributed energy resources could be any type of generation from a typical fossil-fueled generator to the most recent form of a renewable energy generation system. The objective of this study is to highlight the economic superiority of renewable-energy-based microgrids over the traditional microgrids, utilizing only conventional fossil-fuel-based energy resources. This is in addition to the resulting environmental benefit of avoiding large amounts of CO 2 emissions. Simulation results for the four case studies prove the economic feasibility of renewable-based microgrids over diesel- generator-based microgrid in all cases. The economic analysis shows that including renewable energy systems within the microgrids reduced the Net present cost (NPC) of the conventional microgrid in this study by up to 44%. The chosen disparate locations for the smart microgrids are Yuma/AZ/USA, Boston/MA/USA, Ma'an/Jordan, and Plymouth/England.

3. Networked Microgrids: State-of-the-Art and Future Perspectives | https://ieeexplore.ieee.org /document/8536454

The operation of multiple microgrids (MGs) in coordination with distribution system enables high penetration of locally available distributed energy resources (DERs). This approach enhances the reliability and resiliency of the power supply significantly. Also, the overall cost of energy gets reduced because of the integration of cost-free power from photovoltaic panels and wind turbines. The most effective utilization of DERs can be achieved through networked MGs. However, the implementation of the concepts of networked MGs requires extensive research. This paper presents a comprehensive literature review of the most important research works on networked MGs. Major benefits and challenges related to this new and highly exploring area have been analyzed. Also, some of the most important research areas related to networked MGs have been highlighted and discussed as the future perspectives.

Hundreds of papers have been presented on this subject in the past 5 years. Conveying the findings into building premise wiring will improve the NEC and align it more closely with national energy security policy.

## Submitter Information Verification

| | |
|---|---|
| **Submitter Full Name:** | Michael Anthony |
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| **Affiliation:** | IEEE Education & Healthcare Facility Electechnology Committee |
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| **Submittal Date:** | Wed Sep 09 12:36:11 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 572-NFPA 70-2020 [ Section No. 700.4 ]

**700.4** Capacity and Rating.

~~**(B)**~~

**(A)** ~~Rating.~~

~~The emergency system equipment shall be suitable for the available fault current at its terminals.~~

**Capacity.**

An emergency system shall have adequate capacity in accordance with Article 220 or by another approved method.

**(C B )** Selective Load Pickup, Load Shedding, and Peak Load Shaving.

The alternate power source shall be permitted to supply emergency, legally required standby, and optional standby system loads where the source has adequate capacity or where automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the emergency circuits, (2) the legally required standby circuits, and (3) the optional standby circuits, in that order of priority. The alternate power source shall be permitted to be used for peak load shaving, provided these conditions are met.

Peak load shaving operation shall be permitted for satisfying the test requirement of 700.3(B), provided all other conditions of 700.3 are met.

## Statement of Problem and Substantiation for Public Input

This is already covered in 110.9 and 110.10 and therefore already applies [90.3].

## Submitter Information Verification

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**State:**
**Zip:**
**Submittal Date:** Mon Mar 02 13:41:34 EST 2020
**Committee:** NEC-P13

## Public Input No. 394-NFPA 70-2020 [ Section No. 700.4(A) ]

**(A)** Rating.

The emergency system equipment short-circuit current and interrupting ratings shall be suitable for the available fault current at its terminals. Emergency system equipment shall be marked with the available fault current and the date the calculation was performed.

## Statement of Problem and Substantiation for Public Input

Text has been added to clarify what ratings must be adequate for the available fault current. In addition a requirement to mark the available fault current and date of calculation has been added to help ensure compliance.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 395-NFPA 70-2020 [Section No. 701.4(A)] | |

## Submitter Information Verification

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**Submittal Date:** Fri Jan 31 17:21:00 EST 2020
**Committee:** NEC-P13

## Public Input No. 2789-NFPA 70-2020 [ Section No. 700.4(B) ]

**(B)** Capacity.

An emergency system shall have adequate capacity in accordance with Article 220 or by another approved method. The system capacity shall be sufficient for the rapid load changes and transient power and energy requirements associated with any expected loads.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The addition of this new language addresses the common condition where facilities relying on emergency systems have variable loads that can also have significant transient high-power conditions such as motor starting. This language makes it clear that these conditions must be taken into account when sizing the minimum capacity of these systems. See the Word document attached to PI 2788 for the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |

Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

## Submitter Information Verification

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**Street Address:**
**City:**
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**Zip:**
**Submittal Date:** Tue Sep 01 08:37:20 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2794-NFPA 70-2020 [ New Section after 700.4(C) ]

**(D) Parallel Operation**

Parallel operation of the emergency source(s) shall consist of the following:

(1) Normal Source. The emergency source shall be permitted to operate in parallel with the normal source in compliance with Part I or Part II of Article 705 where the capacity required to supply the emergency load is maintained at all times. Any operating condition that results in less than the required emergency source capacity shall initiate a system malfunction signal per 700.6(A).

Parallel operation shall be permitted for satisfying the test requirements of 700.3(B), provided all other conditions of 700.3 are met.

Informational Note: Peak load shaving is one application for parallel source operation.

(2) Emergency Source. Emergency sources shall be permitted to operate in parallel where the necessary equipment to establish and maintain a synchronous condition is provided.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

This new section is being added to aid users of this Code to more easily identify the requirements unique to power sources used in emergency systems that can operate in parallel with a normal source. The application of parallel connected power sources is becoming increasingly popular, both for economics and resiliency. This new language clarifies that there are two distinctly different types of parallel operation. 700.4(D)(1) identifies requirements specific to applications where emergency source(s) operate in parallel with a normal source whereas 700.4(D)(2) identifies requirements for conditions where emergency sources operate in parallel only with each other. Some systems may utilize both conditions, so the charging sentence allows both to be applied. For applications where an emergency source is used in parallel with a normal source, a statement that the required capacity to supply the emergency load be maintained at all times is included. To clarify these applications further with regards to other sections in Article 700, a reference to 700.6(A) is included to ensure that any reduction in the minimum capacity triggers a malfunction signal. Since systems that operate in parallel with a normal source are generally always functioning, a recognition that this operation meets the requirements for periodic testing is also included. All other requirements in 700.3 continue to apply so that is made clear in this new language. The sentences struck from previous 700.4(C) have been moved here (modified) into 700.4(D)(1). A reference to article 705 has been added to point users to this article where requirements for interconnected sources are located. The addition of 700.4(D)(2) clarifies that emergency sources can be paralleled together provided they are suitable for this application. This was not prohibited before, but it is important to state this here to distinguish between sources operated in parallel with each other and those that operate in parallel with a normal source. See the Word document attached to PI 2788 for the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|

Public Input No. 2788-NFPA 70-2020 [Section No. 700.2]
Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)]
Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)]
Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)]
Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)]
Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)]
Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)]
Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)]
Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]
Public Input No. 2788-NFPA 70-2020 [Section No. 700.2]
Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)]
Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)]
Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)]
Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)]
Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)]
Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)]
Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)]
Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

## Submitter Information Verification

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**Submittal Date:** Tue Sep 01 11:26:05 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2793-NFPA 70-2020 [ Section No. 700.4(C) ]

**(C)** Selective Load Pickup, and Load Shedding~~, and Peak Load Shaving~~ .

The alternate power source shall be permitted to supply emergency, legally required standby, and optional standby system loads where the source has adequate capacity or where automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the emergency circuits, (2) the legally required standby circuits, and (3) the optional standby circuits, in that order of priority.~~ The alternate power source shall be permitted to be used for peak load shaving, provided these conditions are met.~~

~~Peak load shaving operation shall be permitted for satisfying the test requirement of 700.3(B) , provided all other conditions of 700.3 are met.~~

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

This action removes "peak load shaving" from this section as the requirements for parallel sources are addressed in a proposed new section 700.4(D) titled "Parallel Operation". The application of peak load shaving is just one use case for these systems while operating in parallel with a normal source.

The allowance for parallel operation of emergency sources to satisfy the test requirements in 700.3(B) has been moved without modification into the proposed new section 700.4(D).

See the Word document attached to PI 2788 for the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |

Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)]
Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)]
Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)]
Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)]
Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

## Submitter Information Verification

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**Submittal Date:** Tue Sep 01 10:47:18 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2753-NFPA 70-2020 [ Section No. 700.5 ]

**700.5** Transfer Equipment.

**(A)** General.

Transfer equipment shall be automatic, listed, and marked for emergency use, and approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705. Meter-mounted transfer switches shall not be permitted for emergency system use.

**(B)** Bypass Isolation Switches.

Means shall be permitted to bypass and isolate the transfer equipment. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

**(C)** Automatic Transfer Switches.

Automatic transfer switches shall be electrically operated and mechanically held. ~~Automatic transfer switches shall not be permitted to be reconditioned.~~

**(D)** Use.

Transfer equipment shall supply only emergency loads.

**(E)** Documentation.

The short-circuit current rating of the transfer equipment, based on the specific overcurrent protective device type and settings protecting the transfer equipment, shall be field marked on the exterior of the transfer equipment.

(F) Reconditioning of Transfer Switches.

Transfer Switches within the scope of this article shall be permitted to be reconditioned in accordance with 700.5(F)(1) through 700.5(F)(4).

(1) The reconditioning process shall be performed in accordance with instructions provided by the manufacturer.

(2) Reconditioning shall be performed using design qualified parts verified under applicable standards.

(3) Reconditioned transfer switch shall be listed or field labeled as reconditioned, and previously applied listing marks, if any, within the portions reconditioned shall be removed.

(4) If equipment has been damaged by fire, products of combustion, or water, it shall be specifically evaluated by its manufacturer or a qualified testing laboratory prior to being returned to service.

## Statement of Problem and Substantiation for Public Input

Self-contained transfer switches, such as meter mounted transfer switches, are usually not designed to facilitate replacement of critical components and are generally not considered appropriate for reconditioning. Other, particularly larger, transfer switch equipment is designed in such a way that modular components like power, control, and switching elements can, relatively easily, be replaced. Such equipment usually resembles switchboards or switchgear and consists of a cabinet in which critical components are installed and connected together via distribution components. The NEC allows

for switchboards and switchgear to be reconditioned, see 408.8(B), but absolutely prohibits reconditioning of transfer switches and transfer equipment. It seems contradictory to provide switchboards an allowance to be reconditioned while reconditioning of transfer equipment of similar construction is absolutely banned.

NEMA published a white paper, “NEMA Technical Position on Reconditioned Equipment” describing the types of products that should be and should not be reconditioned. Text in the body of this document states, “A manufacturer’s design may create a situation where some equipment may be suitable for reconditioning, even if the NEC or NEMA has indicated that it is generally not suitable for reconditioning. Likewise, equipment that is generally considered suitable for reconditioning may not be suitable for reconditioning in a specific case or based on the specific design.” The statement cited above makes it clear that the OEM has a role in determining if products that they manufacture are appropriate for reconditioning.

A blanket ban on reconditioning has the following effects:

- It penalizes OEMs that have invested in the development of equipment that is suitable for reconditioning.
- It penalizes both OEMs and third-party companies that have developed the expertise, tools, processes, and facilities to safely and reliable recondition this equipment.
- It penalizes the end-user by requiring the purchase of new equipment rather than allowing for a safe, more cost-effective means to restore and reuse their own equipment.
- It stifles innovation that could lead to the development of equipment and components that may have longer life spans, if reconditioning is an intended step in the equipment’s life-cycle.
- It creates more waste and makes it more difficult to meet environmental protection and sustainability goals.

Finally, the text submitted in this PI was adopted from section 408.8 of this code. The term “transfer switch” is specifically used because it is a defined term in article 100 of this code. This PI provides a reasonable allowance for reconditioning only when the process is governed by the manufacture’s guidance, use of parts that are design qualified, and certification of safety by a recognized third part evaluation. The guidelines provided in this PI to ensure safety exceed the requirements laid out in the NEC for reconditioning of equipment of similar complexity. In accordance with the stated support of manufacturer discretion in the allowance of reconditioning in NEMA’s whitepaper and the similarities between switchboards and transfer equipment, this PI should be accepted.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2757-NFPA 70-2020 [Section No. 701.5] | |
| Public Input No. 2759-NFPA 70-2020 [Section No. 702.5] | |
| Public Input No. 2761-NFPA 70-2020 [Section No. 708.24] | |
| Public Input No. 2757-NFPA 70-2020 [Section No. 701.5] | |
| Public Input No. 2759-NFPA 70-2020 [Section No. 702.5] | |
| Public Input No. 2761-NFPA 70-2020 [Section No. 708.24] | |

## Submitter Information Verification

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**Submittal Date:** Mon Aug 31 08:52:40 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3003-NFPA 70-2020 [ Section No. 700.5(A) ]

**(A)** General.

Transfer equipment shall be automatic, listed, and marked for emergency use, and approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of ~~Article 705~~ Parts I, II and IV of Article 689 . Meter-mounted transfer switches shall not be permitted for emergency system use.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

The existing language violates the style manual. With the combining of Articles 705, 710 and 712, and moving this new article to 689, this public input brings this section into compliance with the style manual by referencing specific parts within this new Article.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 573-NFPA 70-2020 [ Section No. 700.5(A) ]

**(A)** General.

Transfer equipment shall be automatic, listed, and marked for emergency use~~, and approved by the authority having jurisdiction~~ . Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705. Meter-mounted transfer switches shall not be permitted for emergency system use.

## Statement of Problem and Substantiation for Public Input

This is already required by 110.2.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 1327-NFPA 70-2020 [ Section No. 700.5(B) ]

**(B)** Bypass Isolation Switches.

Means shall be permitted to bypass and isolate the transfer equipment. Where loads are supplied by only one automatic transfer switch, the automatic transfer switch shall include a bypass isolation switch to facilitate maintenance as required in 700.3(C) without jeopardizing continuity of power. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

## Statement of Problem and Substantiation for Public Input

Statement of Problem and Substantiation for Public Input:
(1) Transfer switches provide the only path for feeding power to emergency loads as defined by Article 700 regardless of whether they are being fed by the normal or emergency power source. Therefore, the only safe way to isolate the transfer switch to perform maintenance as required by 700.3(C) is to open the normal and emergency breakers feeding the transfer switch. This situation now renders the emergency loads without power which could be putting human lives in danger.
(2) Article 700.3(F) was added to NEC2017 requiring the installation of a permanent switching means to connect a temporary alternate source of power to enable maintenance or repair of the emergency generator if the emergency system relies on a single alternate source of power. Since the transfer switch is also part of the emergency system it is imperative to have a method for performing inspection and maintenance on the transfer switch without interrupting power to life safety loads. If the power system is designed with emergency loads being fed by only one ATS, maintenance of the ATS may be performed in an unsafe manner or not completed at all.
(3) An automatic transfer bypass-isolation switch (AT/BPS) provides a solution for (1) and (2) because their designs typically include a convenient method to bypass to transfer switch main contacts without interrupting the connected loads and then isolating the transfer switch for safely performing inspection and maintenance purposes. When the AT/BPS is in the isolation mode the bypass switch is providing power to the emergency loads, the ATS is electrically de-energized and physically separated so that proper maintenance can be performed under safe work conditions. In the event the connected power source fails or becomes unacceptable with the ATS in the isolated position, the AT/BPS should include provisions to start the emergency generator and transfer the bypass switch to the alternate source. In addition, most if not all AT/BPSs include a test position to allow the ATS to be electrically tested without interrupting power the loads.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2231-NFPA 70-2020 [ Section No. 700.5(B) ]

**(B)** Bypass Isolation Switches.

Means shall be permitted to bypass and isolate the *automatic* transfer equipment. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided. *When the bypass isolation switch is in the bypass mode, either it shall automatically initiate a transfer between power sources upon loss of the connected power source or it shall remain actively supervised by a qualified person who can manually initiate a transfer between power sources.*

*Informational Note No. 1: Reference 700.12 regarding the maximum time for making emergency power available upon failure of the normal supply.*

*Informational Note No. 2: Bypass isolation switches can be used to comply with the maintenance requirements listed in 700.3(C). For additional information on testing and maintenance of transfer equipment in an emergency power supply systems (EPSS), see NFPA 110, Standard for Emergency and Standby Power Systems.*

## Statement of Problem and Substantiation for Public Input

Per 700.2, “Emergency Systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life”.

Due to the critical nature (life safety) of an emergency system; the maintenance & testing requirements outlined in 700.3; and the 10-sec requirement for restoring power (cited in 700.12) it would be prudent to institute a code change that closely mimics what was introduced in the 2020 code for 708.24.D (shown below as a reference and serves as a precedent).

<< 708.24(D) Bypass Isolation Automatic Transfer Switches. Where loads are supplied by only one automatic transfer switch, the automatic transfer switch shall include a bypass isolation switch to facilitate maintenance as required in 708.6(C) without jeopardizing continuity of power. When the bypass isolation transfer switch is in the bypass mode, either it shall automatically initiate transfer between power sources upon loss of the connected power source or it shall remain actively supervised by a qualified person who can manually initiate a transfer between power sources. >>

When a bypass isolation transfer switch is placed in the bypass mode of operation (for routine testing and/or maintenance per 700.3) the requirement to provide emergency lighting, emergency power or both within 10 seconds upon failure of the normal supply still applies. In order to restore power within this short period of time, the bypass switch must be automatic (self-acting) or a qualified individual must be present to actively supervise and initiate transfer action if needed.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4526-NFPA 70-2020 [ Section No. 700.5(C) ]

**(C)** Automatic Transfer Switches.

Automatic transfer switches shall be electrically operated and mechanically held. Automatic transfer switches shall not be permitted to be reconditioned, unless specifically permitted by another section of this code .

## Statement of Problem and Substantiation for Public Input

Added language for addition to 110.21(A)(2) and new section 517.2

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4496-NFPA 70-2020 [Section No. 110.21(A)(2)] | |
| Public Input No. 4518-NFPA 70-2020 [New Section after 517.1] | |

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**Submittal Date:** Thu Sep 10 14:41:53 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2799-NFPA 70-2020 [ Section No. 700.5(D) ]

**(D)** Use.

Transfer equipment shall supply only emergency loads.

Informational Note: Transfer equipment that supplies emergency loads provides separation of this load type from any others and is independent of any equipment used to combine or parallel sources.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

This informational note helps users understand that systems with multiple power sources often have transfer equipment associated with source interconnection or paralleling. Transfer equipment installed for these purposes is not used to separate emergency loads from other load types as required by this section.

See the Word document attached to PI 2788 for the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |

Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

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**Submittal Date:** Tue Sep 01 12:58:40 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2800-NFPA 70-2020 [ Section No. 700.6(C) ]

**(C)** ~~Not Functioning~~ Storage Battery Charging Malfunction .

To indicate ~~that the~~ a charging malfunction where a battery charger is ~~not functioning~~ required for source readiness, including starting the prime mover .

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The title of this section should be revised to better describe the functional area of the alarm signal. Additionally, the requirement was changed to align with the focus on battery charging and potential impact to source readiness.

See the Word document attached to PI 2788 for the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |

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**Submittal Date:** Tue Sep 01 13:02:05 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2795-NFPA 70-2020 [ Section No. 700.6(D) ]

**(D)** Ground Fault.

To indicate a ground fault in solidly grounded wye emergency systems of more than 150 volts to ground and circuit-protective devices rated 1000 amperes or more. The sensor for the ground-fault signal devices shall be located at, or ahead of, the main system disconnecting means for the emergency source, and the maximum setting of the signal devices shall be for a ground-fault current of 1200 amperes. Instructions on the course of action to be taken in the event of indicated ground fault shall be located at or near the sensor location.

For systems with multiple emergency sources connected to a paralleling bus, ~~the ground fault sensor and the system~~ the system bonding jumper shall be permitted to be at an alternative location.

Generator sets that are equipped with listed overvoltage and unbalanced current sensing protection shall not be required to have ground fault sensing or protection at the generator main breaker for single generator systems, or at the individual generator breakers when paralleled.

## Statement of Problem and Substantiation for Public Input

If a generator set is properly designed and prototype tested, a ground fault on a generator set does not cause a damaging overcurrent condition or mechanical failure. (NFPA 110 requires prototype testing of generator sets.) Further, a generator set has far less instantaneous fault current available compared to a normal service source.

The failure mode of a generator set on a low impedance ground fault is actually overvoltage, which can damage a generator set and connected loads is less than a second. The overvoltage condition on a generator set is likely to also damage load devices.

Most ground faults are not low impedance, so the issue with a generator set will become current imbalance. A worst-case voltage imbalance will need to be resolved in about 2 seconds in order to avoid generator damage.

So, if you want to provide useful protection when a ground fault hits a generator, a fast-operating overvoltage protection device is what is needed, as well as voltage imbalance sensing/protection.

Moving the ground fault trips to feeders would also allow discrimination between emergency, legally required, and optional standby loads, by making emergency and legally required alarm only, and optional standby loads and prevents the potential of nuisance tripping of ground fault devices.

Ground fault sensors on the individual generators in a paralleling application may cause cascading generator failure since a ground fault in any load would likely cause a ground fault on all the generators connected to the bus and the feeder breakers could be considerably larger than a generator paralleling breaker. Rather than risking disconnecting all the generators, it would be preferable to trip a feeder breaker that could clear the fault quickly from the system, leaving the generators serving all other loads. Even on single generators, typical ground fault sensing designs are not effective in preventing generator set damage.

Generators should not be required to have ground fault trips on the generator breakers because they are not required to protect the feeder or downstream loads as long as the protection described in this change is provided, but ground fault trips are definitely desirable on feeders.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3119-NFPA 70-2020 [ Section No. 700.6(D) ]

**(D)** Ground Fault.

To indicate a ground fault in solidly grounded wye emergency systems of more than 150 volts to ground and circuit-protective devices rated 1000 amperes or more. The sensor for the ground-fault signal devices shall be located at, or ahead of, the main system disconnecting means for the emergency source, and the maximum setting of the signal devices shall be for a ground-fault current of 1200 amperes. Instructions on the course of action to be taken in the event of indicated ground fault shall be located at or near the sensor location.

For systems with multiple emergency sources connected to a paralleling bus, the ground fault sensor and the system bonding jumper shall be permitted to be at an alternative location.

Informational Note: Utilizing a transfer switch with a solidly connected neutral would not be permitted in a system that requires ground fault detection .

## Statement of Problem and Substantiation for Public Input

When working with Emergency Systems, the designer and/or installer must to be aware of section 700.6 (D) of the 2020 NEC. This section requires ground fault detection be provided on grounded wye system at 150 V to ground with overcurrent protection 1000 A or greater. Current flows through the current transformer of the Ground fault detection which encompasses the phase and neutral conductors. When a ground fault occurs some current will bypass the current transformer causing the ground fault detector to indicate a fault.

As a result of the aforementioned condition, when utilizing a solidly connected neutral transfer switch in generator mode the ground fault will travel back through the neutral and through the current transformer of the ground fault detection device. As the total returned current will be roughly equivalent to that in normal operating mode the ground fault detection will not provide indication upon a ground fault.

It is not clear presently in the code that using transfer switches with solidly connected neutrals would not be permitted as they do not allow ground fault detection to operate properly.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3080-NFPA 70-2020 [ New Section after 700.8 ]

**700.9 Cybersecurity**

Emergency systems that are connected to a communication network and permitted to control any portion of the premises emergency electrical system shall comply with (1) and (2).

(1) A Cybersecurity Assessment shall be conducted on the connected system determine vulnerabilities to cyber-attacks.

(2) A Cybersecurity Commissioning Certification shall be conducted on the connected system to ensure they are designed against cyber-attacks and known vulnerabilities.

Documentation of the assessment and certification shall be made available to those authorized to inspect, operate, and maintain the system.

Informational note (1): ANSI/ISA 62443 Cybersecurity Standards series can be utilized to meet the assessment requirement. Another way is thru the NIST Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1.

Informational note (2): Examples the commissioning certification used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(a) The ISA Security Compliance Institute (ISCI) conformity assessment program

(b) Certification of compliance by a nationally recognized test laboratory

(c) Manufacturer certification for the specific type and brand of system provided

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Water_Treatment_Plant_Hit_by_Cyber-attack.pdf | Water Treatment Plant Cyber Attack | |
| State_of_Cyber_Attacks_in_Hospital_Emergency_Management_2019.pdf | Hospital Emergency Management of Cybersecurity | |
| History_of_Industrial_Control_System_Cyber_Incidents.pdf | Industrial Control System Cyber incidents | |
| Hackers_force_water_utilities_to_sink_or_swim.pdf | Hackers and Water Utilities | |

## Statement of Problem and Substantiation for Public Input

Cybersecurity should be considered as an aspect of safety and reliability in addition to the other factors affecting emergency systems. If an attacker can affect the emergency control system, individual sensors or other IoT devices to the point of either preventing normal operation or displaying the

appearance of normal operation while failing the system, such as providing indication that a generator has started but in actuality it has not, creates an unsafe condition. The increase in cyber-attacks on industrial, utility, and other installations where emergency systems can be made to create unsafe conditions. Examples of these unsafe conditions can be changing overcurrent protection rating of a circuit breaker, generator controls, SCADA systems, emergency stop functions, motor controllers, or fire protection systems. The public input is focused only on emergency systems that can be controlled from external communication networks such as the internet. These connections can be wired, wireless, or use other data media. cybersecurity is essential to expand the safety and security of emergency systems.

https://www.varonis.com/blog/cybersecurity-statistics/

- 71% of data breaches were financially motivated and 25% were motivated by espionage
- Cybersecurity breaches have increased by 11% since 2018 and 67% since 2014
- 61% of organizations have experienced an IoT security incident
- IoT devices experience an average of 5,200 attacks per month
- The cost of a data breach in the healthcare industry was $6.5 Million
- Average cost of a malware attack on a company is $2.6M

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3055-NFPA 70-2020 [New Section after 110.28] | General Cybersecurity Requirement PI |
| Public Input No. 3070-NFPA 70-2020 [New Section after 517.2] | Health Care Facilities and their emergency systems are linked to protect patients |
| Public Input No. 3083-NFPA 70-2020 [Section No. 708.4] | |
| Public Input No. 3087-NFPA 70-2020 [Section No. 708.8] | |

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 761-NFPA 70-2020 [ New Section after 700.8 ]

**TITLE OF NEW CONTENT**

Type your content here ...

**700.9 Electromagnetic Pulse (EMP) Protection.** Protection for emergency systems against the effects of electromagnetic pulses shall be provided at a minimum of Level 2. See 709.7 for levels of electromagnetic pulse protection.

*Exception: The requirements of 709.7(A)(5) and 709.7(B)(3) shall not apply.*

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

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**Committee:** NEC-P13

## Public Input No. 1792-NFPA 70-2020 [ Section No. 700.8 ]

**700.8** Surge Protection.

A listed SPD shall be installed in or on all switchboard, panelboard or OCPD enclosure suppling emergency systems ~~switchboards and panelboards~~ .

## Statement of Problem and Substantiation for Public Input

the problem here is the way this section reads is if a emergency system feeds a panel board SPD is required for the panel board supplying the emergency system. however when a battery system , unit equipment or UPS emergency system is supplied from a panelboard it is currently not clear that the panelboard supplying the branch circuit or feeder to the emergency equipment (UPS, EBU) is required to have SPD. this new language would make it clear SPD is required in a panelboard/switchboard or circuit breaker/Fuse enclosure supplying emergency equipment. This language would address not only emergency equipment being supplied but also the Panel board being supplied by the emergency power supply system.

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**Committee:** NEC-P13

# Public Input No. 3218-NFPA 70-2020 [ Section No. 700.8 ]

**700.8** ~~Surge~~ Overvoltage Protection.

~~A listed SPD shall~~ Overvoltage protection shall be installed ~~in or on~~ to protect all emergency systems switchboards and panelboards.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Code_Input.docx | input to improve overvoltage protection requirements | |

## Statement of Problem and Substantiation for Public Input

In the 2020 NEC cycle, ARTICLES 280 and 285 were combined to make ARTICLE 242. This was a positive change that began to address the issue of OVERVOLTAGE as a technical subject apart from particular product methods (SPDs and Surge Arresters). There are other technologies and products to address the issue of OVERVOLTAGE. This input attempts to add one such technology as well as correlate the other code references to the subject of OVERVOLTAGE, surge protective devices, and surge arresters to be consistent. This is important to allow for other technologies to be utilized without prejudice to certain products promoted by manufacturers.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3200-NFPA 70-2020 [Section No. 242.1] | |
| Public Input No. 3202-NFPA 70-2020 [New Article after 100] | |
| Public Input No. 3203-NFPA 70-2020 [New Article after 242] | |
| Public Input No. 3205-NFPA 70-2020 [Section No. 501.35] | |
| Public Input No. 3206-NFPA 70-2020 [Section No. 502.35] | |
| Public Input No. 3208-NFPA 70-2020 [Section No. 551.72(E)] | |
| Public Input No. 3209-NFPA 70-2020 [Section No. 490.24] | |
| Public Input No. 3210-NFPA 70-2020 [Section No. 490.48(A)] | |
| Public Input No. 3211-NFPA 70-2020 [Section No. 620.51(E)] | |
| Public Input No. 3212-NFPA 70-2020 [Section No. 645.18] | |
| Public Input No. 3214-NFPA 70-2020 [Section No. 670.6] | |
| Public Input No. 3216-NFPA 70-2020 [Section No. 694.7(D)] | |
| Public Input No. 3217-NFPA 70-2020 [Section No. 695.15] | |
| Public Input No. 3219-NFPA 70-2020 [Section No. 708.20(D)] | |

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| **Committee:** | NEC-P13 |

**Substantiation for Changes: In the 2020 NEC cycle, ARTICLES 280 and 285 were combined to make ARTICLE 242. This was a positive change that began to address the issue of OVERVOLTAGE as a technical subject apart from particular product methods (SPDs and Surge Arresters). There are other technologies and products to address the issue of OVERVOLTAGE. This input attempts to add one such technology as well as correlate the other code references to the subject of OVERVOLTAGE, surge protective devices, and surge arresters to be consistent. This is important to allow for other technologies to be utilized without prejudice to certain products promoted by manufacturers.**

**ARTICLE 100 - DEFINITIONS**

**Voltage Stabilizing Ground Reference (VSGR) System** – an engineered assembly of interconnected passive inductive devices that utilize mutual counter electro-magnetic inductance to stabilize phase voltages of a connected supply system with respect to each other and to ground.

**ARTICLE 242 Overvoltage Protection**

**Part I. General**

**242.1 Scope.**
This article provides the general requirements, installation requirements, and connection requirements for overvoltage protection and overvoltage protective devices. Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal, while Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal. Part IV covers Voltage Stabilizing Ground Reference (VSGR) systems permanently installed on premises wiring systems for any voltage.

Informational Note: Article 242 combines and replaces Articles 280 and 285 in *NFPA 70*-2017.

**242.3 Other Articles.**
Equipment shall be protected against overvoltage in accordance with the article in this *Code* that covers the type of equipment or location specified in Table 242.3.

## Table 242.3 Other Articles

| Equipment | Article |
|---|---|
| Class I locations | 501 |
| Class II locations | 502 |
| Community antenna television and radio distribution systems | 820 |
| Critical operations power systems | 708 |

## Table 242.3 Other Articles

| Equipment | Article |
|---|---|
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | 620 |
| Emergency systems | 700 |
| Equipment over 1000 volts, nominal | 490 |
| Fire pumps | 695 |
| Industrial machinery | 670 |
| Information technology equipment | 645 |
| Modular data centers | 646 |
| Outdoor overhead conductors over 1000 volts | 399 |
| Radio and television equipment | 810 |
| Receptacles, cord connectors, and attachment plugs (caps) | 406 |
| Wind electric systems | 694 |

### Part II. Surge-Protective Devices (SPDs), 1000 Volts or Less

Informational Note: Surge arresters 1000 volts or less are also known as Type 1 SPDs.

### 242.6 Uses Not Permitted.

An SPD device shall not be installed in the following:

1. (1)

   Circuits over 1000 volts

2. (2)

   On ungrounded systems, impedance grounded systems, or corner grounded delta systems unless listed specifically for use on these systems

3. (3)

   Where the rating of the SPD is less than the maximum continuous phase-to-ground voltage at the power frequency available at the point of application

### 242.8 Listing.
An SPD shall be a listed device.

### 242.10 Short-Circuit Current Rating.
The SPD shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating. This marking requirement shall not apply to receptacles.

### 242.12 Type 1 SPDs.
Type 1 SPDs shall be installed in accordance with 242.12(A) and (B).

### 242.12(A) Installation.
Type 1 SPDs shall be permitted to be connected in accordance with one of the following:

1. (1)

   To the supply side of the service disconnect as permitted in 230.82(4)

2. (2)

   As specified in 242.14

### 242.12(B) At the Service.
When installed at services, Type 1 SPDs shall be connected to one of the following:

1. (1)

   Grounded service conductor

2. (2)

   Grounding electrode conductor

3. (3)

   Grounding electrode for the service

4. (4)

   Equipment grounding terminal in the service equipment

### 242.14 Type 2 SPDs.
Type 2 SPDs shall be installed in accordance with 242.14(A) through (C).

### 242.14(A) Service-Supplied Building or Structure.
Type 2 SPDs shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91 unless installed in accordance with 230.82(8).

### 242.14(B) Feeder-Supplied Building or Structure.
Type 2 SPDs shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.

### 242.14(C) Separately Derived System.
The SPD shall be connected on the load side of the first overcurrent device in a separately derived system.

### 242.16 Type 3 SPDs.
Type 3 SPDs shall be permitted to be installed on the load side of branch-circuit overcurrent protection up to the equipment served. If included in the manufacturer's instructions, the Type 3 SPD connection shall be a minimum 10 m (30 ft) of conductor distance from the service or separately derived system disconnect.

### 242.18 Type 4 and Other Component Type SPDs.
Type 4 component assemblies and other component type SPDs shall only be installed by the equipment manufacturer.

### 242.20 Number Required.
Where used at a point on a circuit, the SPD shall be connected to each ungrounded conductor.

### 242.22 Location.
SPDs shall be permitted to be located indoors or outdoors and shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

### 242.24 Routing of Connections.
The conductors used to connect the SPD to the line or bus and to ground shall not be any longer than necessary and shall avoid unnecessary bends.

### 242.26 Connection.
Where an SPD device is installed, it shall comply with 242.12, 242.14, 242.16, 242.28. and 242.30.

### 242.28 Conductor Size.
Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

### 242.30 Connection Between Conductors.
An SPD shall be permitted to be connected between any two conductors — ungrounded conductor(s), grounded conductor, equipment grounding conductor, or grounding electrode conductor. The grounded conductor and the equipment grounding conductor shall be interconnected only by the normal operation of the SPD during a surge.

### 242.32 Grounding Electrode Conductor Connections and Enclosures.
Except as indicated in this article, SPD grounding connections shall be made as specified in Article 250, Part III. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

## Part III. Surge Arresters, Over 1000 Volts

### 242.40 Uses Not Permitted.
A surge arrester shall not be installed where the rating of the surge arrester is less than the maximum continuous phase-to-ground voltage at the power frequency available at the point of application.

### 242.42 Surge Arrester Selection.
The surge arresters shall comply with 242.42(A) and (B).

### 242.42(A) Rating.
The rating of a surge arrester shall be equal to or greater than the maximum continuous operating voltage available at the point of application.

### 242.42(A)(1) Solidly Grounded Systems.
The maximum continuous operating voltage shall be the phase-to-ground voltage of the system.

### 242.42(A)(2) Impedance or Ungrounded System.

The maximum continuous operating voltage shall be the phase-to-phase voltage of the system.

### 242.42(B) Silicon Carbide Types.

The rating of a silicon carbide-type surge arrester shall be not less than 125 percent of the rating specified in 242.42(A).

Informational Note No. 1: For further information on surge arresters, see IEEE C62.11-2012, *Standard for Metal-Oxide Surge Arresters for Alternating-Current Power Circuits (>1 kV)*, and IEEE C62.22-2009, *Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems*.

Informational Note No. 2: The selection of a properly rated metal oxide arrester is based on considerations of maximum continuous operating voltage and the magnitude and duration of overvoltages at the arrester location as affected by phase-to-ground faults, system grounding techniques, switching surges, and other causes. See the manufacturer's application rules for selection of the specific arrester to be used at a particular location.

### 242.44 Number Required.

Where used at a point on a circuit, a surge arrester shall be connected to each ungrounded conductor. A single installation of such surge arresters shall be permitted to protect a number of interconnected circuits if no circuit is exposed to surges while disconnected from the surge arresters.

### 242.46 Location.

Surge arresters shall be permitted to be located indoors or outdoors. Surge arresters shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

### 242.48 Routing of Surge Arrester Equipment Grounding Conductors.

The conductor used to connect the surge arrester to line, bus, or equipment and to an equipment grounding conductor or grounding electrode connection point as provided in 242.50 shall not be any longer than necessary and shall avoid unnecessary bends.

### 242.50 Connection.

The arrester shall be connected to one of the following:

1. (1)

   Grounded service conductor

2. (2)

   Grounding electrode conductor

3. (3)

   Grounding electrode for the service

4. (4)

   Equipment grounding terminal in the service equipment

### 242.52 Surge-Arrester Conductors.

The conductor between the surge arrester and the line, and the surge arrester and the grounding connection, shall not be smaller than 6 AWG copper or aluminum.

### 242.54 Interconnections.

The surge arrester protecting a transformer that supplies a secondary distribution system shall be interconnected as specified in 242.54(A), (B), or (C).

### 242.54(A) Metal Interconnections.
A metal interconnection shall be made to the secondary grounded circuit conductor or the secondary circuit grounding electrode conductor, if, in addition to the direct grounding connection at the surge arrester, the connection complies with 242.54(A)(1) or (A)(2).

### 242.54(A)(1) Additional Grounding Connection.
The grounded conductor of the secondary has a grounding connection elsewhere to a continuous metal underground water piping system. In urban water-pipe areas where there are at least four water-pipe connections on the neutral conductor and not fewer than four such connections in each mile of neutral conductor, the metal interconnection shall be permitted to be made to the secondary neutral conductor with omission of the direct grounding connection at the surge arrester.

### 242.54(A)(2) Multigrounded Neutral System Connection.
The grounded conductor of the secondary system is part of a multigrounded neutral system or static wire of which the primary neutral conductor or static wire has at least four grounding connections in each 1.6 km (1 mile) of line in addition to a grounding connection at each service.

### 242.54(B) Through Spark Gap or Device.
Where the surge arrester grounding electrode conductor is not connected as in 242.54(A), or where the secondary is not grounded as in 242.54(A) but is otherwise grounded as in 250.52, an interconnection shall be made through a spark gap or listed device as required by 242.54(B)(1) or (B)(2).

### 242.54(B)(1) Ungrounded or Unigrounded Primary System.
For ungrounded or unigrounded primary systems, the spark gap for a listed device shall have a 60-Hz breakdown voltage of at least twice the primary circuit voltage but not necessarily more than 10 kV, and there shall be at least one other ground on the grounded conductor of the secondary that is not less than 6.0 m (20 ft) distant from the surge-arrester grounding electrode.

### 242.54(B)(2) Multigrounded Neutral Primary System.
For multigrounded neutral primary systems, the spark gap or listed device shall have a 60-Hz breakdown of not more than 3 kV, and there shall be at least one other ground on the grounded conductor of the secondary that is not less than 6.0 m (20 ft) distant from the surge-arrester grounding electrode.

### 242.54(C) By Special Permission.
An interconnection of the surge-arrester ground and the secondary neutral conductor, other than as provided in 242.54(A) or (B), shall be permitted to be made only by special permission.

### 242.56 Grounding Electrode Conductor Connections and Enclosures.
Except as indicated in this article, surge-arrester grounding electrode conductor connections shall be made as specified in Article 250, Parts III and X. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

## Part IV. Voltage Stabilizing Ground Reference (VSGR) systems.

### 242.68 Listing.
A VSGR shall be a listed device or system composed of listed components.

### 242.70 Short-Circuit Current Rating.
The VSGR shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating.

### 242.71 Voltage Rating.
The rating of the VSGR shall be equal to or greater than the maximum system continuous operating voltage at the point of application.

**242.72 Installation.**
VSGRs shall be installed in accordance with 242.72(A) through (C).

**242.72(A) Service-Supplied Building or Structure.**
VSGR shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91 unless installed in accordance with 230.82(8).

**242.72(B) Feeder-Supplied Building or Structure.**
VSGR shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.

**242.72(C) Separately Derived System.**
VSGR shall be connected on the load side of the first overcurrent device in a separately derived system.

**242.82 Location.**
VSGRs shall be permitted to be located indoors or outdoors and shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

**242.84 Conductor Size.**
Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

**242.90 Connection Between Conductors.**
VSGR connections shall follow the manufacturer's instructions for the system connections.

**242.92 Grounding Electrode Conductor Connections and Enclosures.**
Except as indicated in this article, VSGR grounding connections shall be made as specified in Article 250, Part III. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

**501.35 Overvoltage ~~Surge~~ Protection.**

**501.35(A) Class I, Division 1.**
Overvoltage protection devices, surge arresters, surge-protective devices, and capacitors shall be installed in enclosures identified for Class I, Division 1 locations. Surge-protective capacitors shall be of a type designed for specific duty.

**501.35(B) Class I, Division 2.**
Overvoltage protection devices, surge arresters and surge-protective devices shall be nonarcing, such as metal-oxide varistor (MOV) sealed type, and surge-protective capacitors shall be of a type designed for specific duty. Enclosures shall be permitted to be of the general-purpose type. Overvoltage ~~Surge~~ protection of types other than described in this paragraph shall be installed in enclosures identified for Class I, Division 1 locations.

**502.35 Overvoltage ~~Surge~~ Protection — Class II, Divisions 1 and 2.**
Overvoltage protection devices, surge arresters and surge-protective devices installed in a Class II, Division 1 location shall be in suitable enclosures. Surge-protective capacitors shall be of a type designed for specific duty.

**551.72(E) Connected Devices.**
The use of autotransformers shall not be permitted. The use of listed overvoltage and surge protective devices shall be permitted.

**Table 490.24 Minimum Clearance of Live Parts**

Note: The values given are the minimum clearance for rigid parts and bare conductors under favorable service conditions. They shall be increased for conductor movement or under unfavorable service conditions or wherever space limitations permit. The selection of the associated impulse withstand voltage for a particular system voltage is determined by the characteristics of the overvoltage ~~surge~~ protective equipment.

## 490.48(A) Design and Documentation.

(12) Overvoltage ~~Surge~~ arresters

**620.51(E) Overvoltage ~~Surge~~ Protection.**
Overvoltage protection shall be provided where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, a legally required system load, or a critical operation power system load, ~~listed surge protection shall be provided.~~

**645.18 Overvoltage ~~Surge~~ Protection for Critical Operations Data Systems.**
Overvoltage ~~Listed surge~~ protection shall be provided for critical operations data systems.

**670.6 Surge Protection.**
Industrial machinery with safety interlock control devices not effectively protected from voltage surges on the incoming supply circuit shall have overvoltage ~~surge~~ protection installed.

**694.7(D) Overvoltage Protection ~~Surge Protective Devices (SPD).~~**
Overvoltage protection ~~A surge protective device~~ shall be installed between a wind electric system and any loads served by the premises electrical system. The ~~surge~~ protective device shall be permitted to be a VSGR, or a Type 3 SPD on the circuit serving a wind electric system, or a Type 2 SPD located anywhere on the load side of the service disconnect. Overvoltage ~~Surge~~ protective devices shall be installed in accordance with Part II of Article 242.

**695.15 Overvoltage ~~Surge~~ Protection.**
Overvoltage ~~A listed surge~~ protection ~~device~~ shall be provided for ~~installed in or on~~ the fire pump controller.

**700.8 Overvoltage ~~Surge~~ Protection.**
Overvoltage protection ~~A listed SPD~~ shall be provided ~~installed in or on~~ for all emergency systems switchboards and panelboards.

**708.20(D) Overvoltage ~~Surge~~ Protection ~~Devices~~.**

Surge protection devices shall be provided at all facility distribution voltage levels

## Public Input No. 3726-NFPA 70-2020 [ Section No. 700.8 ]

**700.8** ~~Surge Protection~~ 8 Overvoltage Protection .

A listed surge-protective device ( SPD) shall be installed in accordance with Part II of Article 242 in or on all emergency systems switchboards and panelboards.

## Statement of Problem and Substantiation for Public Input

The purpose of this public input is to correlate and harmonize all of the current sections of the code where “overvoltage protection” is required by:

1. Changing the section titles to “Overvoltage Protection” to properly correlate with Article 242.

2. Correcting the product description to “listed surge-protective device (SPD)” which is defined in Article 100 and correlates with Article 242.

3. Adding a pointer to “Part II. of Article 242” to ensure compliance with all of the requirements for SPDs are met when complying with the rule.

This public input is one of eleven correlating public inputs covering Sections 230.67, 501.35, 502.35, 620.51(E), 645.18, 670.6, 694.7(D), 695.15, 700.8, 708.20(D), and Informative Annex G

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 11:25:32 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4484-NFPA 70-2020 [ Section No. 700.8 ]

**700.8** Surge Protection.

A listed SPD shall be installed in or on all emergency systems switchgear, switchboards and panelboards.

## Statement of Problem and Substantiation for Public Input

The term "switchgear" was added throughout the NEC in the 2014 cycle, but was not included in this rule because it only arrived in 2014 and therefore escaped CMP 9 notice as it swept through the 2011 NEC generating approximately 45 panel proposals to update all such references. This PI creates the required reference.

## Submitter Information Verification

**Submitter Full Name:** Frederic Hartwell
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**Submittal Date:** Thu Sep 10 13:55:48 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2850-NFPA 70-2020 [ New Section after 700.10 ]

**TITLE OF NEW CONTENT**

**700.11 Wiring, Power over Ethernet and other Class-2-Powered Emergency Lighting Systems.**

**(A) Identification.** Emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system by the following methods:

(1) All boxes and enclosures for PoE emergency circuits shall be permanently marked as a component of an emergency circuit or system.

(2) Where boxes or enclosures are not encountered, exposed cable, cable tray or raceways systems shall be permanently marked to be identified as a component of an emergency circuit or system, within 0.3m (1ft) of each connector and at intervals not to exceed 7.6 m (25 ft).

(3) Emergency cables where bundled in visible locations shall be placed as close as practicable to the outer edge of the bundle so that the identification method is visible.

**(B) Separation of Circuits.** Class 2 emergency circuits shall be wired in a Listed, jacketed cable or with one of the wiring methods of Chapter 3. Separation from non-emergency Class 2 circuits shall not be required. Separation from other circuits shall comply with 725.136.

**(C) Protection.** Where subject to physical damage, wiring shall comply with the requirements of 300.4, and be installed in a raceway, armored or metal-clad cable, or cable tray.

## Statement of Problem and Substantiation for Public Input

This PI was developed by a correlating committee task group consisting of:
Joe Schomaker, Eaton, MO [M] CMP-11
Steve Terry, Electronic Theater Controls Inc., NY, US Institute for Theater Technology [M] CMP-15
Fred Carpenter, Acuity Brand Lighting, NEMA [M] CMP-18
Michael Shulman, UL LLC,
Chad Jones, Cisco Systems, OH [M] CMP-3
George Zimmerman, CME Consulting, Inc., CA, Ethernet Alliance [SE] CMP-3
Mike O'Boyle, Signify, American Lighting Association [M] CMP-18
Steve Froemming, City of Franklin, WI, IAEI [E] CMP-13
Dan Caron, Bard, Rao + Athanas Consulting Engineers, LLC [SE], CMP-13

Driven by the availability of new technologies such as Power over Ethernet and low-power-consumption LED luminaires, a new type of emergency lighting system has emerged in the last three years. These systems utilize Class 2 conductors to deliver power, control signals or both, from a central device to one or more emergency luminaires. These luminaires are directly controlled emergency luminaires covered by 700.24.
The current requirements of article 700 regarding wiring of emergency circuits are directed to line-voltage circuits. When the emergency system utilizes Class 2 circuits, additional alternative requirements are needed to insure the system is installed with equivalent performance and safety to those systems using line-voltage conductors. For clarity this PI adds a new section covering Class 2 emergency lighting circuits.
(A) Identification: since these systems use Class 2 conductors, acceptable methods of identification for emergency circuits must be specified in order to be consistently applied to Class 2 wiring methods
(B) Separation of Circuits: The separation of line-voltage emergency circuits required by 700.10(B) exists to prevent damage or destruction of these circuits from faults in adjacent non-emergency circuits. For a PoE or other Class 2 emergency circuit covered by 700.11, there is a significantly

reduced probability of destruction or damage caused by adjacent circuit faults, due to the power-limited nature of these circuits. Therefore, physical separation of these Class 2 circuits from other Class 2 circuits would not provide an increase in reliability and is therefore not required.
(C) Protection: In cases where they might be subject to physical damage, Class 2 wiring methods do not provide suitable protection for emergency circuit conductors. In such cases, Class 2 emergency circuit conductors must be installed in a raceway, armored or metal-clad cable or cable tray in order to provide adequate protection against physical damage.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 02 15:04:50 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2235-NFPA 70-2020 [ Section No. 700.10(A) ]

**(A)** Identification.

Emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system by the following methods:

(1) All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked as a component of an emergency circuit or system.

(2) Where boxes or enclosures are not encountered, exposed cable or raceway systems shall be permanently marked to be identified as a component of an emergency circuit or system, at intervals not to exceed 7.6 m (25 ft).

Receptacles supplied from the emergency system shall have a distinctive color or marking on the receptacle cover plates or the receptacles. This color shall only be used for the emergency system

## Statement of Problem and Substantiation for Public Input

We run into many areas that use red for both life safety (NEC 700) & optional standby (especially hospitals).There is nothing in the code that mandates the color used shall only be used for the emergency system. This change would make it easier for inspectors, installers & users.

## Submitter Information Verification

**Submitter Full Name:** James Dorsey
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**Submittal Date:** Wed Aug 12 10:02:39 EDT 2020
**Committee:** NEC-P13

## Public Input No. 142-NFPA 70-2019 [ Section No. 700.10(B) ]

**(B)** Wiring.

Wiring from an emergency source or emergency source distribution overcurrent protection to emergency loads shall be kept entirely independent of all other wiring and equipment unless otherwise permitted in 700.10(B)(1) through (B)(5):

(1) Wiring from the normal power source located in transfer equipment enclosures

(2) Wiring supplied from two sources in exit or emergency luminaires

(3) Wiring from two sources in a listed load control relay supplying exit or emergency luminaires, or in a common junction box, attached to exit or emergency luminaires

(4) Wiring within a common junction box attached to unit equipment, containing only the branch circuit supplying the unit equipment and the emergency circuit supplied by the unit equipment

(5) ***Emergency circuits contained within elevator equipment***

(6) Wiring from an emergency source to supply emergency and other (nonemergency) loads in accordance with 700.10(B)(5)a., (B)(5)b., (B)(5)c., and (B)(5)d. as follows:

(7) Separate vertical switchgear sections or separate vertical switchboard sections, with or without a common bus, or individual disconnects mounted in separate enclosures shall be used to separate emergency loads from all other loads.

(8) The common bus of separate sections of the switchgear, separate sections of the switchboard, or the individual enclosures shall be either of the following:

(9) Supplied by single or multiple feeders without overcurrent protection at the source

(10) Supplied by single or multiple feeders with overcurrent protection, provided that the overcurrent protection that is common to an emergency system and any nonemergency system(s) is selectively coordinated with the next downstream overcurrent protective device in the nonemergency system(s)

Informational Note: For further information, see Informational Note Figure 700.10(B)(a) and Informational Note Figure 700.10(B)(b) .

**Figure Informational Note Figure 700.10(B)(a) Single or Multiple Feeders Without Overcurrent Protection.**

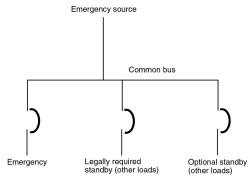
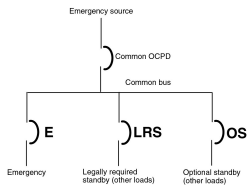



**Figure Informational Note Figure 700.10(B)(b) Single or Multiple Feeders with Overcurrent Protection.**




(11) Emergency circuits shall not originate from the same vertical switchgear section,

vertical switchboard section, panelboard enclosure, or individual disconnect enclosure as other circuits.

(12) It shall be permissible to utilize single or multiple feeders to supply distribution equipment between an emergency source and the point where the emergency loads are separated from all other loads.

Wiring of two or more emergency circuits supplied from the same source shall be permitted in the same raceway, cable, box, or cabinet.

## Statement of Problem and Substantiation for Public Input

Emergency circuits are, at times, required to feed the car lighting in an elevator to satisfy the commercial building code. The circuits are contained within the same traveling cable to the car. This change is only making this standard practice legal.

## Submitter Information Verification

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**Submittal Date:** Fri Nov 22 13:49:49 EST 2019
**Committee:** NEC-P13

## Public Input No. 4372-NFPA 70-2020 [ Section No. 700.10(D)(1) ]

**(1)** Occupancies.

Emergency systems shall meet the additional requirements in 700.10(D)(2) through (D)(4) in the following occupancies:

(1) Assembly occupancies for not less than 1000 persons

(2) Buildings above 23 m (75 ft) in height [building height needs clarification - see comments]

(3) Educational occupancies with more than 300 occupants

## Statement of Problem and Substantiation for Public Input

It would be great if the committee can review this section and provide additional detail:
1. Is the 75' to the very highest point of the structure, elevator bulkhead, roof landing, etc?
2. Or, is the 75' an exact reference to the IBC definition of high-rise, "a building with an occupied floor located more than 75' above the lowest level of fire department vehicle access"?

We've designed numerous 6-story projects where the highest occupied floor is less than 75' but the height of the structure is well over 75'. In one specific municipality, the AHJ has previously interpreted the code to mean from the fire department access lane to the absolute tallest point of the building structure. We understanding that's exactly how the NEC bluntly reads, however, typically in a 6-story building clients eliminate the additional cost of designing a high-rise per the IBC so we also want to eliminate the additional cost of 2-hr rated infrastructure, if permitted.

## Submitter Information Verification

**Submitter Full Name:** Greg Livengood
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**State:**
**Zip:**
**Submittal Date:** Thu Sep 10 11:25:28 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1036-NFPA 70-2020 [ Section No. 700.10(D)(2) ]

**(2)** Feeder-Circuit Wiring.

Feeder-circuit wiring shall meet one of the following conditions:

(1) The cable or raceway is installed in spaces or areas that are fully protected by an approved automatic fire protection system.

(2) The cable or raceway is protected by a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note No. 1: Electrical circuit protective systems could include but not be limited to thermal barriers or a protective shaft and are tested to UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(4) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours and contains only emergency circuits.

(5) The cable or raceway is encased in a minimum of ~~50 mm~~ 127 mm (~~2 in~~ 5 in .) of concrete.

## Statement of Problem and Substantiation for Public Input

In December of 2018 the NFPA Fire Research Foundation published their findings on the fire resistance ratings of concrete protecting electrical conductors. The summary of this report illustrates that in order to provide the minimum required 2 hour fire rating, the minimum concrete encasement without specifying the type of concrete should be 127 mm or 5 inches.

https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Electrical/RFFireResistanceOfConcreteForElectricalConductors.pdf

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1034-NFPA 70-2020 [Section No. 695.14(F)] | fire rating of concrete |
| Public Input No. 1035-NFPA 70-2020 [Section No. 695.6(A)(2)] | fire rating of concrete |
| Public Input No. 1037-NFPA 70-2020 [Section No. 708.10(C)(2)] | |

## Submitter Information Verification

**Submitter Full Name:** Brian Baughman

| | |
|---|---|
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| **Street Address:** | |
| **City:** | |
| **State:** | |
| **Zip:** | |
| **Submittal Date:** | Tue May 12 14:28:29 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 1826-NFPA 70-2020 [ Section No. 700.10(D)(2) ]

**(2)** Feeder-Circuit Wiring.

Feeder-circuit wiring shall meet one of the following conditions:

(1) The cable or raceway is installed in ~~spaces or areas that~~ occupancies that are fully protected by an approved automatic fire protection system in conformance with the appropriate standard .

(2) The cable or raceway is protected by a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note No. 1: Electrical circuit protective systems could include but not be limited to thermal barriers or a protective shaft and are tested to UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(4) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours and contains only emergency circuits.

(5) The cable or raceway is encased in a minimum of 50 mm (2 in.) of concrete.

## Statement of Problem and Substantiation for Public Input

The standard contains a conflict within the NFPA Standard or within another NFPA Standard. Sprinkler systems in conformance with NFPA 13 may or may not have sprinkler protection in every void, shaft, or interstitial space in a building and still protect the building from the spread of fire in all areas of the building. NFPA 70 purports NFPA 13 is inadequate and the building would require additional sprinkler coverage to protect Emergency Feeder Circuits. Occupancies with sprinklers in conformance with "NFPA 13 Standard for the Installation of Sprinkler Systems" have a death rate 87% lower per 1000 reported fires than properties with no automatic extinguishing systems. In addition to the obvious problem of conflicting standards and which AHJ or Engineer of record is responsible for the installation, in a practical sense how does the electrician, electrical designer, or the electrical AHJ coerce the sprinkler designer to add coverage above suspended ceilings, unaccessible voids and shafts not required by NFPA 13? They can't.

## Submitter Information Verification

**Submitter Full Name:** Lawrence Forshner
**Organization:** Bard Rao Athanas Consulting
**Affiliation:** self

| | |
|---|---|
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| **Zip:** | |
| **Submittal Date:** | Thu Jul 09 16:09:24 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 2155-NFPA 70-2020 [ Section No. 700.10(D)(2) ]

**(2)** Feeder-Circuit Wiring.

Feeder-circuit wiring shall meet one of the following conditions:

(1) The cable or raceway is installed in spaces or areas that are fully protected by an approved automatic fire protection system.

(2) The cable or raceway is ~~protected by~~ part of a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note ~~No. 1:~~ ~~Electrical circuit protective systems could include but not be limited to thermal barriers or a protective shaft and are tested to UL 1724~~ : One method of defining an Electrical Circuit Protective Systems is by establishing a rating when tested in accordance with UL 1724 , *Fire Tests for Electrical Circuit* ~~Protection Systems. Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire~~ *Protective Systems.* *UL Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minium 2-hour fire-resistive rating.

(3) The cable or raceway is part of a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note

~~No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, Standard for~~

- 
- : One method of defining a fire-resistive cable system is by establishing a rating when tested in accordance with UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables* .

~~Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire~~

- 
- ~~*UL Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minium 2-hour fire-resistive rating.~~

- ~~The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours and contains only emergency circuits.~~
- ~~The cable or raceway is encased in a minimum of 50 mm (2 in.) of concrete.~~

## Statement of Problem and Substantiation for Public Input

The language is revised to reflect the proper title of the standards, deleting the reference to ANSI at UL's request, and revising to show the allowable methods to protect the cables.This public input is a result of the Correlating Committee Task Group for Circuit Integrity Cable efforts to correlate information on Circuit Integrity (-CI) cable throughout the NEC®. Members of the task group included Blake Shugarman from UL – Principal Engineer for Circuit Integrity Systems, Larry Shudak from UL - Principal Engineer for Life Safety Technologies and member of NFPA 72, Anthony Tassone from UL – Principal Engineer Seasonal and Holiday Decorative Products and Telecommunications Cables - CMP16, Jim Conrad from Marmon Innovation and Technology Group – CMP13, George Straniero from

AFC Cable Systems – CMP6, CMP3, and CC, Paul Casparro from IBEW – CMP3, and Rich Holub from DuPont – CMP14 and CC.

## Submitter Information Verification

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**Submittal Date:** Tue Aug 04 14:13:32 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3710-NFPA 70-2020 [ Section No. 700.10(D)(2) ]

**(2)** Feeder-Circuit Wiring.

Feeder-circuit wiring shall meet one of the following conditions:

(1) The cable or raceway is installed in spaces or areas that are fully protected by an approved automatic fire protection system.

(2) The cable or raceway is protected by a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note No. 1: Electrical circuit protective systems could include but not be limited to thermal barriers or a protective shaft and are tested to UL 1724, *Fire Tests for Electrical Circuit Protection Systems*.

Informational Note No. 2: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(4) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours and contains only emergency circuits.

(5) The cable or raceway is encased in a minimum of ~~50 mm~~ 125 mm (~~2 in~~ 5 in .) of concrete.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 700-10.docx | Detailed substantiation for proposed changes to 700.10 | |

## Statement of Problem and Substantiation for Public Input

Following the NFPA Research Foundation report “Fire Resistance of Concrete for Electrical Conductors” review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada (NBCC), using the terminology “Fire Resistance Rating” where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on aggregate types (table included in attached documentation).

While not exactly the same between these two reports, both detail the same general information that 2”

(50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3685-NFPA 70-2020 [Section No. 695.6(A)(2)] | Proposed changes to similar section addressing same concern. |

## Submitter Information Verification

**Submitter Full Name:** Ryan Drury
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**Zip:**
**Submittal Date:** Wed Sep 09 11:13:11 EDT 2020
**Committee:** NEC-P13

700.10 Wiring, Emergency Systems

(D) Fire Protection

(2) Feeder Circuit Wiring

Feeder Circuit Wiring shall meet one of the following conditions:

(5) The cable or raceway is encased in ~~50 mm (2 in)~~ 125 mm (5 in)of concrete.

**Substantiation:**

Following the NFPA Research Foundation report "Fire Resistance of Concrete for Electrical Conductors" review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada 2015 Volume 1 (NBCC), using the terminology "Fire Resistance Rating" where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on aggregate types:

**Table D-2.1.1.**
**Minimum Equivalent Thicknesses(1) of Unit Masonry and Monolithic Concrete Walls Loadbearing and Non-Loadbearing, mm**

| Type of Wall | Fire-Resistance Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 min | 45 min | 1 h | 1.5 h | 2 h | 3 h | 4 h |
| Solid brick units (80% solid and over), actual overall thickness | 63 | 76 | 90 | 108 | 128 | 152 | 178 |
| Cored brick units and hollow tile units (less than 80% solid), equivalent thickness | 50 | 60 | 72 | 86 | 102 | 122 | 142 |
| Solid and hollow concrete masonry units, equivalent thickness | | | | | | | |
| Type S or N concrete(2) | 44 | 59 | 73 | 95 | 113 | 142 | 167 |
| Type $L_1$20S concrete | 42 | 54 | 66 | 87 | 102 | 129 | 152 |
| Type $L_1$ concrete | 42 | 54 | 64 | 82 | 97 | 122 | 143 |
| Type $L_2$20S concrete | 42 | 54 | 64 | 81 | 94 | 116 | 134 |
| Type $L_2$ concrete | 42 | 54 | 63 | 79 | 91 | 111 | 127 |
| Monolithic concrete and concrete panels, equivalent thickness | | | | | | | |
| Type S concrete | 60 | 77 | 90 | 112 | 130 | 158 | 180 |
| Type N concrete | 59 | 74 | 87 | 108 | 124 | 150 | 171 |
| Type L40S or Type L concrete | 49 | 62 | 72 | 89 | 103 | 124 | 140 |

While not exactly the same between these two reports, both detail the same general information that 2" (50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

## Public Input No. 2801-NFPA 70-2020 [ Section No. 700.10(D)(4) ]

**(4)** ~~Generator~~ Source Control Wiring.

Control conductors installed between the EPSS/SEPSS and the transfer equipment ~~and the emergency generator~~ or control system that initiate the operation of emergency sources or initiate the automatic connection to emergency loads shall be kept entirely independent of all other wiring and shall meet the conditions of 700.10(D)(2) . _ The integrity of the ~~generator remote start circuit~~ control wiring shall be continuously monitored for broken, disconnected, or shorted wires. _ Loss of integrity shall ~~start the generator~~ be considered a system malfunction, initiate the designated signal (s) in 700 . 6(A), and shall start the emergency source.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The requirements of 700.10(D)(4) have been revised to provide clarity that the control conductors from all approved emergency power sources have to meet the requirements of 700.10(D)(2) and be kept entirely independent of all other wiring. The loss of integrity of the control wiring for all emergency power sources shall also be monitored for any malfunctions, and losses in integrity should signal a system malfunction and start the associated emergency source.

The NFPA system formatting of this change isn't correct. See the Word document attached to PI 2788 for the correct format and the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |

Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)]
Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)]
Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)]
Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)]
Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)]
Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

## Submitter Information Verification

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**Submittal Date:** Tue Sep 01 13:10:58 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3507-NFPA 70-2020 [ Section No. 700.10(D)(4) ]

**(4)** Generator Control Wiring.

Control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring and shall meet the conditions of 700.10(D)(2). The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s). Loss of integrity shall also initiate local audible and visual annunciation and facility remote annunciation, or local audible and visual annunciation and network remote annunciation.

Informational Note: See NFPA 110-2013, Standard for Emergency and Standby Power Systems, Section 5.6.6 for more information on Remote Control and Alarms.

## Statement of Problem and Substantiation for Public Input

Throughout the NFPA standards where monitoring of failure, performance or derangement of equipment is required. Monitoring requires a description of the "act of announcing" the event by visual and or audible means and the location of the announcement to alert personnel. The added text paraphrases NFPA 110 A.5.6.6 as to the minimum "remote alarm annunciation" that would be acceptable to alert personnel at a constantly attended station on site and offsite for a Level 1 system.

## Submitter Information Verification

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**Submittal Date:** Tue Sep 08 19:02:08 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4489-NFPA 70-2020 [ Section No. 700.12(B) ]

**(B)** Equipment Design and Location.

Equipment shall be designed and located so as to minimize the hazards that might cause complete failure due to flooding, fires, icing, and vandalism.

Equipment for sources of power as described in 700.12(C) through (H) shall be installed either in spaces fully protected by approved automatic fire protection systems or in spaces with a 2-hour fire rating where located within the following:

(1) Assembly occupancies for more than 1000 persons

(2) Buildings above 23 m (75 ft) in height~~- with any of the following occupancy classes — assembly, educational, residential, detention and correctional, business, and mercantile~~

(3) Educational occupancies with more than 300 occupants

Informational Note No. 1: For the definition of *Occupancy Classification*, see Section 6.1 of NFPA *101*-2018, *Life Safety Code*.

Informational Note No. 2: For information regarding power system reliability, see IEEE 3006.5-2014, *Recommended Practice for the Use of Probability Methods for Conducting a Reliability Analysis of Industrial and Commercial Power Systems*.

## Statement of Problem and Substantiation for Public Input

The requirement presents important information on protection of emergency power sources for certain occupancies. Inexplicably, and apparently through oversight, this material has never been correlated with the changes in 700.10(D) that struck out the list of occupancy classes within the high-rise building classification. So, on the literal text, this requirement now only applies in the designated occupancy classes. This PI correlates this rule with 700.10(D)(1)(2) and thereby covers all high-rise buildings regardless of specific occupancy designations.

## Submitter Information Verification

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**Submittal Date:** Thu Sep 10 14:05:08 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2802-NFPA 70-2020 [ Section No. 700.12(C) ]

**(C)** ~~Storage Battery~~ Supply Duration .

~~Storage batteries~~
The emergency power source shall be of suitable rating and capacity to supply and maintain the total load for

~~a minimum period of 1 1/2 hours, without the voltage applied to the load falling below 87 1/2 percent of normal. Automotive-type batteries shall not be used.An automatic battery charging means shall be provided~~
the duration determined by the system design. In no case shall the duration be less than 2 hours of system operation unless used for emergency illumination in 700.12(C)(4) or unit equipment in 700.12(I). Additionally, the power source shall comply with the following requirements as applicable.

(1) On-Site Fuel Supply. An on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours operation of the system.

(2) Fuel Transfer Pumps. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to the source, these pumps shall be connected to the emergency power system.

(3) Public Gas System, Municipal Water Supply. Sources shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.

Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.

(4) Storage batteries and Uninterruptible Power Supply systems used to supply emergency illumination shall meet the capacity and performance required by 700.12(I)(2)(1).

(5) Automatic Fuel Source Transfer. Where dual fuel sources are used, means shall be provided for automatically transferring from one fuel source to another .

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The existing requirements for storage batteries are being moved to 700.12(C)(4) with this revision. The title was revised in order to have a common section for the emergency source duration required regardless of the source type(s). Additionally, the fuel supply, storage, and transfer pump requirements included are moved from 700.12(D)(2) since these should apply to any applicable sources and not just generators.

The NFPA formatting of this change isn't correct. See the Word document attached to PI 2788 for the correct format and the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |

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**Submittal Date:** Tue Sep 01 13:15:59 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4374-NFPA 70-2020 [ Section No. 700.12(C) ]

**(C)** Storage Battery.

Storage batteries shall be of suitable rating and capacity as required by 700.12 (A) to supply and maintain the total load for a minimum period of 1½ hours, without the voltage applied to the load falling below 87½ percent of normal. Automotive-type batteries shall not be used.

An automatic battery charging means shall be provided.

## Statement of Problem and Substantiation for Public Input

With the new section 700.12 (A) it is unclear that this type of equipment would require the longer duration time required by section 700.12 (A). If a longer time is required to evacuate the appropriate unit equipment of time duration would also be required, if this cannot be achieved by the unit equipment then an other power source is necessary.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4357-NFPA 70-2020 [Section No. 700.12(I)(2)] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4173-NFPA 70-2020 [ Section No. 700.12(D)(1) ]

**(1)** Prime Mover-Driven.

For a generator set driven by a prime mover approved by the authority having jurisdiction and sized in accordance with 700.4, means shall be provided for automatically starting the prime mover on failure of the normal ~~service~~ power source and for automatic transfer and operation of all required electrical circuits. A time-delay feature shall be provided to avoid retransfer in case of short-time reestablishment of the normal source.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious

injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 1038-NFPA 70-2020 [ Section No. 700.12(D)(2) ]

**(2)** Internal Combustion Engines as Prime Movers.

(a) *On-Site Fuel Supply.* Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours' operation of the system.

(b) *Fuel Transfer Pumps.* Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the emergency power system.

(c) *Public Gas System, Municipal Water Supply.* Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.

*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.* *Where off-site fuel is approved, the requirements of 700.12(D)(2)(a) shall not apply.*

(d) *Automatic Fuel Transfer.* Where dual fuel supplies are used, means shall be provided for automatically transferring from one fuel supply to another.

## Statement of Problem and Substantiation for Public Input

The exception in 700.12(D)(2)(c) allows the AHJ of approve the use of off-site fuel, like a public gas system. Since the exception applies only to line item (c) , the requirement for 2 hours of on-site fuel in (a) can be enforced by the AHJ. With a utility public gas fuel system there is no practical method to store 2 hours worth of utility natural gas in a tank as is common with diesel fuel or liquid propane fuel. The storage capacity of fuel is built into the utility infrastructure. The proposed language to the exception will provide clarity that when the public utility gas system is the sole source of fuel for the generator, there is no need for the storage of 2 hours worth of fuel.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1039-NFPA 70-2020 [Section No. 701.12(D)(3)] | off-site fuel requirements |
| Public Input No. 1039-NFPA 70-2020 [Section No. 701.12(D)(3)] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2561-NFPA 70-2020 [ Section No. 700.12(D)(2) ]

**(2)** Internal Combustion Engines as Prime Movers.

(a) *On-Site Fuel Supply.* Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours' operation of the system at all times .

(b) *Fuel Transfer Pumps.* Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the emergency power system.

(c) *Public Gas System, Municipal Water Supply.* Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.

*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.*

(d) *Automatic Fuel Transfer.* Where dual fuel supplies are used, means shall be provided for automatically transferring from one fuel supply to another.

## Statement of Problem and Substantiation for Public Input

Since generator sets are required to be tested on a regular basis, and the timing of a normal service failure can't be predicted, it is quite possible that a generator with a "2-hour" tank will not have 2-hours worth of fuel in it. Consequently, if the desired ability to maintain power two hours to be achieved, the machine must always have at least 2 hours of fuel available.

## Submitter Information Verification

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**Submittal Date:** Mon Aug 24 17:25:16 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2803-NFPA 70-2020 [ Section No. 700.12(D)(2) ]

~~**(2)** Internal Combustion Engines as Prime Movers.~~

~~(a) *On-Site Fuel Supply.* Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours' operation of the system.~~

~~(b) *Fuel Transfer Pumps.* Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the emergency power system.~~

~~(c) *Public Gas System, Municipal Water Supply.* Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.~~

~~*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.*~~

~~(d) *Automatic Fuel Transfer.* Where dual fuel supplies are used, means shall be provided for automatically transferring from one fuel supply to another.~~

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The requirements in 700.12(D)(2) were moved to 700.12(C) to correlate with a task group public input to that section. The requirements apply to more than just generator sources and this action moves them into a common requirement section.

See the Word document attached to PI 2788 for the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |

Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]
Public Input No. 2788-NFPA 70-2020 [Section No. 700.2]
Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)]
Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)]
Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)]
Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)]
Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)]
Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)]
Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)]
Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

## Submitter Information Verification

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**Submittal Date:** Tue Sep 01 13:21:13 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4165-NFPA 70-2020 [ Section No. 700.12(D)(2) ]

**(2)** Internal Combustion Engines as Prime Movers.

(a) *On-Site Fuel Supply.* Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours' operation of the system.

(b) *Fuel Transfer Pumps.* Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the ~~emergency power system~~ emergency system .

(c) *Public Gas System, Municipal Water Supply.* Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.

*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.*

(d) *Automatic Fuel Transfer.* Where dual fuel supplies are used, means shall be provided for automatically transferring from one fuel supply to another.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110

and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word “system” since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 663-NFPA 70-2020 [ Section No. 700.12(D)(3) ]

**(3)** Battery Power and ~~Dampers~~ Auxiliary Equipment .

Where ~~a storage battery is used for control or signal~~ the following equipment is used, it shall be connected to the emergency system.

(1) Automatic battery chargers for Storage battery(ies) systems used for controlling, monitoring, and signaling power or as the means of starting the prime mover,

~~it~~

(1) the storage battery (ies) shall be suitable for the purpose

~~and shall be equipped with an automatic charging means independent of the generator set. Where the battery charger is required for the operation of the generator set, it shall be connected to the emergency system. Where power is required for the operation of dampers used to ventilate the generator set, the dampers shall be connected to the emergency system.~~

(1) .

(2) Block heater required for starting the prime mover.

(3) Damper valves or motors used to ventilate.

(4) Combustion air intake damper valves or motors supplying prime mover

(5) Fuel pumps supplying the prime mover

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 700.12_B_4.docx | 700.12 B (4) | |

## Statement of Problem and Substantiation for Public Input

Teraview messed up numbers please see attached, currently not all equipment that is required to start and keep the prime mover operational are addressed, I was in a base building in DC where the genset was installed three floors below grade requiring fresh make-up air for combustion in addition to damper valves and fuel pumps. This change is now in a easy to read format. keeping the block heater on the emergency system enhances the integrity of the branch circuit supplying the heater and combustion air and fuel is vital to the operation of the system

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**Committee:** NEC-P13

# Public Input No. 2598-NFPA 70-2020 [ Section No. 700.12(D)(5) ]

~~**(5)** Outdoor Generator Sets.~~

~~Where an outdoor-housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18 , and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36 .~~

~~*Exception: For installations under single management, where conditions of maintenance and supervision ensure that only qualified persons will monitor and service the installation and where documented safe switching procedures are established and maintained for disconnection, the generator set disconnecting means shall not be required to be located within sight of the building or structure served.*~~

## Statement of Problem and Substantiation for Public Input

The text is not being deleted, it is being relocated to 445.18 as proposed in PI-2594

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2594-NFPA 70-2020 [Section No. 445.18] | Generator disconnecting means |
| Public Input No. 2603-NFPA 70-2020 [Section No. 708.20(F)] | Generator disconnecting means |
| Public Input No. 2600-NFPA 70-2020 [Section No. 701.12(D)(5)] | Generator disconnecting means |
| Public Input No. 2601-NFPA 70-2020 [Section No. 702.12] | Generator disconnecting means |
| Public Input No. 2600-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 2601-NFPA 70-2020 [Section No. 702.12] | |
| Public Input No. 2603-NFPA 70-2020 [Section No. 708.20(F)] | |

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**Committee:** NEC-P13

(3) Battery Power and Auxiliary Equipment.

(A) Where the following equipment is used, it shall be connected to the emergency system.

1. Automatic battery chargers for Storage battery(ies) systems used for controlling, Monitoring, and signaling power or as the means of starting the prime mover, the storage battery (ies) shall be suitable for the purpose.
2. Block heater required for starting the prime mover.
3. Damper valves or motors used to ventilate.
4. Combustion air intake motors supplying prime mover
5. Fuel pumps supplying the prime mover

## Public Input No. 265-NFPA 70-2020 [ Section No. 700.12(D)(5) ]

**(5)** Outdoor Generator Sets.

Where an outdoor-housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means for the building or structure shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

*Exception: For installations under single management, where conditions of maintenance and supervision ensure that only qualified persons will monitor and service the installation and where documented safe switching procedures are established and maintained for disconnection, the generator set disconnecting means shall not be required to be located within sight of the building or structure served.*

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| generator_shutdown_means_ecm.pdf | | |

## Statement of Problem and Substantiation for Public Input

Due to the 2017 changes in 445.18, this wording became unclear as to which disconnecting means is being referred to when it says, "an additional disconnecting means shall not be required."

It was the 2017 NEC that introduced a new requirement for generators, 445.18(B), to have 2 means of disconnect for prime mover for any generator greater than 15kW rating. Contractors and engineers are getting confused when emergency systems are being supplied via generator -- as to exactly what disconnecting means shall not be required per 700.12(D)(5). This happens so much so, that an article was written on this very subject in EC&M magazine. I have included a copy of the full article. It helps to illustrate what I'm talking about. Here is a snippet:

https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

"I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional “disconnecting means” is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives."

I also mention this in an article that I wrote, which can be found here:

https://www.ecmag.com/section/codes-standards/exit-lighting-and-emergency-lighting-without-battery-backup-fed-generator

"What Article 700.12(B)(6) speaks of is the disconnecting means for the building and is merely stating that the 445.18(B) disconnecting means for the generator can be used to meet Article 225.31 and 225.32 requirements. The 2017 NEC Handbook confirms this. In my opinion, the sentence should have been written like this:

Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in

accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means for the building shall not be required where ungrounded conductors serve or pass through the building or structure.

Article 700.12(B)(6) points to an entirely different Code requirement and has no detrimental effect on 445.18(B). So don't be confused here—generators with greater than a 15-kilowatt rating must still be provided with two 445.18(B) Code-compliant means to shut down the prime mover start controls. This holds true for both interior and exterior generators greater than 15 kilowatts.

And just to recap—if there is a generator enclosure, the second disconnecting means must be located somewhere outside of the generator enclosure."

So adding the five words, "for the building or structure" totally clarifies the meaning of 700.12(D)(5) such that it cannot be confused with the required disconnecting means for generator. Reason for change is clarity.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 283-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 284-NFPA 70-2020 [Section No. 702.12(A)] | |
| Public Input No. 285-NFPA 70-2020 [Section No. 708.20(F)(5)] | |
| Public Input No. 283-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 284-NFPA 70-2020 [Section No. 702.12(A)] | |
| Public Input No. 285-NFPA 70-2020 [Section No. 708.20(F)(5)] | |

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**Committee:** NEC-P13

EC&M®



NATIONAL ELECTRICAL CODE

# Generator Shutdown Means

Change to the 2017 NEC requires both exterior and interior generators to have a second means of shutting down the prime mover.

Krista McDonald Biason

MAY 19, 2017

Most of my previous articles have focused on big electrical "system" issues, complex design issues, or issues of controversy — but the topic for this article is a bit different. I want to focus on a single Code requirement — the shutdown requirements for a prime mover (aka, generator). The original intent of this article was to quickly highlight a change in the 2017 NEC, but being a Code nerd I started crosschecking other Sections in the Code to validate alignment of this new directive. Once I started doing this, the "simple" topic became significantly more complex.

Section 445.18 was revised in the 2017 National Electrical Code. In the 2014 version, this section was titled "Disconnecting Means Required for Generators." It is now titled "Disconnecting Means and Shutdown of Prime Movers" and is split into Sections (A) "Disconnecting Means" and (B) "Shutdown of Prime Mover." The general intent of this requirement is very similar to what it was in the 2014 edition with one significant exception. Section 445.18(B) now indicates: "Generators with greater than 15kW rating shall be provided with an additional requirement to shut down the prime mover. This additional shutdown means shall be located outside the equipment room or generator enclosure and shall also meet the requirements of Sec. 445.18(B)(1) and (B)(2)."

What this means is that both exterior and interior generators are required to have a second means of shutting down the prime mover. This second means is to be a remote shutdown (stop) that is not physically located on the prime mover, on the prime mover enclosure, or within the room that the prime mover is located.

I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional "disconnecting means" is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives.

Article 5.6.5.6 in NFPA 110, "Standard for Emergency and Standby Power Systems" (2016 edition), requires that "All installations shall have a remote manual stop station of a type to prevent inadvertent or unintentional operation located outside the room housing the prime mover, where so installed, or elsewhere on the premises where the prime mover is located outside the building." After reading this Article 43 times, I still think the wording is awkward. The Annex information for the Article states: "For systems located outdoors, the manual shutdown should be located external to the weatherproof enclosure and should be appropriately identified." This helps clarify

that the intent of the Article is that a manual shutdown is required for exterior generators and that the shutdown station cannot be located within the generator enclosure. What the Annex doesn't quite clarify is the statement of "all installations shall have a remote manual stop station" portion. If the commas were relocated, this Article could be interpreted to actually be closely aligned with the changes in Sec. 445.18 of the 2017 NEC. The revisions to 445.18 now indicate that the remote manual stop cannot be located on the enclosure, so that verbiage is more stringent than NFPA 110.

So, after an exhausting analysis of NFPA 70 and NFPA 110, the summary of the "simple" Code change I was hoping to convey is: Both interior and exterior generators require a secondary remote stop, and that remote stop to shut down the prime mover and the remote stop station cannot be located within the same room as the prime mover or located on an exterior generator enclosure. (Note I did say exhausting — not exhaustive search. As with most Code items, once you start down the rabbit hole, there is always another Code reference that will suck you in and add to your analysis.)

**Source URL:** https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

## Public Input No. 2428-NFPA 70-2020 [ Section No. 700.12(E) ]

**(E)** Uninterruptible Power Supplies.

Uninterruptible power supplies used to provide power for emergency systems shall comply with ~~the applicable provisions of~~ all of the following:

(1) Listed or identified for emergency use.

(2) Shall not be installed the same room containing supply equipment rated over 150 volts to ground and 1000 amp and over.

(3) The emergency system shall begin at the OCPD suppling the UPS to the utilization equipment, luminary or outlet supplied.

The provisions of this section shall not apply if the UPS is supplied from a source listed in 700.12 ( ~~B~~ D ) (F) and (~~C~~ G ).~~.~~

## Statement of Problem and Substantiation for Public Input

It actually not clear if this equipment needs to be identified for emergency use. the product is readily available and UL has a standard (924) to cover the equipment. NFPA 111 prohibits this equipment in this location so this would be a natural extension for that requirement when NFPA 111 is not adopted. there is also some misunderstanding of where the emergency system starts and ends this would make it easier to apply all the rules required in 700

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## Public Input No. 2804-NFPA 70-2020 [ Section No. 700.12(E) ]

**(E)** ~~Uninterruptible Power Supplies.~~

~~Uninterruptible power supplies used to provide power for emergency systems shall comply with the applicable provisions of 700.12(B) and (C).~~

**Stored-Energy Power Supply Systems (SEPSS).**

Stored-Energy Power Supply Systems shall comply with all of the following:

(1) Systems shall consist of one or more of the following system types:

(2) Uninterruptible Power Supply (UPS). Informational Note: For further information, see UL 1778, *Uninterruptible Power Systems* .

(3) Fuel Cell System. Fuel cell systems used as a source of power shall also meet the requirements of Article 692.

(4) Energy Storage System (ESS). The installation of an energy storage system shall also meet the requirements of Article 706.

(5) Storage Battery. A storage battery used as a source of power for dc loads shall also comply with Article 480.

(6) Other approved equivalent stored-energy sources that comply with 700.12.

(7) Systems shall be Installed with the fire protection and suppression, ventilation and separation requirements specified in the manufacturer's instructions or equipment listing.

Informational Note: Additional information on fire protection installation requirements can be found in NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems;* NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems.*

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

These changes are intended to expand what can be utilized for the newly defined stored-energy power supply systems (SEPSS) to include a number of different technologies that are currently available and can be used for this application including UPS, fuel cell systems, ESS, storage batteries for DC loads and an "other" option since these technologies may not represent an all-inclusive list.

The NFPA formatting for this public input has incorrect numbering. See the Word document attached to PI 2788 for the correct format and complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |

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**Committee:** NEC-P13

## Public Input No. 2952-NFPA 70-2020 [ Section No. 700.12(F) ]

**(F)** Separate Service.

Where approved by the authority having jurisdiction as suitable for use as an emergency source of power, an additional service shall be permitted. This service shall be in accordance with the applicable provisions of Article 230 and the following additional requirements:

(1) Separate overhead service conductors, service drops, underground service conductors, or service laterals shall be installed.

(2) The service conductors for the separate service shall be installed sufficiently remote electrically and physically from any other service conductors to minimize the possibility of simultaneous interruption of supply in accordance with 230 .72(B).

## Statement of Problem and Substantiation for Public Input

Adding the reference to 230.72(B) provides more continunity for the reader.

230.72(B) Additional Service Disconnecting Means. The one or more additional service disconnecting means for fire pumps, emergency systems, legally required standby, or optional standby services permitted by 230.2 shall be installed remote from the one to six service disconnecting means for normal service to minimize the possibility of simultaneous interruption of supply.

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## Public Input No. 2806-NFPA 70-2020 [ Section No. 700.12(G) ]

~~(G) Fuel Cell System.~~

~~Fuel cell systems used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.~~

~~Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.~~

~~Where a single fuel cell system serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the emergency standby system.~~

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The requirements in 700.12(G) for fuel cell systems were moved into the revised 700.12(E) for stored-energy power supply systems in a public input submitted to that section by the task group.

See the Word document attached to PI 2788 for the complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |

Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)]
Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)]
Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)]
Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)]
Public Input No. 2808-NFPA 70-2020 [Section No. 700.12(H)]

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2808-NFPA 70-2020 [ Section No. 700.12(H) ]

**(H)** ~~DC~~ Microgrid Systems.

~~Sources~~

On-site sources, designated as emergency sources, shall be permitted to be connected to a

~~dc~~

microgrid system

~~shall be permitted where the system is capable of being isolated~~

.

The system shall isolate the emergency system from all non-emergency

~~sources.~~

~~DC microgrid systems used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total emergency load for not less than 2 hours of full-demand operation.~~

~~Where a dc microgrid system source serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the emergency standby system~~

loads when the normal electric supply is interrupted or shall meet the requirements of 700.4(C). Interruption, partial or complete failure of the normal or non-emergency source(s) shall not impact the availability, capacity and duration provided by the designated emergency sources.

Designated stored-energy electrical emergency power source(s) of a microgrid system shall be permitted to remain interconnected to any available power production source during the emergency source(s) operation where the lack of, or failure, of the interconnected power production source(s), or related controls, does not impact system operation. Interconnected power production sources, other than the designated stored emergency power source(s) shall not be required to meet the requirements of Article 700 .

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy (Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

Modifying this section to recognize that there are different types of microgrids, in addition to any that might be categorized as dc only. The first sentence is similar to the 2020 language but modified to include other microgrid configurations. New second sentence clarifies that, similar to optional standby systems, non-emergency loads are permitted to be supplied by the emergency sources within the microgrid but these shall be isolated from the emergency sources during emergency operation, or shall be controlled per 700.4(C). Language to address the condition where there is a failure of one or more interconnected sources not categorized as emergency sources is addressed in the third sentence. Failures with emergency sources require a malfunction signal in 700.6 however other sources are not included so this language has been added. This language would require that an evaluation of these conditions is considered in the installation of such a system.

The final paragraph provides and allowance that where a stored-energy emergency source, such as a battery or ESS, is used as part of the emergency power system, it shall be permitted to be charged by other sources, not just those categorized as emergency sources. This is not a blanket allowance however, since an evaluation must be performed to ensure that the lack of any of these sources, or any failure within them, will not impact the ability of the emergency system to supply the emergency loads.

The formatting shown within the NFPA system isn't correct. See the Word document attached to PI 2788 for the correct formatting and complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |
| Public Input No. 2788-NFPA 70-2020 [Section No. 700.2] | |
| Public Input No. 2789-NFPA 70-2020 [Section No. 700.4(B)] | |
| Public Input No. 2793-NFPA 70-2020 [Section No. 700.4(C)] | |
| Public Input No. 2794-NFPA 70-2020 [New Section after 700.4(C)] | |
| Public Input No. 2799-NFPA 70-2020 [Section No. 700.5(D)] | |
| Public Input No. 2800-NFPA 70-2020 [Section No. 700.6(C)] | |
| Public Input No. 2801-NFPA 70-2020 [Section No. 700.10(D)(4)] | |
| Public Input No. 2802-NFPA 70-2020 [Section No. 700.12(C)] | |
| Public Input No. 2803-NFPA 70-2020 [Section No. 700.12(D)(2)] | |
| Public Input No. 2804-NFPA 70-2020 [Section No. 700.12(E)] | |
| Public Input No. 2806-NFPA 70-2020 [Section No. 700.12(G)] | |

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**Committee:** NEC-P13

## Public Input No. 2204-NFPA 70-2020 [ Section No. 700.12(I) ]

**(I)** ~~Unit Equipment~~ Battery-Equipped Emergency Luminaires .

**(1)** ~~Components of Unit Equipment.~~

~~Individual unit equipment for emergency illumination shall consist of the following:~~

(1) ~~A rechargeable battery~~

(2) ~~A battery charging means~~

(3) ~~Provisions for one or more lamps mounted on the equipment, or shall be permitted to have terminals for remote lamps, or both~~

(4) ~~A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment~~

~~**(2)** Installation of Unit Equipment.~~

~~Unit equipment~~

**Listing Required. All battery-equipped emergency luminaires shall be listed.**

Informational Note: See ANSI/UL 924, Emergency Lighting and Power Equipment, for the requirements covering battery-equipped emergency luminaires and emergency battery packs. A listed emergency battery pack installed in a listed luminaire will provide similar functionality as a listed battery-equipped emergency luminaire.

**(2)** Installation.

Battery-equipped emergency luminaires shall be installed in accordance with the following:

(1) ~~The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:~~

(2) ~~For a period of at least 1 1/2 hours without the voltage falling below 87 1/2 percent of normal battery voltage.~~

(3) ~~The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1 1/2 hours.~~

~~Unit equipment~~

(4) Battery-equipped emergency luminaires shall be permanently fixed in place (i.e., not portable)
~~in place and shall have all wiring~~

(5) .

(6) Wiring to each
~~unit~~

(7) luminaire shall be installed in accordance with the requirements of any of the wiring methods in Chapter 3 unless otherwise specified in this Article . Flexible cord-and-plug connection shall be permitted for unit equipment , provided that the cord does not exceed 900 mm (3 ft) in length. Flexible cord, with or without a plug, shall also be permitted for battery-equipped emergency luminaires installed in accordance with 410.62(C)(1).

(8) The branch circuit feeding the ~~unit equipment shall~~ battery-equipped emergency luminaire shall be one of the following:

a. The same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches.

b. The same or a different branch circuit as that serving the normal lighting in the area but with means to monitor the status of that area's normal lighting branch circuit ahead of any local switches.

c. Where the normal lighting circuit is served by one or more branch circuits, a separate branch circuit, provided with a lock-on feature, that originates from the same panelboard as the normal lighting circuits. The branch circuit disconnecting means for this branch circuit shall be provided with a lock-on feature.

(9) The branch circuit that feeds ~~unit equipment shall~~ battery-equipped emergency luminaires shall be clearly identified at the distribution panel.

(10) Emergency luminaires that obtain power from a ~~unit equipment and are not part of the unit equipment shall~~ battery-equipped emergency luminaire shall be wired to the ~~unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3 .~~
~~Remote heads providing~~

(11) battery-equipped emergency luminaire as elsewhere required in this Article.

(12) Remote luminaires providing lighting for the exterior of an exit door shall be permitted to be supplied by the ~~unit equipment serving~~ battery-equipped emergency luminaire serving the area immediately inside the exit door.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|

| | |
|---|---|
| NEC_2023_PI_700.2_and_700.12_emergency_battery-equipped_luminaires_and_unit_equipment_Shulman_8-10-2020.docx | Revisions to 700.12(I) to address battery-equipped emergency luminaires, and to recognize unit equipment as a type of battery-equipped emergency luminaire |

## Statement of Problem and Substantiation for Public Input

This PI re-organizes and expands some of the Article 700 text associated with battery-equipped emergency lighting.

Related PI 2203 defines battery-equipped emergency luminaires and then defines unit equipment as a type of battery-equipped emergency luminaire. Most of the existing content of 700.12(I) applies to all battery-equipped emergency luminaires. PI 2203 shifts some of the existing 700.12(I) text to the definitions; this PI then revises the remaining 700.12(I) content to address the installation requirements applicable to battery-equipped emergency luminaires.

This PI retitles 700.12(I) to reflect its application to the broader class of battery-equipped emergency luminaires.

The content of existing subsection 1 (Components of Unit Equipment) has been shifted to the definition, as described earlier and shown in PI 2203. The first portion of existing subsection 2 (Installation of Unit Equipment) actually describes the intended performance of unit equipment (minimum 90 minutes of operation without excess battery discharge or light level reduction) but this is directly addressed by the listing requirements of UL 924. So this PI replaces this subsection with such a listing requirement. An informational note is provided to clarify that comparable functionality can be achieved by adding a (UL 924) listed emergency battery pack to a listed luminaire. This practice has been accepted for many years; with fluorescent luminaires, the emergency battery packs were commonly referred to as “inverter/charger packs.” UL 924 requires emergency battery packs to include markings and/or instructions to identify suitably compatible luminaires and/or lamps for the purpose of meeting required emergency illumination performance.

The remaining existing content under 700.12(I) addresses installation issues. This PI replaces “unit equipment” with “battery-equipped emergency luminaire”, and makes the following supplemental revisions:
revisions:

1) Subsection (2) addresses the fixed in place (versus portable) requirement and the supply wiring requirement. For the supply wiring requirements, the PI proposes expanding the allowance to use flexible cord to include any battery-equipped luminaire otherwise permitted to use flexible cord per 410.62(C)(1) (i.e., high bays and pendants); these designs are permitted under UL 924. An additional exemption to Chapter 3 wiring is added, through the phrase “unless otherwise specified in this Article”, to support alternatives that may be separately adopted during this Code revision cycle (such as for class 2 luminaires).

2) Subsection (3) adds an allowance for the battery-equipped emergency luminaire to be connected after (and thus be controlled by) a local switch, or on a different branch circuit than the other local (normal power only) luminaires, provided that the emergency luminaire has means to monitor the status of the normal lighting branch circuit ahead of that local switch. This feature was/is not needed

for unit equipment since it is never controlled by a local switch. But it is a common application for other types of battery-equipped emergency luminaires and it is evaluated by the UL 924 listing program.

3) Subsection (5) removes the requirement for luminaires remote from and supplied by the battery-equipped emergency luminaire to be wired exclusively using Chapter 3 methods. Many (if not all) of these remote-installed luminaires will be supplied within class 2 power levels. By referring more broadly to wiring "…as elsewhere required in this Article" this subclause anticipates and avoids conflict with existing or to-be-developed wiring requirements.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2203-NFPA 70-2020 [New Definition after Definition: Emergency Luminaire, Direc...] | New definitions that are integral to this PI. |
| Public Input No. 2203-NFPA 70-2020 [New Definition after Definition: Emergency Luminaire, Direc...] | |

## Submitter Information Verification

**Submitter Full Name:** Michael Shulman
**Organization:** UL LLC
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Mon Aug 10 15:22:49 EDT 2020
**Committee:** NEC-P13

**700.2**

**Emergency Luminaire, Battery-Equipped**. A luminaire with a rechargeable battery, a battery charging means, and an automatic load control relay.

**Unit Equipment.** A battery-equipped emergency luminaire that illuminates only as part of the emergency illumination system and is not illuminated when the normal supply is available.

**700.12 General Requirements.** Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, emergency lighting, emergency power, or both shall be available within the time required for the application but not to exceed 10 seconds. The supply system for emergency purposes, in addition to the normal services to the building and meeting the general requirements of this section, shall be one or more of the types of systems described in 700.12(C) through H. ~~Unit equipment~~Battery-equipped emergency luminaires in accordance with 700.12(I) shall satisfy the applicable requirements of this article.

**(I) ~~Unit Equipment.~~ Battery-Equipped Emergency Luminaires**
**(1) Listing Required. All battery-equipped emergency luminaires shall be listed.**

Informational Note No. 1: See ANSI/UL 924, *Emergency Lighting and Power Equipment*, for the requirements covering battery-equipped emergency luminaires and emergency battery packs. A listed emergency battery pack installed in a listed luminaire will provide similar functionality as a listed battery-equipped emergency luminaire.

~~**(1) Components of Unit Equipment.** Individual unit equipment for emergency illumination shall consist of the following:~~
~~(1) A rechargeable battery~~
~~(2) A battery charging means~~
~~(3) Provisions for one or more lamps mounted on the equipment, or shall be permitted to have terminals for remote lamps, or both~~
~~(4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment~~
~~**(2) Installation of Unit Equipment.** Unit equipment shall be installed in accordance with the following:~~
~~(1) The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:~~
~~(a) For a period of at least 1-1/2 hours without the voltage falling below 87-1/2 percent of normal battery voltage below~~
~~(b) The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1 1/2 hours~~
**(2) Installation.** Battery-equipped emergency luminaires shall be installed in accordance with the following:
~~(2)~~(1) ~~Unit equipment~~Battery-equipped emergency luminaires shall be permanently fixed ~~(i.e., not portable)~~ in place (i.e., not portable) ~~and shall have all w~~
(2) Wiring to each ~~unit~~luminaire shall be installed in accordance with the requirements of any of the wiring methods in Chapter 3 unless otherwise specified in this Article. Flexible cord-and-plug connection shall be permitted for unit equipment, provided that the cord does not exceed 900 mm (3 ft) in length. Flexible cord, with or without a plug, shall also be permitted for battery-equipped emergency luminaires installed in accordance with 410.62(C)(1).
(3) The branch circuit feeding the battery-equipped emergency luminaire ~~unit equipment~~ shall be one of the following:
    a. The same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches.

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b. The same or a different branch circuit as that serving the normal lighting in the area but with means to monitor the status of that area's normal lighting branch circuit ahead of any local switches.

c~~b~~. Where the normal lighting circuit is served by one or more branch circuits, a separate branch circuit, provided with a lock-on feature, that originates from the same panelboard as the normal lighting circuits. The branch circuit disconnecting means for this branch circuit shall be provided with a lock-on feature.

(4) The branch circuit that feeds battery-equipped emergency luminaires ~~unit equipment~~ shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a battery-equipped emergency luminaire ~~unit equipment and are not part of the unit equipment~~ shall be wired to the battery-equipped emergency luminaire as elsewhere required in this Article~~unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3~~.

(6) Remote luminaires~~heads~~ providing lighting for the exterior of an exit door shall be permitted to be supplied by the battery-equipped emergency luminaire ~~unit equipment~~ serving the area immediately inside the exit door.

**Substantiation:**

This PI re-organizes and expands some of the Article 700 text associated with battery-equipped emergency lighting.

The PI defines battery-equipped emergency luminaires and then defines unit equipment as a type of battery-equipped emergency luminaire. Most of the existing content of 700.12(I) applies to all battery-equipped emergency luminaires. The PI shifts some of the existing 700.12(I) text to the definitions and then revises the remaining 700.12(I) content to address the installation requirements applicable to battery-equipped emergency luminaires.

The definition for unit equipment identifies its functional difference from other battery-supplied emergency luminaires. The existing text in 700.12(I)(1)(4) that refers to unit equipment including "a relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment" is not needed, because this text describes an automatic load control relay (ALCR), and ALCRs are noted as a required element within the battery-equipped emergency luminaire definition.

This PI retitles 700.12(I) to reflect its application to the broader class of battery-equipped emergency luminaires. The content of existing subsection 1 (Components of Unit Equipment) has been shifted to the definition, as described earlier. The first portion of existing subsection 2 (Installation of Unit Equipment) actually describes the intended performance of unit equipment (minimum 90 minutes of operation without excess battery discharge or light level reduction) but this is directly addressed by the listing requirements of UL 924. So this PI replaces this subsection with such a listing requirement. An informational note is provided to clarify that comparable functionality can be achieved by adding a (UL 924) listed emergency battery pack to a listed luminaire. This practice has been accepted for many years; with fluorescent luminaires, the emergency battery packs were commonly referred to as "inverter/charger packs." UL 924 requires emergency battery packs to include markings and/or instructions to identify suitably compatible luminaires and/or lamps for the purpose of meeting required emergency illumination performance.

The remaining existing content under 700.12(I) addresses installation issues. This PI replaces "unit equipment" with "battery-equipped emergency luminaire", and makes the following supplemental revisions:

1) Subsection (2) addresses the fixed in place (versus portable) requirement and the supply wiring requirement. For the supply wiring requirements, the PI proposes expanding the allowance to use flexible cord to include any battery-equipped luminaire otherwise permitted to use flexible cord per 410.62(C)(1) (i.e., high bays and pendants); these designs are permitted under UL 924. An additional exemption to Chapter 3 wiring is added, through the phrase “unless otherwise specified in this Article”, to support alternatives that may be separately adopted during this Code revision cycle (such as for class 2 luminaires).
2) Subsection (3) adds an allowance for the battery-equipped emergency luminaire to be connected after (and thus be controlled by) a local switch, or on a different branch circuit than the other local (normal power only) luminaires, provided that the emergency luminaire has means to monitor the status of the normal lighting branch circuit ahead of that local switch. This feature was/is not needed for unit equipment since it is never controlled by a local switch. But it is a common application for other types of battery-equipped emergency luminaires and it is evaluated by the UL 924 listing program.
3) Subsection (5) removes the requirement for luminaires remote from and supplied by the battery-equipped emergency luminaire to be wired exclusively using Chapter 3 methods. Many (if not all) of these remote-installed luminaires will be supplied within class 2 power levels. By referring more broadly to wiring “…as elsewhere required in this Article” this subclause anticipates and avoids conflict with existing or to-be-developed wiring requirements.

## Public Input No. 1051-NFPA 70-2020 [ Section No. 700.12(I)(2) ]

**(2)** Installation of Unit Equipment.

Unit equipment shall be installed in accordance with the following:

(1) The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:

a. For a period of at least 1½ hours without the voltage falling below 87½ percent of normal battery voltage.

b. The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours.

(2) Unit equipment shall be permanently fixed (i.e., not portable) in place and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length.

(3) The branch circuit feeding the unit equipment shall be ~~one of the following:~~ ~~The~~ t he same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches ~~Where the normal lighting circuit is served by one or more branch circuits~~ . Exception: In the case where there are no local switches and the unit equipment is fed directly from a circuit breaker , a separate ~~branch circuit, provided with a lock-on feature, that originates from the same panelboard as the normal lighting circuits. The branch circuit disconnecting means for this branch circuit shall be provided with a lock-on feature~~ circuit to feed the unit equipment shall be permitted .

(4) The branch circuit that feeds unit equipment shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3.

(6) Remote heads providing lighting for the exterior of an exit door shall be permitted to be supplied by the unit equipment serving the area immediately inside the exit door.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 1987_NEC.PNG | 1987 NEC - Unit Equipment | |

## Statement of Problem and Substantiation for Public Input

The proposed change is to remove option 700.12(I)(2)(3)(b) and to create an Exception to allow the application of [now] 700.12(I)(2)(3)(b) in certain instances.

Option (b) is somewhat disingenuous, as a circuit is still capable of tripping even though it is "locked-on." If the circuit should trip, it isn't always apparent. Should this happen when the building isn't occupied (such as at nighttime) then the unit equipment battery will simply drain out and it will go unnoticed that the unit equipment is no longer operable. The typical emergency light will only stay on for a few hours, based on the criteria in 700.12(I)(2)(1).

Option (b) provides a lesser degree of safety and should only be allowed in certain circuimstances.

Option (b) was introduced as an Exception in the 1987 NEC. At that time, lighting for mercantile was usually switched directly from the breaker panel, and there were no "local" switches to speak of. In 1987, the Exception to allow a separate circuit made total sense. I have attached the ROP for that code change, which highlights the reason that the "separate circuit" exception was allowed. A lot of time has passed since the 1987 NEC and lighting controls and switching (in general) have increased exponentially.

The year is 2020. 33 years have passed since the 1987 NEC. More often than not, there is always going to be a local switch or a point ahead of a local switch that unit equipment can receive power from. This provides a much greater degree of safety for the reason that I've described. I have also run this by many electrical engineers and plans examiners and they all agree.

The ability to power the unit equipment by separate circuit with "lock on" should only be allowed when the situation exists as described in Log #1599 (uploaded). I believe it should still be in the code, but only as an exception for situations where there are no local switches. Nothing is more safe than someone seeing that the normal lighting isn't working. Unit equipment really needs to be connected to the normal lighting circuit, ahead of any local switch, whenever possible.

The reason for this proposed change is an increase in life-safety.

## Submitter Information Verification

**Submitter Full Name:** Nick Sasso
**Organization:** Clark County Building and Fire
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Wed May 13 13:47:31 EDT 2020
**Committee:** NEC-P13

Log # 1599

15- 108 - (700-12(f), Exception-(New)): Accept

SUBMITTER: Robert H. Keis, First State Inspection Agency, Inc.

COMMENT ON PROPOSAL NO.: 15-151

RECOMMENDATION: This proposal should be accepted as Panel Action indicates.

SUBSTANTIATION: This exception is very much needed. The Code as presently written is impossible to enforce in most retail stores, as most switching is from the panelboard. The submitter's substantiation is correct.

PANEL ACTION: Accept.

VOTE ON PANEL ACTION:

AFFIRMATIVE: 11

NEGATIVE: Flach, Strasser.

EXPLANATION OF VOTE:

FLACH: I agree with Mr. Strasser's comments in the TCR.

If all three of the lighting circuits are connected to the "a" phrase and the emergency lighting is supplied from the "b" phrase, an open fuse on the "a" phrase fuses to the lighting panel will leave the area in darkness, and the emergency lighting will not energize because the "s" phase fuse has not "blown."

I have no objection to this proposal if words are added to require that the emergency lighting be connected to one of the phases which supply normal lighting to the area.

STRASSER: The exception does not require the unit equipment to be connected to the same phase or circuit as the normal lighting circuits. It is possible to connect the normal lights and unit equipment to different circuits, therefore, the normal lights could fail and the unit equipment would not function.

## Public Input No. 3290-NFPA 70-2020 [ Section No. 700.12(I)(2) ]

**(2)** Installation of Unit Equipment.

Unit equipment shall be installed in accordance with the following:

(1) The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:

a. For a period of at least 1½ hours without the voltage falling below 87½ percent of normal battery voltage.

b. The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours.

(2) Unit equipment shall be permanently fixed (i.e., not portable) in place and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length.

(3) The branch circuit feeding the unit equipment shall be one of the following:

a. The same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches

b. Where the normal lighting circuit is served by ~~one~~ two or more branch circuits, a separate branch circuit, provided with a lock-on feature, that originates from the same panelboard as the normal lighting circuits. The branch circuit disconnecting means for this branch circuit shall be provided with a lock-on feature.

(4) The branch circuit that feeds unit equipment shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3.

(6) Remote heads providing lighting for the exterior of an exit door shall be permitted to be supplied by the unit equipment serving the area immediately inside the exit door.

## Statement of Problem and Substantiation for Public Input

I understand that with newer lighting loads, less circuits are required, but we still need to make sure that the unit equipment will illuminate the area when there is a circuit failure. The current code language does not accomplish this as it permits the unit equipment for an area served by a single lighting circuit to be supplied by a circuit that is independent from that single lighting circuit. The lighting branch circuit can fail and the unit equipment will not be activated to supply illumination for that area. With LED lighting, very large areas can be supplied by a single lighting circuit, and failure of that circuit without activation of the unit equipment is a serious safety hazard.

## Submitter Information Verification

**Submitter Full Name:** Don Ganiere
**Organization:** [ Not Specified ]
**Street Address:**
**City:**

**State:**
**Zip:**
**Submittal Date:** Mon Sep 07 15:17:47 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4126-NFPA 70-2020 [ Section No. 700.12(I)(2) ]

**(2)** Installation of Unit Equipment.

Unit equipment shall be installed in accordance with the following:

(1) The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:

a. For a period of at least 1½ hours without the voltage falling below 87½ percent of normal battery voltage.

b. The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours.

(2) Unit equipment shall be permanently fixed (i.e., not portable) in place and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length.

(3) The branch circuit feeding the unit equipment shall be one of the following:

a. The same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches

b. Where the normal lighting circuit is served by ~~one or~~ two or more branch circuits, a separate branch circuit, provided with a lock-on feature, that originates from the same panelboard as the normal lighting circuits. The branch circuit disconnecting means for this branch circuit shall be provided with a lock-on feature.

(4) The branch circuit that feeds unit equipment shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3.

(6) Remote heads providing lighting for the exterior of an exit door shall be permitted to be supplied by the unit equipment serving the area immediately inside the exit door.

## Statement of Problem and Substantiation for Public Input

Reducing the required branch circuits to "one or more" allows any type of wiring to be installed. You could now have one circuit for normal lights, one circuit for exit signs and one circuit for emergency lights. The reduction down to 1 circuit allows too many options for an inspector to follow. I'm not sure how this new language adds anything useful in maintaining life safety emergency lighting.

## Submitter Information Verification

**Submitter Full Name:** James Dorsey
**Organization:** Douglas County Electrical Insp
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Wed Sep 09 21:33:16 EDT 2020

**Committee:** NEC-P13

## Public Input No. 4357-NFPA 70-2020 [ Section No. 700.12(I)(2) ]

**(2)** Installation of Unit Equipment.

Unit equipment shall be installed in accordance with the following:

(1) The batteries shall be of suitable rating and capacity not less than required by 700.12 (A) to supply and maintain the total lamp load associated with the unit in accordance with the following:

a. For a minimum period of at least 1½ hours without the voltage falling below 87½ percent of normal battery voltage.

b. The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours.

(2) Unit equipment shall be permanently fixed (i.e., not portable) in place and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length.

(3) The branch circuit feeding the unit equipment shall be one of the following:

a. The same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches

b. Where the normal lighting circuit is served by one or more branch circuits, a separate branch circuit, provided with a lock-on feature, that originates from the same panelboard as the normal lighting circuits. The branch circuit disconnecting means for this branch circuit shall be provided with a lock-on feature.

(4) The branch circuit that feeds unit equipment shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3.

(6) Remote heads providing lighting for the exterior of an exit door shall be permitted to be supplied by the unit equipment serving the area immediately inside the exit door.

## Statement of Problem and Substantiation for Public Input

With the new section 700.12 (A) it is unclear that this type of equipment would require the longer duration time required by section 700.12 (A). If a longer time is required to evacuate the appropriate unit equipment of time duration would also be required, if this cannot be achieved by the unit equipment then an other power source is necessary.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4374-NFPA 70-2020 [Section No. 700.12(C)] | |

## Submitter Information Verification

**Submitter Full Name:** Alfio Torrisi

**Organization:** Master electrician

| | |
|---|---|
| **Street Address:** | |
| **City:** | |
| **State:** | |
| **Zip:** | |
| **Submittal Date:** | Thu Sep 10 11:11:43 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 577-NFPA 70-2020 [ Section No. 700.12(I)(2) ]

**(2)** Installation of Unit Equipment.

Unit equipment shall be installed in accordance with the following:

(1) The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:

a. For a period of at least 1½ hours without the voltage falling below 87½ percent of normal battery voltage.

b. The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours.

(2) Unit equipment shall be permanently fixed (i.e., not portable) in place and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length.

(3) The branch circuit feeding the unit equipment shall be ~~one of~~ the ~~following:The~~ same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches ~~Where the normal lighting circuit is served by one or more branch circuits~~ .

*Exception: In a separate and uninterrupted area supplied by a minimum of three normal lighting circuits that are not part of a multiwire branch circuit , a separate branch circuit* ~~, provided with a lock-on feature, that~~ *for unit equipment shall be permitted if it originates from the same panelboard as that of the normal lighting circuits* ~~. The branch circuit disconnecting means for this branch circuit shall be~~ *and is provided with a lock-on feature.*

(4) The branch circuit that feeds unit equipment shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3.

(6) Remote heads providing lighting for the exterior of an exit door shall be permitted to be supplied by the unit equipment serving the area immediately inside the exit door.

## Statement of Problem and Substantiation for Public Input

This PI seeks to revert tot he 2017 language of this section. The change made in 2020 was made without any technical substantiation and is a SIGNIFICANT decrease in safety.

## Submitter Information Verification

**Submitter Full Name:** Ryan Jackson
**Organization:** Ryan Jackson
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Mon Mar 02 14:19:57 EST 2020

**Committee:** NEC-P13

## Public Input No. 2117-NFPA 70-2020 [ Section No. 700.16 ]

**700.16** Emergency Illumination.

**(A)** General.

Emergency illumination shall include means of egress lighting, illuminated exit signs, and all other luminaires specified as necessary to provide required illumination.

**(B)** System Reliability.

Emergency lighting systems shall be designed and installed so that the failure of any ~~illumination source cannot~~ individual illumination device, such as the buring out of a lamp cannot leave in total darkness any space that requires emergency illumination. Control devices in the emergency lighting system shall be listed for use in emergency systems. Listed unit equipment in accordance with 700.12(I) shall be considered as meeting the provisions of this section.

Informational Note: 700.23 through 700.26 provide requirements for applications of emergency system control devices.

**(C)** Discharge Lighting.

Where high-intensity discharge lighting such as high- and low-pressure sodium, mercury vapor, and metal halide is used as the sole source of normal illumination, the emergency lighting system shall be required to operate until normal illumination has been restored.

**(D)** Disconnecting Means.

Where an emergency system is installed, emergency illumination shall be provided in the area of the disconnecting means required by 225.31 and 230.70, as applicable, where the disconnecting means are installed indoors.

*Exception: Alternative means that ensure that the emergency lighting illumination level is maintained shall be permitted.*

## Statement of Problem and Substantiation for Public Input

The revision for the 2020 NEC by adding the term source' is way too broad in the sense that it changes the intent of the rule. My edits is to make it clear that it's the rule is addressing the 'illumination' such as a lamp.

## Submitter Information Verification

**Submitter Full Name:** Mike Holt
**Organization:** Mike Holt Enterprises Inc
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Sat Aug 01 16:11:09 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2303-NFPA 70-2020 [ Section No. 700.16(A) ]

**(A)** General.

Emergency illumination shall include means of egress lighting, illuminated combination exit / frogeyes signs, and all other luminaires specified as necessary to provide required illumination.

## Statement of Problem and Substantiation for Public Input

We have run into projects where the engineer has designed the exit signs to be on a dedicated circuit that only supplies the exit signs. This project has a inverter backed up emergency lighting. The engineer states that they are not including the illumination from the exit signs as part of the egress lighting. I have asked around and have gotten mixed answers as whether this installation is NEC 700.16 compliant. As the code reads now, I believe that the exit signs are part of the egress lighting and should be on the same circuit as the normal circuit or atleast on the same circuit as the inverter circuit

## Submitter Information Verification

**Submitter Full Name:** James Dorsey
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**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Fri Aug 14 09:21:51 EDT 2020
**Committee:** NEC-P13

# Public Input No. 155-NFPA 70-2019 [ New Section after 700.16(B) ]

**TITLE OF NEW CONTENT**

Type your content here ... Emergency Equipment indoor locations shall be provided with battery-powered emergency lighting. This requirement shall not apply if an adjacent light source illuminates the equipment to at least 32.3 lux (3.0 ft-candles) when emergency equipment is de-energized for maintenance or repair.

## Statement of Problem and Substantiation for Public Input

Comment: This would correlate NFPA 70 with the requirements of NFPA 110 7.3.1 & 7.3.3 and be consistent with the NEC 480.10G. We have a project building a hospital with an emergency equipment room with 4 lights all on emergency power, if you shut down the equipment in that room for maintenance or repair your in total darkness.

## Submitter Information Verification

**Submitter Full Name:** Kelly Wofford
**Organization:** Prism Electric Inc
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Tue Nov 26 15:19:12 EST 2019
**Committee:** NEC-P13

## Public Input No. 1828-NFPA 70-2020 [ Section No. 700.16(B) ]

**(B)** System Reliability.

(1) The emergency lighting system shall be arranged to provide the required illumination automatically in the event of any of the following:

a. Failure of public utility or other outside electrical power supply

b. Opening of a circuit breaker or fuse

c. Manual act(s), including accidental opening of a switch controlling normal lighting facilities.

(2) Emergency lighting systems shall be designed and installed so that the failure of any illumination source cannot leave in total darkness any space that requires emergency illumination. ~~Control devices in the emergency lighting system shall be listed for use in emergency systems.~~

(3) Where emergency lighting is provided by automatic transfer between normal power service and an emergency generator, the installation, for any reason, of a single switch, circuit breaker, fuse, or similar device that can interrupt both energy sources shall be prohibited.

(4) Listed unit equipment in accordance with 700.12(I) shall be considered as meeting the provisions of this section.

(5) Control devices in the emergency lighting system shall be listed for use in emergency systems.

Informational Note: 700.23 through 700.26 provide requirements for applications of emergency system control devices.

## Statement of Problem and Substantiation for Public Input

Many jurisdictions enforce the International Building Code and the NEC for building permits and construction. Requirements in NFPA 101 are typically only enforced where referenced by the IBC or during annual fire inspections once the building has been occupied. The International Building Code, Section 1008 does not reference the requirements in NFPA 101, Section 7.9.2.3, nor does Article 700 of the NEC. If building Owners, designers and AHJ's do not look beyond the IBC and NEC to the more stringent requirements of NFPA 101, it is possible to construct a facility that can fail to provide egress, emergency egress, and general building illumination upon the failure of a switch, circuit breaker, fuse, or feeder.

Many electrical engineers, lighting designers, and others in the design community are not aware of the more stringent emergency lighting requirements in NFPA 101 Section 7.9.2.3.

The proposed change will increase NEC requirements for emergency illumination system reliability by adding the requirements of NFPA 101 Section 7.9.2.3 to NEC Section 700.16(B).

Recently, I reviewed design documents for several large assembly occupancies. In each case, the electrical distribution system was designed such that the opening of a single switch would have put an area of the building (or the entire building, depending on the switch) into total darkness. The designs did not comply with NFPA 101 Section 7.9.2.3.

One set of documents was for a new convention center. Each exhibit hall and ballroom was to be provided with its own dedicated lighting control panelboard to provide branch circuits for both normal and emergency lighting . The relay panelboards were UL 924 listed as required by NEC 700.23. A generator was to provide emergency power for the facility. The documents called for "sense circuits" to be installed between the normal side of the automatic transfer switch to each relay panelboard so that the panelboard relays will selectively energize only those branch circuits required to provide minimum

emergency illumination upon failure of normal power (and likewise de-energize or shed the branch circuits supplying luminaires that are not required for emergency illumination).

There were no other branch circuit panelboards serving lighting in the exhibit halls and ballrooms. If a single automatic transfer switch failed, the entire wing of the building would have been without egress, emergency egress, and general building illumination.
If a panelboard's main circuit breaker failed, an entire ballroom or exhibit hall would have been thrown into total darkness.

The team that designed the above facility truly believed that the emergency distribution system was code-compliant based on the premise that all branch circuits supplied by the lighting control relay system cabinet complied with the wiring methods of NEC Article 700. In reality, the emergency distribution system contained several points of failure that could subject large areas of the building to total darkness. Fortunately, the facility's design standards referenced NFPA 101 Section 7.9 for emergency lighting requirements and the design had to be corrected.

## Submitter Information Verification

**Submitter Full Name:** Jeanne Tebera
**Organization:** Henry Adams LLC
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**Submittal Date:** Thu Jul 09 16:37:24 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4493-NFPA 70-2020 [ Section No. 700.16(B) ]

**(B)** System Reliability.

Emergency lighting systems shall be designed and installed so that the failure of any illumination source cannot leave in total darkness any space that requires emergency illumination. ~~Control~~ Automatic control devices in the emergency lighting system shall be listed for use in emergency systems. Listed unit equipment in accordance with 700.12(I) shall be considered as meeting the provisions of this section.

Informational Note: 700.23 through 700.26 provide requirements for applications of emergency system control devices.

## Statement of Problem and Substantiation for Public Input

This rule requires that any control devices in the emergency system be listed for emergency system use. However, this part of the rule should be limited to automatic devices; it is difficult to imagine a snap switch or a circuit breaker being specifically listed for this duty.

## Submitter Information Verification

**Submitter Full Name:** Frederic Hartwell
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**Submittal Date:** Thu Sep 10 14:13:25 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1125-NFPA 70-2020 [ Section No. 700.16(C) ]

**(C)**– _ _ Electric- Discharge Lighting.

(1) Where high-intensity discharge lighting such as high- and low-pressure sodium, mercury vapor, and metal halide is used as the sole source of normal illumination, the emergency lighting system shall be required to operate until normal illumination has been restored.

(2) Exit Luminaires. A ballast in a fluorescent exit luminaire shall not have thermal protection.

(3) Egress Luminaires. A ballast in a fluorescent luminaire that is used for egress lighting and energized only during a failure of the normal supply shall not have thermal protection

## Statement of Problem and Substantiation for Public Input

This requirement is in 410.130 (E) (3)& (4) and is overlooked when designing for an emergency system. Having it relocated in 700 would make this information more user friendly.

## Submitter Information Verification

**Submitter Full Name:** Alfio Torrisi
**Organization:** master electrician
**Street Address:**
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**Submittal Date:** Mon May 18 12:38:56 EDT 2020
**Committee:** NEC-P13

# Public Input No. 671-NFPA 70-2020 [ Section No. 700.17 ]

**700.17** Branch Circuits for Emergency Lighting.

Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when the normal supply for lighting is interrupted. Such installations shall provide either of the following:

(1) An emergency lighting supply, independent of the normal lighting supply, with provisions for automatically transferring the emergency lights upon the event of failure of the normal lighting ~~branch circuit~~ supply.

(2) Two or more branch circuits supplied from separate and complete systems with independent power sources. One of the two power sources and systems shall be part of the emergency system, and the other shall be permitted to be part of the normal power source and system. Each system shall provide sufficient power for emergency lighting purposes.

Unless both systems are used for regular lighting purposes and are both kept lighted, means shall be provided for automatically energizing either system upon failure of the other. Either or both systems shall be permitted to be a part of the general lighting of the protected occupancy if circuits supplying lights for emergency illumination are installed in accordance with other sections of this article.

## Statement of Problem and Substantiation for Public Input

Current wording of 700.17(1) requires the emergency control system to individually sense power on each and every normal/emergency lighting branch circuit overcurrent protective device. This is not practical in centralized emergency control systems. However, failure of the normal-only supply will indeed cause failure of the normal/emergency branch circuit until a transfer to emergency power occurs—the issue is where to sense such a failure. 700.23 already allows sensing of a related normal-only power source that is not a specific individual normal/emergency branch circuit. Revised wording of 700.17 is needed to clarify that this type of sensing is permitted in emergency control equipment other than that covered by 700.23.

700.16(B) already requires an emergency system design and installation such that “the failure of any illumination source cannot leave in total darkness any space that requires emergency illumination.” In practice, this requires redundancy of normal/emergency branch circuits and luminaires. It is this redundancy that protects against the loss of illumination prohibited by 700.16(B) that could occur on failure of a single piece of equipment or the opening of a single branch circuit overcurrent protective device.

## Submitter Information Verification

**Submitter Full Name:** Steven Terry
**Organization:** Electronic Theatre Controls In
**Affiliation:** USITT
**Street Address:**
**City:**

| | |
|---|---|
| **State:** | |
| **Zip:** | |
| **Submittal Date:** | Tue Mar 17 10:51:12 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 4161-NFPA 70-2020 [ Section No. 700.18 ]

**700.18** Circuits for Emergency Power.

For branch circuits that supply equipment classed as emergency, there shall be an emergency system supply source to which the load will be transferred automatically upon the failure of the normal supply.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per

the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 23:10:57 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2851-NFPA 70-2020 [ New Section after 700.26 ]

**TITLE OF NEW CONTENT**

**700.27 Power over Ethernet and other Class-2-Powered Emergency Lighting Systems.**

Devices that combine control signals with Class 2 emergency power sources on a single circuit shall be listed as emergency lighting control devices.

*Informational Note: An example of a device combining control signals with Class 2 emergency power sources is a Power over Ethernet (PoE) switch*

## Statement of Problem and Substantiation for Public Input

This PI was developed by a correlating committee task group consisting of:
Joe Schomaker, Eaton, MO [M] CMP-11
Steve Terry, Electronic Theater Controls Inc., NY, US Institute for Theater Technology [M] CMP-15
Fred Carpenter, Acuity Brand Lighting, NEMA [M] CMP-18
Michael Shulman, UL LLC,
Chad Jones, Cisco Systems, OH [M] CMP-3
George Zimmerman, CME Consulting, Inc., CA, Ethernet Alliance [SE] CMP-3
Mike O'Boyle, Signify, American Lighting Association [M] CMP-18
Steve Froemming, City of Franklin, WI, IAEI [E] CMP-13
Dan Caron, Bard, Rao + Athanas Consulting Engineers, LLC [SE], CMP-13

The UL924 standard makes it clear that a PoE switch or similar device that combines control and class 2 power on a single circuit qualifies as an Emergency Lighting Control Device (ELCD). 700.16(B) mandates that control devices in the emergency system must be listed for use in emergency systems. However, since most users of the NEC do not have access to the details of UL924, explicit clarification is needed in article 700 to make clear that devices combining control and class 2 power on a single circuit in emergency systems (PoE switches, as one example cited in the informational note) qualify as emergency lighting control devices and thus require listing for use in emergency systems.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2849-NFPA 70-2020 [New Definition after Definition: Branch-Circuit Emergency L...] | Definition of term used in new section |

## Submitter Information Verification

**Submitter Full Name:** Joe Schomaker
**Organization:** Eaton
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**Submittal Date:** Wed Sep 02 15:09:06 EDT 2020
**Committee:** NEC-P13

# Public Input No. 3503-NFPA 70-2020 [ New Section after 700.32 ]

**TITLE OF NEW CONTENT**

Type your content here ...Equipment enclosures for selectively coordinated overcurrent devices shall be legible marked in the field to indicate the overcurrent devices are selectively coordinated, the marking shall meet the requirements of 110.21 (B)

and shall be readily visible and state the following. CAUTION OVERCURRENT DEVICES IN THIS ENCLOSURE ARE SELECTIVELY COORDINATED EQUIVALENT REPLACEMENTS AND TRIP SETTINGS ARE REQUIRED

## Statement of Problem and Substantiation for Public Input

the field marking will alert those who are authorized to maintain, inspect or work on the system that the overcurrent devices are selectively coordinated. The field marking will clearly identify what overcurrent are selectively coordinated per the engineer documentation after the final inspection for future modifications to the system. This will also make this section consistent with NEC 620.65 for the same requirements

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3504-NFPA 70-2020 [New Section after 701.32] | |

## Submitter Information Verification

**Submitter Full Name:** Michael Dempsey
**Organization:** trinity code inspections
**Street Address:**
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**Submittal Date:** Tue Sep 08 18:24:44 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1467-NFPA 70-2020 [ Section No. 700.32 ]

**700.32** Selective Coordination.

Emergency system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

(A) Field Marking

Breakers with adjustable settings shall be field marked to accurately coordinate the approved selective coordination study settings. These markings shall be located on the breaker frame prior to inspections and shall include the date

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

Informational Note: See Informational Note Figure 700.32 for an example of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

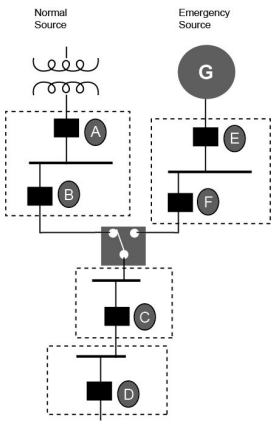
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.

OCPD C selectively coordinates with OCPDs F, E, B, and A.

OCPD F selectively coordinates with OCPD E.

OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

**Figure Informational Note Figure 700.32 Emergency System Selective Coordination.**




## Statement of Problem and Substantiation for Public Input

i have become familiar to what moves our industry forward. One thing obvious is "field marking" When the contractor has to file mark or label an item required by the code to pass inspection, he quickly becomes educated for obvious reasons. The bi product is education.The industry experienced this 1st hand when 110.24 was inserted in 2011. I am certain that with field marking requirements will produce the same outcome (education). Requiring selective coordination without a follow up plan is not a good plan. simply requiring these labels will have a major impact on educating the industry. This will also

give direction as to who, when & where this information should be

## Submitter Information Verification

**Submitter Full Name:** James Dorsey
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**Submittal Date:** Sat Jun 06 18:06:36 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2237-NFPA 70-2020 [ Section No. 700.32 ]

**700.32** Selective Coordination.

Emergency system(s) ~~overcurrent~~ overcurrent protective devices (OCPD) shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

Informational Note: See Informational Note Figure 700.32 for an example of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

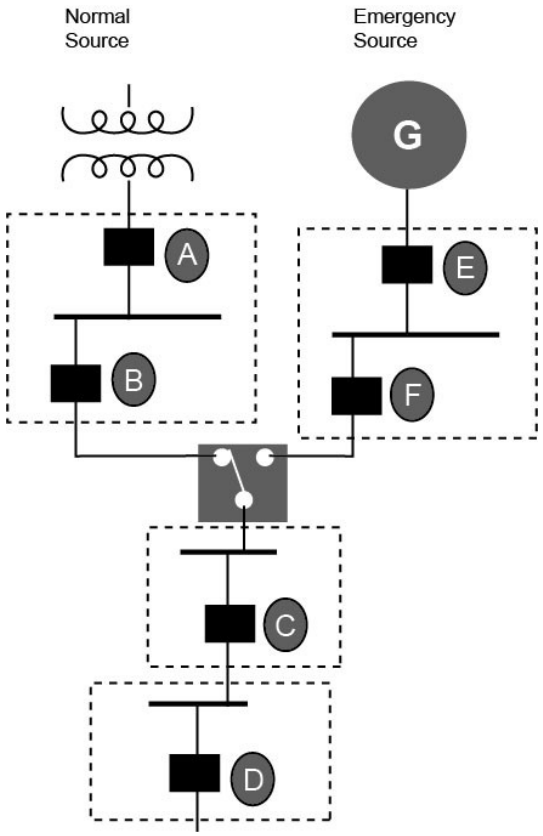
OCPD ~~D~~ H selectively coordinates with OCPDs ~~C~~ G , ~~F~~ B , A, E ~~, B,~~ and ~~A.~~ D

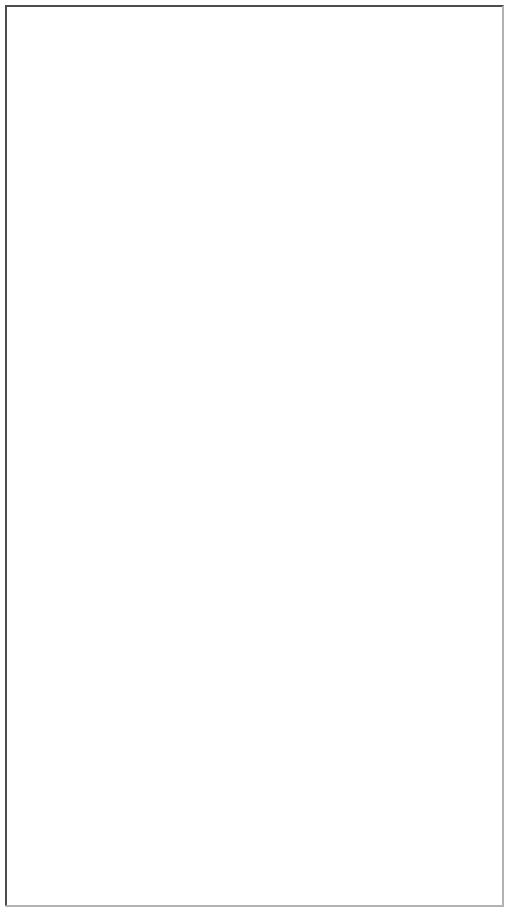
OCPD ~~C~~ G selectively coordinates with OCPDs ~~F~~ B , A, E ~~, B,~~ and ~~A~~ D .

OCPD ~~F~~ B selectively coordinates with OCPD ~~E~~ A .~~OCPD B~~

Selective coordination is not required ~~to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~ for non-emergency loads.

**Figure Informational Note Figure 700.32 Emergency System Selective Coordination.**





## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 700DOT32_AND_701DOT_32_VS_ORIGINAL_ILLUSTRATION.pdf | Illustration shows recommended changes to the existing illustration | |

## Statement of Problem and Substantiation for Public Input

The current text is in error in that OCPD B must coordinate with OCPD A if it is not the same ampacity device as A. Breaker B in the illustration is clearly serving an emergency load so must be selectively coordinated with all downstream devices.

The illustration itself is potentially confusing because it does not show non-emergency loads as being completely separated from emergency loads. This is particularly important because there are nearly always non-emergency loads connected to the same generator as emergency loads. The expanded illustration provides more clarity as to the requirements.

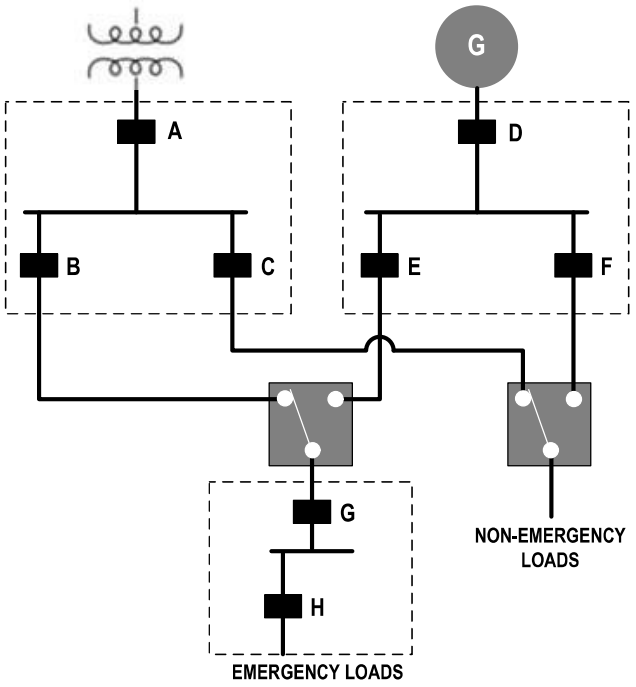
## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2796-NFPA 70-2020 [Section No. 701.32] | |

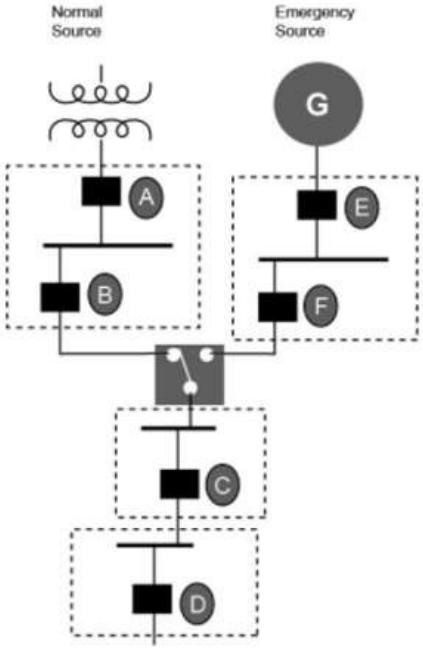
## Submitter Information Verification

**Submitter Full Name:** Gary Olson
**Organization:** kWRx LLC
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**Submittal Date:** Wed Aug 12 11:02:54 EDT 2020
**Committee:** NEC-P13

SUGGESTED CHANGE




CURRENT ILLUSTRATION



## Public Input No. 247-NFPA 70-2020 [ Section No. 700.32 ]

**700.32** Selective Coordination.

Emergency system(s) overcurrent devices shall be selectively coordinated with all emergency supply-side overcurrent protective devices to the maximum available fault current delivered by either the normal or emergency source .

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

Informational Note: See Informational Note Figure 700.32 for an example of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

OCPD D selectively coordinates with OCPDs C, F, and E~~, B, and A~~ .

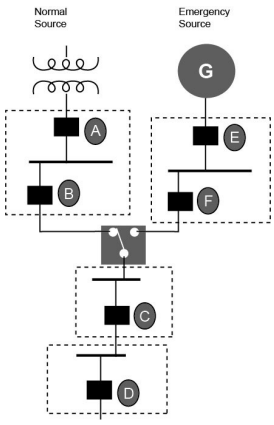
OCPD C selectively coordinates with OCPDs F, and E~~, B, and A~~ .

OCPD F selectively coordinates with OCPD E.

OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

OCPD C and D need to be coordinated to the higher available fault current from either the normal or emergency source.

**Figure Informational Note Figure 700.32 Emergency System Selective Coordination.**




## Statement of Problem and Substantiation for Public Input

A lack of selective coordination on the normal side of the automatic transfer switch will not result in loss of emergency load. In the informational note if OCPD D were to trip along with OCPD's A or B, the Automatic Transfer Switch would see a loss of power, start the generator and restore power to OCPD C. This would result in no additional or unnecessary loss of emergency loads. The only outage on OCPD C would be the time allowed for the emergency system to engage. OCPD's C and D need to be selectively coordinated at the highest available fault current form the normal or emergency source to assure that the emergency devices are coordinated under all conditions.

## Submitter Information Verification

**Submitter Full Name:** Randall Jacobs
**Organization:** TKDA
**Street Address:**
**City:**
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**Submittal Date:** Fri Jan 03 19:57:37 EST 2020
**Committee:** NEC-P13

## Public Input No. 3372-NFPA 70-2020 [ Section No. 700.32 ]

**700.32** Selective Coordination.

Emergency system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

Informational Note: See Informational Note Figure 700.32 for an example of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

OCPD D selectively coordinates with OCPDs C, F, E and with OCPDs C , B, and A.

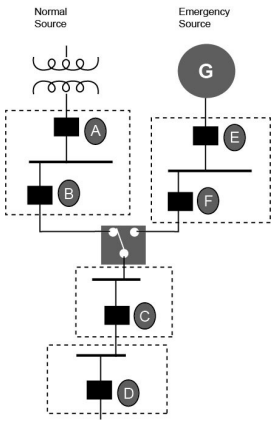
OCPD C selectively coordinates with OCPDs F, E and with OCPDs , B, and A.

OCPD F selectively coordinates with OCPD E.

OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

The entire system must coordinate as indicated above beginning with the OCPD closest to the emergency load and working upstream to the supply-side source(s). Modifications of any OCPD in the source path require all OCPD in the path to be evaluated to enure selective coordination is maintained.

**Figure Informational Note Figure 700.32 Emergency System Selective Coordination.**




## Statement of Problem and Substantiation for Public Input

The inclusion of diagrams within the Code can assist users with both the structure and application of the requirements within the premises electrical system. The diagram for emergency system selective coordination provides illustrative guidance on how the overcurrent protective devices are required to selectively coordinate. This revision would provide additional clarity on how the requirements apply to each source path and include guidance on ensuring that selective coordination is maintained when OCPDs are modified or replaced in existing systems.

## Related Public Inputs for This Document

| Related Input | Relationship |
| --- | --- |
| Public Input No. 3373-NFPA 70-2020 [Section No. 701.32] | Same proposal for legally required |
| Public Input No. 3373-NFPA 70-2020 [Section No. 701.32] | |

## Submitter Information Verification

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**Submittal Date:** Tue Sep 08 11:50:25 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4662-NFPA 70-2020 [ Section No. 700.32 ]

**700.32** Selective Coordination.

Emergency system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

Exception: Selective coordination shall not be required for overcurrent devices located inside listed equipment or between listed equipment and their feeder overcurrent device.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

Informational Note: See Informational Note Figure 700.32 for an example of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

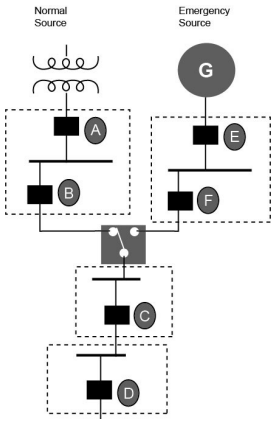
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.

OCPD C selectively coordinates with OCPDs F, E, B, and A.

OCPD F selectively coordinates with OCPD E.

OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

**Figure Informational Note Figure 700.32 Emergency System Selective Coordination.**




## Statement of Problem and Substantiation for Public Input

Oftentimes, the overcurrent protection devices in listed emergency inverters or listed uninterruptible power supplies (UPS) cannot be changed out without voiding either or both the manufacture warranty and/or the listing of equipment, making selective coordination costly, impracticable, or impossible.

## Submitter Information Verification

**Submitter Full Name:** Christopher Bond

| | |
|---|---|
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| **Submittal Date:** | Thu Sep 10 16:29:18 EDT 2020 |
| **Committee:** | NEC-P13 |

# Public Input No. 3952-NFPA 70-2020 [ Section No. 701.2 ]

( Relocate all definitions in the 701.2 to Article 100, arrange them in alphabetical order and without any subdivisions.)701. 2 Definition.

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

**Legally Required Standby Systems.**

Those systems required and so classed as legally required standby by municipal, state, federal, or other codes or by any governmental agency having jurisdiction. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source.

Informational Note: Legally required standby systems are typically installed to serve loads, such as heating and refrigeration systems, communications systems, ventilation and smoke removal systems, sewage disposal, lighting systems, and industrial processes, that, when stopped during any interruption of the normal electrical supply, could create hazards or hamper rescue or fire-fighting operations.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4177-NFPA 70-2020 [ Definition: Legally Required Standby Systems. ]

**Legally Required Standby Systems.**

Those systems required and so classed as legally required standby by municipal, state, federal, or other codes or by any governmental agency having jurisdiction. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source.

Informational Note No 1 : Legally required standby systems are typically installed to serve loads, such as heating and refrigeration systems, communications systems, ventilation and smoke removal systems, sewage disposal, lighting systems, and industrial processes, that, when stopped during any interruption of the normal electrical supply, could create hazards or hamper rescue or fire-fighting operations.

Informational Note No 2: Legally Required Standby Systems are considered level one for systems when faliure to perform could result in loss of human life or serious injuries and level two systems when failure of legally required standby system to perform is less critical to human life and safety when applying NFPA110-2019. Standard for Emergency and Standby Power Systems.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note

3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word “system” since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2882-NFPA 70-2020 [ Section No. 701.3 ]

**701.3** ~~Tests~~ Commissioning and Maintenance.

**(A)** ~~Conduct or~~ Commissioning Witness Test.

The authority having jurisdiction shall conduct or witness ~~a test~~ the commissioning and testing of the complete system upon installation in compliance with 110 .17.

**(B)** Tested Periodically.

Systems shall be tested periodically on a schedule and in a manner approved by the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

**(C)** Maintenance.

Legally required standby system equipment shall be maintained in accordance with manufacturer instructions and industry standards.

**(D)** Written Record.

A written record shall be kept on such tests and maintenance.

**(E)** Testing Under Load.

Means for testing legally required standby systems under load shall be provided.

Informational Note: For information on testing and maintenance of emergency power supply systems (EPSSs), see NFPA 110-2019, *Standard for Emergency and Standby Power Systems*.

## Statement of Problem and Substantiation for Public Input

Common requirements for device and system commissioning are being proposed to Article 110 in PI 2844 that will help drive consistency in the actions necessary prior to devices and systems being placed into service. This public input is part of a series of revisions proposed throughout the code to include commissioning where the existing requirements only mention testing.

Confirming the installation, setup, and initial performance for devices and equipment necessary for proper system operation and safety extend well beyond a simple testing requirement. Existing requirements for specific tests are not focused on how the device or equipment fits within the overall system. In addition to verifying operational controls and sequence of operation, this revision also adds clarity that overcurrent and protective devices must have settings that have been adjusted and verified when inspected by the AHJ. The requirement to include as-built documentation and a record of the actions taken to correct any shortcomings will enhance the safety of those who will operate, maintain, and service the equipment.

The term commissioning is defined in 708.2 and applies throughout the code.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2844-NFPA 70-2020 [New Section after 110.16] | |
| Public Input No. 2880-NFPA 70-2020 [Section No. 700.3] | |
| Public Input No. 2885-NFPA 70-2020 [Section No. 706.7] | |
| Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.] | |
| Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)] | |

Public Input No. 2880-NFPA 70-2020 [Section No. 700.3]
Public Input No. 2885-NFPA 70-2020 [Section No. 706.7]
Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.]
Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)]

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 395-NFPA 70-2020 [ Section No. 701.4(A) ]

**(A)** Rating.

Legally required standby system equipment short-circuit current and interrupting ratings shall be suitable for the available fault current at its terminals. Legally required standby system equipment shall be marked with the available fault current and the date the calculation was performed.

## Statement of Problem and Substantiation for Public Input

Text has been added to clarify what ratings must be adequate for the available fault current. In addition a requirement to mark the available fault current and date of calculation has been added to help ensure compliance.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 394-NFPA 70-2020 [Section No. 700.4(A)] | |

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**Committee:** NEC-P13

## Public Input No. 2815-NFPA 70-2020 [ Section No. 701.4(B) ]

**(B)** Capacity.

A legally required standby system shall have adequate capacity in accordance with Article 220 or by another approved method. The system capacity shall be sufficient for the rapid load changes and transient power and energy requirements associated with any expected loads.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 200822_NEC_701_Revisions_R1.docx | NEC CC Emergency Sources TG Article 701 | |

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The addition of this new language addresses the common condition where facilities relying on legally required standby systems have variable loads that can also have significant transient high-power conditions such as motor starting. This language makes it clear that these conditions must be taken into account when sizing the minimum capacity of these systems.

See the attached Word document for the complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |

Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)]
Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)]

## Submitter Information Verification

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**Submittal Date:** Tue Sep 01 16:41:22 EDT 2020
**Committee:** NEC-P13

## Legally Required Standby Systems

**701.4(B) Capacity.**

A legally required standby system shall have adequate capacity in accordance with Article 220 or by another approved method. The system capacity shall be sufficient for the rapid load changes and transient power and energy requirements associated with any expected loads.

**Commented [CK1]:** Jason
The addition of this new language addresses the common condition where facilities relying on legally required standby systems have variable loads that can also have significant transient high-power conditions such as motor starting. This language makes it clear that these conditions must be taken into account when sizing the minimum capacity of these systems.

**701.4(C) Load Pickup~~,~~ and Load Shedding~~, and Peak Load Shaving.~~**

The alternate power source shall be permitted to supply legally required standby and optional standby system loads where the alternate source has adequate capacity or where automatic selective load pickup and load shedding are provided that will ensure adequate power to the legally required standby circuits.

**701.4(D) Parallel Operation.**

**Commented [CK2]:**

Parallel operation of the alternate power source(s) shall consist of the following:

(1) Normal Source. The alternate power source shall be permitted to operate in parallel with the normal source in compliance with Part I or Part II of Article 705 where the capacity required to supply the legally required standby load is maintained at all times. Any operating condition that results in less than the required source capacity shall initiate a system malfunction signal per 701.6(A).

Parallel operation shall be permitted for satisfying the test requirements of 701.3(B), provided all other conditions of 701.3 are met.

Informational Note: Peak load shaving is one application for parallel source operation.

(2) Alternate Source. Legally required standby sources shall be permitted to operate in parallel where the necessary equipment to establish and maintain a synchronous condition is provided.

Rationale: This new section is being added to aid users of this Code to more easily identify the requirements unique to power sources used in legally required systems that can operate in parallel with a normal source. The application of parallel connected power sources is becoming increasingly popular, both for economics and resiliency. This new language clarifies that there are two distinctly different types of parallel operation. 701.4(D)(1) identifies requirements specific to applications where legally required standby source(s) operate in parallel with a normal source whereas 701.4(D)(2) identifies requirements for conditions where alternate sources operate in parallel only with each other. Some systems may utilize both conditions, so the charging sentence allows both to be applied. For applications where an alternate source is used in parallel with a normal source, a statement that the required

capacity to supply the legally required standby load be maintained at all times is included. To clarify these applications further with regards to other sections in article 701, a reference to 701.6(A) is included to ensure that any reduction in the minimum capacity trigger a malfunction signal. Since systems that operate in parallel with a normal source are generally always functioning, a recognition that this operation meets the requirements for periodic testing is also included. All other requirements in 701.3 continue to apply so that is made clear in this new language. The sentences struck from previous 701.4(C) have been moved here (modified) into 701.4(D)(1). A reference to article 705 has been added to point users to this article where requirements for interconnected sources are located. The addition of 701.4(D)(2) clarifies that alternate sources can be paralleled together provided they are suitable for this application. This was not prohibited before, but it is important to state this here to distinguish between sources operated in parallel with each other and those that operate in parallel with a normal source.

**701.6 Signals.**

Audible and visual signal devices shall be provided, where practicable, for the purpose described in 701.6(A) through (D).

**…**

**701.6(C) ~~Not Functioning.~~ Storage Battery Charging Malfunction.**

To indicate ~~that the battery charger is not functioning~~ a charging malfunction where a battery charger is required for source readiness, including engine starting.

**Commented [CK3]:** Rationale: The title of this section should be revised to better describe the functional area of the alarm signal. Additionally, the requirement was changed to align with the focus on battery charging and potential impact to source readiness.

**Part III. Sources of Power**

**701.12 General Requirements.** (no changes)

**701.12(A) Power Source Considerations.** (no changes)

**701.12(B) Equipment Design and Location.** (no changes)

**701.12(C) ~~Storage Battery.~~ Supply Duration**

~~Storage batteries shall be of suitable rating and capacity to supply and maintain the total load for a minimum period of 11⁄2 hours, without the voltage applied to the load falling below 871⁄2 percent of normal. Automotive-type batteries shall not be used.~~

~~An automatic battery charging means shall be provided.~~

This requirement was moved to 701.12(C)(4).

**Commented [CK4]:** Rationale: The existing requirements for storage batteries are being moved to 701.12(C)(4) with this revision. The title was revised in order to have a common section for the emergency source duration required regardless of the source type(s). Additionally, the fuel supply, storage, and transfer pump requirements included are moved from 701.12(D)(2) since these should apply to any applicable sources and not just generators.

The alternate power source shall be of suitable rating and capacity to supply and maintain the total load for the duration determined by the system design. In no case shall the duration be less than 2 hours of system operation. Additionally, the power source shall comply with the following requirements as applicable.

(1) *On-Site Fuel Supply.* An on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours operation of the system.

(2) *Fuel Transfer Pumps.* Where power is needed for the operation of the fuel transfer pumps to deliver fuel to the source, these pumps shall be connected to the legally required standby system.

(3) *Public Gas System, Municipal Water Supply.* Sources shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.

*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.*

(4) Storage batteries and Uninterruptable Power Supply systems used to supply standby illumination shall meet the capacity and performance required by 701.12(J)(2)(1).

(5) Automatic Fuel Source Transfer. Where dual fuel sources are used, means shall be provided for automatically transferring from one fuel source to another.

**701.12(D) Generator Set.**

**701.12(D)(1) Prime Mover-Driven.** (no changes)

This requirement was moved to 701.12(C) since it applies to more than generators.

~~**701.12(D)(2) Internal Combustion Engines as Prime Movers.**~~

~~Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours of full-demand operation of the system. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, the pumps shall be connected to the legally required standby power system.~~

~~**701.12(D)(3) Public Gas System, Municipal Water Supply.**~~

~~Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or on a municipal water supply for their cooling systems. Means shall be provided for automatically transferring one fuel supply to another where dual fuel supplies are used.~~

~~Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.~~

**701.12(D)(4) Battery Power.** (no changes)

**701.12(D)(5) Outdoor Generator Sets.** (no changes)

**701.12(E) ~~Uninterruptible Power Supplies~~ Stored-Energy Power Supply Systems (SEPSS).** ~~Uninterruptible power supplies used to provide power for emergency systems shall comply with 701.12(B) and (C).~~ Stored Energy Power Supply Systems shall comply with all of the following:

1. Systems shall consists of one or more of the following system types
    a) Uninterruptible Power Supply (UPS).
        Informational Note: For further information, see UL 1778, *Uninterruptable Power Systems*.

    b) Fuel Cell System. Fuel cell systems used as a source of power shall also meet the requirements of Article 692.

    c) Energy Storage System (ESS). The installation of an energy storage system shall also meet the requirements of Article 706.

    d) Storage Battery. A storage battery system for dc emergency loads shall also comply with Article 480.

    e) Other approved equivalent stored energy sources that comply with 701.12.

2. Systems shall be installed with the fire protection and suppression, ventilation and separation requirements specified in the manufacturer's instructions or equipment listing.

Informational Note: Additional information on fire protection installation requirements can be found in NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems;* NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems.*

**701.12(F) Separate Service.** (no changes)

**~~701.12(H) Fuel Cell System.~~** (This was moved to 701.12(E))

**Commented [CK5]:** Laurie Florence
The rationale for 701.12(E) These changes are intended to expand what can be utilized for the newly defined stored-energy power supply systems (SEPSS) to include a number of different technologies that are currently available and can be used for this application including UPS, fuel cell systems, ESS, storage batteries for DC loads and an "other" option since these technologies may not represent an all-inclusive list

~~Fuel cell systems used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.~~

~~Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.~~

**700.12(I) ~~DC~~ Microgrid Systems.**

~~Sources connected to a dc microgrid system shall be permitted where the system is capable of being isolated from all nonlegally required sources.~~

~~A dc microgrid system used as a source of power for legally required systems shall be of suitable rating and capacity to supply and maintain the total legally required load for not less than 2 hours of full-demand operation.~~

~~Where a dc microgrid system source serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the emergency standby system.~~

On-site sources, designated as legally required standby sources, connected to a microgrid system

The system shall isolate the legally required standby system from all non-legally required loads when the normal electric supply is interrupted or shall meet the requirements of 701.4(C). Interruption, partial or complete failure of the normal source(s) shall not impact the availability, capacity and duration provided by the designated legally required standby sources.

Designated stored-energy legally required standby power source(s) of a microgrid system shall be permitted to remain interconnected to any available power production source during the legally required standby source(s) operation where the lack of, or failure, of the interconnected power production source(s), or related controls, does not impact system operation. Interconnected power production sources, other than the designated SEPSS shall not be required to meet the requirements of Article 701.

SUBSTANTIATION:
Modifying this section to recognize that there are different types of microgrids, in addition to any that might be categorized as dc only. The first sentence is similar to the 2020 language but modified to include other microgrid configurations. New second sentence clarifies that, similar to optional standby systems, non-emergency loads are permitted to be supplied by the legally required standby sources within the microgrid but these shall be isolated from the legally required standby sources during system operation, or shall be controlled per 701.4(C). Language to address the condition where there is a failure of one or more interconnected sources not

categorized as legally required standby sources is addressed in the third sentence. Failures with legally required sources require a malfunction signal in 701.6 however other sources are not included so this language has been added. This language would require that an analysis of these conditions is considered in the installation of such a system.
The final paragraph provides and allowance that where a stored-energy emergency source, such as a battery or ESS, is used as part of the legally required standby system, it shall be permitted to be charged by other sources, not just those categorized as legally required standby sources. This is not a blanket allowance however, since an analysis must be performed to ensure that the lack of any of these sources, or any failure within them, will not impact the ability of the system to supply the legally required standby loads.

**701.12(J) Unit Equipment.** (no changes)

**700.12(J)(2) Installation of Unit Equipment.**

Unit equipment shall be installed in accordance with the following:

(1) The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit in accordance with the following:

a. For a period of at least 1-1⁄2 hours without the voltage falling below 87-1⁄2 percent of normal battery voltage.

b. The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1-1⁄2 hours.

## Public Input No. 2818-NFPA 70-2020 [ New Section after 701.4(C) ]

**(D) Parallel Operation.**

Parallel operation of the alternate power source(s) shall consist of the following:

(1) Normal Source. The alternate power source shall be permitted to operate in parallel with the normal source in compliance with Part I or Part II of Article 705 where the capacity required to supply the legally required standby load is maintained at all times. Any operating condition that results in less than the required source capacity shall initiate a system malfunction signal per 701.6(A).

Parallel operation shall be permitted for satisfying the test requirements of 701.3(B), provided all other conditions of 701.3 are met.

Informational Note: Peak load shaving is one application for parallel source operation.

(2) Alternate Source. Legally required standby sources shall be permitted to operate in parallel where the necessary equipment to establish and maintain a synchronous condition is provided.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

This new section is being added to aid users of this Code to more easily identify the requirements unique to power sources used in legally required systems that can operate in parallel with a normal source. The application of parallel connected power sources is becoming increasingly popular, both for economics and resiliency. This new language clarifies that there are two distinctly different types of parallel operation. 701.4(D)(1) identifies requirements specific to applications where legally required standby source(s) operate in parallel with a normal source whereas 701.4(D)(2) identifies requirements for conditions where alternate sources operate in parallel only with each other. Some systems may utilize both conditions, so the charging sentence allows both to be applied. For applications where an alternate source is used in parallel with a normal source, a statement that the required capacity to supply the legally required standby load be maintained at all times is included. To clarify these applications further with regards to other sections in article 701, a reference to 701.6(A) is included to ensure that any reduction in the minimum capacity trigger a malfunction signal. Since systems that operate in parallel with a normal source are generally always functioning, a recognition that this operation meets the requirements for periodic testing is also included. All other requirements in 701.3 continue to apply so that is made clear in this new language. The sentences struck from previous 701.4(C) have been moved here (modified) into 701.4(D)(1). A reference to article 705 has been added to point users to this article where requirements for interconnected sources are located. The addition of 701.4(D)(2) clarifies that alternate sources can be paralleled together provided they are suitable for this application. This was not prohibited before, but it is important to state this here to distinguish between sources operated in parallel with each other and those that operate in parallel with a normal source.

See the Word document attached to PI 2815 for the correct format and complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |

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**Committee:** NEC-P13

## Public Input No. 2816-NFPA 70-2020 [ Section No. 701.4(C) ]

**(C)** Load Pickup ~~,~~ and Load Shedding~~, and Peak Load Shaving~~ .

The alternate power source shall be permitted to supply legally required standby and optional standby system loads where the alternate source has adequate capacity or where automatic selective load pickup and load shedding are provided that will ensure adequate power to the legally required standby circuits.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

This action removes "peak load shaving" from the title since the requirements for parallel sources are addressed in a proposed new section 701.4(D) titles "Parallel Operation". The application of peak load shaving is just one use case for these systems while operating in parallel with the normal source. See the Word document attached to PI 2815 for the complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |

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## Public Input No. 2757-NFPA 70-2020 [ Section No. 701.5 ]

**701.5** Transfer Equipment.

**(A)** General.

Transfer equipment shall be automatic, listed, and marked for emergency system or legally required standby use, and approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and alternate sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705. Meter-mounted transfer switches shall not be permitted for legally required system use.

**(B)** Bypass Isolation Switches.

Means to bypass and isolate the transfer switch equipment shall be permitted. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

**(C)** Automatic Transfer Switches.

Automatic transfer switches shall be electrically operated and mechanically held. ~~Automatic transfer switches shall not be permitted to be reconditioned.~~

**(D)** Documentation.

The short-circuit current rating of the transfer equipment, based on the specific overcurrent protective device type and settings protecting the transfer equipment, shall be field marked on the exterior of the transfer equipment.

**(E) Reconditioning Transfer Switches.**

Transfer Switches within the scope of this article shall be permitted to be reconditioned in accordance with 701.5(E)(1) through 701.5(E)(4).

(1) The reconditioning process shall be performed in accordance with instructions provided by the manufacturer.

(2) Reconditioning shall be performed using design qualified parts, verified under applicable standards.

(3) Reconditioned transfer switches shall be listed or field labeled as reconditioned, and previously applied listing marks, if any, within the portions reconditioned shall be removed.

(4) If equipment has been damaged by fire, products of combustion, or water, it shall be specifically evaluated by its manufacturer or a qualified testing laboratory prior to being returned to service

## Statement of Problem and Substantiation for Public Input

Self-contained transfer switches, such as meter mounted transfer switches, are usually not designed to facilitate replacement of critical components and are generally not considered appropriate for reconditioning. Other, particularly larger, transfer switch equipment is designed in such a way that modular components like power, control, and switching elements can, relatively easily, be replaced. Such equipment usually resembles switchboards or switchgear and consists of a cabinet in which critical components are installed and connected together via distribution components. The NEC allows for switchboards and switchgear to be reconditioned, see 408.8(B), but absolutely prohibits reconditioning of transfer switches and transfer equipment. It seems contradictory to provide

switchboards an allowance to be reconditioned while reconditioning of transfer equipment of similar construction is absolutely banned.

NEMA published a white paper, “NEMA Technical Position on Reconditioned Equipment” describing the types of products that should be and should not be reconditioned. Text in the body of this document states, “A manufacturer’s design may create a situation where some equipment may be suitable for reconditioning, even if the NEC or NEMA has indicated that it is generally not suitable for reconditioning. Likewise, equipment that is generally considered suitable for reconditioning may not be suitable for reconditioning in a specific case or based on the specific design.” The statement cited above makes it clear that the OEM has a role in determining if products that they manufacture are appropriate for reconditioning.

A blanket ban on reconditioning has the following effects:

- It penalizes OEMs that have invested in the development of equipment that is suitable for reconditioning.
- It penalizes both OEMs and third-party companies that have developed the expertise, tools, processes, and facilities to safely and reliable recondition this equipment.
- It penalizes the end-user by requiring the purchase of new equipment rather than allowing for a safe, more cost-effective means to restore and reuse their own equipment.
- It stifles innovation that could lead to the development of equipment and components that may have longer life spans, if reconditioning is an intended step in the equipment’s life-cycle.
- It creates more waste and makes it more difficult to meet environmental protection and sustainability goals.

Finally, the text submitted in this PI was adopted from section 408.8 of this code. The term “transfer switch” is specifically used because it is a defined term in article 100 of this code. This PI provides a reasonable allowance for reconditioning only when the process is governed by the manufacture’s guidance, use of parts that are design qualified, and certification of safety by a recognized third part evaluation. The guidelines provided in this PI to ensure safety exceed the requirements laid out in the NEC for reconditioning of equipment of similar complexity. In accordance with the stated support of manufacturer discretion in the allowance of reconditioning in NEMA’s whitepaper and the similarities between switchboards and transfer equipment, this PI should be accepted.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2753-NFPA 70-2020 [Section No. 700.5] | |
| Public Input No. 2753-NFPA 70-2020 [Section No. 700.5] | |
| Public Input No. 2759-NFPA 70-2020 [Section No. 702.5] | |
| Public Input No. 2761-NFPA 70-2020 [Section No. 708.24] | |

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**Committee:** NEC-P13

## Public Input No. 3004-NFPA 70-2020 [ Section No. 701.5(A) ]

**(A)** General.

Transfer equipment shall be automatic, listed, and marked for emergency system or legally required standby use, and approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and alternate sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of ~~Article 705~~ Parts I, II and IV of Article 689 . Meter-mounted transfer switches shall not be permitted for legally required system use.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

The existing language violates the style manual. With the combining of Articles 705, 710 and 712, and moving this new article to 689, this public input brings this section into compliance with the style manual by referencing specific parts within this new Article.

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## Public Input No. 574-NFPA 70-2020 [ Section No. 701.5(A) ]

**(A)** General.

Transfer equipment shall be automatic, listed, and marked for emergency system or legally required standby use~~, and approved by the authority having jurisdiction.~~ .. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and alternate sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705. Meter-mounted transfer switches shall not be permitted for legally required system use.

## Statement of Problem and Substantiation for Public Input

This is already required in 110.2.

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## Public Input No. 4528-NFPA 70-2020 [ Section No. 701.5(C) ]

**(C)** Automatic Transfer Switches.

Automatic transfer switches shall be electrically operated and mechanically held. Automatic transfer switches shall not be permitted to be reconditioned, unless specifically permitted by another section of this code .

## Statement of Problem and Substantiation for Public Input

Added language for addition to 110.21(A)(2) and new section 517.2

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4496-NFPA 70-2020 [Section No. 110.21(A)(2)] | |
| Public Input No. 4518-NFPA 70-2020 [New Section after 517.1] | |

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## Public Input No. 2819-NFPA 70-2020 [ Section No. 701.6(C) ]

**(C)** ~~Not Functioning~~ Storage Battery Charging Malfunction .

To indicate ~~that the~~ a charging malfunction where a battery charger is ~~not functioning.~~

~~Informational Note: For signals for generator sets, see NFPA 110-2016, *Standard for Emergency and Standby Power Systems*~~

required for source readiness, including starting the prime mover .

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The title of this section should be revised to better describe the functional area of the alarm signal. Additionally, the requirement was changed to align with the focus on battery charging and potential impact to source readiness.

The formatting in the NFPA system isn't correct. See the Word document attached to PI 2815 for the correct formatting and complete set of changes proposed for Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |

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**Submittal Date:** Tue Sep 01 17:01:04 EDT 2020
**Committee:** NEC-P13

# Public Input No. 771-NFPA 70-2020 [ New Section after 701.7(B) ]

**TITLE OF NEW CONTENT**

Type your content here ...

**701.8 Electromagnetic Pulse (EMP) Protection.** Protection for legally required standby systems against the effects of electromagnetic pulses shall be provided at a minimum of Level 2. See 709.7 for levels of electromagnetic pulse protection.

*Exception: The requirements of 709.7(A)(5) and 709.7(B)(3) shall not apply.*

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

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**Committee:** NEC-P13

## Public Input No. 2822-NFPA 70-2020 [ New Section after 701.12(C) ]

**(C) Supply Duration.**

The alternate power source shall be of suitable rating and capacity to supply and maintain the total load for the duration determined by the system design. In no case shall the duration be less than 2 hours of system operation. Additionally, the power source shall comply with the following requirements as applicable.

(1) *On-Site Fuel Supply.* An on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours operation of the system.

(1) *Fuel Transfer Pumps.* Where power is needed for the operation of the fuel transfer pumps to deliver fuel to the source, these pumps shall be connected to the legally required standby system.

(1) *Public Gas System, Municipal Water Supply.* Sources shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems.

*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.*

(1) Storage batteries and Uninterruptable Power Supply systems used to supply standby illumination shall meet the capacity and performance required by 701.12(J)(2)(1).

(1) Automatic Fuel Source Transfer. Where dual fuel sources are used, means shall be provided for automatically transferring from one fuel source to another.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The existing requirements for storage batteries are being moved to 701.12(C)(4) with this revision. The title was revised in order to have a common section for the legally required source duration required regardless of the source type(s). Additionally, the fuel supply, storage, and transfer pump requirements included are moved from 701.12(D)(2) since these should apply to any applicable sources and not just generators.

See the Word document attached to PI 2815 for the complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |

Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)]
Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)]
Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)]
Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)]
Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)]
Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)]
Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)]
Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)]
Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)]
Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)]
Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)]
Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)]
Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)]
Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)]
Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)]
Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)]
Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)]

## Submitter Information Verification

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**Submittal Date:** Tue Sep 01 17:13:00 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2820-NFPA 70-2020 [ Section No. 701.12(C) ]

~~(C) Storage Battery.~~

~~Storage batteries shall be of suitable rating and capacity to supply and maintain the total load for a minimum period of 1 1/2 hours without the voltage applied to the load falling below 87 1/2 percent of normal. Automotive-type batteries shall not be used.~~

~~An automatic battery charging means shall be provided.~~

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The existing requirements for storage batteries are being moved to 701.12(C)(4) with this revision. The title was revised in order to have a common section for the emergency source duration required regardless of the source type(s). Additionally, the fuel supply, storage, and transfer pump requirements included are moved from 701.12(D)(2) since these should apply to any applicable sources and not just generators.

See the Word document attached to PI 2815 for the complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |

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**Submittal Date:** Tue Sep 01 17:08:34 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2823-NFPA 70-2020 [ Section No. 701.12(D) ]

**(D)** Generator Set.

**(1)** Prime Mover-Driven.

For a generator set driven by a prime mover approved by the authority having jurisdiction and sized in accordance with 701.4, means shall be provided for automatically starting the prime mover upon failure of the normal service and for automatic transfer and operation of all required electrical circuits. A time-delay feature permitting a 15-minute setting shall be provided to avoid retransfer in case of short-time re-establishment of the normal source.

~~**(4)**~~

**(2)** ~~Internal Combustion Engines as Prime Mover.~~

~~Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours of full-demand operation of the system. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, the pumps shall be connected to the legally required standby power system.~~

~~**(3)** Public Gas System, Municipal Water Supply.~~

~~Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or on a municipal water supply for their cooling systems. Means shall be provided for automatically transferring one fuel supply to another where dual fuel supplies are used.~~

~~*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.*~~

**Battery Power.**

Where a storage battery is used for control or signal power or as the means of starting the prime mover, it shall be suitable for the purpose and shall be equipped with an automatic charging means independent of the generator set.

**(~~5~~ 3 )** Outdoor Generator Sets.

Where an outdoor-housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The requirements in 701.12(D)(2) and (D)(3) were moved to 701.12(C) to correlate with a task group public input no. 2820 to that section. The requirements apply to more than just generator sources and this action moves them into a common requirement section.
See the Word document attached to PI 2815 for the complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |

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**Committee:** NEC-P13

## Public Input No. 4174-NFPA 70-2020 [ Section No. 701.12(D)(1) ]

**(1)** Prime Mover-Driven.

For a generator set driven by a prime mover approved by the authority having jurisdiction and sized in accordance with 701.4, means shall be provided for automatically starting the prime mover upon failure of the normal ~~service~~ power source and for automatic transfer and operation of all required electrical circuits. A time-delay feature permitting a 15-minute setting shall be provided to avoid retransfer in case of short-time re-establishment of the normal source.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally

required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 23:42:56 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4166-NFPA 70-2020 [ Section No. 701.12(D)(2) ]

**(2)** Internal Combustion Engines as Prime Mover.

Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours of full-demand operation of the system. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, the pumps shall be connected to the legally required ~~standby power~~ standby_ system.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious

injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

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## Public Input No. 1039-NFPA 70-2020 [ Section No. 701.12(D)(3) ]

**(3)** Public Gas System, Municipal Water Supply.

Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or on a municipal water supply for their cooling systems. Means shall be provided for automatically transferring one fuel supply to another where dual fuel supplies are used.

*Exception: Where approved by the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company._ Where off-site fuel is approved, the requirements of 701.12(D)(2) shall not apply.*

## Statement of Problem and Substantiation for Public Input

The exception in 701.12(D)(3) allows the AHJ of approve the use of off-site fuel, like a public gas system. Since the exception applies only to (D)(3) , the requirement for 2 hours of on-site fuel in (D)(2) can be enforced by the AHJ. With a utility public gas fuel system there is no practical method to store 2 hours worth of utility natural gas in a tank as is common with diesel fuel or liquid propane fuel. The storage capacity of fuel is built into the utility infrastructure. The proposed language to the exception will provide clarity that when the public utility gas system is the sole source of fuel for the generator, there is no need for the storage of 2 hours worth of fuel.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1038-NFPA 70-2020 [Section No. 700.12(D)(2)] | Off-site fuel requirements |
| Public Input No. 1038-NFPA 70-2020 [Section No. 700.12(D)(2)] | |

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**Committee:** NEC-P13

# Public Input No. 2600-NFPA 70-2020 [ Section No. 701.12(D)(5) ]

~~**(5)** Outdoor Generator Sets.~~

~~Where an outdoor-housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18 , and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36 .~~

## Statement of Problem and Substantiation for Public Input

The text is not being deleted, it is being relocated to 445.18 as proposed in PI-2594

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2594-NFPA 70-2020 [Section No. 445.18] | Generator disconnecting means |
| Public Input No. 2598-NFPA 70-2020 [Section No. 700.12(D)(5)] | Generator disconnecting means |
| Public Input No. 2601-NFPA 70-2020 [Section No. 702.12] | Generator disconnecting means |
| Public Input No. 2603-NFPA 70-2020 [Section No. 708.20(F)] | Generator disconnecting means |
| Public Input No. 2598-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 2601-NFPA 70-2020 [Section No. 702.12] | |
| Public Input No. 2603-NFPA 70-2020 [Section No. 708.20(F)] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 283-NFPA 70-2020 [ Section No. 701.12(D)(5) ]

**(5)** Outdoor Generator Sets.

Where an outdoor-housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means for the building or structure shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| generator_shutdown_means_ecm.pdf | | |

## Statement of Problem and Substantiation for Public Input

Due to the 2017 changes in 445.18, this wording became unclear as to which disconnecting means is being referred to when it says, "an additional disconnecting means shall not be required."

It was the 2017 NEC that introduced a new requirement for generators, 445.18(B), to have 2 means of disconnect for prime mover for any generator greater than 15kW rating. Contractors and engineers are getting confused when emergency systems are being supplied via generator -- as to exactly what disconnecting means shall not be required per 700.12(D)(5). This happens so much so, that an article was written on this very subject in EC&M magazine. I have included a copy of the full article. It helps to illustrate what I'm talking about. Here is a snippet:

https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

"I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional “disconnecting means” is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives."

I also mention this in an article that I wrote, which can be found here:

https://www.ecmag.com/section/codes-standards/exit-lighting-and-emergency-lighting-without-battery-backup-fed-generator

"What Article 700.12(B)(6) speaks of is the disconnecting means for the building and is merely stating that the 445.18(B) disconnecting means for the generator can be used to meet Article 225.31 and 225.32 requirements. The 2017 NEC Handbook confirms this. In my opinion, the sentence should have been written like this:

Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means for the building shall not be required where ungrounded conductors serve or pass through the building or structure.

Article 700.12(B)(6) points to an entirely different Code requirement and has no detrimental effect on

445.18(B). So don't be confused here—generators with greater than a 15-kilowatt rating must still be provided with two 445.18(B) Code-compliant means to shut down the prime mover start controls. This holds true for both interior and exterior generators greater than 15 kilowatts.

And just to recap—if there is a generator enclosure, the second disconnecting means must be located somewhere outside of the generator enclosure."

So adding the five words, "for the building or structure" totally clarifies the meaning of 700.12(D)(5) such that it cannot be confused with the required disconnecting means for generator. Reason for change is clarity.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 265-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 284-NFPA 70-2020 [Section No. 702.12(A)] | |
| Public Input No. 285-NFPA 70-2020 [Section No. 708.20(F)(5)] | |
| Public Input No. 265-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 284-NFPA 70-2020 [Section No. 702.12(A)] | |
| Public Input No. 285-NFPA 70-2020 [Section No. 708.20(F)(5)] | |

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**Committee:** NEC-P13

EC&M®



NATIONAL ELECTRICAL CODE

# Generator Shutdown Means

Change to the 2017 NEC requires both exterior and interior generators to have a second means of shutting down the prime mover.

Krista McDonald Biason

MAY 19, 2017

Most of my previous articles have focused on big electrical "system" issues, complex design issues, or issues of controversy — but the topic for this article is a bit different. I want to focus on a single Code requirement — the shutdown requirements for a prime mover (aka, generator). The original intent of this article was to quickly highlight a change in the 2017 NEC, but being a Code nerd I started crosschecking other Sections in the Code to validate alignment of this new directive. Once I started doing this, the "simple" topic became significantly more complex.

Section 445.18 was revised in the 2017 National Electrical Code. In the 2014 version, this section was titled "Disconnecting Means Required for Generators." It is now titled "Disconnecting Means and Shutdown of Prime Movers" and is split into Sections (A) "Disconnecting Means" and (B) "Shutdown of Prime Mover." The general intent of this requirement is very similar to what it was in the 2014 edition with one significant exception. Section 445.18(B) now indicates: "Generators with greater than 15kW rating shall be provided with an additional requirement to shut down the prime mover. This additional shutdown means shall be located outside the equipment room or generator enclosure and shall also meet the requirements of Sec. 445.18(B)(1) and (B)(2)."

What this means is that both exterior and interior generators are required to have a second means of shutting down the prime mover. This second means is to be a remote shutdown (stop) that is not physically located on the prime mover, on the prime mover enclosure, or within the room that the prime mover is located.

I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional "disconnecting means" is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives.

Article 5.6.5.6 in NFPA 110, "Standard for Emergency and Standby Power Systems" (2016 edition), requires that "All installations shall have a remote manual stop station of a type to prevent inadvertent or unintentional operation located outside the room housing the prime mover, where so installed, or elsewhere on the premises where the prime mover is located outside the building." After reading this Article 43 times, I still think the wording is awkward. The Annex information for the Article states: "For systems located outdoors, the manual shutdown should be located external to the weatherproof enclosure and should be appropriately identified." This helps clarify

that the intent of the Article is that a manual shutdown is required for exterior generators and that the shutdown station cannot be located within the generator enclosure. What the Annex doesn't quite clarify is the statement of "all installations shall have a remote manual stop station" portion. If the commas were relocated, this Article could be interpreted to actually be closely aligned with the changes in Sec. 445.18 of the 2017 NEC. The revisions to 445.18 now indicate that the remote manual stop cannot be located on the enclosure, so that verbiage is more stringent than NFPA 110.

So, after an exhausting analysis of NFPA 70 and NFPA 110, the summary of the "simple" Code change I was hoping to convey is: Both interior and exterior generators require a secondary remote stop, and that remote stop to shut down the prime mover and the remote stop station cannot be located within the same room as the prime mover or located on an exterior generator enclosure. (Note I did say exhausting — not exhaustive search. As with most Code items, once you start down the rabbit hole, there is always another Code reference that will suck you in and add to your analysis.)

**Source URL:** https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

## Public Input No. 2825-NFPA 70-2020 [ Section No. 701.12(E) ]

**(E)** ~~Uninterruptible Power Supplies.~~

~~Uninterruptible power supplies used to provide power for legally required standby systems shall comply with 701.12(B) and (C).~~

**Stored-Energy Power Supply Systems (SEPSS).**

Stored Energy Power Supply Systems shall comply with all of the following:

(1) Systems shall consist of one or more of the following system types

(2) Uninterruptible Power Supply (UPS). Informational Note: For further information, see UL 1778, *Uninterruptable Power Systems* .

(3) Fuel Cell System. Fuel cell systems used as a source of power shall also meet the requirements of Article 692.

(4) Energy Storage System (ESS). The installation of an energy storage system shall also meet the requirements of Article 706.

(5) Storage Battery. A storage battery system for dc emergency loads shall also comply with Article 480.

(6) Other approved equivalent stored energy sources that comply with 701.12.

(7) Systems shall be installed with the fire protection and suppression, ventilation and separation requirements specified in the manufacturer's instructions or equipment listing.

Informational Note: Additional information on fire protection installation requirements can be found in NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems;* NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems.*

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

These changes are intended to expand what can be utilized for the newly defined stored-energy power supply systems (SEPSS) to include a number of different technologies that are currently available and can be used for this application including UPS, fuel cell systems, ESS, storage batteries for DC loads and an "other" option since these technologies may not represent an all-inclusive list.

The NFPA formatting for this public input has incorrect numbering. See the Word document attached to PI 2815 for the correct format and complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |

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**Committee:** NEC-P13

# Public Input No. 4023-NFPA 70-2020 [ Section No. 701.12(F) ]

**(F)** Separate Service.

Where approved

~~, a separate~~

by the authority having jurisdiction as suitable for use as a standby source of power, an additional service shall be permitted

~~as a legally required source of standby power~~

. This service shall be in

~~accordance~~

accordance with the applicable provisions of Article 230

~~, with a separate service drop or lateral or a separate set of overhead or underground service conductors~~

and the following additional requirements:

(1) Separate overhead service conductors, service drops, underground service conductors, or service laterals shall be installed.

(2) The service conductors for teh separate service shall be installed and sufficiently remote electrically and physically from any other service conductors to minimize the possibility of simultaneous interruption of supply

~~from an occurrence in another service~~

.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 701.12_F_.docx | Terra broke up the content awkwardly so the attached word document indicates the proposed change. | |

## Statement of Problem and Substantiation for Public Input

Article 701.12(F) and Article 700.12(F) both include the same requirements for utilization of a separate service as either an emergency or standby source of power. The proposed change only revises the format of Article 701 to be in alignment with the format in Article 700. It does not change the requirements or the content.

## Submitter Information Verification

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**Committee:** NEC-P13

**701.12(F) Separate Service.**

Where approved by the authority having jurisdiction as suitable for use as a standby source of power, an additional service shall be permitted. This service shall be in accordance with the applicable provisions of Article 230 and the following additional requirements:

(1) Separate overhead service conductors, service drops, underground service conductors, or service laterals shall be installed.

(2) The service conductors for the separate service shall be installed sufficiently remote electrically and physically from any other service conductors to minimize the possibility of simultaneous interruption of supply.

## Public Input No. 2826-NFPA 70-2020 [ Section No. 701.12(H) ]

~~**(H)** Fuel Cell System.~~

~~Fuel cell systems used as a source of power for legally required standby systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.~~

~~Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.~~

~~Where a single fuel cell system serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the legally required standby system.~~

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

The requirements in 701.12(H) for fuel cell systems were moved into the revised 701.12(E) for stored-energy power supply systems in a public input submitted to that section by the task group.

See the Word document attached to PI 2815 for the complete set of changes proposed to Article 701.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |

Public Input No. 2827-NFPA 70-2020 [Section No. 701.12(I)]

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**Committee:** NEC-P13

## Public Input No. 2827-NFPA 70-2020 [ Section No. 701.12(I) ]

**(I)** ~~DC~~ Microgrid Systems.

~~Sources~~
On-site sources, designated as legally required standby sources, connected to a

~~dc~~
microgrid system

~~shall be permitted where the system is capable of being isolated from all nonlegally required sources.~~

~~A dc microgrid system used as a source of power for legally required systems shall be of suitable rating and capacity to supply and maintain the total legally required load for not less than 2 hours of full-demand operation.~~

~~Where a dc microgrid system source serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the legally required standby system~~

The system shall isolate the legally required standby system from all non-legally required loads when the normal electric supply is interrupted or shall meet the requirements of 701.4(C). Interruption, partial or complete failure of the normal source(s) shall not impact the availability, capacity and duration provided by the designated legally required standby sources.

Designated stored-energy legally required standby power source(s) of a microgrid system shall be permitted to remain interconnected to any available power production source during the legally required standby source(s) operation where the lack of, or failure, of the interconnected power production source(s), or related controls, does not impact system operation. Interconnected power production sources, other than the designated SEPSS shall not be required to meet the requirements of Article 701 .

## Statement of Problem and Substantiation for Public Input

This public input is part of a series of changes submitted on behalf of a task group appointed by the NEC Correlating Committee. This task group was appointed to clarify the sources used with an emergency power system and to align the requirements for the installation of these sources within the applicable industry standards. The members of the task group are: Brian Baughman, Ronald Bethea, Krista Biason, Kevin Digenova, Steve Edley, Jason Fisher, Laurie Florence, Jeff Jonas, Chad Kennedy(Chair), Lakshmi Srinivasan, Roger Lin, and Charles Picard.

Modifying this section to recognize that there are different types of microgrids, in addition to any that might be categorized as dc only. The first sentence is similar to the 2020 language but modified to include other microgrid configurations. New second sentence clarifies that, similar to optional standby systems, non-emergency loads are permitted to be supplied by the legally required standby sources within the microgrid but these shall be isolated from the legally required standby sources during system operation, or shall be controlled per 701.4(C). Language to address the condition where there is a failure of one or more interconnected sources not categorized as legally required standby sources is addressed in the third sentence. Failures with legally required sources require a malfunction signal in 701.6 however other sources are not included so this language has been added. This language would require that an analysis of these conditions is considered in the installation of such a system. The final paragraph provides and allowance that where a stored-energy emergency source, such as a battery or ESS, is used as part of the legally required standby system, it shall be permitted to be

charged by other sources, not just those categorized as legally required standby sources. This is not a blanket allowance however, since an analysis must be performed to ensure that the lack of any of these sources, or any failure within them, will not impact the ability of the system to supply the legally required standby loads.

The formatting shown within the NFPA system isn't correct. See the Word document attached to PI 2815 for the correct formatting and complete set of changes proposed.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |
| Public Input No. 2815-NFPA 70-2020 [Section No. 701.4(B)] | |
| Public Input No. 2816-NFPA 70-2020 [Section No. 701.4(C)] | |
| Public Input No. 2818-NFPA 70-2020 [New Section after 701.4(C)] | |
| Public Input No. 2819-NFPA 70-2020 [Section No. 701.6(C)] | |
| Public Input No. 2820-NFPA 70-2020 [Section No. 701.12(C)] | |
| Public Input No. 2822-NFPA 70-2020 [New Section after 701.12(C)] | |
| Public Input No. 2823-NFPA 70-2020 [Section No. 701.12(D)] | |
| Public Input No. 2825-NFPA 70-2020 [Section No. 701.12(E)] | |
| Public Input No. 2826-NFPA 70-2020 [Section No. 701.12(H)] | |

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**Committee:** NEC-P13

## Public Input No. 4106-NFPA 70-2020 [ Section No. 701.12(J) ]

**(J)** Unit Equipment.

Individual unit equipment for legally required standby illumination shall consist of the following:

(1) A rechargeable battery

(2) A battery charging means

(3) Provisions for one or more lamps mounted on the equipment and shall be permitted to have terminals for remote lamps

(4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment

The batteries shall be of suitable rating and capacity to supply and maintain the total lamp load associated with the unit for not less than the following:

(1) For a period of 1½ hours, without the voltage falling below 87½ percent of normal voltage

(2) The unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours.

Unit equipment shall be permanently fixed in place (i.e., not portable) and shall have all wiring to each unit installed in accordance ~~with the requirements of~~ with any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length. The branch circuit feeding the unit equipment shall be the same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches. Legally required standby luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment by one of the wiring methods of Chapter 3.

*Exception: In a separate and uninterrupted area supplied by a minimum of three normal lighting circuits, a separate branch circuit for unit equipment shall be permitted if it originates from the same panelboard as that of the normal lighting circuits and is provided with a lock-on feature.*

## Statement of Problem and Substantiation for Public Input

Deleting the words "the requirements of" does not change the meaning of the section.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 3504-NFPA 70-2020 [ New Section after 701.32 ]

**TITLE OF NEW CONTENT**

Type your content here ...Equipment enclosures for selectively coodinated overcurrent devices shall be legibly marked in the field to indicate the overcurrent devices are selectively coordinated, the marking shall meet the requirements of 110.21 (B) and shall be readily visible and state the following. CAUTION OVERCURRENT DEVICES ARE SELECTIVELY COORDINATED EQUIVALENT REPLACEMENT AND TRIP SETTINGS ARE REQUIRED

## Statement of Problem and Substantiation for Public Input

the field marking will alert those who are authorized to maintain, inspect or work on the system that the overcurrent devices are selectively coordinated. the field marking will clearly identify what overcurrent devices are selectively coordinated per the engineer documentation after the final inspection for future modifications to the system. This will also make this section consistent with NEC 620.65 for the same requirements

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3503-NFPA 70-2020 [New Section after 700.32] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2796-NFPA 70-2020 [ Section No. 701.32 ]

**701.32** Selective Coordination.

Legally required standby system(s) overcurrent protective devices (OCPD) shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

Informational Note: See Informational Note Figure 701.32 for an example of how legally required standby system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

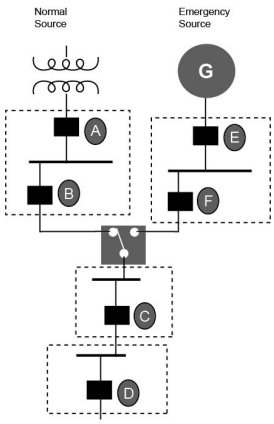
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.

OCPD C selectively coordinates with OCPDs F, E, B, and A.

OCPD F selectively coordinates with OCPD E.

OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

**Figure Informational Note Figure 701.32 Legally Required Standby System Selective Coordination.**




## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 700DOT32_AND_701DOT_32_VS_ORIGINAL_ILLUSTRATION.pdf | Illustration showing existing and recommended changes | |

## Statement of Problem and Substantiation for Public Input

Justification is the same as is used in 700.32. Here is that text:

The current text is in error in that OCPD B must coordinate with OCPD A if it is not the same ampacity device as A. Breaker B in the illustration is clearly serving an emergency load so must be selectively coordinated with all downstream devices.

The illustration itself is potentially confusing because it does not show non-emergency loads as being completely separated from emergency loads. This is particularly important because there are nearly always non-emergency loads connected to the same generator as emergency loads. The expanded illustration provides more clarity as to the requirements.

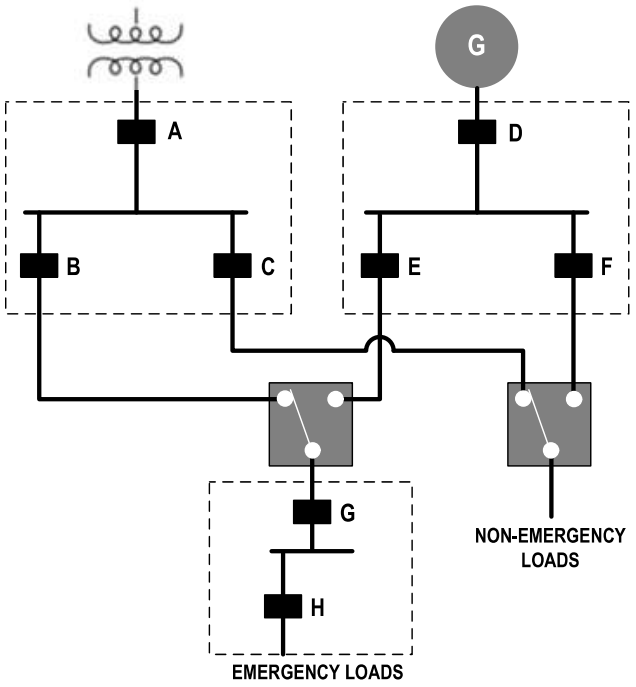
## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2237-NFPA 70-2020 [Section No. 700.32] | The requirement for selective coordination is the same in both sections noted. |

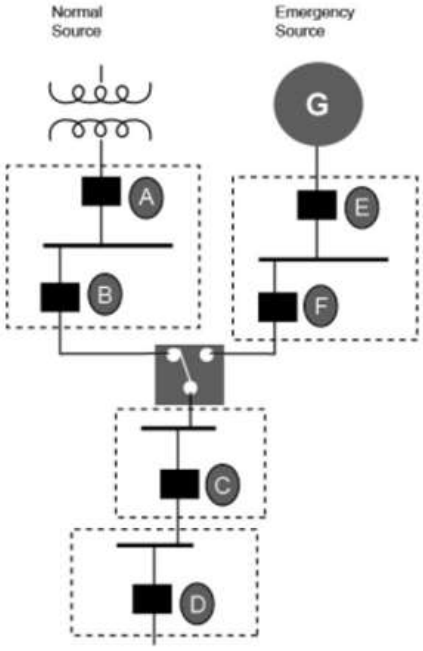
## Submitter Information Verification

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**Committee:** NEC-P13

SUGGESTED CHANGE




CURRENT ILLUSTRATION



## Public Input No. 3373-NFPA 70-2020 [ Section No. 701.32 ]

**701.32** Selective Coordination.

Legally required standby system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

Informational Note: See Informational Note Figure 701.32 for an example of how legally required standby system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

OCPD D selectively coordinates with OCPDs C, F, E, and with OCPDs C, B, and A.

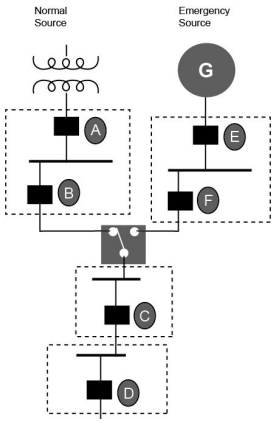
OCPD C selectively coordinates with OCPDs F, E, and with OCPDs B, and A.

OCPD F selectively coordinates with OCPD E.

OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

The entire system must coordinate as indicated above beginning with the OCPD closest to the emergency load and working upstream to the supply-side source(s). Modifications of any OCPD in the source path require all OCPD in the path to be evaluated to enure selective coordination is maintained.

**Figure Informational Note Figure 701.32 Legally Required Standby System Selective Coordination.**




## Statement of Problem and Substantiation for Public Input

The inclusion of diagrams within the Code can assist users with both the structure and application of the requirements within the premises electrical system. The diagram for emergency system selective coordination provides illustrative guidance on how the overcurrent protective devices are required to selectively coordinate. This revision would provide additional clarity on how the requirements apply to each source path and include guidance on ensuring that selective coordination is maintained when OCPDs are modified or replaced in existing systems.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3372-NFPA 70-2020 [Section No. 700.32] | Same recommendation for Emergency |
| Public Input No. 3372-NFPA 70-2020 [Section No. 700.32] | |

## Submitter Information Verification

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**Submittal Date:** Tue Sep 08 11:56:40 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3954-NFPA 70-2020 [ Section No. 702.2 ]

(Relocate all definitions in the 702. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**702. 2** Definition.

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

**Optional Standby Systems.**

Those systems intended to supply power to public or private facilities or property where life safety does not depend on the performance of the system. These systems are intended to supply on-site generated or stored power to selected loads either automatically or manually.

Informational Note: Optional standby systems are typically installed to provide an alternate source of electric power for such facilities as industrial and commercial buildings, farms, and residences and to serve loads such as heating and refrigeration systems, data processing and communications systems, and industrial processes that, when stopped during any power outage, could cause discomfort, serious interruption of the process, damage to the product or process, or the like.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3012-NFPA 70-2020 [ Section No. 702.4 ]

**702.4** Capacity and Rating.

**(A)** Available Fault Current.

Optional standby system equipment shall be suitable for the available fault current at its terminals.

**(B)** System Capacity.

**(1)** Manual Transfer Equipment.

Where manual transfer equipment is used, an optional standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the optional standby system shall be permitted to select the load connected to the system.

**(2)** Automatic Transfer Equipment.

Where automatic transfer equipment is used, an optional standby system shall comply with 702.4(B)(2)(a) or (B)(2)(b) in accordance with Article 220 or by another approved method.

(a) ~~*Full*~~ *Manual Load* . ~~The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment. *Management.* Where load management is controlled manually, the standby source 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 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.~~

(b) *Automatic Load Management.* Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system at one period of time .

(c) *No Load Management* . Where load management is not used, the system shall have adequate capacity and rating equal to or greater-than the full load that is transferred by the automatic transfer equipment.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| NFPA-70_2023_AAC-AETG_Draft_PI_702_4_capacity_language.doc.docx | | |

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This input seeks to correlate revised requirements as proposed by this task group located in Article 705 (new Article 689) with those in Article 702.

Manual load management was specified which provides a means for the installation of an automatic transfer switch for a generator source that may not be sized for the entire load and require manual load shedding. When this option is selected transparency is provided to the end customer, contractor, inspector and others to ensure awareness of this selection by the installer / designer.

Clarity was added to the option of when automatic load shedding is employed noting that the load to be compared is that maximum load connected by the load management system at a given period in time.

A new option was provided when no load management is selected at which time the system must be designed to serve the entire load.

This public input provides options to the installer / designer / owner while also providing the transparency through marking and labeling requirements to identify those instances when the system requires manual load shedding to possibly operate properly.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2541-NFPA 70-2020 [New Section after 705.70] | |

## Submitter Information Verification

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**Submittal Date:** Thu Sep 03 21:37:52 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3012-NFPA 70-2020 [ Revision to 702.4(B)]

**702.4(B) System Capacity.**
**702.4(B)(1) Manual Transfer Equipment.**

Where manual transfer equipment is used, an optional standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the optional standby system shall be permitted to select the load connected to the system.

**702.4(B)(2) Automatic Transfer Equipment.**

Where automatic transfer equipment is used, an optional standby system shall comply with 702.4(B)(2)(a) or (B)(2)(b) in accordance with Article 220 or by another approved method.

(a) ~~*Full Load*~~ *Manual Load Management.* Where load management is controlled manually, ~~T~~the standby source shall ~~be capable of supplying the full load that is transferred by the automatic transfer equipment.~~ 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 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.

(b) *Automatic Load Management.* Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity and rating sufficient to supply the maximum load that will be connected by the load management system at one period of time.

(c) *No Load Management*. Where load management is not used, the system shall have adequate capacity and rating equal to or greater-than the full load that is transferred by the automatic transfer equipment.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

## Public Input No. 575-NFPA 70-2020 [ Section No. 702.4 ]

**702.4** _ System Capacity ~~and Rating~~ .

**(A)**_

~~Available Fault Current.~~

~~Optional standby system equipment shall be suitable for the available fault current at its terminals.~~

~~**(B)** System Capacity.~~

~~**(1)**~~ Manual Transfer Equipment.

Where manual transfer equipment is used, an optional standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the optional standby system shall be permitted to select the load connected to the system.

**(~~2~~ B )** Automatic Transfer Equipment.

Where automatic transfer equipment is used, an optional standby system shall comply with 702.4(B)(2)(a) or (B)(2)(b) in accordance with Article 220 or by another approved method.

(a) ~~*Full*~~ *Full Load.* The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment.

(b) *Load Management.* Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system.

## Statement of Problem and Substantiation for Public Input

Redundant material. See 110.9 and 110.10.

## Submitter Information Verification

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**Submittal Date:** Mon Mar 02 13:50:12 EST 2020
**Committee:** NEC-P13

## Public Input No. 435-NFPA 70-2020 [ Section No. 702.4(B) ]

**(B)** System Capacity.

**(1)** Manual Transfer Equipment.

Where manual transfer equipment is used, an optional standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the optional standby system shall be permitted to select the load connected to the system.

**(2)** Automatic Transfer Equipment.

Where automatic transfer equipment is used, an optional standby system shall comply with 702.4(B)(2)(a) or (B)(2)(b) ~~in accordance with Article 220 or by another approved method~~ .

(a) *Full Load.* The standby source shall ~~be capable of supplying~~ have adequate capacity and rating to supply the full load that is being transferred by the automatic transfer equipment.

(b) *Load Management.* Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system.

## Statement of Problem and Substantiation for Public Input

There is no reason to reference Article 220 in this section. Leaving the reference to 220 will cause enforcement nightmares.

Applying the requirements of Article 220 will cause generators to be oversized and that will cause the generators to operate in an inefficient manner and shorten the life of the generator. Article 702's title is "Optional Standby Systems" and these systems are not mandated by an AHJ; therefore, the system capacity should be determined by the load being supplied.

## Submitter Information Verification

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**Submittal Date:** Thu Feb 06 21:36:29 EST 2020
**Committee:** NEC-P13

# Public Input No. 2249-NFPA 70-2020 [ Section No. 702.4(B)(1) ]

**(1)** Manual and Non-Automatic Transfer Equipment.

Where manual or non-automatic transfer equipment is used, an optional standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the optional standby system shall be permitted to select the load connected to the system.

## Statement of Problem and Substantiation for Public Input

The standard for transfer switches, UL 1008, identifies three types of transfer switches: Manual, Non-Automatic, and Automatic. The definitions for these types of transfer switches are as follows:

Manual Transfer Switch – A non-electrically operated transfer switch

Non-Automatic transfer switch – An electrically operated transfer switch that is not self-acting

Automatic transfer switch – A self-acting transfer switch

Manual transfer switches require the user to physically change the state of the transfer switch by moving an operating handle. No power is needed for this type of switch.

Non-automatic transfer switches require interaction by the user, but the transfer is made electrically. For example, the user will turn a selector switch or push a button to cause the switch to transfer to the other source. These switches will not transfer without intentional user interaction.

Automatic transfer switches will transfer without user interaction if the preferred source (typically the utility) is lost.

702.4(B)(1) allows the user of the optional standby system to select the load connected to the system when the transfer switch is a manual transfer switch. It is expected that since the user must initiate the transfer, the appropriate load will be selected prior to initiating the transfer, and if not, the user is present and will notice that the load cannot be supported by the optional source and will take appropriate action. The same can be said for users operating a non-automatic transfer switch. In both cases, the user is present to select the load connected to the system and to take immediate action if improper loads were selected. As such, it makes sense to include “non-automatic” transfer equipment in 702.4(B)(1).

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 407-NFPA 70-2020 [ Section No. 702.4(B)(2) ]

**(2)** Automatic Transfer Equipment .

Where automatic transfer ~~equipment is~~ equipment is used, an optional standby system shall comply with 702.4(B)(2)(a) or (B)(2)(b) in accordance with Article 220 or by another approved method.

(a) *Full Load.* The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment.

(b) ~~*Load*~~ *Energy Management System* . Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the energy management system.

(3) Multimode Inverters and Microgrid Interconnection Devices.

Where a multimode inverter or microgrid interconnection device is used, the calculation of load on the standby source shall be in accordance with continuous output rating of the standby source. Loads connected to an energy management system shall not be included in the load calculation on the standby source . Energy management system shall meet the requirements of Article 750.

## Statement of Problem and Substantiation for Public Input

The installation of multimode inverters or microgrid interconnection devices needs to be recognized in Article 702 as it applies to sizing the load on the optional standby system (ESS). These types of connection devices are common with residential and light commercial energy storage systems. ESS's are rated in total capacity in kWh and have a continuous load kW rating, typically between 4-8 kW. Energy monitoring equipment is typically used to monitor the actual real time load on the ESS and energy management systems are used to manage loads off of the ESS to prevent overloading. Without this language in the NEC, an ESS would be subjected to the same requirements for a generator.

The term "load management system" is not a defined term in the NEC, but energy management system is a defined term in Article 750.2. An energy management system by definition is a load management system and 750.30 clearly lays out what types of loads can be connected to an energy management system for load management purposes. Using the proper terms in the NEC improves usability and provides clarity to the code. A direct reference to Article 750 provides guidance to the code user for the installation requirements for these types of systems.

## Submitter Information Verification

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**Submittal Date:** Mon Feb 03 13:51:19 EST 2020
**Committee:** NEC-P13

## Public Input No. 4605-NFPA 70-2020 [ Section No. 702.4(B)(2) ]

**(2)** Automatic Transfer Equipment.

Where automatic transfer equipment is used, an optional standby system shall comply with 702.4(B)(2)(a) or (B)(2)(b) in accordance with Article 220 or by another approved method.

(a) *Full Load.* The ~~standby source~~ automatic transfer equipment shall be capable of supplying at minimum the full load ~~that is transferred by the automatic transfer equipment.~~ of the standby source. The standby source shall supply the minimum load as determined by the user.

(b) *Load Management.* Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system.

## Statement of Problem and Substantiation for Public Input

It is acceptable to install a 100A generator that satisfies 100% of load requirements using an automatic transfer switch rated for 200A. The 200A system has more room for wiring and more breaker spaces for optimal installation. Requiring a 200A generator for use with a 200A transfer switch with a max load of 100A is inefficient. However, a 100A generator with a 200A transfer switch and a max load of 100A makes installation so much easier.

## Submitter Information Verification

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**Submittal Date:** Thu Sep 10 15:44:29 EDT 2020
**Committee:** NEC-P13

## Public Input No. 518-NFPA 70-2020 [ Section No. 702.4(B)(2) ]

**(2)** Automatic Transfer Equipment.

Where automatic transfer equipment is used, an optional standby system shall comply with 702.4(B)(2)(a) or 702.4 (B)(2)(b) ~~in accordance with Article 220 or by another approved method.~~ :

(a) *Full Load.* The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment, as calculated in accordance with Article 220 .

(b) *Load Management.* Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system.

## Statement of Problem and Substantiation for Public Input

Since (B)(2)(b) in and of itself doesn't comply with the NEC style manual, we need to include 702.4 in front of it.

Please remove "or other approved method." In reality, there is no other approved method. The language in 702 was revised over a decade ago to allow a load calculation for sizing generators in lieu of adding all the loads that can be transferred to the generator at one time. An article 220 calculation IS the other approved method.

What is happening now in the field is that contractors are attempting to size generators with automatic transfer even LOWER than the Article 220 calculated load. This simply isn't correct. AHJs rely on the Article 220 calculated load in order to do their job correctly. This method provides the lowest possible load for the generator to be correctly sized. There is also more than one way to calculate a load according to Article 220. Depending upon the method of calculation, even lower values can be obtained. Nevertheless, these are still valid NEC calculations.

We really need this ambiguous language removed. Reason for code change is for code enforcement and to make it easier for electrical inspectors and electrical plans examiners to do their job.

If the panel decides to keep the language, "or other approved method" then please include for the AHJ an Informational Note stating one or two examples of what the "other approved methods" are.

## Submitter Information Verification

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**Submittal Date:** Fri Feb 21 13:19:12 EST 2020
**Committee:** NEC-P13

# Public Input No. 1559-NFPA 70-2020 [ Section No. 702.5 ]

**702.5** ~~Transfer~~ Interconnection Equipment. Interconnection equipment shall be provided in accordance with 702.5(A) or (B).

**(A)** – ~~General~~ Transfer Equipment .

Transfer equipment shall be required for all standby systems subject to the requirements of this article and for which an electric utility supply is either the normal or standby source. Transfer switches shall not be permitted to be reconditioned.

*Exception: Temporary connection of a portable generator without transfer equipment shall be permitted where conditions of maintenance and supervision ensure that only qualified persons service the installation and where the normal supply is physically isolated by a lockable disconnecting means or by disconnection of the normal supply conductors.*

**(~~B~~ 1 )** Meter-Mounted Transfer Switches.

Transfer switches installed between the utility meter and the meter enclosure shall be listed meter-mounted transfer switches and shall be approved. Meter-mounted transfer switches shall be of the manual type unless rated as determined by 702.4(B)(2).

Informational Note: For more information, see UL 1008M, *Transfer Switch Equipment, Meter Mounted*.

**(~~C~~ 2 )** Documentation.

In other than dwelling units, the short-circuit current rating of the transfer equipment, based on the specific overcurrent protective device type and settings protecting the transfer equipment, shall be field marked on the exterior of the transfer equipment.

**(~~D~~ 3 )** Inadvertent Interconnection.

Transfer equipment shall be suitable for the intended use and shall be listed, designed, and installed so as to prevent the inadvertent interconnection of all sources of supply in any operation of the transfer equipment.

**(~~E~~ 4 )** Parallel Installation.

Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall also meet the requirements of Article 705.

**(B) Multimode Inverters and Microgrid Interconnection Devices.**

Multimode inverters and microgrid interconnection devices shall be in accordance with Article 705.

## Statement of Problem and Substantiation for Public Input

Multimode inverters and microgrid interconnection devices are commonly used for the connection of an ESS where the ESS also serves as an optional standby system. Since these systems do not utilize transfer equipment, Article 702 needs to recognize other types of interconnection devices.

## Submitter Information Verification

**Submitter Full Name:** Brian Baughman
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**Street Address:**
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| | |
|---|---|
| **State:** | |
| **Zip:** | |
| **Submittal Date:** | Wed Jun 17 16:37:34 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 2759-NFPA 70-2020 [ Section No. 702.5 ]

**702.5** Transfer Equipment.

**(A)** General.

Transfer equipment shall be required for all standby systems subject to the requirements of this article and for which an electric utility supply is either the normal or standby source. ~~Transfer switches shall not be permitted to be reconditioned.~~

*Exception: Temporary connection of a portable generator without transfer equipment shall be permitted where conditions of maintenance and supervision ensure that only qualified persons service the installation and where the normal supply is physically isolated by a lockable disconnecting means or by disconnection of the normal supply conductors.*

**(B)** Meter-Mounted Transfer Switches.

Transfer switches installed between the utility meter and the meter enclosure shall be listed meter-mounted transfer switches and shall be approved. Meter-mounted transfer switches shall be of the manual type unless rated as determined by 702.4(B)(2).

Informational Note: For more information, see UL 1008M, *Transfer Switch Equipment, Meter Mounted*.

**(C)** Documentation.

In other than dwelling units, the short-circuit current rating of the transfer equipment, based on the specific overcurrent protective device type and settings protecting the transfer equipment, shall be field marked on the exterior of the transfer equipment.

**(D)** Inadvertent Interconnection.

Transfer equipment shall be suitable for the intended use and shall be listed, designed, and installed so as to prevent the inadvertent interconnection of all sources of supply in any operation of the transfer equipment.

**(E)** Parallel Installation.

Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall also meet the requirements of Article 705.

**(F)** Reconditioning of Transfer Switches.

(1) Meter Mounted Transfer Switches. Meter Mounted Transfer Switches shall not be permitted to be reconditioned.

(2) Transfer switches other than Meter Mounted Transfer Switches. Transfer switches other than Meter Mounted Transfer Switches within the scope of this article shall be permitted to be reconditioned in accordance with 702.5(F)(2)a through 702.5(F)(2)d

(3) The reconditioning process shall be performed in accordance with instructions provided by the manufacturer.

(4) Reconditioning shall be performed using design qualified parts verified under applicable standards.

(5) Reconditioned transfer switch shall be listed or field labeled as reconditioned, and previously applied listing marks, if any, within the portions reconditioned shall be removed.

(6) If equipment has been damaged by fire, products of combustion, or water, it shall be specifically evaluated by its manufacturer or a qualified testing laboratory prior to being returned to service.

## Statement of Problem and Substantiation for Public Input

Self-contained transfer switches, such as meter mounted transfer switches, are usually not designed to facilitate replacement of critical components and are generally not considered appropriate for reconditioning. Other, particularly larger, transfer switch equipment is designed in such a way that modular components like power, control, and switching elements can, relatively easily, be replaced. Such equipment usually resembles switchboards or switchgear and consists of a cabinet in which critical components are installed and connected together via distribution components. The NEC allows for switchboards and switchgear to be reconditioned, see 408.8(B), but absolutely prohibits reconditioning of transfer switches and transfer equipment. It seems contradictory to provide switchboards an allowance to be reconditioned while reconditioning of transfer equipment of similar construction is absolutely banned.

NEMA published a white paper, “NEMA Technical Position on Reconditioned Equipment” describing the types of products that should be and should not be reconditioned. Text in the body of this document states, “A manufacturer’s design may create a situation where some equipment may be suitable for reconditioning, even if the NEC or NEMA has indicated that it is generally not suitable for reconditioning. Likewise, equipment that is generally considered suitable for reconditioning may not be suitable for reconditioning in a specific case or based on the specific design.” The statement cited above makes it clear that the OEM has a role in determining if products that they manufacture are appropriate for reconditioning.

A blanket ban on reconditioning has the following effects:

- It penalizes OEMs that have invested in the development of equipment that is suitable for reconditioning.
- It penalizes both OEMs and third-party companies that have developed the expertise, tools, processes, and facilities to safely and reliable recondition this equipment.
- It penalizes the end-user by requiring the purchase of new equipment rather than allowing for a safe, more cost-effective means to restore and reuse their own equipment.
- It stifles innovation that could lead to the development of equipment and components that may

have longer life spans, if reconditioning is an intended step in the equipment's life-cycle.
• It creates more waste and makes it more difficult to meet environmental protection and sustainability goals.

Finally, the text submitted in this PI was adopted from section 408.8 of this code. The term "transfer switch" is specifically used because it is a defined term in article 100 of this code. This PI provides a reasonable allowance for reconditioning only when the process is governed by the manufacture's guidance, use of parts that are design qualified, and certification of safety by a recognized third part evaluation. The guidelines provided in this PI to ensure safety exceed the requirements laid out in the NEC for reconditioning of equipment of similar complexity. In accordance with the stated support of manufacturer discretion in the allowance of reconditioning in NEMA's whitepaper and the similarities between switchboards and transfer equipment, this PI should be accepted.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2753-NFPA 70-2020 [Section No. 700.5] | |
| Public Input No. 2757-NFPA 70-2020 [Section No. 701.5] | |
| Public Input No. 2761-NFPA 70-2020 [Section No. 708.24] | |
| Public Input No. 2753-NFPA 70-2020 [Section No. 700.5] | |
| Public Input No. 2761-NFPA 70-2020 [Section No. 708.24] | |

## Submitter Information Verification

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**Submittal Date:** Mon Aug 31 09:35:45 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3602-NFPA 70-2020 [ Section No. 702.5 ]

**702.~~5~~ 5 Interconnection** or Transfer Equipment.

**(A)** General.

~~Transfer~~ Interconnection or transfer equipment shall be required for all standby systems subject to the requirements of this article~~ and for which an electric utility supply is either the normal or standby source. Transfer switches shall not be permitted to be reconditioned~~ . The equipment shall be suitable for the intended use and shall be listed, designed, and installed so as to prevent the inadvertent interconnection of all sources of supply in any operation of the equipment .

*Exception: Temporary connection of a portable generator without transfer equipment shall be permitted where conditions of maintenance and supervision ensure that only qualified persons service the installation and where the normal supply is physically isolated by a lockable disconnecting means or by disconnection of the normal supply conductors.*

**(B)** Transfer Switches.

(1) Reconditioned. Transfer switches shall not be permitted to be reconditioned.

(2) Meter-Mounted Transfer Switches.

(1) ~~Transfer switches installed between the utility meter and the meter enclosure shall be listed meter-mounted transfer switches and shall be approved. Meter-mounted transfer switches shall be of the manual type unless rated as determined by 702.4(B)(2) .~~

~~Informational Note: For more information, see UL 1008M, *Transfer Switch Equipment, Meter Mounted* .~~

**(C)** Documentation.

In other than dwelling units, the short-circuit current rating of the interconnection or transfer equipment, based on the specific overcurrent protective device type and settings protecting ~~the transfer~~ the equipment, shall be field marked on the exterior of the ~~transfer~~ equipment.

~~(~~

~~**(D)** Inadvertent Interconnection.~~

~~Transfer equipment shall be suitable for the intended use and shall be listed, designed, and installed so as to prevent the inadvertent interconnection of all sources of supply in any operation of the transfer equipment.~~

**E)** Parallel Installation.

~~Transfer equipment and electric power production systems~~ Systems installed to permit operation in parallel with the normal source shall also meet ~~the requirements of~~ Part I or Part II of Article 705.

## Statement of Problem and Substantiation for Public Input

The requirements in this section to provide equipment necessary to prevent the inadvertent interconnection of sources is a key safety factor when supplying loads during an interruption of the normal source. Systems which meet the appropriate code requirements for paralleling of sources typically refer to the equipment which separates or isolates the connection to the normal source as Interconnection equipment rather than transfer equipment. This change would make 702.5(A) apply generally and maintain the safety requirement for inadvertent source interconnection.

The revisions to 702.5(B) group the existing requirements for transfer switches into the same section for ease of use. Terra system did not format this change correctly.

The documentation requirements in 702.5(C) for equipment short-circuit current ratings were revised to align with the proposed revision to 702.5(A) adding interconnection equipment.

The proposed revision to 702.5(A) moves the requirements for inadvertent interconnection in 702.5(D) into the general section since this key safety aspect applies to any equipment used to connect sources together or loads to sources.

Section 702.5(E) for parallel installation was revised to align with the proposed 702.5(A) which includes both interconnection equipment and transfer equipment. The reference to Article 705 was expanded since the requirements for paralleling of sources will fall into either Part I or Part II of Article 705 depending upon the system type.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 08:37:09 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4529-NFPA 70-2020 [ Section No. 702.5(A) ]

**(A)** General.

Transfer equipment shall be required for all standby systems subject to the requirements of this article and for which an electric utility supply is either the normal or standby source. Transfer switches shall not be permitted to be reconditioned, unless specifically permitted by another section of this code .

*Exception: Temporary connection of a portable generator without transfer equipment shall be permitted where conditions of maintenance and supervision ensure that only qualified persons service the installation and where the normal supply is physically isolated by a lockable disconnecting means or by disconnection of the normal supply conductors.*

## Statement of Problem and Substantiation for Public Input

Added language for addition to 110.21(A)(2) and new section 517.2

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4496-NFPA 70-2020 [Section No. 110.21(A)(2)] | |
| Public Input No. 4518-NFPA 70-2020 [New Section after 517.1] | |

## Submitter Information Verification

**Submitter Full Name:** Joshua Brackett
**Organization:**
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**Submittal Date:** Thu Sep 10 14:44:25 EDT 2020
**Committee:** NEC-P13

## Public Input No. 484-NFPA 70-2020 [ Section No. 702.5(A) ]

**(A)** General.

Transfer equipment shall be required for all standby systems subject to the requirements of this article and for which an electric utility supply is either the normal or standby source. Transfer switches shall not be permitted to be reconditioned.

*Exception: Temporary connection of a portable ~~generator~~ power supply without transfer equipment shall be permitted where conditions of maintenance and supervision ensure that only qualified persons service the installation and where the normal supply is physically isolated by a lockable disconnecting means or by disconnection of the normal supply conductors.*

## Statement of Problem and Substantiation for Public Input

This section should also recognize other portable power supply's such as Portable fuel cell power systems, Stored energy, and Hybrid energy systems

https://powr2.com/hybrid-energy-systems/

## Submitter Information Verification

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**Submittal Date:** Wed Feb 19 11:57:31 EST 2020
**Committee:** NEC-P13

## Public Input No. 2062-NFPA 70-2020 [ Section No. 702.5(B) ]

**(B)** Meter-Mounted Transfer Switches.

Transfer switches installed between the utility meter and the meter enclosure shall be listed meter-mounted transfer switches and shall be approved. Meter-mounted transfer switches shall be of the manual ~~type~~ or non-automatic type unless rated as determined by 702.4(B)(2).

Informational Note: For more information, see UL 1008M, *Transfer Switch Equipment, Meter Mounted*.

## Statement of Problem and Substantiation for Public Input

SUBSTANTIATION:

The standard for transfer switches, UL 1008, identifies three types of transfer switches: Manual, Non-Automatic, and Automatic. The definitions for these types of transfer switches are as follows:

Manual Transfer Switch – A non-electrically operated transfer switch

Non-Automatic transfer switch – An electrically operated transfer switch that is not self-acting

Automatic transfer switch – A self-acting transfer switch

The standard for meter-mounted transfer switches, UL 1008M does not include a definition section, but has text that identifies meter mounted transfer switches as automatic or non-automatic, with explanation that non-automatic may be manually operated or electrically operated.

Including both “manual” and ‘non-automatic” in the text will make it clear that both types are allowed.

Manual transfer switches require the user to physically change the state of the transfer switch by moving an operating handle. No power is needed for initiating a transfer for this type of switch.

Non-automatic transfer switches require interaction by the user, but the transfer is made electrically. For example, the user will turn a selector switch or push a button to cause the switch to transfer to the other source. These switches will NOT transfer without intentional user interaction.

Automatic transfer switches will transfer without user interaction if the preferred source (typically the utility) is lost.

702.5(B) requires a meter-mounted transfer switch to be of the manual type unless it is rated for the full load of the system or has automatic load management - see 702.4(B)(2). The reason for requiring a manual type switch is to allow the user of the optional standby system to select the load connected to the system before operating the transfer switch.

It is expected that since the user must initiate the transfer, the appropriate load will be selected prior to initiating the transfer, and if not, the user is present and will notice that the load cannot be supported by the optional source and will take appropriate action. The same can be said for users operating a non-automatic transfer switch. In both cases, the user is present to select the load connected to the system and to take immediate action if improper loads were selected. As such, it makes sense to include “non-automatic” transfer equipment in 702.5(B)(1).

## Submitter Information Verification

**Submitter Full Name:** Paul Barnhart

| | |
|---|---|
| **Organization:** | UL LLC |
| **Street Address:** | |
| **City:** | |
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| **Submittal Date:** | Mon Jul 27 09:29:15 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 578-NFPA 70-2020 [ Section No. 702.5(B) ]

~~**(B)** Meter-Mounted Transfer Switches.~~

~~Transfer switches installed between the utility meter and the meter enclosure shall be listed meter-mounted transfer switches and shall be approved. Meter-mounted transfer switches shall be of the manual type unless rated as determined by 702.4(B)(2) .~~

~~Informational Note: For more information, see UL 1008M, *Transfer Switch Equipment, Meter Mounted* .~~

## Statement of Problem and Substantiation for Public Input

With the new requirements of 702.5(D), this section is not needed.

## Submitter Information Verification

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**Submittal Date:** Mon Mar 02 14:52:30 EST 2020
**Committee:** NEC-P13

## Public Input No. 3005-NFPA 70-2020 [ Section No. 702.5(E) ]

**(E)** Parallel Installation.

Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall also meet the requirements of ~~Article~~ ~~705~~ Parts I, II and IV of Article 689 .

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

The existing language violates the style manual. With the combining of Articles 705, 710 and 712, and moving this new article to 689, this public input brings this section into compliance with the style manual by referencing specific parts within this new Article.

## Submitter Information Verification

**Submitter Full Name:** Thomas Domitrovich
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**Submittal Date:** Thu Sep 03 21:05:03 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1727-NFPA 70-2020 [ Section No. 702.7(A) ]

**(A)** ~~Standby~~ Power Source .

(1) Commercial and Industrial. A sign shall be placed at the service-entrance equipment for commercial and industrial installations that indicates the type and location of each on-site optional standby power source.

(2) One- and Two-Family Dwelling Units. For one- and two-family dwelling units, a sign shall be placed at the disconnecting means required in 230.85 that indicates the location of each permanently installed on-site optional standby power source disconnect or means to shut down the prime mover as required in 445.18(D).

## Statement of Problem and Substantiation for Public Input

Make into a list format and revised the title to reflect the rule(s).

## Submitter Information Verification

**Submitter Full Name:** Mike Holt
**Organization:** Mike Holt Enterprises Inc
**Street Address:**
**City:**
**State:**
**Zip:**
**Submittal Date:** Thu Jun 25 15:51:35 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3387-NFPA 70-2020 [ Section No. 702.7(A) ]

**(A)** Standby.

A sign shall be placed at the service-entrance equipment for commercial and industrial installations that indicates the type and location of each on-site optional standby power source. For one- and two-family dwelling units, a sign shall be placed at the disconnecting means required in 230.85 that indicates the location of each permanently installed on-site optional standby power source disconnect or means to shut down the prime mover as required in 445.18(D).

Information Note: Means of identifying the location of an optional standby source can include, but are not limited to, the use of cardinal directions, site diagrams, or locations around associated buildings and structures.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 2023_NEC_Proposal.docx | 702.7 PI Informational Note | |

## Statement of Problem and Substantiation for Public Input

In the original article 702.7 there is no specification on what should be on the sign for location of the Optional Standby System. For location of Optional Standby equipment, the use of cardinal direction, site diagrams, or locations shall be sufficient to address the sign requirements of 702.7 Signs. Informational note gives clarity to what should be used for verbiage on a sign to designate the location of the Optional Standby System.

## Submitter Information Verification

**Submitter Full Name:** Jesse Dunk
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**Submittal Date:** Tue Sep 08 13:26:47 EDT 2020
**Committee:** NEC-P13

**702.7 Signs.**

**(A) Standby.** A sign shall be placed at the service-entrance equipment for commercial and industrial installations that indicates the type and location of each on-site optional standby power source. For one- and two-family dwelling units, a sign shall be placed at the disconnecting means required in 230.85 that indicates the location of each permanently installed on-site optional standby power source disconnect or means to shut down the prime mover as required in 445.18(D).

Information Note: Means of identifying the location of an optional standby source can include, but are not limited to, the use of cardinal directions, site diagrams, or locations around associated buildings and structures.

## Public Input No. 4501-NFPA 70-2020 [ Section No. 702.7(A) ]

**(A)** Standby.

A sign shall be placed at the service-entrance equipment for commercial and industrial installations, and for multifamily housing, that indicates the type and location of each on-site optional standby power source. For one- and two-family dwelling units, a sign shall be placed at the disconnecting means required in 230.85 that indicates the location of each permanently installed on-site optional standby power source disconnect or means to shut down the prime mover as required in 445.18(D).

## Statement of Problem and Substantiation for Public Input

The 2020 NEC in Part (A) removed the rule mandating markings on service equipment identifying the type and location of standby power sources in the case of residential occupancies. Instead, there is now a rule that for one- and two-family dwellings, adjacent to the 230.85 disconnect, there must be signage to indicate the location of power source disconnect or the prime mover shut-down controls covered in 445.18(D). What got entirely missed here is the enormous numbers of residential applications larger than a two-family dwelling, and now, with no substantiation, are removed from any marking requirement in this article. This PI rectifies this by including multifamily housing in the same marking requirements as apply to commercial and industrial occupancies.

## Submitter Information Verification

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**Affiliation:** self
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**Submittal Date:** Thu Sep 10 14:19:33 EDT 2020
**Committee:** NEC-P13

## Public Input No. 579-NFPA 70-2020 [ Section No. 702.7(A) ]

**(A)** Standby.

A sign shall be placed at the ~~service-entrance equipment for commercial and industrial installations~~ service equipment for other than dwelling units that indicates the type and location of each on-site optional standby power source. For one- and two-family dwelling units, a sign shall be placed at the disconnecting means required in 230.85 that indicates the location of each permanently installed on-site optional standby power source disconnect or means to shut down the prime mover as required in 445.18(D).

## Statement of Problem and Substantiation for Public Input

It seems strange to requires this at industrial facilities and places that engage in commerce but not institutional or educational facilities. "Commercial" is usually not the best term to use.

## Submitter Information Verification

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**Submittal Date:** Mon Mar 02 14:55:56 EST 2020
**Committee:** NEC-P13

# Public Input No. 775-NFPA 70-2020 [ New Section after 702.7(C) ]

**TITLE OF NEW CONTENT**

Type your content here ...

**702.8 Electromagnetic Pulse (EMP) Protection.** Protection for optional standby systems against the effects of electromagnetic pulses shall be provided at a minimum of Level 1. See 709.7 for levels of electromagnetic pulse protection.

*Exception: The requirements of 709.7(A)(5) and 709.7(B)(3) shall not apply.*

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

## Submitter Information Verification

**Submitter Full Name:** Vincent Saporita
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**Zip:**
**Submittal Date:** Mon Mar 23 16:00:36 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1506-NFPA 70-2020 [ Section No. 702.10 ]

**702.~~10~~ ~~Wiring~~ 10 Circuit Conductors** Optional Standby Systems.

(A) The optional standby system ~~wiring~~ conductors shall be permitted to occupy the same raceways, cables, boxes, and cabinets with other general wiring.

(B) The transference of power shall not bypass or negate any circuit protection that is provided, or required elsewhere in the code.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| reliance-controls-transfer-switches-306a-4f_1000.jfif | manual transfer sw | |

## Statement of Problem and Substantiation for Public Input

Installers and designers are not understanding the requirement to maintain circuit protection, if it exist at the breaker level, such as: a GFCI or AFCI branch circuit breakers, when the power is transferred to the optional stand-by mode. This includes GFCI OR GPE feeder protection. this new section makes it clear the same level of protection needs to be provided as the normal supply.

## Submitter Information Verification

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**Organization:** Master electrician
**Street Address:**
**City:**
**State:**
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**Submittal Date:** Thu Jun 11 11:46:43 EDT 2020
**Committee:** NEC-P13


A C E
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RELIANCE

## Public Input No. 1608-NFPA 70-2020 [ Section No. 702.11 ]

**702.11** Portable Generator Grounding.

**(A)** Separately Derived System.

Where a portable ~~optional standby source is~~ generator is used as a separately derived system, it shall be grounded ~~to a grounding electrode~~ in accordance with 250.30.

**(B)** Nonseparately Derived System.

Where a portable optional standby source is used as a nonseparately derived system, ~~the equipment grounding conductor shall be bonded to the system grounding electrode.~~ it shall be grounded in accordance with 250.34.

## Statement of Problem and Substantiation for Public Input

The current text is difficult to understand and apply. If the rule simply reference the rule in the NEC that applies, then the requirement will be easier to understand and apply.

## Submitter Information Verification

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**Submittal Date:** Wed Jun 24 11:02:39 EDT 2020
**Committee:** NEC-P13

## Public Input No. 485-NFPA 70-2020 [ Section No. 702.11 ]

**702.~~11~~ ~~Portable~~ 11 Generator System Grounding.**

**(A)** Separately Derived System.

~~Where a portable~~ All 15 KW or less generators shall be installed as a separately derived system. Where any optional standby source is ~~used~~ installed as a separately derived system, it shall be grounded to a grounding electrode in accordance with 250.30.

**(B)** Nonseparately Derived System.

Where ~~a portable~~ an optional standby source is used as a nonseparately derived system, the equipment grounding conductor shall be bonded to the system grounding electrode.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| TIA_695.PNG | UL listing | |

## Statement of Problem and Substantiation for Public Input

This subject relates to both permanently and portable generators and should give guidance in grounding both of the electrical "system" Section 445.6 requires stationary generators to be listed. Listed portable generators 15 kw or less are required to be installed as a separately derived system (FTCN). If the home owner installs an UN-listed generator it should be subject to the same requirements as the listed portable genset.

## Submitter Information Verification

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**Street Address:**
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**Zip:**
**Submittal Date:** Wed Feb 19 12:21:11 EST 2020
**Committee:** NEC-P13

**NFPA 70®-2017 Edition**
***National Electrical Code®***
**TIA Log No.: 1357**
**Reference:** 695.14(F) and 700.10(D)(3)
**Comment Closing Date: May 17, 2018**
**Submitter:** Timothy Windey, Cummins Power Generation
www.nfpa.org/70

1. *Revise 695.14(F) to read as follows:*

**695.14 (F) Generator Control Wiring Methods**. Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator ~~control wiring~~ remote start circuit shall be ~~continuously~~ monitored for broken, disconnected, or shorted wires. Loss of integrity ~~of the remote start circuit(s)~~ shall ~~initiate visual and audible annunciation of generator malfunction at the generator local and remote annunciator(s) and~~ start the generator(s).

2. *Revise 700.10(D)(3) to read as follows:*

**700.10(D)(3) Generator Control Wiring.** Control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring and shall meet the conditions of 700.10(D)(1). The integrity of the generator ~~control wiring~~ remote start circuit shall be ~~continuously~~ monitored for broken, disconnected, or shorted wires. Loss of integrity ~~of the remote start circuit(s)~~ shall ~~initiate visual and audible annunciation of generator malfunction at the generator local and remote annunciator(s) and~~ start the generator(s).

# Public Input No. 2601-NFPA 70-2020 [ Section No. 702.12 ]

**702.12** ~~Outdoor Generator Sets.~~

~~(A) (C)~~

~~–~~

~~Portable Generators Greater Than 15 kW and Permanently Installed Generators.~~

~~Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with~~ 445.18 ~~, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of~~ 225.36 ~~.~~

~~**(B)** Portable Generators 15 kW or Less.~~

~~Where a portable generator, rated 15 kW or less, is installed using a flanged inlet or other cord- and plug-type connection, a disconnecting means shall not be required where ungrounded conductors serve or pass through a building or structure.~~

**Power Inlets Rated at 100 Amperes or Greater, for Portable Generators.**

Equipment containing power inlets for the connection of a generator source shall be listed for the intended use. Systems with power inlets shall be equipped with an interlocked disconnecting means.

*Exception No. 1: If the inlet device is rated as a disconnecting means*

*Exception No. 2: Supervised industrial installations where permanent space is identified for the portable generator located within line of sight of the power inlets shall not be required to have interlocked disconnecting means nor inlets rated as disconnects.*

## Statement of Problem and Substantiation for Public Input

The text in (A) and (B) is not being deleted, it is being relocated to 445.18 as proposed in PI-2594. 702.12 will only apply to power inlets rated 100A and greater.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2594-NFPA 70-2020 [Section No. 445.18] | generator disconnecting means |
| Public Input No. 2598-NFPA 70-2020 [Section No. 700.12(D)(5)] | generator disconnecting means |
| Public Input No. 2600-NFPA 70-2020 [Section No. 701.12(D)(5)] | generator disconnecting means |
| Public Input No. 2603-NFPA 70-2020 [Section No. 708.20(F)] | Generator disconnecting means |
| Public Input No. 2598-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 2600-NFPA 70-2020 [Section No. 701.12(D)(5)] | |

Public Input No. 2603-NFPA 70-2020 [Section No. 708.20(F)]

## Submitter Information Verification

**Submitter Full Name:** Brian Baughman
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**Zip:**
**Submittal Date:** Tue Aug 25 15:12:58 EDT 2020
**Committee:** NEC-P13

## Public Input No. 284-NFPA 70-2020 [ Section No. 702.12(A) ]

**(A)** Portable Generators Greater Than 15 kW and Permanently Installed Generators.

Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means for the building or structure shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| generator_shutdown_means_ecm.pdf | | |

## Statement of Problem and Substantiation for Public Input

Due to the 2017 changes in 445.18, this wording became unclear as to which disconnecting means is being referred to when it says, "an additional disconnecting means shall not be required."

It was the 2017 NEC that introduced a new requirement for generators, 445.18(B), to have 2 means of disconnect for prime mover for any generator greater than 15kW rating. Contractors and engineers are getting confused when emergency systems are being supplied via generator -- as to exactly what disconnecting means shall not be required per 700.12(D)(5). This happens so much so, that an article was written on this very subject in EC&M magazine. I have included a copy of the full article. It helps to illustrate what I'm talking about. Here is a snippet:

https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

"I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional “disconnecting means” is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives."

I also mention this in an article that I wrote, which can be found here:

https://www.ecmag.com/section/codes-standards/exit-lighting-and-emergency-lighting-without-battery-backup-fed-generator

"What Article 700.12(B)(6) speaks of is the disconnecting means for the building and is merely stating that the 445.18(B) disconnecting means for the generator can be used to meet Article 225.31 and 225.32 requirements. The 2017 NEC Handbook confirms this. In my opinion, the sentence should have been written like this:

Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means for the building shall not be required where ungrounded conductors serve or pass through the building or structure.

Article 700.12(B)(6) points to an entirely different Code requirement and has no detrimental effect on 445.18(B). So don’t be confused here—generators with greater than a 15-kilowatt rating must still be

provided with two 445.18(B) Code-compliant means to shut down the prime mover start controls. This holds true for both interior and exterior generators greater than 15 kilowatts.

And just to recap—if there is a generator enclosure, the second disconnecting means must be located somewhere outside of the generator enclosure."

So adding the five words, "for the building or structure" totally clarifies the meaning of 700.12(D)(5) such that it cannot be confused with the required disconnecting means for generator. Reason for change is clarity.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 265-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 283-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 285-NFPA 70-2020 [Section No. 708.20(F)(5)] | |
| Public Input No. 265-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 283-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 285-NFPA 70-2020 [Section No. 708.20(F)(5)] | |

## Submitter Information Verification

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**Zip:**
**Submittal Date:** Tue Jan 14 15:49:03 EST 2020
**Committee:** NEC-P13

EC&M®



NATIONAL ELECTRICAL CODE

# Generator Shutdown Means

Change to the 2017 NEC requires both exterior and interior generators to have a second means of shutting down the prime mover.

Krista McDonald Biason

MAY 19, 2017

Most of my previous articles have focused on big electrical "system" issues, complex design issues, or issues of controversy — but the topic for this article is a bit different. I want to focus on a single Code requirement — the shutdown requirements for a prime mover (aka, generator). The original intent of this article was to quickly highlight a change in the 2017 NEC, but being a Code nerd I started crosschecking other Sections in the Code to validate alignment of this new directive. Once I started doing this, the "simple" topic became significantly more complex.

Section 445.18 was revised in the 2017 National Electrical Code. In the 2014 version, this section was titled "Disconnecting Means Required for Generators." It is now titled "Disconnecting Means and Shutdown of Prime Movers" and is split into Sections (A) "Disconnecting Means" and (B) "Shutdown of Prime Mover." The general intent of this requirement is very similar to what it was in the 2014 edition with one significant exception. Section 445.18(B) now indicates: "Generators with greater than 15kW rating shall be provided with an additional requirement to shut down the prime mover. This additional shutdown means shall be located outside the equipment room or generator enclosure and shall also meet the requirements of Sec. 445.18(B)(1) and (B)(2)."

What this means is that both exterior and interior generators are required to have a second means of shutting down the prime mover. This second means is to be a remote shutdown (stop) that is not physically located on the prime mover, on the prime mover enclosure, or within the room that the prime mover is located.

I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional "disconnecting means" is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives.

Article 5.6.5.6 in NFPA 110, "Standard for Emergency and Standby Power Systems" (2016 edition), requires that "All installations shall have a remote manual stop station of a type to prevent inadvertent or unintentional operation located outside the room housing the prime mover, where so installed, or elsewhere on the premises where the prime mover is located outside the building." After reading this Article 43 times, I still think the wording is awkward. The Annex information for the Article states: "For systems located outdoors, the manual shutdown should be located external to the weatherproof enclosure and should be appropriately identified." This helps clarify

that the intent of the Article is that a manual shutdown is required for exterior generators and that the shutdown station cannot be located within the generator enclosure. What the Annex doesn't quite clarify is the statement of "all installations shall have a remote manual stop station" portion. If the commas were relocated, this Article could be interpreted to actually be closely aligned with the changes in Sec. 445.18 of the 2017 NEC. The revisions to 445.18 now indicate that the remote manual stop cannot be located on the enclosure, so that verbiage is more stringent than NFPA 110.

So, after an exhausting analysis of NFPA 70 and NFPA 110, the summary of the "simple" Code change I was hoping to convey is: Both interior and exterior generators require a secondary remote stop, and that remote stop to shut down the prime mover and the remote stop station cannot be located within the same room as the prime mover or located on an exterior generator enclosure. (Note I did say exhausting — not exhaustive search. As with most Code items, once you start down the rabbit hole, there is always another Code reference that will suck you in and add to your analysis.)

**Source URL:** https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

## Public Input No. 338-NFPA 70-2020 [ Section No. 702.12(A) ]

**(A)** Portable Generators Greater Than 15 kW and Permanently Installed Generators.

Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the ~~disconnecting means~~ generator set is located within sight of the building or structure supplied, ~~an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a~~ The 225.31 building or structure ~~, the~~ disconnecting means shall ~~meet the requirements of 225.36~~ . not be required.

## Statement of Problem and Substantiation for Public Input

This section is not clear that the relocated building disconnect will be only at the gen set location. This is the only one needed however. some inspectors believe it is still required at the building. This is the only section modified and should not need to refer to all section such as 225.36, 37 ect. that's automatic. The burden to have the disconnect means visible is high and confusing to most as they believe even from the building to the Disconnect mean must be visible or from the gen set to the building which is correct so times this disconnect is behind the gen housing. the gen set language would make it easier to comply with the same safety concerns addressed

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## Public Input No. 622-NFPA 70-2020 [ Section No. 702.12(B) ]

**(B)** Portable Generators 15 kW or Less.

Where a portable generator, rated 15 kW or less, is installed using a flanged inlet or other cord- and plug-type connection, a disconnecting means shall not be required where ungrounded conductors serve or pass through a building or structure. The flanged inlet or other cord- and plug-type connection shall be located outside of a building or structure.

## Statement of Problem and Substantiation for Public Input

To help reduce carbon monoxide poisonings and deaths as a result of using portable generators in garages, basements and other indoor locations

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## Public Input No. 929-NFPA 70-2020 [ Section No. 702.12(B) ]

**(B)** Portable Generators 15 kW or Less 250 Volts or less .

Where a portable generator ~~, rated 15 kW or less, is~~ is used to supply a building or structure premise wiring system:

(1) A listed generator shall be installed as a separately derived system.

(2) The listed generator shall be connected through permanently installed listed transfer equipment that switches all conductors other than the equipment grounding conductor.

(3) The frame of a listed generator is connected to the equipment grounding conductor and the grounded (neutral) conductor of the generator.

(4) When connected to a premises or structure wiring system, the portable generator shall be connected to the premises or structure grounding electrode system.

(5) Where a portable generator, installed using a flanged inlet or other cord- and plug-type connection,

~~a~~

(1) an additional building or structure disconnecting means shall not be required

~~where ungrounded conductors serve or pass through a building or structure~~

(1) .

(2) Portable generators used other than to power building or structure wiring systems are intended to be connected to ground when required elsewhere by this code .

## Statement of Problem and Substantiation for Public Input

Again it looks like Terra screwed up the numbers.., it is relatively unknown that a UL requirement for the 15KW or less 250v or less listed generators is required to be installed as a separately derived system. This new text will make everyone aware of this requirement and provide guidance for a safe installation. also a PI has been submitted for the 15 KW or less gen to be listed. however this information is need now for those listed systems that are being install now.

ENGINE GENERATORS FOR PORTABLE
USE (FTCN)
GENERAL
This category covers internal-combustion-engine-driven generators rated 15 kW or less, 250 V or less, which are provided only with receptacle outlets for the ac output circuits. The generators may incorporate alternating- or direct-current generator sections for supplying energy to battery-charging circuits.
When a portable generator is used to supply a building or structure wiring system:
1. The generator is considered a separately derived system in accordance with ANSI/NFPA 70, “National Electrical Code” (NEC).
2. The generator is intended to be connected through permanently installed certified transfer equipment that switches all conductors other than the equipment grounding conductor.
3. The frame of a certified generator is connected to the equipmentgrounding conductor and the grounded (neutral) conductor of the generator.
When properly connected to a premises or structure wiring system, the portable generator will be connected to the premises or

structure grounding electrode for its ground reference.
4. Portable generators used other than to power building or structure wiring systems are intended to be connected to ground if required by the NEC.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 930-NFPA 70-2020 [Section No. 445.6] | |
| Public Input No. 930-NFPA 70-2020 [Section No. 445.6] | |

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# Public Input No. 140-NFPA 70-2019 [ New Section after 702.12(C) ]

**Selective Coordination**

Optional system overcurrent devices, that share common overcurrent devices with either emergency system or legally required system overcurrent devices, shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed profesional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

## Statement of Problem and Substantiation for Public Input

I previously submitted Public Input 104 NFPA 70-2014. With the proposal I was addressing an issue with selective coordination on optional systems that are also fed with a common breaker as an emergency or legally required system. The change that ended up being approved by the committee was a modified version only requiring the first downstream overcurrent device to selectively coordinate with the upstream breaker that is common to these systems. I apparently did not provide enough information for the committee to see that there was another issue this was trying to resolve. Since legally required systems do not have the same wiring separation requirements as emergency systems (700.10(B)), optional system and legally required circuits can be fed from the same panel board. Legally required systems require selective coordination under 701.27. By intermixing legally required circuits and optional system circuits together, we are allowing the legally required system circuits coordination to be compromised since optional circuits do not require selective coordination. Either we need to require a separate transfer switch for optional loads or we need to require the selective coordination to protect the circuits of a legally required system.

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# Public Input No. 3262-NFPA 70-2020 [ New Section after 702.12(C) ]

**TITLE OF NEW CONTENT**

Type your content here ...

Part III. Overcurrent Protection

**702.32 Selective Coordination.** Where automatic transfer equipment is used in other than dwelling units, optional standby system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

## Statement of Problem and Substantiation for Public Input

Selective coordination has not been previously required for optional standby systems because life safety does not depend on the performance of the system. However, optional standby systems do provide system continuity for refrigeration, data processing, communications, and industrial processes that, when stopped during any power outage, could cause serious interruption of the process, damage to the product, or the like.

When manual transfer equipment is utilized, users must be present to manually re-energize the system when the normal source is lost. If power is lost due to a lack of selective coordination, the manual transfer may not restore power, but the user is right there to trouble-shoot the problem. When users invest in automatic transfer equipment, they expect that the system will continue to operate when the normal source is interrupted, even when maintenance personnel are not in the immediate vicinity.

Thus, this PI limits the selective coordination requirement to optional standby systems that utilize automatic transfer equipment. It also limits the requirement to other than dwelling units.

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# Public Input No. 3006-NFPA 70-2020 [ Article 706 ]

~~**Article 706**~~ Article 695 Energy Storage Systems

**Part I.** General

~~**706**~~ **695 .1** Scope.

This article applies to all energy storage systems (ESS) having a capacity greater than 3.6 MJ (1 kWh) that may be stand-alone or interactive with other electric power production sources. These systems are primarily intended to store and provide energy during normal operating conditions.

Informational Note No. 1: For batteries rated in ampere hours, kWh is equal to the nominal rated voltage times ampere-hour rating divided by 1000.

Informational Note No. 2: There can be a subtle distinction between a battery storing energy and an energy storage system. A battery storing energy is not necessarily an ESS. See Article 480. An ESS can be comprised of batteries storing energy. See Article 706.

Informational Note No. 3: The following standards are frequently referenced for the installation of energy storage systems:

(1) NFPA 111-2016, *Standard on Stored Electrical Energy Emergency and Standby Systems*

(2) NECA 416-2016, *Recommended Practice for Installing Energy Storage Systems (ESS)*

(3) UL 810A, *Electrochemical Capacitors*

(4) UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*

(5) UL 1989, *Standard for Standby Batteries*

(6) UL 9540, *Standard for Safety Energy Storage Systems and Equipment*

(7) UL Subject 2436, *Spill Containment For Stationary Lead Acid Battery Systems*

~~**706**~~ **695 .2** Definitions.

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

**Diversion Charge Controller.**

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

**Energy Storage System (ESS).**

One or more components assembled together capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network.

Informational Note No. 1: ESS(s) can include but is not limited to batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air). Energy storage systems can include inverters or converters to change voltage levels or to make a change between an ac or a dc system.

Informational Note No. 2: These systems differ from other storage systems such as a UPS system, which is a power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

**Flow Battery.**

An energy storage component similar to a fuel cell that stores its active materials in the form of two electrolytes external to the reactor interface. When in use, the electrolytes are transferred between reactor and storage tanks.

Informational Note: Two commercially available flow battery technologies are zinc bromine and vanadium redox, sometimes referred to as pumped electrolyte ESS.

**Inverter Utilization Output Circuit.**

Conductors between the multimode or stand-alone inverter and utilization equipment.

**~~706~~ 695 .3** Qualified Personnel.

The installation and maintenance of ESS equipment and all associated wiring and interconnections shall be performed only by qualified persons.

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

**~~706~~ 695 .4** System Requirements.

Each ESS shall be provided with a nameplate plainly visible after installation and marked with the following:

(1) Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for supplying the ESS can be identified

(2) Rated frequency

(3) Number of phases, if ac

(4) Rating (kW or kVA)

(5) Available fault current derived by the ESS at the output terminals

(6) Maximum output and input current of the ESS at the output terminals

(7) Maximum output and input voltage of the ESS at the output terminals

(8) Utility-interactive capability, if applicable

**~~706~~ 695 .5** Listing.

Energy storage systems shall be listed.

**~~706~~ 695 .6** Multiple Systems.

Multiple ESSs shall be permitted to be installed in or on a single building or structure.

**~~706~~ 695 .7** Maintenance.

Energy storage systems shall be maintained in proper and safe operating condition. The required maintenance shall be in accordance with the manufacturer's requirements and industry standards. A written record of the system maintenance shall be kept and shall include records of repairs and replacements necessary to maintain the system in proper and safe operating condition.

Informational Note: For information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program, see NFPA 70B-2019, *Recommended Practice for Electrical Equipment Maintenance*, or ANSI/NETA ATS-2017, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*.

**~~706~~ 695 .8** Storage Batteries.

Storage batteries not associated with an ESS shall comply with Article 480.

**~~706~~ 695 .9** Maximum Voltage.

The maximum voltage of an ESS shall be the rated ESS input and output voltage(s) indicated on the ESS nameplate(s) or system listing.

**Part II.** Disconnecting Means

**~~706~~ 695 .15** Disconnecting Means.

**(A)** ESS Disconnecting Means.

A disconnecting means shall be provided for all ungrounded conductors derived from an ESS and shall be permitted to be integral to listed ESS equipment. The disconnecting means shall comply with all of the following:

(1) The disconnecting means shall be readily accessible.

(2) The disconnecting means shall be located within sight of the ESS. Where it is impractical to install the disconnecting means within sight of the ESS, the disconnect shall be installed as close as practicable, and the location of the disconnecting means shall be field marked on or immediately adjacent to the ESS. The marking shall be of sufficient durability to withstand the environment involved and shall not be handwritten.

(3) The disconnecting means shall be lockable open in accordance with 110.25.

For one-family and two-family dwellings, a disconnecting means or its remote control shall be located at a readily accessible location outside the building.

**(B)** Remote Actuation.

Where controls to activate the disconnecting means of an ESS are used and are not located within sight of the system, the location of the controls shall be field marked on the disconnecting means.

**(C)** Notification and Marking.

Each ESS disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position and be permanently marked “ENERGY STORAGE SYSTEM DISCONNECT.” The disconnecting means shall be legibly marked in the field to indicate the following:

(1) Nominal ESS ac voltage and maximum ESS dc voltage

(2) Available fault current derived from the ESS

(3) An arc-flash label applied in accordance with acceptable industry practice

(4) Date the calculation was performed

*Exception: List items (2), (3), and (4) shall not apply to one- and two-family dwellings.*

Informational Note No. 1: Industry practices for equipment labeling are described in NFPA *70E*-2018, *Standard for Electrical Safety in the Workplace*. This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, arc-flash boundaries, minimum required levels of personal protective equipment, and so forth.

Informational Note No. 2: Battery equipment suppliers can provide information about available fault current on any particular battery model.

For ESS disconnecting means where the line and load terminals may be energized in the open position, the device shall 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

The notification(s) and marking(s) shall comply with 110.21(B).

**(D)** Partitions Between Components.

Where circuits from the input or output terminals of energy storage components in an ESS pass through a wall, floor, or ceiling, a readily accessible disconnecting means shall be provided within sight of the energy storage component. Fused disconnecting means or circuit breakers shall be permitted to be used.

**~~706~~ 695 .16** Connection to Energy Sources.

The connection of an ESS to sources of energy shall comply with 706.16(A) through (F).

**(A)** Source Disconnect.

A disconnect that has multiple sources of power shall disconnect all energy sources when in the off position.

**(B)** Identified Interactive Equipment.

ESS that operate in parallel with other ac sources shall use inverters that are listed and identified as interactive.

**(C)** Loss of Interactive System Power.

Upon loss of a primary source of power, an ESS with a utility-interactive inverter shall comply with the requirements of 705.40.

**(D)** Unbalanced Interconnections.

Unbalanced ac connections between an ESS and other ac electric power production sources shall be in accordance with 705.45

**(E)** Other Energy Sources.

The connection of an ESS to other energy sources shall be in accordance with 705.12 and Parts III and VI of Article 712.

**(F)** Stand-Alone Operation.

Where the output of an ESS is capable of operating in stand-alone mode, the requirements of 710.15 shall apply.

**Part III.** Installation Requirements

**~~706~~ 695 .20** General.

**(A)** Ventilation.

Provisions appropriate to the energy storage technology shall be made for sufficient diffusion and ventilation of any possible gases from the storage device, if present, to prevent the accumulation of an explosive mixture. Ventilation of an ESS shall be permitted to be provided in accordance with the manufacturer's recommendations and listing for the system.

Informational Note No. 1: See NFPA 1-2018, *Fire Code*, Chapter 52, for ventilation considerations for specific battery chemistries.

Informational Note No. 2: Some storage technologies do not require ventilation.

Informational Note No. 3: A source for design of ventilation of battery systems is IEEE 1635-2018/ASHRAE Guideline 21-2018, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*.

Informational Note No. 4: Fire protection considerations are addressed in NFPA 1-2018, *Fire Code*.

**(B)** Dwelling Units.

An ESS for one- and two-family dwelling units shall not exceed 100 volts dc between conductors or to ground.

*Exception: Where live parts are not accessible during routine ESS maintenance, a maximum ESS voltage of 600 volts dc shall be permitted.*

**(C)** Spaces About ESS Components.

**(1)** General.

Working spaces for ESS shall comply with 110.26 and 110.34.

**(2)** Space Between Components.

ESSs shall be permitted to have space between components in accordance with the manufacturer's instructions and listing.

Informational Note: Additional space may be needed to accommodate ESS hoisting equipment, tray removal, or spill containment.

**~~706~~ 695 .21** Directory (Identification of Power Sources).

ESS shall be indicated by markings or labels that shall be in accordance with 110.21(B).

**(A)** Facilities with Utility Services and ESS.

Plaques or directories shall be installed in accordance with 705.10 and 712.10.

**(B)** Facilities with Stand-Alone Systems.

Plaques or directories shall be installed in accordance with 710.10.

**Part IV.** Circuit Requirements

**~~706~~ 695 .30** Circuit Sizing and Current.

**(A)** Maximum Rated Current for a Specific Circuit.

The maximum current for the specific circuit shall be calculated in accordance with 706.30(A)(1) through (A)(5).

**(1)** Nameplate-Rated Circuit Current.

Circuit current shall be the rated current indicated on the ESS nameplate(s) or system listing. Where the ESS has separate input (charge) and output (discharge) circuits or ratings, these shall be considered individually. Where the same terminals on the ESS are used for charging and discharging, the rated current shall be the greater of the two.

**(2)** Inverter Output Circuit Current.

The maximum current shall be the inverter continuous output current rating.

**(3)** Inverter Input Circuit Current.

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

**(4)** Inverter Utilization Output Circuit Current.

The maximum current shall be the continuous ac output current rating of the inverter when the inverter is producing rated power.

**(5)** DC to DC Converter Output Current.

The maximum current shall be the dc-to-dc converter continuous output current rating.

**(B)** Conductor Ampacity.

The ampacity of the feeder circuit conductors from the ESS(s) to the wiring system serving the loads to be serviced by the system shall not be less than the greater of the (1) nameplate(s)-rated circuit current as determined in accordance with 706.30(A)(1) or (A)(2) the rating of the ESS(s) overcurrent protective device(s).

**(C)** Ampacity of Grounded or Neutral Conductor.

If the output of a single-phase, 2-wire ESS output(s) is connected to the grounded or neutral conductor and a single ungrounded conductor of a 3-wire system or of a 3-phase, 4-wire, wye-connected system, the maximum unbalanced neutral load current plus the ESS(s) output rating shall not exceed the ampacity of the grounded or neutral conductor.

**~~706~~ 695 .31** Overcurrent Protection.

**(A)** Circuits and Equipment.

ESS circuit conductors shall be protected in accordance with the requirements of Article 240. Protection devices for ESS circuits shall be in accordance with the requirements of 706.31(B) through (F). Circuits shall be protected at the source from overcurrent.

**(B)** Overcurrent Device Ampere Ratings.

Overcurrent protective devices, where required, shall be rated in accordance with Article 240 and the rating provided on systems serving the ESS and shall be not less than 125 percent of the maximum currents calculated in 706.30(A).

*Exception: Where the assembly, including the overcurrent protective devices, is listed for operation at 100 percent of its rating, the ampere rating of the overcurrent devices shall be permitted to be not less than the maximum currents calculated in 706.30(B).*

**(C)** Direct Current Rating.

Overcurrent protective devices, either fuses or circuit breakers, used in any dc portion of an ESS shall be listed for dc and shall have the appropriate voltage, current, and interrupting ratings for the application.

**(D)** Current Limiting.

A listed and labeled current-limiting overcurrent protective device shall be installed adjacent to the ESS for each dc output circuit.

*Exception: Where current-limiting overcurrent protection is provided for the dc output circuits of a listed ESS, additional current-limiting overcurrent devices shall not be required.*

**(E)** Fuses.

Means shall be provided to disconnect any fuses associated with ESS equipment and components when the fuse is energized from both directions and is accessible to other than qualified persons. Switches, pullouts, or similar devices that are rated for the application shall be permitted to serve as a means to disconnect fuses from all sources of supply.

**(F)** Location.

Where circuits from the input or output terminals of energy storage components in an ESS pass through a wall, floor, or ceiling, overcurrent protection shall be provided at the energy storage component end of the circuit.

**~~706~~ 695 .33** Charge Control.

**(A)** General.

Provisions shall be provided to control the charging process of the ESS. All adjustable means for control of the charging process shall be accessible only to qualified persons.

**(B)** Diversion Charge Controller.

**(1)** Sole Means of Regulating Charging.

An ESS employing a diversion charge controller as the sole means of regulating charging shall be equipped with a second independent means to prevent overcharging of the storage device.

**(2)** Circuits with Diversion Charge Controller and Diversion Load.

Circuits containing a diversion charge controller and a diversion load shall comply with the following:

(1) The current rating of the diversion load shall be less than or equal to the current rating of the diversion load charge controller. The voltage rating of the diversion load shall be greater than the maximum ESS voltage. The power rating of the diversion load shall be at least 150 percent of the power rating of the charging source.

(2) The conductor ampacity and the rating of the overcurrent device for this circuit shall be at least 150 percent of the maximum current rating of the diversion charge controller.

**(3)** ESS Using Interactive Inverters.

Systems using interactive inverters to control energy storage state-of-charge by diverting excess power into an alternate electric power production and distribution system, such as utility, shall comply with 706.33(B)(3)(a) and (B)(3)(b).

(a) These systems shall not be required to comply with 706.33(B)(2).

(b) These systems shall have a second, independent means of controlling the ESS charging process for use when the alternate system is not available or when the primary charge controller fails or is disabled.

**(C)** Charge Controllers and DC-to-DC Converters.

Where charge controllers and other DC-to-DC power converters that increase or decrease the output current or output voltage with respect to the input current or input voltage are installed, all of the following shall apply:

(1) The ampacity of the conductors in output circuits shall be based on the maximum rated continuous output current of the charge controller or converter for the selected output voltage range.

(2) The voltage rating of the output circuits shall be based on the maximum voltage output of the charge controller or converter for the selected output voltage range.

**Part V.** Flow Battery Energy Storage Systems

Part V applies to ESSs composed of or containing flow batteries.

Informational Note: Due to the unique design features and difference in operating characteristics of flow batteries as compared with that of storage batteries such as lead acid or lithium ion batteries, the requirements for flow batteries have been included here rather than in Article 480.

**~~706~~ 695 .40** General.

All electrical connections to and from the system and system components shall be in accordance with the applicable provisions of Article 692. The system and system components shall also meet Parts I, II, and III of this article. Unless otherwise directed by this article, flow battery ESS shall comply with the applicable provisions of Article 692.

**~~706~~ 695 .41** Electrolyte Classification.

The electrolyte(s) that are acceptable for use in the batteries associated with the ESS shall be identified by name and chemical composition. Such identification shall be provided by readily discernable signage adjacent to every location in the system where the electrolyte can be put into or taken out of the system.

**~~706~~ 695 .42** Electrolyte Containment.

Flow battery systems shall be provided with a means for electrolyte containment to prevent spills of electrolyte from the system. An alarm system shall be provided to signal an electrolyte leak from the system. Electrical wiring and connections shall be located and routed in a manner that mitigates the potential for exposure to electrolytes.

**~~706~~ 695 .43** Flow Controls.

Controls shall be provided to safely shut down the system in the event of electrolyte blockage.

**~~706~~ 695 .44** Pumps and Other Fluid Handling Equipment.

Pumps and other fluid handling equipment are to be rated/specified suitable for exposure to the electrolytes.

**Part VI.** Other Energy Storage Technologies

Part VI applies to ESSs using other technologies intended to store energy and when there is a demand for electrical power to use the stored energy to generate the needed power.

**~~706~~ 695 .50** General.

All electrical connections to and from the system and system components shall be in accordance with the applicable provisions of this *Code*. Unless otherwise directed by this article, other energy storage technologies shall comply with the applicable provisions of Part III of Article 705.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This change aligns with an effort to re-organize the alternative energy sources NEC Articles into a series of articles closely located together. This reorganization places all sources alternate sources as follows:

689 On-Site Energy Sources
690 Solar Photovoltaic (PV) Systems
691 Large-Scale Photovoltaic (PV) Systems
692 Fuel Cell Systems
693 Generators
694 Wind Electric Systems
695 Energy Storage Systems
696 Storage Batteries

This public input changes 706 to 695 to support this effort and to better align with the fact that this Article is closely related to alternative energy systems. This move makes way for alignment of alternative energy sources article arrangement. These articles are closely related to each other and this change is in alignment with the direction by the correlating committee to review alternative energy sources for conflicts and usability. This new alignment will create a similar structure as that found for hazardous locations. The new Article 689 is the a combination of Articles 705, 710 and 712 and will act to be the new general requirements for this series of alternative energy sources.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3011-NFPA 70-2020 [Definition: ] | |
| Public Input No. 4685-NFPA 70-2020 [Global Input] | |

## Submitter Information Verification

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**Submittal Date:** Thu Sep 03 21:07:00 EDT 2020
**Committee:** NEC-P13

## Public Input No. 254-NFPA 70-2020 [ Section No. 706.1 ]

**706.1** Scope.

This article applies to all energy storage systems (ESS) having a capacity greater than 3.6 MJ (1 kWh) that may be stand-alone or interactive with other electric power production sources. These systems are primarily intended to store and provide energy during normal operating conditions.

Informational Note No. 1: For batteries rated in ampere hours, kWh is equal to the nominal rated voltage times ampere-hour rating divided by 1000.

Informational Note No. 2: There can be a subtle distinction between a battery storing energy and an energy storage system. A battery storing energy is not necessarily an ESS. See Article 480. An ESS can be comprised of batteries storing energy. See Article 706.

Informational Note No. 3: The following standards are frequently referenced for the installation of energy storage systems:

(1) NFPA 111-2016, *Standard on Stored Electrical Energy Emergency and Standby Systems*

(2) *NFPA 855-2020, Standard for the Installation of Stationary Energy Storage Systems*

(3) NECA 416-2016, *Recommended Practice for Installing Energy Storage Systems (ESS)*

(4) UL 810A, *Electrochemical Capacitors*

(5) UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*

(6) UL 1989, *Standard for Standby Batteries*

(7) UL 9540, *Standard for Safety Energy Storage Systems and Equipment*

(8) UL Subject 2436, *Spill Containment For Stationary Lead Acid Battery Systems*

## Statement of Problem and Substantiation for Public Input

NFPA 855-2020 Standard for the Installation of Stationary Energy Storage Systems should be included in the list items for referenced standards in Informational Note No. 3 under the Scope of Article 706. This standard is in its first edition and was approved as an American National Standard on August 25, 2019. According to the purpose of this standard it provides the minimum requirements for mitigating the hazards associated with ESS's. This includes ESS installed in one and two family dwellings. NFPA 855 also references NFPA 70 as a referenced standard and shall be considered part of the requirements for NFPA 855. Therefore NFPA 855 should also be referenced here in Article 706 for ESS to comply with both standards when installing these systems.

## Submitter Information Verification

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| **Submittal Date:** | Tue Jan 07 14:55:15 EST 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 4209-NFPA 70-2020 [ Section No. 706.1 ]

**706.1** Scope.

This article applies to all energy storage systems (ESS) having a capacity greater than 3.6 MJ (1 kWh) that may be stand-alone or interactive with other electric power production sources. These systems are primarily intended to store and provide energy during normal operating conditions.

~~Informational Note No. 1: For batteries rated in ampere hours, kWh is equal to the nominal rated voltage times ampere-hour rating divided by 1000.~~

~~Informational Note No. 2: There can be a subtle distinction between a battery storing energy and an energy storage system. A battery storing energy is not necessarily an ESS. See Article 480. An ESS can be comprised of batteries storing energy. See Article 706.~~

~~Informational Note No. 3: The following standards are frequently referenced for the installation of energy storage systems:~~

(1) ~~NFPA 111-2016, *Standard on Stored Electrical Energy Emergency and Standby Systems*~~

(2) ~~NECA 416-2016, *Recommended Practice for Installing Energy Storage Systems (ESS)*~~

(3) ~~UL 810A, *Electrochemical Capacitors*~~

(4) ~~UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*~~

(5) ~~UL 1989, *Standard for Standby Batteries*~~

(6) ~~UL 9540, *Standard for Safety Energy Storage Systems and Equipment*~~

(7) ~~UL Subject 2436, *Spill Containment For Stationary Lead Acid Battery Systems*~~

## Statement of Problem and Substantiation for Public Input

The educational value of these informational notes has expired and the information in these notes is more suitable for Handbook commentary. Referenced standards directly related to NEC compliance are noted in Annex A. Any confusion with the use of an ESS or UPS should be addressed directly within the mandatory text of each article rather than with an Informational Note.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is

assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

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**Committee:** NEC-P13

## Public Input No. 4613-NFPA 70-2020 [ Section No. 706.1 ]

**706.1** Scope.

This article applies to all energy storage systems (ESS) having a capacity greater than 3.6 MJ (1 kWh) that may be stand-alone or interactive with other electric power production sources. These systems are primarily intended to store and provide energy during normal operating conditions.

Informational Note No. 1: For batteries rated in ampere hours, kWh is equal to the nominal rated voltage times ampere-hour rating divided by 1000.

Informational Note No. 2: There can be a subtle distinction between a battery storing energy and an energy storage system. A battery storing energy is not necessarily an ESS. See Article 480. An ESS can be comprised of batteries storing energy. See Article 706.

Informational Note No. 3: The following standards are frequently referenced for the installation of energy storage systems:

(1) NFPA 1-2018, *Standard for Fire Code*

(2) NFPA 855-2020, *Standard for the Installation of Stationary Energy Storage Systems*

(3) NFPA 111-2016, *Standard on Stored Electrical Energy Emergency and Standby Systems*

(4) NECA 416-2016, *Recommended Practice for Installing Energy Storage Systems (ESS)*

(5) UL 810A, *Electrochemical Capacitors*

(6) UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*

(7) UL 1989, *Standard for Standby Batteries*

(8) UL 9540, *Standard for Safety Energy Storage Systems and Equipment*

(9) UL Subject 2436, *Spill Containment For Stationary Lead Acid Battery Systems*

## Statement of Problem and Substantiation for Public Input

Advances in ESS system and their use has grown with the need to provide for multiple applications: energy management, backup power, load leveling, frequency regulation, voltage support, and grid stabilization. With the recent UL Firefighter Safety Research Institute report on the April 2019 Surprise AZ Lithium-Ion Battery ESS Explosion, the AHJ should have available to them all references that are addressing these systems. NFPA 1 and NFPA 855 are not included in the informational note but they should be, as the most recent additions are beginning to address requirements and best practices for the installation of ESS systems.

## Submitter Information Verification

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| **Committee:** | NEC-P13 |

## Public Input No. 803-NFPA 70-2020 [ Section No. 706.1 ]

**706.1** Scope.

This article applies to all energy storage systems (ESS) having a capacity greater than 3.6 MJ (1 kWh) that may be stand-alone or interactive with other electric power production sources. These systems are primarily intended to store and provide energy during normal operating conditions.

Informational Note No. 1: For batteries rated in ampere hours, kWh is equal to the nominal rated voltage times ampere-hour rating divided by 1000.

Informational Note No. 2: There can be a subtle distinction between a battery storing energy and an energy storage system. A battery storing energy is not necessarily an ESS. See Article 480. An ESS can be comprised of batteries storing energy. See Article 706.

Informational Note No. 3: The following standards are frequently referenced for the installation of energy storage systems:

(1) NFPA 111-2016, *Standard on Stored Electrical Energy Emergency and Standby Systems*

(2) NFFP 855-2020, *Standard for Installation of Stationary Energy Storage Systems*

(3) NECA 416-2016, *Recommended Practice for Installing Energy Storage Systems (ESS)*

(4) UL 810A, *Electrochemical Capacitors*

(5) UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications*

(6) UL 1989, *Standard for Standby Batteries*

(7) UL 9540, *Standard for Safety Energy Storage Systems and Equipment*

(8) UL Subject 2436, *Spill Containment For Stationary Lead Acid Battery Systems*

## Statement of Problem and Substantiation for Public Input

NFPA 855 is now a published NFPA document, and the inclusion of this ESS Installation Standard is appropriate in the Informational Note in 706.1

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 3112-NFPA 70-2020 [ Section No. 706.2 ]

**706.2** Definitions.

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

**Diversion Charge Controller.**

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

**Energy Storage System (ESS).**

One or more components assembled together capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network.

Informational Note No. 1: ESS(s) can include but is not limited to batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air). Energy storage systems can include inverters or converters to change voltage levels or to make a change between an ac or a dc system.

Informational Note No. 2: These systems differ from other storage systems such as a UPS system, which is a power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

**Flow Battery.**

An energy storage component similar to a fuel cell that stores its active materials in the form of two electrolytes external to the reactor interface. When in use, the electrolytes are transferred between reactor and storage tanks.

Informational Note: Two commercially available flow battery technologies are zinc bromine and vanadium redox, sometimes referred to as pumped electrolyte ESS.

**Inverter Utilization Output Circuit.**

Conductors between the multimode or stand-alone inverter and utilization equipment.

**Flywheel ESS (FESS)** - A mechanical energy storage system composed of a spinning mass referred to as a rotor and an energy conversion mechanism such as a motor-generator that converts the mechanical energy to electrical energy.

*Informational Note: There are primarily two types of rotor constructions, solid metal mass design and composite fiber design.*

**Spin Down** - A shutdown condition of the FESS, where energy is being dissipated and the flywheel rotor is slowing down to a stop.

*Informational Note: A complete stop of a flywheel rotor cannot occur instantaneously because of the high kinetic energy of the rotor, but rather occurs over time due to a gradual slowdown to a stop as a result friction forces acting on the rotor.*

## Statement of Problem and Substantiation for Public Input

The definitions for flywheel ESS (FESS) and the term Spin Down are proposed to support additional PIs addressing FESS. It is necessary to define what a flywheel energy storage system is and it is important to define a term used to address FESS shutdown.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|

Public Input No. 3115-NFPA 70-2020 [New Section after 706.50]

## Submitter Information Verification

**Submitter Full Name:** Laurie Florence
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**Submittal Date:** Fri Sep 04 18:13:25 EDT 2020
**Committee:** NEC-P13

# Public Input No. 3957-NFPA 70-2020 [ Section No. 706.2 ]

(Relocate all definitions in the 706. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**706. 2** Definitions.

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

**Diversion Charge Controller.**

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

**Energy Storage System (ESS).**

One or more components assembled together capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network.

Informational Note No. 1: ESS(s) can include but is not limited to batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air). Energy storage systems can include inverters or converters to change voltage levels or to make a change between an ac or a dc system.

Informational Note No. 2: These systems differ from other storage systems such as a UPS system, which is a power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

**Flow Battery.**

An energy storage component similar to a fuel cell that stores its active materials in the form of two electrolytes external to the reactor interface. When in use, the electrolytes are transferred between reactor and storage tanks.

Informational Note: Two commercially available flow battery technologies are zinc bromine and vanadium redox, sometimes referred to as pumped electrolyte ESS.

**Inverter Utilization Output Circuit.**

Conductors between the multimode or stand-alone inverter and utilization equipment.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 16:17:09 EDT 2020

**Committee:** NEC-P13

## Public Input No. 4211-NFPA 70-2020 [ Definition: Energy Storage System (ESS). ]

**Energy Storage System (ESS).**

One or more ~~components assembled together~~ devices installed as a system capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network.

Informational Note No. 1: ESS(s) can include but is not limited to batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air). Energy storage systems can include inverters or converters to change voltage levels or to make a change between an ac or a dc system.

Informational Note No. 2: These systems differ from other storage systems such as a UPS system or storage batteries , which ~~is a power supply used to provide alternating current~~ typically provide power to a dedicated load for some period of time in the event of a power failure.

## Statement of Problem and Substantiation for Public Input

There has been some confusion as to what constitutes field assembly. The term “assembled” paired with “component” has very specific connotations in the context of listed products. ESS are unusual in that individual subassemblies may not be directly and physically connected to each other, while still being code-compliant.
The informational note 2 is revised to address the differences with UPS systems and storage batteries (article 480) and how those systems are used compared to ESS systems.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF’s effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI’s as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI’s submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali

Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Submitter Information Verification

**Submitter Full Name:** Evelyn Butler
**Organization:** Solar Energy Industries Assn
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**Submittal Date:** Thu Sep 10 06:07:41 EDT 2020
**Committee:** NEC-P13

# Public Input No. 1603-NFPA 70-2020 [ Definition: Flow Battery. ]

**Flow Battery.**

An energy storage ~~component similar to a fuel cell~~ component that stores its active materials in the form of one or two electrolytes external to the reactor interface. When in use, the electrolytes are transferred between reactor and storage tanks.

Informational Note: ~~Two commercially~~ Three commercially available flow battery technologies ~~are~~ are zinc air, zinc bromine and vanadium redox, sometimes referred to as pumped electrolyte ESS.

## Statement of Problem and Substantiation for Public Input

We propose changing the definition of a flow battery because, mentioning that it is similar to a fuel cell in that manner is confusing because it suggests that they are very similar systems. That is not true as they are different technologies and subjected to different safety criteria. Also, there are systems with one active electrolyte so those systems should be included.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1604-NFPA 70-2020 [Section No. 706.40] | same topic |
| Public Input No. 1604-NFPA 70-2020 [Section No. 706.40] | |

## Submitter Information Verification

**Submitter Full Name:** Laurie Florence
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**Submittal Date:** Tue Jun 23 12:19:54 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4216-NFPA 70-2020 [ Definition: Flow Battery. ]

**Flow Battery.**

An energy storage component ~~similar to a fuel cell~~ that stores its active materials in the form of one or two electrolytes external to the reactor interface. When in use, the electrolytes are transferred between reactor and storage tanks.

Informational Note: ~~Two commercially~~ Three commercially available flow battery technologies are zinc air, zinc bromine and vanadium redox, sometimes referred to as pumped electrolyte ESS.

## Statement of Problem and Substantiation for Public Input

Flow battery chemistries are evolving so this list and informational note would benefit from this additional information.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
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White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Submitter Information Verification

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**Submittal Date:** Thu Sep 10 06:35:04 EDT 2020
**Committee:** NEC-P13

## Public Input No. 4213-NFPA 70-2020 [ New Definition after Definition: Energy Storage System (ESS... ]

**Energy Storage Equipment**

Individual pieces of equipment installed as part of a ESS.

Informational Note: This equipment is often identified by a marking applied during its listing. It is common for this equipment to be connected at the time of installation using wiring methods that are not supplied by the ESS manufacturer.

## Statement of Problem and Substantiation for Public Input

An ESS could include shared equipment such as a multimode inverter that could be shared with other power sources such as PV. There can be a complete ESS that does not have multiple pieces of energy storage equipment (no field wiring) but for those systems that do, it is important to identify that there are unique requirements for isolation of this equipment, etc. during installation and service. The term “energy storage component” is used within UL9540 however using the NEC term “equipment” is more suitable here.
As the requirements for parts of an ESS are added or clarified, additional definitions are necessary that provide more granular descriptions of these system parts.

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## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4256-NFPA 70-2020 [Section No. 706.15] | |

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## Public Input No. 4210-NFPA 70-2020 [ Section No. 706.2 [Excluding any Sub-Sections] ]

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

## Statement of Problem and Substantiation for Public Input

Given that energy storage systems, as covered in Section 706, are heavily referenced in the context of solar PV (690), small wind (694), and other technology-specific sections, this change is important to ensure consistent language and treatment of ESS throughout the Code.

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**Committee:** NEC-P13

## Public Input No. 4217-NFPA 70-2020 [ Section No. 706.4 ]

~~**706.4** System Requirements.~~

~~Each ESS shall be provided with a nameplate plainly visible after installation and marked with the following:~~

(1) ~~Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for supplying the ESS can be identified~~

(2) ~~Rated frequency~~

(3) ~~Number of phases, if ac~~

(4) ~~Rating (kW or kVA)~~

(5) ~~Available fault current derived by the ESS at the output terminals~~

(6) ~~Maximum output and input current of the ESS at the output terminals~~

(7) ~~Maximum output and input voltage of the ESS at the output terminals~~

(8) ~~Utility-interactive capability, if applicable~~

## Statement of Problem and Substantiation for Public Input

This section should be removed since this information is already required and/or not necessary through the ESS listing. Item 1 is required by 110.21. UL 9540 already has nameplate requirements, and ESS are now required to be listed to this standard so the markings required during the listing process will be most accurate. Note that other requirements for markings of specific equipment related to the ESS still exist in this article.

Here is are some edited (not extracted) general requirements found in UL 9540, Ed.2:
Energy storage systems must be marked with the manufacturer's name, trade name, trademark or other descriptive marking, which identifies the organization responsible for the product, part number or model number.
Additionally, here are other ratings typically required for most listed ESS:
a) Output and input current (maximum) in A;
b) Output and input voltage (minimum and maximum) in V;
c) Power input and output (maximum) in W or VA;
d) Energy output in Wh (maximum);
e) Auxiliary output and input voltage (V), current (A) and frequency (Hz) if applicable;
f) Number of phases (for input and output if applicable);
g) Frequency in Hz (if applicable);
h) Duty cycle (if applicable);
i) Maximum short circuit current in A (based upon fault current tolerance of the power conditioning system at its output directly connected to the grid);
j) Ambient temperature range in °C or °F;
k) Special environmental ratings and limitations as applicable (e.g. seismic, indoor/outdoor only, etc.);
l) Weight (maximum) in lbs or kg, etc.;
m) Maximum dimensions for height, width, and length (this dimensions information need not be marked on the system as long as it is provided in the installation instructions);
n) Systems complying with 23.2.2 shall be marked "Suitable For Use in Residential Dwelling Units Where Permitted";
o) Suppression system to be installed if applicable;

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## Public Input No. 1789-NFPA 70-2020 [ Section No. 706.5 ]

**706.5** Listing.

Energy storage systems shall be listed as an assembly or be constructed of listed components and installed in accordance with the manufacturer's instructions .

## Statement of Problem and Substantiation for Public Input

The language was changed for the 2020 NEC based on Public Comment 1572-NFPA 70-2018 and the supporting substantiation was simply that UL 9540 exists so all ESS Systems should be listed to it. That certainly has merit for a complete assembly but has caused confusion in the field. It is common for energy storage to be added to existing on site power production sources and some are of the opinion that items such as existing inverters that are capable of handling energy storage need to be replaced because they are not part of a listed system. It is my opinion that clarifying the language will remove any doubt that it is still permissible to add elements of energy storage that are not from the same manufacturer and thus not a listed system but are individually listed and provided with proper installation instructions as required in 110.3(B)

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## Public Input No. 4218-NFPA 70-2020 [ Section No. 706.5 ]

**706.5** Listing.

Energy storage ~~systems shall~~ equipment shall be listed.

## Statement of Problem and Substantiation for Public Input

Energy storage systems are most often installed utilizing equipment compatible with the listing of the energy storage equipment, but not supplied by the same manufacturer. Additionally, there is often equipment connected to energy storage equipment that is shared with other systems such as PV systems or wind generators. The existing language implies that all equipment connected to an energy storage device must be included in a single listing through a single manufacturer. This is causing confusion in the field and is not in keeping with the rest of this Code that should continue to allow the installation of equipment that meets the general requirements in this code for safety, regardless of the manufacturer. This is especially important when considering the future servicing of these systems as suitable and safe listed replacement equipment should not be restricted from being installed in the future where it is compatible with the ESS equipment that was originally installed. This article should not imply that the entire system must be listed as a system by one manufacturer. That is not in keeping with the statements included during the original creation of this article in the 2017 cycle. This new language clarifies that the equipment that makes up the ESS must be listed. The installation of this equipment will be governed by the instructions included with that equipment's listing, plus the other requirements within article 706 and the rest of this Code.

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## Public Input No. 4223-NFPA 70-2020 [ Section No. 706.6 ]

**706.6** Multiple Systems.

Multiple ESSs shall be permitted to be installed ~~in or on a single building or structure~~ on the same premises .

## Statement of Problem and Substantiation for Public Input

Some energy storage systems will not be in or on a building or structure. This language better allows for such applications as outdoor systems, or microgrids.

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## Public Input No. 2762-NFPA 70-2020 [ Section No. 706.7 ]

~~**706.7** Maintenance.~~

~~Energy storage systems shall be maintained in proper and safe operating condition. The required maintenance shall be in accordance with the manufacturer's requirements and industry standards. A written record of the system maintenance shall be kept and shall include records of repairs and replacements necessary to maintain the system in proper and safe operating condition.~~

~~Informational Note: For information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program, see NFPA 70B-2019, *Recommended Practice for Electrical Equipment Maintenance* , or ANSI/NETA ATS-2017, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems* .~~

## Statement of Problem and Substantiation for Public Input

This section is out of scope for NFPA 70. Section 90.2(A) states the Code covers the installation and removal of conductors, equipment, and raceways. Providing maintenance requirements is outside the scope of NFPA 70. NFPA 70B is the document that provides guidance on maintenance practices.

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## Public Input No. 2885-NFPA 70-2020 [ Section No. 706.7 ]

**706.~~7~~ 7 Commissioning and** Maintenance.

706.7(A) Commissioning.

Energy Storage Systems shall be commissioned upon installation in compliance with 110.17.

Informational Note: For information related to the commissioning of energy storage systems, see NFPA 855-2020.

706.7(B) Maintenance.

Energy storage systems shall be maintained in proper and safe operating condition. The required maintenance shall be in accordance with the manufacturer's requirements and industry standards. A written record of the system maintenance shall be kept and shall include records of repairs and replacements necessary to maintain the system in proper and safe operating condition.

Informational Note: For information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program, see NFPA 70B-2019, *Recommended Practice for Electrical Equipment Maintenance*, or ANSI/NETA ATS-2017, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*.

## Statement of Problem and Substantiation for Public Input

This revision adds commissioning requirements for energy storage systems in a new (A). The existing requirements for maintenance were moved into the new (B).

Common requirements for device and system commissioning are being proposed to Article 110 in PI 2844 that will help drive consistency in the actions necessary prior to devices and systems being placed into service. This public input is part of a series of revisions proposed throughout the code to include commissioning where system verification is warranted.

Commissioning requirements should be added to align with Chapter 6 of NFPA 855-2020. ESS systems require setup and initial performance verification for devices and equipment necessary for proper system operation and safety. Operational controls, system sequence of operation, and fire safety systems are examples of items typically covered during commissioning activities. The requirement to include as-built documentation and a record of the actions taken to correct any shortcomings will enhance the safety of those who will operate, maintain, and service the equipment.

The term commissioning is defined in 708.2 and applies throughout the code.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2844-NFPA 70-2020 [New Section after 110.16] | |
| Public Input No. 2880-NFPA 70-2020 [Section No. 700.3] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |
| Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.] | |
| Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)] | |
| Public Input No. 2880-NFPA 70-2020 [Section No. 700.3] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |

Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.]
Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)]

## Submitter Information Verification

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## Public Input No. 4224-NFPA 70-2020 [ Section No. 706.7 ]

~~**706.7** Maintenance.~~

~~Energy storage systems shall be maintained in proper and safe operating condition. The required maintenance shall be in accordance with the manufacturer's requirements and industry standards. A written record of the system maintenance shall be kept and shall include records of repairs and replacements necessary to maintain the system in proper and safe operating condition.~~

~~Informational Note: For information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program, see NFPA 70B-2019, *Recommended Practice for Electrical Equipment Maintenance* , or ANSI/NETA ATS-2017, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems* .~~

## Statement of Problem and Substantiation for Public Input

This requirement is not found in other articles addressing power sources (480, 445, 694,692,691,etc) and is not enforceable at the time of installation. Per 90.2(A) the scope of the NEC is limited to the installation and removal of various types of electrical equipment. While the subject of maintenance is certainly appropriate (such as when describing clearance requirements, or control of equipment), this requirement is not in keeping with other articles in this Code and is more suitable for NFPA-70B and other codes. Note that this subject is covered under updated building and fire codes so any usefulness here is expired and now could simply cause conflict or confusing when applying those codes.

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This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus

Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

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**Submittal Date:** Thu Sep 10 07:13:49 EDT 2020
**Committee:** NEC-P13

## Public Input No. 584-NFPA 70-2020 [ Section No. 706.7 ]

~~**706.7** Maintenance.~~

~~Energy storage systems shall be maintained in proper and safe operating condition. The required maintenance shall be in accordance with the manufacturer's requirements and industry standards. A written record of the system maintenance shall be kept and shall include records of repairs and replacements necessary to maintain the system in proper and safe operating condition.~~

~~Informational Note: For information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program, see NFPA 70B-2019, *Recommended Practice for Electrical Equipment Maintenance* , or ANSI/NETA ATS-2017, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems* .~~

## Statement of Problem and Substantiation for Public Input

The NEC covers installations, not maintenance. See 90.2(A).

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**Committee:** NEC-P13

## Public Input No. 4227-NFPA 70-2020 [ Section No. 706.8 ]

**706.8** Storage Batteries.

~~Storage batteries not associated with~~ Where batteries are used as a component of an ESS their installation shall ~~comply with Article 480~~ be in compliance with the energy storage equipment listing(s) and this Article. Article 480 requirements shall not apply to the installation of listed energy storage equipment that includes batteries .

## Statement of Problem and Substantiation for Public Input

There continues to be confusion in the application of Articles 480 and 706. More explicit guidance is needed to make it clear that Article 480 is not to be applied to listed energy storage equipment that may contain batteries.

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This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

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**Committee:** NEC-P13

# Public Input No. 762-NFPA 70-2020 [ New Section after 706.9 ]

**TITLE OF NEW CONTENT**

Type your content here ...

**706.10 Electromagnetic Pulse (EMP) Protection.** Protection for energy storage systems against the effects of electromagnetic pulses shall be provided at a minimum of Level 2. See 709.7 for levels of electromagnetic pulse protection.

*Exception: The requirements of 709.7(A)(5) and 709.7(B)(3) shall not apply.*

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

## Submitter Information Verification

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**Submittal Date:** Mon Mar 23 13:29:44 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1870-NFPA 70-2020 [ Section No. 706.15 ]

**706.15** Disconnecting Means.

~~**(A)** ESS Disconnecting~~
Means

~~.~~

~~A disconnecting means~~

shall be provided

~~for all ungrounded conductors derived from an ESS and shall be permitted to be integral to listed ESS equipment. The disconnecting means shall comply with all of the following:~~

(1) ~~The disconnecting means shall be readily accessible.~~

(2) ~~The disconnecting means shall be located within sight of the ESS. Where it is impractical to install the disconnecting means within sight of the ESS, the disconnect shall be installed as close as practicable, and the location of the disconnecting means shall be field marked on or immediately adjacent to the ESS. The marking shall be of sufficient durability to withstand the environment involved and shall not be handwritten.~~

(3) ~~The disconnecting means shall be lockable open in accordance with 110.25 .~~

~~For one-family and two-family dwellings, a disconnecting means or its remote control shall be located at a readily accessible location outside the building.~~

~~**(B)** Remote Actuation.~~

~~Where controls to activate the disconnecting means of an ESS are used and are not located within sight of the system, the location of the controls shall be field marked on the disconnecting means.~~

~~**(C)** Notification and Marking.~~

~~Each ESS~~

to disconnect the ESS system from all wiring systems including power systems, energy storage systems, and utilization equipment and its associated premises wiring.

(A) Location.

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

(B) Marking.

Each EES system disconnecting means shall plainly indicate whether

~~it is~~

in the open (off) or closed (on) position and be permanently marked

~~"ENERGY STORAGE SYSTEM DISCONNECT." The disconnecting means shall be legibly marked in the field to indicate the following:~~

(1) ~~Nominal ESS ac voltage and maximum ESS dc voltage~~

(2) ~~Available fault current derived from the ESS~~

(3) ~~An arc-flash label applied in accordance with acceptable industry practice~~

(4) ~~Date the calculation was performed~~

~~*Exception: List items (2), (3), and (4) shall not apply to one- and two-family dwellings.*~~

~~Informational Note No. 1: Industry practices for equipment labeling are described in NFPA *70E* -2018, *Standard for Electrical Safety in the Workplace* . This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, arc-flash boundaries, minimum required levels of personal protective equipment, and so forth.~~

~~Informational Note No. 2: Battery equipment suppliers can provide information about available fault current on any particular battery model.~~

~~For ESS~~

"EES SYSTEM DISCONNECT" or equivalent. Additional markings shall be permitted based upon the specific system configuration. For EES system disconnecting means where the line and load terminals may be energized in the open position, the device shall 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~~

~~The~~

~~notification~~

~~warning sign (s)~~

~~and marking~~

~~or label (s) shall comply~~

~~with~~

~~with 110.21(B) .~~

~~(~~

~~D) Partitions Between Components. Where circuits from the input or output terminals of energy storage components in an ESS pass through a wall, floor, or ceiling, a readily accessible disconnecting means shall be provided within sight of the energy storage component. Fused disconnecting means or circuit breakers shall be permitted to be used~~

~~C) Ratings.~~

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

~~(D) Type of Disconnect.~~

~~The EES system disconnecting means shall simultaneously disconnect the EES system conductors that are not solidly grounded from all conductors of other wiring systems. The EES system disconnecting means or its remote operating device or the enclosure providing access to the disconnecting means shall be capable of being locked in accordance with 110.25 . The EES system disconnecting means shall be one of the following:~~

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

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

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

(4) ~~A device listed or approved for the intended application~~

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

## Statement of Problem and Substantiation for Public Input

The rules for disconnecting means should be consistent with other articles where possible. I copied the text from the 2020 NEC 690.15 and pasted it into 706.15.

## Submitter Information Verification

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**Submittal Date:** Mon Jul 13 10:20:41 EDT 2020
**Committee:** NEC-P13

# Public Input No. 4256-NFPA 70-2020 [ Section No. 706.15 ]

**706.**

~~15~~

**15 . Disconnecting Means**

~~.~~

~~**(A)** ESS Disconnecting Means.~~

~~A disconnecting~~

**for Isolating Energy Storage Equipment**

Disconnecting means shall be provided

~~for all ungrounded conductors derived from an ESS and shall be permitted to be integral to listed ESS equipment. The~~

to disconnect equipment that makes up the ESS from all conductors that are not solidly grounded.

Informational Note: Some ESS may only be made up of a single piece of equipment, while others are composed of several individual pieces of equipment connected together in the field.

**706.15(A) Type of Disconnecting Means.**

Where disconnects are required to isolate equipment, the disconnecting means shall comply with

~~all~~

one or more of the following

~~:~~

(1) ~~The disconnecting means shall be readily accessible.~~

(2) ~~The disconnecting means shall be located within sight of the ESS. Where it is impractical to install the disconnecting means within sight of the ESS, the disconnect shall be installed as close as practicable, and the location of the disconnecting means shall be field marked on or immediately adjacent to the ESS. The marking shall be of sufficient durability to withstand the environment involved and shall not be handwritten.~~

(3) ~~The disconnecting means shall be lockable open in accordance with 110.25 .~~

~~For one-family and two-family dwellings, a disconnecting means or its remote control shall be located at a readily accessible location outside the building.~~

~~**(B)** Remote Actuation.~~

~~Where controls to activate the disconnecting means of an ESS are used and are not located within sight of the system, the location of the controls shall be field marked on the disconnecting means.~~

~~**(C)** Notification and Marking.~~

~~Each ESS disconnecting means shall plainly indicate whether it is~~

applicable types:

(1) For circuits with a maximum circuit current of 30 amperes or less, an isolating device in accordance with 706.15(B)

(2) For any circuit, an isolating device where there are means as part of listed equipment to first remove current and then allow access to the isolating device

(3) For any circuit, an equipment disconnecting means in accordance with 706.15(C)

**706.15(B) Isolating Device.**

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

(1) A mating connector meeting the requirements of 690.33 and listed and identified for the application

(2) A finger-safe fuse holder

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

(4) An isolating device listed for the intended application

**706.15(C) Equipment Disconnecting Means.**

Equipment disconnecting means shall comply with each of the following:

(1) Equipment disconnecting means shall have ratings sufficient for the maximum circuit current, available fault current, and voltage that is available at the terminals.

(2) Equipment disconnecting means shall simultaneously disconnect all current-carrying conductors that are not solidly grounded to the circuit to which it is connected.

(3) Equipment disconnecting means shall be externally operable without exposing the operator to contact with energized parts and shall indicate whether in the open (off) or closed (on) position

~~and be permanently marked "ENERGY STORAGE SYSTEM DISCONNECT." The disconnecting means shall be legibly marked in the field to indicate the following:~~

~~(1) Nominal ESS ac voltage and maximum ESS dc voltage~~

~~(2) Available fault current derived from the ESS~~

~~(3) An arc-flash label applied in accordance with acceptable industry practice~~

~~(4) Date the calculation was performed~~

~~*Exception: List items (2), (3), and (4) shall not apply to one- and two-family dwellings.*~~

~~Informational Note No. 1: Industry practices for equipment labeling are described in NFPA *70E* -2018, *Standard for Electrical Safety in the Workplace* . This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, arc-flash boundaries, minimum required levels of personal protective equipment, and so forth.~~

~~Informational Note No. 2: Battery equipment suppliers can provide information about available fault current on any particular battery model.~~

~~For ESS disconnecting means where the line and load terminals may be energized in the open position, the device shall 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~~

~~The notification(s) and marking(s) shall comply with 110.21(B) .~~

~~**(D)** Partitions Between Components.~~

~~Where circuits from the input or output terminals of energy storage components in an ESS pass through a wall, floor, or ceiling, a readily accessible disconnecting means shall be provided within sight of the energy storage component. Fused disconnecting means or circuit breakers shall be permitted to be used~~

(1) .

(2) Equipment disconnecting means, where used, shall be one of the types in 706.13(E)(1) through (E)(5).

*Exception: A system disconnect complying with 706.13 where all ESS equipment and conductors are de-energized shall be permitted to serve as the individual equipment disconnecting means.*

Equipment disconnecting means, other than those complying with 690.33, shall be marked in accordance with the warning in 706.15(E) if the line and load terminals can be energized in the open position.

Informational Note: In some cases, there may be multiple power sources connected to one, or both, terminals of the disconnect.

**706.15(D) Location and control.**

Isolating devices or equipment disconnecting means shall comply with one or more of the following:

(1) Located within the equipment

(2) Located within site of, and readily accessible from the equipment.

(3) Where not located within sight the disconnecting means or its remote operating device, or the enclosure providing access to the disconnecting means, shall be capable of being locked in accordance with 110.25.

(4) Provided with remote controls to activate the disconnecting means. Where the remote controls for the disconnecting means are not located within sight of the equipment, the disconnecting means shall be lockable in accordance with 110.25, and the location of the controls shall be marked on the disconnecting means .

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 706.15_correct_text.pdf | Correct clean text for this PI | |

## Statement of Problem and Substantiation for Public Input

This proposal is part of a broader effort to align disconnect requirements for energy storage equipment and systems with those found for other power sources elsewhere in this Code. This effort is intended to ensure that the characteristics of disconnecting means are tailored to the intended end user. Similar work has been done within Article 690, that largely forms the basis for these requirements as stated here.

The end users for these disconnects could generally be categorized as:

1. Firefighters/emergency personnel, or
2. Qualified service/maintenance personnel

The mandatory language applying to the disconnecting or isolating means should address the functional requirements unique to each group. As with PV systems, firefighters require an easily identifiable and readily accessible means to de-energize circuits (especially those that could be concealed within walls etc.) from onsite power sources but other users, such as electrical workers, will require disconnection and isolation equipment that could have different locational and functional requirements. There may be cases where a disconnect requirement in one section also meets the requirements in another section, such as a system disconnect that also meets the emergency shutdown requirement.

This new section is intended to replace the existing 706.15 with requirements for the isolation of equipment that makes up an energy storage system. These requirements largely mirror 690.15 requirements (including changes being proposed this cycle by this group) and are intended to provide clear and practical requirements for the isolation of the various equipment parts that could make up an ESS and would likely need servicing and repair throughout it's lifetime. Unique areas of concern such as the location and control of the isolation devices are addressed here in a manner similar to how the same issues are addressed elsewhere in this Code.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.

This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.

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## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4251-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4234-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4213-NFPA 70-2020 [New Definition after Definition: Energy Storage System (ESS...] | |
| Public Input No. 4234-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4251-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4268-NFPA 70-2020 [Section No. 706.16(E)] | |
| Public Input No. 4567-NFPA 70-2020 [Section No. 706.31] | |

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**Committee:** NEC-P13

## 706.15. Disconnecting Means for Isolating Energy Storage Equipment

Disconnecting means shall be provided to disconnect equipment that makes up the ESS from all conductors that are not solidly grounded.
Informational Note: Some ESS may only be made up of a single piece of equipment, while others are composed of several individual pieces of equipment connected together in the field.

### 706.15(A) Type of Disconnecting Means.

Where disconnects are required to isolate equipment, the disconnecting means shall comply with one or more of the following applicable types:

1. For circuits with a maximum circuit current of 30 amperes or less, an isolating device in accordance with 706.15(B)
2. For any circuit, an isolating device where there are means as part of listed equipment to first remove current and then allow access to the isolating device
3. For any circuit, an equipment disconnecting means in accordance with 706.15(C)

### 706.15(B) Isolating Device.

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

1. A mating connector meeting the requirements of 690.33 and listed and identified for the application
2. A finger-safe fuse holder
3. An isolating device that requires a tool to place the device in the open (off) position
4. An isolating device listed for the intended application

### 706.15(C) Equipment Disconnecting Means.

Equipment disconnecting means shall comply with each of the following:

1. Equipment disconnecting means shall have ratings sufficient for the maximum circuit current, available fault current, and voltage that is available at the terminals.
2. Equipment disconnecting means shall simultaneously disconnect all current-carrying conductors that are not solidly grounded to the circuit to which it is connected.
3. Equipment disconnecting means shall be externally operable without exposing the operator to contact with energized parts and shall indicate whether in the open (off) or closed (on) position.
4. Equipment disconnecting means, where used, shall be one of the types in 706.13(E)(1) through (E)(5).

*Exception: A system disconnect complying with 706.13 where all ESS equipment and conductors are de-energized shall be permitted to serve as the individual equipment disconnecting means.*

Equipment disconnecting means, other than those complying with 690.33, shall be marked in accordance with the warning in 706.15(E) if the line and load terminals can be energized in the open position.
*Informational Note: In some cases, there may be multiple power sources on one, or both, terminals of the disconnect.*

### 706.15(D) Location and control.

Isolating devices or equipment disconnecting means shall comply with one or more of the following:

1. Located within the equipment
2. Located within site of, and readily accessible from the equipment.
3. Where not located within sight the disconnecting means or its remote operating device, or the enclosure providing access to the disconnecting means, shall be capable of being locked in accordance with 110.25.
4. Provided with remote controls to activate the disconnecting means. Where the remote controls for the disconnecting means are not located within sight of the equipment, the disconnecting means shall be lockable in accordance with 110.25, and the location of the controls shall be marked on the disconnecting means.

## Public Input No. 463-NFPA 70-2020 [ Section No. 706.15 ]

**706.15** Disconnecting Means.

**(A)** ESS Disconnecting Means.

A disconnecting means shall be provided for all ungrounded conductors derived from an ESS and shall be permitted to be integral to listed ESS equipment. The disconnecting means shall comply with all of the following:

(1) The disconnecting means shall be readily accessible.

(2) The disconnecting means shall be located within sight of the ESS. Where it is impractical to install the disconnecting means within sight of the ESS, the disconnect shall be installed as close as practicable, and the location of the disconnecting means shall be field marked on or immediately adjacent to the ESS. The marking shall be of sufficient durability to withstand the environment involved and shall not be handwritten.

(3) The disconnecting means shall be lockable open in accordance with 110.25.

A readily accessible remote ESS shutdown device shall be permitted to satisfy the requirements of 706.15(A) where it is capable of being locked in the open position in accordance with 110.25. For one-family and two-family dwellings, a disconnecting means or its remote control shall be located at a readily accessible location outside the building.

**(B)** Remote Actuation.

Where controls to activate the disconnecting means of an ESS are used and are not located within sight of the system, the location of the controls shall be field marked on the disconnecting means.

**(C)** Notification and Marking.

Each ESS disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position and be permanently marked “ENERGY STORAGE SYSTEM DISCONNECT.” The disconnecting means shall be legibly marked in the field to indicate the following:

(1) Nominal ESS ac voltage and maximum ESS dc voltage

(2) Available fault current derived from the ESS

(3) An arc-flash label applied in accordance with acceptable industry practice

(4) Date the calculation was performed

*Exception: List items (2), (3), and (4) shall not apply to one- and two-family dwellings.*

Informational Note No. 1: Industry practices for equipment labeling are described in NFPA *70E*-2018, *Standard for Electrical Safety in the Workplace*. This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, arc-flash boundaries, minimum required levels of personal protective equipment, and so forth.

Informational Note No. 2: Battery equipment suppliers can provide information about available fault current on any particular battery model.

For ESS disconnecting means where the line and load terminals may be energized in the open position, the device shall 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

The notification(s) and marking(s) shall comply with 110.21(B).

**(D)** Partitions Between Components.

Where circuits from the input or output terminals of energy storage components in an ESS pass through a wall, floor, or ceiling, a readily accessible disconnecting means shall be provided within sight of the energy storage component. Fused disconnecting means or circuit breakers shall be permitted to be used.

## Statement of Problem and Substantiation for Public Input

A remote shutdown device that disables the ESS and is capable of being lockable open should be permitted to serve as a disconnect means for an ESS. There is precedence in the NEC for allowing a shutdown device to serve as the required disconnecting means in Article 445.18 where the device can be locked in the open position.

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## Public Input No. 3488-NFPA 70-2020 [ Section No. 706.15(A) ]

**(A)** ESS Disconnecting Means.

A disconnecting means shall be provided for all ungrounded conductors derived from an ESS and shall be permitted to be integral to listed ESS equipment. The disconnecting means shall comply with all of the following:

(1) The disconnecting means shall be readily accessible.

(2) The disconnecting means shall be located within sight ~~of the ESS. Where it is impractical to install the disconnecting means within sight of the ESS, the disconnect shall be installed as close as practicable, and the location of the disconnecting means shall be field marked on or immediately adjacent to the ESS. The marking shall be of sufficient durability to withstand the environment involved and shall not be handwritten.~~ and within 3 m (10 ft) of the ESS.

(3) The disconnecting means shall be lockable open in accordance with 110.25.

For one-family and two-family dwellings, a disconnecting means or its remote control shall be located at a readily accessible location outside the building.

## Statement of Problem and Substantiation for Public Input

A local means of disconnect for the ESS power source output conductors is essential for both maintenance and emergency use. The use of the words “impractical” and “practicable” in the second sentence is unenforceable and creates an exception to the primary rule. Table 3.2.1 of the NEC Style includes the term “practical(ly) “as an example of vague or unenforceable language.

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**Committee:** NEC-P13

## Public Input No. 4104-NFPA 70-2020 [ Section No. 706.15(A) ]

**(A)** ESS Disconnecting Means.

A disconnecting means shall be provided for all ungrounded conductors derived from an ESS and shall be permitted to be integral to listed ESS equipment. The disconnecting means shall comply with all of the following:

(1) The disconnecting means shall be readily accessible.

(2) The disconnecting means shall be located within sight of the ESS. Where it is impractical to install the disconnecting means within sight of the ESS, the disconnect shall be installed as close as practicable, and the location of the disconnecting means shall be field marked on or immediately adjacent to the ESS. The marking shall be of sufficient durability to withstand the environment involved and shall not be handwritten.

(3) The disconnecting means shall be lockable open in accordance with 110.25.

For one-family and two-family dwellings, ~~a disconnecting means or its remote control shall be located at~~ an emergency disconnecting means shall comply with (4)(a) through (4)(d).

(a) Be located in a readily accessible location outside the building

(b) Be located within 1 m (3 ft) of any required emergency service disconnect or where there is no required emergency service disconnect, be located within 1 m (3 ft) of any other power source emergency disconnect or any PV rapid shutdown initiator

(c) If remotely controlled, the remote-control system shall be “fail safe” where the disconnect automatically opens on loss of control signal or control power

(d) Be labeled “EMERGENCY ESS DISCONNECT” and comply with 110 . 21(B).

## Statement of Problem and Substantiation for Public Input

This proposal is one of several related, but separate proposals involving the 2020 NEC requirements for external (outside the building) emergency disconnects on one- and two-family dwellings for energy sources such as the utility service, batteries, energy storage systems (ESS), wind systems and also stand-alone PV systems plus PV rapid shutdown systems. The intent of these proposals is to require multiple emergency disconnects to be grouped in one location to increase safety for Fire Service first responders.

Also, when remote activation of these disconnects is allowed, the proposal establishes an additional safety requirement that the remote controls be “fail safe” and in the event of loss of control power or control signal, the emergency disconnect shall automatically be opened. It has been determined that some inverter manufacturers are already starting to put inputs on their products to allow an external remote shutdown control system that is fail safe.

It has been determined that adding such a fail-safe remotely controlled emergency disconnect system is relatively inexpensive using voltage-trip circuit breakers and a relay on large battery banks or ESS.

## Submitter Information Verification


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| **Submitter Full Name:** | John Wiles |
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| **Committee:** | NEC-P13 |

## Public Input No. 805-NFPA 70-2020 [ Section No. 706.15(C) ]

**(C)** Notification and Marking.

Each ESS disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position and be permanently marked “ENERGY STORAGE SYSTEM DISCONNECT.” The disconnecting means shall be legibly marked in the field to indicate the following:

(1) Nominal ESS ac voltage and maximum ESS dc voltage

(2) Available fault current derived from the ESS

(3) An arc-flash label applied in accordance with acceptable industry practice

(4) Date the calculation was performed

*Exception No 1 : Nominal ESS ac voltage shall not be required to be field labeled on the ESS disconnecting means where the ESS is a component of a dc coupled multimode system.*

*Exception No. 2: List items (2), (3), and (4) shall not apply to one- and two-family dwellings.*

Informational Note No. 1: Industry practices for equipment labeling are described in NFPA *70E*-2018, *Standard for Electrical Safety in the Workplace*. This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, arc-flash boundaries, minimum required levels of personal protective equipment, and so forth.

Informational Note No. 2: Battery equipment suppliers can provide information about available fault current on any particular battery model.

For ESS disconnecting means where the line and load terminals may be energized in the open position, the device shall 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

The notification(s) and marking(s) shall comply with 110.21(B).

## Statement of Problem and Substantiation for Public Input

There is no reason why a DC coupled ESS disconnecting means should have to be field labeled with an ac nominal voltage value. Without the exception, an installer could be required to label a DC coupled ESS with a label states "0 V AC" by an AHJ.

## Submitter Information Verification

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## Public Input No. 3007-NFPA 70-2020 [ Section No. 706.16 ]

**706.16** Connection to Energy Sources.

The connection of an ESS to sources of energy shall comply with 706.16(A) through (F).

**(A)** Source Disconnect.

A disconnect that has multiple sources of power shall disconnect all energy sources when in the off position.

**(B)** Identified Interactive Equipment.

ESS that operate in parallel with other ac sources shall use inverters that are listed and identified as interactive.

**(C)** Loss of Interactive System Power.

Upon loss of a primary source of power, an ESS with a utility-interactive inverter shall comply with the requirements of ~~705~~ 689 .40.

**(D)** Unbalanced Interconnections.

Unbalanced ac connections between an ESS and other ac electric power production sources shall be in accordance with ~~705~~ 689 .45

~~**(E)** Other Energy Sources.~~

~~The connection of an ESS to other energy sources shall be in accordance with 705.12 and Parts III and VI of Article 712 .~~

~~**(F)** Stand-Alone Operation.~~

~~Where the output of an ESS is capable of operating in stand-alone mode, the requirements of 710.15 shall apply.~~

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

The references to 705.40 and 705.45 are changed to align with the introduction of new Article 689.

(E) and (F) of this section are being deleted as these "pointers" are no longer necessary with the new arrangement of these articles as part of this task group effort to increase usability and technical accuracy of the alternative energy articles.

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| **Committee:** | NEC-P13 |

## Public Input No. 4270-NFPA 70-2020 [ Section No. 706.16(A) ]

~~(A) Source Disconnect.~~

~~A disconnect that has multiple sources of power shall disconnect all energy sources when in the off position.~~

## Statement of Problem and Substantiation for Public Input

Section (A) is deleted as general requirements for source disconnects are covered by existing Part 1 of Article 705, and the proposed changes in this article in 706.15. Additional requirements in this section would just cause potential confusion or conflict.

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## Public Input No. 4268-NFPA 70-2020 [ Section No. 706.16(E) ]

**(E)** Other Energy Sources.

The connection of an ESS to other energy sources shall be in accordance with ~~705.12 and Parts III and VI~~ Part I of Article ~~712~~ 705 .

## Statement of Problem and Substantiation for Public Input

This simple pointer will help ensure that where interconnected to other power sources, the application of an ESS will be guided to the correct starting point for determining the requirements. For the purposes of this section, guiding users to part 1 of 705 is in compliance with the style manual and is sufficient since other applications, such as the installation in a stand-alone or microgrid application, will be determined from that point.

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## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4256-NFPA 70-2020 [Section No. 706.15] | |

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**Committee:** NEC-P13

## Public Input No. 4273-NFPA 70-2020 [ Section No. 706.16(F) ]

~~(F)~~ ~~Stand-Alone Operation.~~

~~Where the output of an ESS is capable of operating in stand-alone mode, the requirements of 710.15 shall apply.~~

### Statement of Problem and Substantiation for Public Input

This section is not necessary or advised. Guiding users of this Code toward Article 705 (in the "Other Energy Sources" subsection of this section) will ensure they apply the correct rules to the interconnection of an ESS to any type of system that will contain other power sources, such as a stand-alone or microgrid system.

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This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
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## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4277-NFPA 70-2020 [ Section No. 706.20(A) ]

**(A)** Ventilation.

~~Provisions appropriate to the energy storage technology shall be made for sufficient diffusion and ventilation of any possible gases from the storage device, if present, to prevent the accumulation of an explosive mixture.~~ Ventilation of an ESS shall be ~~permitted to be~~ provided in accordance with the manufacturer's recommendations and listing for the system.

~~Informational~~ Infor mational Note ~~No. 1: See NFPA 1-2018, *Fire Code* , Chapter 52, for ventilation considerations for specific battery chemistries.~~

~~Informational Note No. 2: Some storage technologies do not require ventilation.~~

~~Informational Note No. 3: A source for design of ventilation of battery systems is IEEE 1635-2018/ASHRAE Guideline 21-2018, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications* .~~

~~Informational Note No. 4: Fire protection considerations are addressed in NFPA 1-2018, *Fire Code* :~~ Not all ESS technologies require ventilation. See NFPA 855-2020: Standard for the Installation of Stationary Energy Storage Systems for specific technology-specific guidance .

## Statement of Problem and Substantiation for Public Input

Modern ESS use a variety of chemistries, many of which require minimal ventilation. With the prevalence of lithium-ion chemistries and the specific treatment of ventilation in other codes and standards, there is reduced need to emphasize these items in NFPA 70. A reminder to adhere to manufacturer Listing requirements, combined with enforcement of relevant building and fire codes, is a more appropriate means of requiring that ventilation be handled appropriately for ESS with reduced risk of providing conflicting requirements. This is primarily addressed through the updated text for 706.20(A).

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SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

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**Committee:** NEC-P13

## Public Input No. 586-NFPA 70-2020 [ Section No. 706.20(A) ]

~~**(A)** Ventilation.~~

~~Provisions appropriate to the energy storage technology shall be made for sufficient diffusion and ventilation of any possible gases from the storage device, if present, to prevent the accumulation of an explosive mixture. Ventilation of an ESS shall be permitted to be provided in accordance with the manufacturer's recommendations and listing for the system.~~

~~Informational Note No. 1: See NFPA 1-2018, *Fire Code* , Chapter 52, for ventilation considerations for specific battery chemistries.~~

~~Informational Note No. 2: Some storage technologies do not require ventilation.~~

~~Informational Note No. 3: A source for design of ventilation of battery systems is IEEE 1635-2018/ASHRAE Guideline 21-2018, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications* .~~

~~Informational Note No. 4: Fire protection considerations are addressed in NFPA 1-2018, *Fire Code* .~~

## Statement of Problem and Substantiation for Public Input

The last sentence of this section tells us to follow instructions, as required by 110.3(B) via 706.5. The rest of this section is filler.

## Submitter Information Verification

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## Public Input No. 587-NFPA 70-2020 [ Section No. 706.20(C) ]

~~(C) Spaces About ESS Components.~~

~~(1) General.~~

~~Working spaces for ESS shall comply with 110.26 and 110.34 .~~

~~(2) Space Between Components.~~

~~ESSs shall be permitted to have space between components in accordance with the manufacturer's instructions and listing.~~

~~Informational Note: Additional space may be needed to accommodate ESS hoisting equipment, tray removal, or spill containment.~~

## Statement of Problem and Substantiation for Public Input

This is all covered by 90.3 and 110.3. As indicated in the Style manual, it should not be here.

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## Public Input No. 4625-NFPA 70-2020 [ Section No. 706.20(C)(2) ]

~~(2) Space Between Components.~~

~~ESSs shall be permitted to have space between components in accordance with the manufacturer's instructions and listing.~~

~~Informational Note: Additional space may be needed to accommodate ESS hoisting equipment, tray removal, or spill containment.~~

## Statement of Problem and Substantiation for Public Input

This section is redundant, this is already made clear by 110.3(B). These details will already be noted in the installation manuals. Related fire-safety concerns regarding propagation between units are also covered in the applicable fire and building codes.

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**Submittal Date:** Thu Sep 10 15:56:37 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3008-NFPA 70-2020 [ Section No. 706.21 ]

**706.21** Directory (Identification of Power Sources).

ESS shall be indicated by markings or labels that shall be in accordance with 110.21(B).

**(A)** Facilities with ~~Utility Services and ESS~~ Other Sources .

Plaques or directories shall be installed in accordance with ~~705~~ 689 .10 ~~and 712 .10~~ .

~~**(B)** Facilities with Stand-Alone Systems.~~

~~Plaques or directories shall be installed in accordance with 710.10 .~~

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This modification is necessary as 710, 712 and 689 are combined as part of this task group effort into a new Article 689. The proper reference for plaques and directories is found in 689.10 only. In addition, this section was simplified as only one reference section exists. Changes simplify and add clarity.

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## Public Input No. 4567-NFPA 70-2020 [ Section No. 706.31 ]

**706.31** Overcurrent Protection.

**(A)** Circuits and Equipment.

~~ESS circuit conductors shall be protected in accordance with the requirements of Article 240.~~ Protection devices for ESS circuits shall be in accordance with the requirements of 706.31(B) through (F). Circuits shall be protected at the location of each source from overcurrent.

*Exception: A circuit conductor connected at one end to an ESS having a current-limited supply, where the conductor is rated for the maximum circuit current from that supply, and also connected to sources having an available maximum circuit current greater than the ampacity of the conductor, shall be protected from overcurrent at the point of connection to the higher current source.*

**(B)** Overcurrent Device Ampere Ratings.

Overcurrent protective devices, where required, shall be rated in accordance with Article 240 and the rating provided on systems serving the ESS and shall be not less than 125 percent of the maximum currents calculated in 706.30(A).

*Exception: Where the assembly, including the overcurrent protective devices, is listed for operation at 100 percent of its rating, the ampere rating of the overcurrent devices shall be permitted to be not less than the maximum currents calculated in 706.30(B).*

**(C)** Direct Current Rating.

Overcurrent protective devices, either fuses or circuit breakers, used in any dc portion of an ESS shall be listed for dc and shall have the appropriate voltage, current, and interrupting ratings for the application.

**(D)** Current Limiting.

A listed and labeled current-limiting overcurrent protective device shall be installed adjacent to the ESS for each dc output circuit.

*Exception: Where current-limiting overcurrent protection is provided for the dc output circuits of a listed ESS, additional current-limiting overcurrent devices shall not be required.*

**(E)** Fuses.

Means shall be provided to disconnect any fuses associated with ESS equipment and components when the fuse is energized from both directions and is accessible to other than qualified persons. Switches, pullouts, or similar devices that are rated for the application shall be permitted to serve as a means to disconnect fuses from all sources of supply.

~~**(F)** Location.~~

~~Where circuits from the input or output terminals of energy storage components in an ESS pass through a wall, floor, or ceiling, overcurrent protection shall be provided at the energy storage component end of the circuit.~~

## Statement of Problem and Substantiation for Public Input

An exception is proposed to mimic allowances found elsewhere in the code where a source is current limited or has other protections in place to address fault conditions. ESS may have current limited sources and will include fault protection as part of the UL 9540 and UL 1741 listings. For example see section 12.3 of UL 9540 Ed. 2: "12.3 Fuses, circuit breakers and disconnect devices shall be rated for the application including fault current ratings, suitability for disconnect under load, etc., as applicable to the device and application in the system. The ESS shall be provided with short circuit protection within the system to mitigate hazards associated with a short circuit condition of the integral energy storage

technology, including addressing the potential for additive fault currents when multiple battery systems are connected in parallel. This protection shall be provided as part of the energy storage technology or installed as a separate component within the ESS. Protection against overload and short circuits of external circuits shall use branch circuit rated protectors or electronic circuits evaluated for the purpose." Systems that are not listed to UL 9540 will more appropriately fall under the scope of Article 480 which adequately addresses overcurrent protection of battery circuits. The opening reference in item (A) to Article 240 is educational in nature as this article applies generally to all electrical equipment and circuits. This reference in item (A) can be deleted since this is also covered by item (B). Item(F) here can be deleted since it is intended to be required in the charging language in item (A). However, there may be some confusion as to how this is applied since (A) only refers to a single source. A change to the language in (A) will make it more clear that overcurrent protection needs to be provided at the location of each source energizing an ESS input or output circuit. Article 240 establishes this general rule, and this new language reinforces it. The language regarding walls and partitions was driven by the concern that in some systems a disconnecting means may not be available to interrupt current flow. Therefore this concern is more appropriately addressed directly by the rules governing the location of disconnecting means. Since disconnecting means or their remote controls will always be located within site of an ESS we believe that this change along with the added exception ensures that no ESS will contribute to a fault condition without both overcurrent protection and a disconnecting means available.

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## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4234-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4256-NFPA 70-2020 [Section No. 706.15] | |

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**Committee:** NEC-P13

## Public Input No. 4110-NFPA 70-2020 [ Section No. 706.31(A) ]

**(A)** Circuits and Equipment.

ESS circuit conductors shall be protected in accordance with ~~the requirements of~~ Article 240. Protection devices for ESS circuits shall be in accordance ~~with the requirements of~~ with 706.31(B) through (F). Circuits shall be protected at the source from overcurrent.

## Statement of Problem and Substantiation for Public Input

"Deleting the words ""the requirements of"" does not change the meaning of the section.
The panel should consider revising the section due to a Style Manual issue 4.1.4 where a section shall not reference a complete article."

## Submitter Information Verification

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# Public Input No. 462-NFPA 70-2020 [ New Section after 706.31(F) ]

**706.32 Wiring Methods.**

**(A) General.** All raceway and cable wiring methods included in Chapter 3 of this *Code* shall be permitted for ESS ac or dc circuit conductors.

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

**(B) Identification and Grouping.** ESS ac circuits, ESS dc circuits, and remote control, signaling, and power-limited circuits of an ESS system installed in accordance with Article 725 shall be permitted to occupy the same cable, enclosure, or raceway. ESS ac and dc circuit conductors shall be identified and grouped in accordance with 706.32(B)(1) and (B)(2).

**(1) Identification** . ESS ac and dc circuit conductors shall be identified at all termination, connection, and slice points by color coding, marking tape, tagging, or other approved means. ESS dc conductors operating at more than 60 volts, shall be marked in accordance with 215.12(C)(2).

**(2) Grouping** . Where the conductors of more than one ESS occupy the same enclosure or raceway with a removable cover, the conductors of each ESS system shall be grouped by cable ties or other approved means.

## Statement of Problem and Substantiation for Public Input

Article 706 has to address the wiring methods for all types of ESS, and should permit all Chapter 3 wiring methods to be installed in the field. ESS dc circuit conductors should be marked in accordance with the requirements for dc feeder conductors in 215.12(C)(2). Where multiple sets of ESS conductors occupy the raceway or enclosure, the conductors should be grouped together. Any associated remote control or signaling circuits shall be installed in accordance with Article 725.

## Submitter Information Verification

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# Public Input No. 1604-NFPA 70-2020 [ Section No. 706.40 ]

**706.40** General.

~~All electrical connections to and from the system and system components shall be in accordance with the applicable provisions of Article 692 . The system and system components~~ Flow batteries not associated with an ESS shall comply with Article 480.

ESS incorporating flow batteries shall also meet Parts I, II, and III of this article. ~~Unless otherwise directed by this article, flow battery ESS shall comply with the applicable provisions of Article 692 .~~

Informational Note: For installation requirements for ESS including requirements for flow batteries, refer to NFPA 855-2020, Standard for the Installation of Stationary Energy Storage Systems.

## Statement of Problem and Substantiation for Public Input

A flow battery is a battery and not a fuel cell system, nor is it a complete energy storage system. It can be the storage component of an energy storage system. The criteria outlined in Article 480 would apply to flow batteries as well as the storage batteries currently covered, so reference back to 480 applies. One of the main differences between the storage batteries covered under Article 480 and flow batteries is that the active materials in flow batteries are stored in the electrolyte rather than on anode and cathode plates. The flow battery is a closed system unlike a fuel cell system that requires a constant supply of fuel and oxidant. As a result, they are evaluated to different safety standards (i.e. flow batteries are evaluated to ANSI UL 1973 and fuel cell systems are evaluated to ANSI CSA FC1), The installation standard for flow battery systems is NFPA 855 and not NFPA 853, which is the installation standard for fuel cell systems. It is confusing at best to reference Article 692 as that may force flow battery energy storage systems to comply with requirements for safety and their installation that are not applicable to them. These changes hopefully will correct this.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1603-NFPA 70-2020 [Definition: Flow Battery.] | addresses same topic |
| Public Input No. 1603-NFPA 70-2020 [Definition: Flow Battery.] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3115-NFPA 70-2020 [ New Section after 706.50 ]

**706.51 Flywheel Energy Storage Systems (FESS).** Flywheel energy storage systems (FESS) using flywheels as the storage mechanism shall also comply with 706.51.1 through 706.51.4.

706.51.1 FESS shall not be used for one or two family dwelling units.

*Informational Note: FESS are intended for high power shorter term applications. They contain parts that rotate under high speed with hazardous kinetic energy and include parts such as magnetic bearings that require ongoing monitoring and maintenance, and are therefore not suitable for residential type applications.*

706.51.2 FESS shall be provided with bearing monitoring and controls that can identify bearing wear or damage to avoid catastrophic failure from occuring.

*Informational Note: The bearing monitoring controls should be evaluated as part of the listing evaluation.*

706.51.3 FESS shall be provided with a containment means to contain moving parts that may break from the system upon catastrophic failure.

*Informational Note: The containment means should be evaluated as part of the listing evaluation.*

706.51.4 The spin down time of the FESS shall be provided in the maintenance documentation for the FESS.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| PIs_for_Article_706_Part_VI.docx | Flywheel energy storage system proposals | |

## Statement of Problem and Substantiation for Public Input

These Proposals are to address flywheel energy storage systems that are also included under article 706 in the other section. for these systems it is important to have bearing monitoring and containment in case there are projectiles that break off of the system.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3112-NFPA 70-2020 [Section No. 706.2] | |

## Submitter Information Verification

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**Submittal Date:** Fri Sep 04 18:32:58 EDT 2020
**Committee:** NEC-P13

**PIs for Article 706 Part VI -**

**706.50 General**. All electrical connections to and from the system and system components shall be in accordance with the applicable provisions of this Code. The systems shall comply with Parts I, II and III of this article. ~~Unless otherwise directed by this article, other energy storage technologies shall comply with the applicable provisions of part III of Article 705~~.

**706.51 Flywheel Energy Storage Systems (FESS).** Flywheel energy storage systems (FESS) using flywheels as the storage mechanism shall also comply with 706.51.1 through 706.51.4.

**706.51.1** FESS shall not be used for one or two family dwelling units.

*Informational note: FESS are intended for high power shorter term applications. They contain parts that rotate under high speed with hazardous kinetic energy and include parts such as magnetic bearings that require ongoing monitoring and maintenance, and are therefore not suitable for residential type applications.*

**706.51.2** FESS shall be provided with bearing monitoring controls that can identify magnetic bearing wear or damage to avoid catastrophic failure from occurring.

*Informational note: The bearing monitoring controls should be evaluated as part of the FESS listing evaluation.*

**706.51.3** FESS shall be provided with a containment means to contain moving parts that may break from the system upon catastrophic failure.

*Informational note: The containment means of the FESS should be evaluated as part of the FESS listing evaluation.*

**706.51.4** The FESS spin down time shall be provided in the maintenance documentation for the FESS.

**Add to the definitions in 706.2** –

**Flywheel ESS (FESS)** - A mechanical energy storage system composed of a spinning mass referred to as a rotor and an energy conversion mechanism such as a motor-generator that converts the mechanical energy to electrical energy.

*Informational Note: There are primarily two types of rotor constructions, solid metal mass design and composite fiber design.*

**Spin down** – A shutdown condition of the FESS, where energy is being dissipated and the flywheel rotor is slowing down to a stop.

*Informational Note: A complete stop of the flywheel rotor cannot occur instantaneously because of the high kinetic energy of the rotor, but rather occurs over time due to a gradual slowdown to a stop as a result friction forces acting on the rotor.*

**Rationale**: The sentence was removed from 706.50 because there is no Part III to 705, so it is not clear what is meant by this sentence. The added sentence mentioning compliance to Parts I, II and III is to match what was included under the flow battery information, because the criteria in those parts should apply to other systems as well.

The flywheel additions point to critical protection needed for flywheel systems that should be considered. These are some monitoring of magnetic bearing wear, a containment means in the event that there is a catastrophic failure of the moving parts and breakage, and a spin down time for the safe maintenance on these systems, which should not occur before they are allowed to come to a stop for safety purposes.

As a result of the additional information on flywheel systems two definitions are needed: one for the flywheel ESS or FESS itself and a definition for spin down, which is critical to the safe maintenance or transport of the system.

## Public Input No. 3114-NFPA 70-2020 [ Section No. 706.50 ]

**706.50** General.

All electrical connections to and from the system and system components shall be in accordance with the applicable provisions of this *Code*. ~~Unless otherwise directed by this article, other energy storage technologies~~ The systems shall comply with ~~the applicable provisions of Part III of Article~~ ~~705~~ Parts I, II and III of this article .

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| PIs_for_Article_706_Part_VI.docx | Revisions to the General of Part VI | |

## Statement of Problem and Substantiation for Public Input

The reference to article 705 was incorrect as their is no Part III of that article. However, the requirements outlined in the previous parts of article 706 would apply to these other systems.

## Submitter Information Verification

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**Committee:** NEC-P13

**PIs for Article 706 Part VI -**

**706.50 General**. All electrical connections to and from the system and system components shall be in accordance with the applicable provisions of this Code. The systems shall comply with Parts I, II and III of this article. ~~Unless otherwise directed by this article, other energy storage technologies shall comply with the applicable provisions of part III of Article 705~~.

**706.51 Flywheel Energy Storage Systems (FESS).** ESS using flywheels as the storage mechanism shall also comply with 706.51.1 through 706.51.4.

**706.51.1** FESS shall not be used for one or two family dwelling units.

*Informational note: FESS are intended for high power shorter term applications. They contain parts that rotate under high speed with hazardous kinetic energy and include parts such as magnetic bearings that require ongoing monitoring and maintenance, and are therefore not suitable for residential type applications.*

**706.51.2** FESS shall be provided with bearing monitoring controls that can identify magnetic bearing wear or damage to avoid catastrophic failure from occurring.

*Informational note: The bearing monitoring controls should be evaluated as part of the FESS listing evaluation.*

**706.51.3** FESS shall be provided with a containment means to contain moving parts that may break from the system upon catastrophic failure.

*Informational note: The containment means of the FESS should be evaluated as part of the FESS listing evaluation.*

**706.51.4** The FESS spin down time shall be provided in the maintenance documentation for the FESS.

**Add to the definitions in 706.2** –

**Flywheel ESS (FESS)** - A mechanical energy storage system composed of a spinning mass referred to as a rotor and an energy conversion mechanism such as a motor-generator that converts the mechanical energy to electrical energy.

*Informational Note: There are primarily two types of rotor constructions, solid metal mass design and composite fiber design.*

**Spin down** – A shutdown condition of the FESS, where energy is being dissipated and the flywheel rotor is slowing down to a stop.

*Informational Note: A complete stop of the flywheel rotor cannot occur instantaneously because of the high kinetic energy of the rotor, but rather occurs over time due to a gradual slowdown to a stop as a result friction forces acting on the rotor.*

**Rationale**: The sentence was removed from 706.50 because there is no Part III to 705, so it is not clear what is meant by this sentence. The added sentence mentioning compliance to Parts I, II and III is to match what was included under the flow battery information, because the criteria in those parts should apply to other systems as well.

The flywheel additions point to critical protection needed for flywheel systems that should be considered. These are some monitoring of magnetic bearing wear, a containment means in the event that there is a catastrophic failure of the moving parts and breakage, and a spin down time for the safe maintenance on these systems, which should not occur before they are allowed to come to a stop for safety purposes.

As a result of the additional information on flywheel systems two definitions are needed: one for the flywheel ESS or FESS itself and a definition for spin down, which is critical to the safe maintenance or transport of the system.

## Public Input No. 4606-NFPA 70-2020 [ Section No. 706.50 ]

~~**706.50** General.~~

~~All electrical connections to and from the system and system components shall be in accordance with the applicable provisions of this *Code* . Unless otherwise directed by this article, other energy storage technologies shall comply with the applicable provisions of Part III of Article 705.~~

## Statement of Problem and Substantiation for Public Input

This section is informative in nature, and points to a section of the code that does not exist since there is no Part III of Article 705. The relevant articles outside of 706 are already referenced in each applicable section. This broad pointer is therefore unnecessary.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 1711-NFPA 70-2020 [ Section No. 708.1 ]

**708.1** Scope.

This article applies to the installation, operation, monitoring, control, and maintenance of the portions of the premises wiring system intended to supply, distribute, and control electricity to designated critical operations areas (DCOA) in the event of disruption to elements of the normal system.

Critical operations power systems are those systems so classed by municipal, state, federal, or other codes by any governmental agency having jurisdiction or by facility engineering documentation establishing the necessity for such a system. These systems include but are not limited to power systems, HVAC, fire alarm, security, communications, and signaling for designated critical operations areas.

Informational Note No. 1: Critical operations power systems are generally installed in vital infrastructure facilities that, if destroyed or incapacitated, would disrupt national security, the economy, public health or safety; and where enhanced electrical infrastructure for continuity of operation has been deemed necessary by governmental authority.

Informational Note No. 2: For further information on disaster and emergency management, see *NFPA 1600*-2019, *Standard on Continuity, Emergency, and Crisis Management*.

Informational Note No. 3: For further information regarding performance of emergency and standby power systems, see NFPA 110-2019, *Standard for Emergency and Standby Power Systems*.

Informational Note No. 4: For specification of locations where emergency lighting is considered essential to life safety, see NFPA *101*-2018, *Life Safety Code*, or the applicable building code.

Informational Note No. 5: For further information regarding physical security, see NFPA 730-2018, *Guide for Premises Security* - *and ANSI/TIA-5017-2016 Telecommunications Physical Network Security Standard*

Informational Note No. 6: Threats to facilities that may require transfer of operation to the critical systems include both naturally occurring hazards and human-caused events. See also A.5.3.2 of *NFPA 1600*-2019, *Standard on Continuity, Emergency, and Crisis Management*.

Informational Note No. 7: See Informative Annex F, Availability and Reliability for Critical Operations Power Systems; and Development and Implementation of Functional Performance Tests (FPTs) for Critical Operations Power Systems.

Informational Note No. 8: See Informative Annex G, Supervisory Control and Data Acquisition (SCADA).

Informational Note No. 9: Text that is followed by a reference in brackets has been extracted from *NFPA 1600*-2019, *Standard on Continuity, Emergency, and Crisis Management*. Only editorial changes were made to the extracted text to make it consistent with this *Code*.

## Statement of Problem and Substantiation for Public Input

ANSI/TIA-5017:2016 includes requirements and guidelines for the physical network security including risk assessment, several levels of security to match the risk assessment to prevent vandalism, theft, etc. This document is widely referenced in TIA premises infrastructure standards

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 3958-NFPA 70-2020 [ Section No. 708.2 ]

(Relocate all definitions in the 708. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**708. 2** Definitions.

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

**Commissioning.**

The acceptance testing, integrated system testing, operational tune-up, and start-up testing is the process by which baseline test results verify the proper operation and sequence of operation of electrical equipment, in addition to developing baseline criteria by which future trend analysis can identify equipment deterioration.

**Critical Operations Power Systems (COPS).**

Power systems for facilities or parts of facilities that require continuous operation for the reasons of public safety, emergency management, national security, or business continuity.

**Designated Critical Operations Areas (DCOA).**

Areas within a facility or site designated as requiring critical operations power.

**Supervisory Control and Data Acquisition (SCADA).**

An electronic system that provides monitoring and controls for the operation of the critical operations power system. This can include the fire alarm system, security system, control of the HVAC, the start/stop/monitoring of the power supplies and electrical distribution system, annunciation and communications equipment to emergency personnel, facility occupants, and remote operators.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 16:18:05 EDT 2020
**Committee:** NEC-P13

# Public Input No. 2887-NFPA 70-2020 [ Definition: Commissioning. ]

**Commissioning.**

The ~~acceptance testing, integrated system testing, operational tune-up, and start-up testing is the process by which baseline test results verify the proper operation~~ process, procedures, and testing used to setup and verify the initial performance, operational controls, safety systems and sequence of operation of electrical devices and equipment ~~, in addition to developing baseline criteria by which future trend analysis can identify equipment deterioration~~ prior to it being placed into active service .

## Statement of Problem and Substantiation for Public Input

The commissioning of electrical devices and systems are paramount to ensure a safe installation that complies with the requirements in the NEC. This often includes special setup steps to adjust device and system settings, performing verification tests, interlock and safety system operational performance, and validation of the sequence of operation. The revisions proposed will add clarity to definition and encompass more of the purpose intended with this term.

Common requirements for device and system commissioning are also being proposed to Article 110 in PI 2844 that will help drive consistency in the actions necessary prior to devices and systems being placed into service. This public input is part of a series of revisions proposed throughout the code to include commissioning where the existing requirements only mention testing.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2844-NFPA 70-2020 [New Section after 110.16] | |
| Public Input No. 2880-NFPA 70-2020 [Section No. 700.3] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |
| Public Input No. 2885-NFPA 70-2020 [Section No. 706.7] | |
| Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)] | |
| Public Input No. 2844-NFPA 70-2020 [New Section after 110.16] | |
| Public Input No. 2873-NFPA 70-2020 [Section No. 230.95(C)] | |
| Public Input No. 2875-NFPA 70-2020 [Section No. 240.87(C)] | |
| Public Input No. 2876-NFPA 70-2020 [Section No. 240.67(C)] | |
| Public Input No. 2877-NFPA 70-2020 [New Section after 517.26] | |
| Public Input No. 2880-NFPA 70-2020 [Section No. 700.3] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |
| Public Input No. 2884-NFPA 70-2020 [New Section after 705.50] | |
| Public Input No. 2885-NFPA 70-2020 [Section No. 706.7] | |
| Public Input No. 2888-NFPA 70-2020 [Section No. 708.8(A)] | |
| Public Input No. 2894-NFPA 70-2020 [New Section after 712.4] | |

## Submitter Information Verification

**Submitter Full Name:** Chad Kennedy

| | |
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| **Organization:** | Schneider Electric |
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| **Zip:** | |
| **Submittal Date:** | Thu Sep 03 08:28:15 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 4179-NFPA 70-2020 [ Definition: Critical Operations Power Systems (COPS). ]

**Critical Operations Power Systems (COPS).**

Power systems for facilities or parts of facilities that require continuous operation for the reasons of public safety, emergency management, national security, or business continuity.

Informational Note: Critical Operations Power Systems are considered level one systems when applying NFPA110-2019. *Standard for Emergency and Standby Power Systems* .

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally

required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.
701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

## Submitter Information Verification

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**Submittal Date:** Wed Sep 09 23:49:25 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3083-NFPA 70-2020 [ Section No. 708.4 ]

**708.4** Risk Assessment.

Risk assessment for critical operations power systems shall be documented and shall be conducted in accordance with 708.4(A) through (~~C~~ D ).

Informational Note: Chapter 5 of *NFPA 1600*-2019, *Standard on Continuity, Emergency, and Crisis Management*, provides additional guidance concerning risk assessment and hazard analysis.

**(A)** Conducting Risk Assessment.

In critical operations power systems, risk assessment shall be performed to identify hazards, the likelihood of their occurrence, and the vulnerability of the electrical system to those hazards.

**(B)** Identification of Hazards.

Hazards to be considered at a minimum shall include, but shall not be limited to, the following:

(1) Naturally occurring hazards (geological, meteorological, and biological)

(2) Human-caused events (accidental and intentional) [**1600:**5.3.2]

**(C)** Developing Mitigation Strategy.

Based on the results of the risk assessment, a strategy shall be developed and implemented to mitigate the hazards that have not been sufficiently mitigated by the prescriptive requirements of this *Code*.

(D) Cybersecurity Assesment.

Critical operation power system that is connected to a communication network and permitted to control any portions of the premises electrical system shall comply with (1) and (2).

(1) A Cybersecurity Assessment shall be conducted on the connected system determine vulnerabilities to cyber-attacks.

(2) Documentation of the assessment shall be made available to those authorized to inspect, operate, and maintain the system.

Informational note (1): ANSI/ISA 62443 Cybersecurity Standards series can be utilized to meet the assessment requirement. Another way is thru the NIST Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Hackers_force_water_utilities_to_sink_or_swim.pdf | Hackers and Water Utilities | |
| Cyberattack_The_Possibilities_Emergency_Managers_Need_to_Consider.pdf | Emergency Managers need consider Cyberattacks | |

| | |
|---|---|
| History_of_Industrial_Control_System_Cyber_Incidents.pdf | Control system cyber incidents |

## Statement of Problem and Substantiation for Public Input

Cybersecurity should be considered as an aspect of safety and reliability in addition to the other factors affecting critical operation power systems. If an attacker can affect the control system, individual sensors or other IoT devices to the point of either preventing normal operation or displaying the appearance of normal operation while failing the system, such as providing indication that a generator has started but it has not, creates an unsafe condition. The increase in cyber-attacks on government, industrial, utility, and other installations that have critical operations power systems can be made to create unsafe conditions. Examples of these unsafe conditions can be changing overcurrent protection rating of a circuit breaker, generator controls, SCADA systems, security systems, emergency communication functions, motor controllers, or fire protection systems. The public input is focused only on critical operation power systems that can be controlled from external communication networks such as the internet. These connections can be wired, wireless, or use other data media. cybersecurity is essential to expand the safety and security of critical operation power systems. The U.S. has seen an increasing number of cyber-attacks on the 911 Call Center infrastructure. While a lot of these attacks are designed to overburden the communication system, they can attack the power system infrastructure and its emergency back-up systems.

https://www.varonis.com/blog/cybersecurity-statistics/

- 71% of data breaches were financially motivated and 25% were motivated by espionage
- Cybersecurity breaches have increased by 11% since 2018 and 67% since 2014
- 61% of organizations have experienced an IoT security incident
- IoT devices experience an average of 5,200 attacks per month
- The cost of a data breach in the healthcare industry was $6.5 Million
- Average cost of a malware attack on a company is $2.6M

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3055-NFPA 70-2020 [New Section after 110.28] | Cybersecurity General Requirement PI |
| Public Input No. 3080-NFPA 70-2020 [New Section after 700.8] | cybersecurity for emergency systems |
| Public Input No. 3087-NFPA 70-2020 [Section No. 708.8] | |

## Submitter Information Verification

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**Submittal Date:** Fri Sep 04 14:16:39 EDT 2020
**Committee:** NEC-P13

## Public Input No. 3087-NFPA 70-2020 [ Section No. 708.8 ]

**708.8** Commissioning.

**(A)** Commissioning Plan.

A commissioning plan shall be developed and documented.

Informational Note: For further information on developing a commissioning program see NFPA 70B-2019, *Recommended Practice for Electrical Equipment Maintenance*.

**(B)** Component and System Tests.

The installation of the equipment shall undergo component and system tests to ensure that, when energized, the system will function properly.

**(C)** Baseline Test Results.

A set of baseline test results shall be documented for comparison with future periodic maintenance testing to identify equipment deterioration.

**(D)** Functional Performance Tests.

A functional performance test program shall be established, documented, and executed upon complete installation of the critical system in order to establish a baseline reference for future performance requirements.

Informational Note: See Informative Annex F for more information on developing and implementing a functional performance test program.

(E) Cybersecurity Commissioning Certification.

The connected system with the ability to control shall be certified to ensure it has been protected against cyber-attacks and known vulnerabilities as directed by the cybersecurity assessment.

Informational note (1): Examples of the commissioning certification used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(a) The ISA Security Compliance Institute (ISCI) conformity assessment program

(b) Certification of compliance by a nationally recognized test laboratory

(c) Manufacturer certification for the specific type and brand of system provided

## Statement of Problem and Substantiation for Public Input

Cybersecurity should be considered as an aspect of safety and reliability in addition to the other factors affecting critical operation power systems. If an attacker can affect the control system, individual sensors or other IoT devices to the point of either preventing normal operation or displaying the appearance of normal operation while failing the system, such as providing indication that a generator has started but it has not, creates an unsafe condition. The increase in cyber-attacks on government, industrial, utility, and other installations that have critical operations power systems can be made to create unsafe conditions. Examples of these unsafe conditions can be changing overcurrent protection rating of a circuit breaker, generator controls, SCADA systems, emergency communication functions, motor controllers, security systems, or fire protection systems. The public input is focused only on critical operation power systems that can be controlled from external communication networks such as the internet. These connections can be wired, wireless, or use other data media. cybersecurity is essential to expand the safety and security of critical operation power systems. The U.S. has seen an increasing number of cyber-attacks on the 911 Call Center infrastructure. While a lot of these attacks are designed to overburden the communication system, they can attack the power system infrastructure and its emergency back-up systems. This PI adds the certification requirement

based on actions taken based on the cybersecurity assessment requirement recommended to be added to 708.4.

https://www.varonis.com/blog/cybersecurity-statistics/
- 71% of data breaches were financially motivated and 25% were motivated by espionage
- Cybersecurity breaches have increased by 11% since 2018 and 67% since 2014
- 61% of organizations have experienced an IoT security incident
- IoT devices experience an average of 5,200 attacks per month
- The cost of a data breach in the healthcare industry was $6.5 Million
- Average cost of a malware attack on a company is $2.6M

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3055-NFPA 70-2020 [New Section after 110.28] | Cybersecurity general requirement |
| Public Input No. 3080-NFPA 70-2020 [New Section after 700.8] | Emergency System Cybersecurity |
| Public Input No. 3083-NFPA 70-2020 [Section No. 708.4] | Cybersecurity Assesment requirement linked to this certification requirement |

## Submitter Information Verification

**Submitter Full Name:** Keith Waters
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**Submittal Date:** Fri Sep 04 14:24:24 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2888-NFPA 70-2020 [ Section No. 708.8(A) ]

**(A)** Commissioning Plan.

A commissioning plan in compliance with 110.17 shall be developed and documented.

Informational Note: For further information on developing a commissioning program see NFPA 70B-2019, *Recommended Practice for Electrical Equipment Maintenance*.

## Statement of Problem and Substantiation for Public Input

Common requirements for device and system commissioning are being proposed to Article 110 in PI 2844 that will help drive consistency in the actions necessary prior to devices and systems being placed into service. The creation of a commissioning plan should include all of the elements required within the common requirements for commissioning provided in the new section in Article 110.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2844-NFPA 70-2020 [New Section after 110.16] | |
| Public Input No. 2880-NFPA 70-2020 [Section No. 700.3] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |
| Public Input No. 2885-NFPA 70-2020 [Section No. 706.7] | |
| Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.] | |
| Public Input No. 2880-NFPA 70-2020 [Section No. 700.3] | |
| Public Input No. 2882-NFPA 70-2020 [Section No. 701.3] | |
| Public Input No. 2885-NFPA 70-2020 [Section No. 706.7] | |
| Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.] | |

## Submitter Information Verification

**Submitter Full Name:** Chad Kennedy
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**Submittal Date:** Thu Sep 03 08:32:41 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1037-NFPA 70-2020 [ Section No. 708.10(C)(2) ]

**(2)** Fire Protection for Feeders.

Feeders shall meet one of the following conditions:

(1) The cable or raceway is protected by a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note: The listing organization provides information for electrical circuit protection systems on proper installation requirements to maintain the fire rating.

(2) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours.

(4) The cable or raceway is encased in a minimum of ~~50 mm~~ 127 mm (~~2 in~~ 5 in .) of concrete.

## Statement of Problem and Substantiation for Public Input

In December of 2018 the NFPA Fire Research Foundation published their findings on the fire resistance ratings of concrete protecting electrical conductors. The summary of this report illustrates that in order to provide the minimum required 2 hour fire rating, the minimum concrete encasement without specifying the type of concrete should be 127 mm or 5 inches.

https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Electrical/RFFireResistanceOfConcreteForElectricalConductors.pdf

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 1034-NFPA 70-2020 [Section No. 695.14(F)] | fire rating of concrete |
| Public Input No. 1035-NFPA 70-2020 [Section No. 695.6(A)(2)] | fire rating of concrete |
| Public Input No. 1036-NFPA 70-2020 [Section No. 700.10(D)(2)] | fire rating of concrete |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2313-NFPA 70-2020 [ Section No. 708.10(C)(2) ]

**(2)** Fire Protection for Feeders.

Feeders shall meet one of the following conditions:

(1) The cable or raceway is ~~protected by~~ part of a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note: ~~The listing organization provides information for electrical circuit protection systems on proper installation requirements to maintain the fire~~ One method of defining an electrical circuit protective system is by establishing a rating when tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protective Systems* . UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

(2) The cable or raceway is part of a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note ~~No. 1~~ : ~~Fire-resistive cables are tested to ANSI/UL 2196-2017, Standard for~~ One method of defining a fire-resistive cable system is by establishing a rating when tested in accordance with UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables* . ~~Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.~~

(3) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours.

(4) The cable or raceway is encased in a minimum of 50 mm (2 in.) of concrete.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| PI2313_for_708.10_C_2_.pdf | Correct wording for PI 2313 | |

## Statement of Problem and Substantiation for Public Input

Proposed changes to (1) and (2) only. Terra underlined (3) and (4) but no changes are being proposed by this PI. Please see attachment for proposed wording. The language is revised to reflect the proper title of the standards, deleting the reference to ANSI at UL's request, and revising to show some allowable methods to protect the cables. This public input is a result of the Correlating Committee Task Group for Circuit Integrity Cable efforts to correlate information on Circuit Integrity (-CI) cable throughout the NEC®. Members of the task group included Blake Shugarman from UL – Principal Engineer for Circuit Integrity Systems, Larry Shudak from UL - Principal Engineer for Life Safety Technologies and member of NFPA 72, Anthony Tassone from UL – Principal Engineer Seasonal and Holiday Decorative Products and Telecommunications Cables - CMP16, Jim Conrad from Marmon Innovation and Technology Group – CMP13, George Straniero from AFCCable Systems – CMP6, CMP3, and CC, Paul Casparro from IBEW – CMP3, and Rich Holub from DuPont – CMP14 and CC.

## Submitter Information Verification

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**Submittal Date:** Fri Aug 14 12:21:58 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2313-NFPA 70-2020 [ Section No. 708.10(C)(2) ]

Original | Show Markup

**(2)** Fire Protection for Feeders.

Feeders shall meet one of the following conditions:

(1) The cable or raceway is part of a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note: One method of defining an electrical circuit protective system is by establishing a rating when tested in accordance with UL 1724, *Fire Tests for Electrical Circuit Protective Systems*. UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

(2) The cable or raceway is part of a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note : One method of defining a fire-resistive cable system is by establishing a rating when tested in accordance with UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables.* UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) contains information to identify the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

(3) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours.

(4) The cable or raceway is encased in a minimum of 50 mm (2 in.) of concrete.

### Statement of Problem and Substantiation for Public Input

Proposed changes to (1) and (2) only. Terra underlined (3) and (4) but no changes are being proposed by this PI. Please see attachment for proposed wording. The language is revised to reflect the proper title of the standards, deleting the reference to ANSI at UL's request, and revising to show some allowable methods to protect the cables. This public input is a result of the Correlating Committee Task Group for Circuit Integrity Cable efforts to correlate information on Circuit Integrity (-CI) cable throughout the NEC®. Members of the task group included Blake Shugarman from UL – Principal Engineer for Circuit Integrity Systems, Larry Shudak from UL - Principal Engineer for Life Safety Technologies and member of NFPA 72, Anthony Tassone from UL – Principal Engineer Seasonal and Holiday Decorative Products and Telecommunications Cables - CMP16, Jim Conrad from Marmon Innovation and Technology Group – CMP13, George Straniero from AFCCable Systems – CMP6, CMP3, and CC, Paul Casparro from IBEW – CMP3, and Rich Holub from DuPont – CMP14 and CC.

### Submitter Information Verification


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**Submittal Date:** Fri Aug 14 12:21:58 EDT 2020
**Committee:** NEC-AAC

## Public Input No. 3717-NFPA 70-2020 [ Section No. 708.10(C)(2) ]

**(2)** Fire Protection for Feeders.

Feeders shall meet one of the following conditions:

(1) The cable or raceway is protected by a listed electrical circuit protective system with a minimum 2-hour fire rating.

Informational Note: The listing organization provides information for electrical circuit protection systems on proper installation requirements to maintain the fire rating.

(2) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 1: Fire-resistive cables are tested to ANSI/UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*.

Informational Note No. 2: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

(3) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours.

(4) The cable or raceway is encased in a minimum of ~~50 mm~~ 125 mm (~~2 in~~ 5 in .) of concrete.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 708-10.docx | Detailed substantiation for proposed changes to 708.10 | |

## Statement of Problem and Substantiation for Public Input

Following the NFPA Research Foundation report “Fire Resistance of Concrete for Electrical Conductors” review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada (NBCC), using the terminology “Fire Resistance Rating” where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on aggregate types (table included in attached documentation).

While not exactly the same between these two reports, both detail the same general information that 2” (50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|

| | |
|---|---|
| Public Input No. 3685-NFPA 70-2020 [Section No. 695.6(A)(2)] | Similar proposed changes to related section |

## Submitter Information Verification

**Submitter Full Name:** Ryan Drury
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**Zip:**
**Submittal Date:** Wed Sep 09 11:16:51 EDT 2020
**Committee:** NEC-P13

708.10 Feeder and Branch Circuit Wiring

(C) COPS Feeder Wiring Requirements

(2) Fire Protection for Feeders

Feeders shall meet one of the following Conditions

(4) The cable or raceway is encased in ~~50 mm (2 in)~~ 125 mm (5 in)of concrete.

**Substantiation:**

Following the NFPA Research Foundation report "Fire Resistance of Concrete for Electrical Conductors" review of existing information regarding the fire resistance of concrete for electrical conductors, it is clear that 50 mm (2 in) does not equate to 2 hours of protection. Due to the conclusions noted in this report and because code does not state the required type of concrete to achieve a fire rating, 125mm (5in) of concrete should be used to ensure 2 hrs of protection.

Additionally, along the same directional line, the National Building Code of Canada 2015 Volume 1 (NBCC), using the terminology "Fire Resistance Rating" where it is required to provide fire protection. This statement is used to cover structural and safety elements, including critical and life safety circuits. Section D-1.4 details the different types of concrete aggregate by material type and concentrations. Section D.2 details information on Fire Resistance Ratings, with section D-2.1.1. Minimum Equivalent Thickness for Fire Resistance Rating, which includes the chart below detailing the require thicknesses based on aggregate types:

**Table D-2.1.1.**
**Minimum Equivalent Thicknesses[1] of Unit Masonry and Monolithic Concrete Walls Loadbearing and Non-Loadbearing, mm**

| Type of Wall | Fire-Resistance Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 min | 45 min | 1 h | 1.5 h | 2 h | 3 h | 4 h |
| Solid brick units (80% solid and over), actual overall thickness | 63 | 76 | 90 | 108 | 128 | 152 | 178 |
| Cored brick units and hollow tile units (less than 80% solid), equivalent thickness | 50 | 60 | 72 | 86 | 102 | 122 | 142 |
| Solid and hollow concrete masonry units, equivalent thickness | | | | | | | |
| Type S or N concrete[2] | 44 | 59 | 73 | 95 | 113 | 142 | 167 |
| Type $L_1$20S concrete | 42 | 54 | 66 | 87 | 102 | 129 | 152 |
| Type $L_1$ concrete | 42 | 54 | 64 | 82 | 97 | 122 | 143 |
| Type $L_2$20S concrete | 42 | 54 | 64 | 81 | 94 | 116 | 134 |
| Type $L_2$ concrete | 42 | 54 | 63 | 79 | 91 | 111 | 127 |
| Monolithic concrete and concrete panels, equivalent thickness | | | | | | | |
| Type S concrete | 60 | 77 | 90 | 112 | 130 | 158 | 180 |
| Type N concrete | 59 | 74 | 87 | 108 | 124 | 150 | 171 |
| Type L40S or Type L concrete | 49 | 62 | 72 | 89 | 103 | 124 | 140 |

While not exactly the same between these two reports, both detail the same general information that 2" (50 mm) of concrete do not provide 2 hrs of fire protection. Furthermore, both detail that different aggregates provide different protection levels against fire. This detail should be investigated and included within NEC as a new table in Chapter 9 addressing aggregate type fire performance.

## Public Input No. 2314-NFPA 70-2020 [ Section No. 708.14 ]

**708.14** Wiring of HVAC, Fire Alarm, Security, Emergency Communications, and Signaling Systems.

All conductors or cables shall be installed using any of the metal wiring methods permitted by 708.10(C)(1) and, in addition, shall comply with the following, as applicable:

(1) All cables for fire alarm, security, signaling systems, and emergency communications shall be shielded twisted pair cables or installed to comply with the performance requirements of the system.

(2) Shields of cables for fire alarm, security, signaling systems, and emergency communications shall be arranged in accordance with the manufacturer's published installation instructions.

(3) Optical fiber cables shall be used for connections between two or more buildings on the property and under single management.

(4) A listed primary protector shall be provided on all communications circuits. Listed secondary protectors shall be provided at the terminals of the communications circuits.

(5) Conductors for all control circuits rated above 50 volts shall be rated not less than 600 volts.

(6) Communications, fire alarm, and signaling circuits shall use relays with contact ratings that exceed circuit voltage and current ratings in the controlled circuit.

(7) All cables for fire alarm, security, emergency communications, and signaling systems shall be riser-rated and shall be part of a listed 2-hour ~~electrical circuit protective system. Emergency communications cables shall be Type CMR-CI or shall be riser-rated and shall be a~~ fire-resistive cable system or a part of a listed 2-hour electrical circuit protective system.

(8) Control, monitoring, and power wiring to HVAC systems shall be part of a listed 2-hour fire-resistive cable system or a part of a listed 2- hour electrical circuit protective system.

## Statement of Problem and Substantiation for Public Input

Since Circuit Integrity (-CI) cables are rated for "free air" installation and this section requires Type CMR cables to be installed in a raceway per 708.10, Type CMR-CI cables should be deleted to minimize confusion. Additionally, The language is revised to reflect the proper language such that a 2-hour listed fire-resistive rating meets the requirement. The language is updated to remain consistent with other uses throughout the NEC®, for correlation.This public input is a result of the Correlating Committee Task Group for Circuit Integrity Cable efforts to correlate information on Circuit Integrity (-CI) cable throughout the NEC®. Members of the task group included Blake Shugarman from UL – Principal Engineer for Circuit Integrity Systems, Larry Shudak from UL - Principal Engineer for Life Safety Technologies and member of NFPA 72, Anthony Tassone from UL – Principal Engineer Seasonal and Holiday Decorative Products and Telecommunications Cables - CMP16, Jim Conrad from Marmon Innovation and Technology Group – CMP13, George Straniero from AFC Cable Systems – CMP6, CMP3, and CC, Paul Casparro from IBEW – CMP3, and Rich Holub from DuPont – CMP14 and CC.

## Submitter Information Verification

**Submitter Full Name:** James Conrad

**Organization:** RSCC Wire & Cable

| | |
|---|---|
| **Street Address:** | |
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| **Submittal Date:** | Fri Aug 14 12:31:55 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 3928-NFPA 70-2020 [ Section No. 708.14 ]

**708.14** Wiring of HVAC, Fire Alarm, Security, Emergency Communications, and Signaling Systems.

All conductors or cables shall be installed using any of the metal wiring methods permitted by 708.10(C)(1) and, in addition, shall comply with the following, as applicable:

(1) All cables for fire alarm, security, signaling systems, and emergency communications shall be shielded twisted pair cables or installed to comply with the performance requirements of the system.

(2) Shields of cables for fire alarm, security, signaling systems, and emergency communications shall be arranged in accordance with the manufacturer's published installation instructions.

(3) Optical fiber cables shall be used for connections between two or more buildings on the property and under single management.

(4) A listed primary protector shall be provided on all communications circuits. Listed secondary protectors shall be provided at the terminals of the communications circuits.

(5) Conductors for all control circuits rated above 50 volts shall be rated not less than 600 volts.

(6) Communications, fire alarm, and signaling circuits shall use relays with contact ratings that exceed circuit voltage and current ratings in the controlled circuit.

(7) All cables for fire alarm, security, emergency communications and signaling systems shall be riser CI ~~- rated and shall be a listed 2-hour electrical circuit protective system. Emergency communications cables shall be Type CMR-CI~~ listed cable or shall be ~~riser-rated and shall be~~ part of a listed 2-hour electrical circuit protective system.

(8) Control, monitoring, and power wiring to HVAC systems shall be a listed 2-hour electrical circuit protective system.

## Statement of Problem and Substantiation for Public Input

The listed requirements are confusing as a “listed 2-hour electrical circuit protective system” is not a cable and the only notable difference between the first and second sentence is the presence of a CMR-CI cable. Additionally, the second sentence can be read as requiring either a CMR-CI or riser rated cable but still requiring a listed 2-hour electrical circuit protective system. The change proposed retains operational survivability and leaves the cable rating required (e.g., CMP, CMR) to be governed by the environment in which it is placed.

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 3219-NFPA 70-2020 [ Section No. 708.20(D) ]

**(D)** ~~Surge~~ Overvoltage Protection ~~Devices~~ .

~~Surge~~ Overvoltage protection ~~devices~~ shall be provided at all facility distribution voltage levels.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| Code_Input.docx | input to improve overvoltage protection requirements | |

## Statement of Problem and Substantiation for Public Input

In the 2020 NEC cycle, ARTICLES 280 and 285 were combined to make ARTICLE 242. This was a positive change that began to address the issue of OVERVOLTAGE as a technical subject apart from particular product methods (SPDs and Surge Arresters). There are other technologies and products to address the issue of OVERVOLTAGE. This input attempts to add one such technology as well as correlate the other code references to the subject of OVERVOLTAGE, surge protective devices, and surge arresters to be consistent. This is important to allow for other technologies to be utilized without prejudice to certain products promoted by manufacturers.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3200-NFPA 70-2020 [Section No. 242.1] | |
| Public Input No. 3202-NFPA 70-2020 [New Article after 100] | |
| Public Input No. 3203-NFPA 70-2020 [New Article after 242] | |
| Public Input No. 3205-NFPA 70-2020 [Section No. 501.35] | |
| Public Input No. 3206-NFPA 70-2020 [Section No. 502.35] | |
| Public Input No. 3208-NFPA 70-2020 [Section No. 551.72(E)] | |
| Public Input No. 3209-NFPA 70-2020 [Section No. 490.24] | |
| Public Input No. 3210-NFPA 70-2020 [Section No. 490.48(A)] | |
| Public Input No. 3211-NFPA 70-2020 [Section No. 620.51(E)] | |
| Public Input No. 3212-NFPA 70-2020 [Section No. 645.18] | |
| Public Input No. 3214-NFPA 70-2020 [Section No. 670.6] | |
| Public Input No. 3216-NFPA 70-2020 [Section No. 694.7(D)] | |
| Public Input No. 3217-NFPA 70-2020 [Section No. 695.15] | |
| Public Input No. 3218-NFPA 70-2020 [Section No. 700.8] | |

## Submitter Information Verification

**Submitter Full Name:** Karl Cunningham
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| | |
|---|---|
| **Zip:** | |
| **Submittal Date:** | Sun Sep 06 19:13:41 EDT 2020 |
| **Committee:** | NEC-P13 |

**Substantiation for Changes: In the 2020 NEC cycle, ARTICLES 280 and 285 were combined to make ARTICLE 242. This was a positive change that began to address the issue of OVERVOLTAGE as a technical subject apart from particular product methods (SPDs and Surge Arresters). There are other technologies and products to address the issue of OVERVOLTAGE. This input attempts to add one such technology as well as correlate the other code references to the subject of OVERVOLTAGE, surge protective devices, and surge arresters to be consistent. This is important to allow for other technologies to be utilized without prejudice to certain products promoted by manufacturers.**

**ARTICLE 100 - DEFINITIONS**

**Voltage Stabilizing Ground Reference (VSGR) System** – an engineered assembly of interconnected passive inductive devices that utilize mutual counter electro-magnetic inductance to stabilize phase voltages of a connected supply system with respect to each other and to ground.

**ARTICLE 242 Overvoltage Protection**

**Part I. General**

**242.1 Scope.**
This article provides the general requirements, installation requirements, and connection requirements for overvoltage protection and overvoltage protective devices. Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal, while Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal. Part IV covers Voltage Stabilizing Ground Reference (VSGR) systems permanently installed on premises wiring systems for any voltage.

Informational Note: Article 242 combines and replaces Articles 280 and 285 in *NFPA 70*-2017.

**242.3 Other Articles.**
Equipment shall be protected against overvoltage in accordance with the article in this *Code* that covers the type of equipment or location specified in Table 242.3.

## Table 242.3 Other Articles

| Equipment | Article |
|---|---|
| Class I locations | 501 |
| Class II locations | 502 |
| Community antenna television and radio distribution systems | 820 |
| Critical operations power systems | 708 |

## Table 242.3 Other Articles

| Equipment | Article |
|---|---|
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | 620 |
| Emergency systems | 700 |
| Equipment over 1000 volts, nominal | 490 |
| Fire pumps | 695 |
| Industrial machinery | 670 |
| Information technology equipment | 645 |
| Modular data centers | 646 |
| Outdoor overhead conductors over 1000 volts | 399 |
| Radio and television equipment | 810 |
| Receptacles, cord connectors, and attachment plugs (caps) | 406 |
| Wind electric systems | 694 |

### Part II. Surge-Protective Devices (SPDs), 1000 Volts or Less

Informational Note: Surge arresters 1000 volts or less are also known as Type 1 SPDs.

### 242.6 Uses Not Permitted.

An SPD device shall not be installed in the following:

1. (1)

   Circuits over 1000 volts

2. (2)

   On ungrounded systems, impedance grounded systems, or corner grounded delta systems unless listed specifically for use on these systems

3. (3)

   Where the rating of the SPD is less than the maximum continuous phase-to-ground voltage at the power frequency available at the point of application

### 242.8 Listing.
An SPD shall be a listed device.

### 242.10 Short-Circuit Current Rating.
The SPD shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating. This marking requirement shall not apply to receptacles.

### 242.12 Type 1 SPDs.
Type 1 SPDs shall be installed in accordance with 242.12(A) and (B).

### 242.12(A) Installation.
Type 1 SPDs shall be permitted to be connected in accordance with one of the following:

1. (1)

   To the supply side of the service disconnect as permitted in 230.82(4)

2. (2)

   As specified in 242.14

### 242.12(B) At the Service.
When installed at services, Type 1 SPDs shall be connected to one of the following:

1. (1)

   Grounded service conductor

2. (2)

   Grounding electrode conductor

3. (3)

   Grounding electrode for the service

4. (4)

   Equipment grounding terminal in the service equipment

### 242.14 Type 2 SPDs.
Type 2 SPDs shall be installed in accordance with 242.14(A) through (C).

### 242.14(A) Service-Supplied Building or Structure.
Type 2 SPDs shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91 unless installed in accordance with 230.82(8).

### 242.14(B) Feeder-Supplied Building or Structure.
Type 2 SPDs shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.

### 242.14(C) Separately Derived System.
The SPD shall be connected on the load side of the first overcurrent device in a separately derived system.

### 242.16 Type 3 SPDs.
Type 3 SPDs shall be permitted to be installed on the load side of branch-circuit overcurrent protection up to the equipment served. If included in the manufacturer's instructions, the Type 3 SPD connection shall be a minimum 10 m (30 ft) of conductor distance from the service or separately derived system disconnect.

### 242.18 Type 4 and Other Component Type SPDs.
Type 4 component assemblies and other component type SPDs shall only be installed by the equipment manufacturer.

### 242.20 Number Required.
Where used at a point on a circuit, the SPD shall be connected to each ungrounded conductor.

### 242.22 Location.
SPDs shall be permitted to be located indoors or outdoors and shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

### 242.24 Routing of Connections.
The conductors used to connect the SPD to the line or bus and to ground shall not be any longer than necessary and shall avoid unnecessary bends.

### 242.26 Connection.
Where an SPD device is installed, it shall comply with 242.12, 242.14, 242.16, 242.28. and 242.30.

### 242.28 Conductor Size.
Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

### 242.30 Connection Between Conductors.
An SPD shall be permitted to be connected between any two conductors — ungrounded conductor(s), grounded conductor, equipment grounding conductor, or grounding electrode conductor. The grounded conductor and the equipment grounding conductor shall be interconnected only by the normal operation of the SPD during a surge.

### 242.32 Grounding Electrode Conductor Connections and Enclosures.
Except as indicated in this article, SPD grounding connections shall be made as specified in Article 250, Part III. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

## Part III. Surge Arresters, Over 1000 Volts

### 242.40 Uses Not Permitted.
A surge arrester shall not be installed where the rating of the surge arrester is less than the maximum continuous phase-to-ground voltage at the power frequency available at the point of application.

### 242.42 Surge Arrester Selection.
The surge arresters shall comply with 242.42(A) and (B).

### 242.42(A) Rating.
The rating of a surge arrester shall be equal to or greater than the maximum continuous operating voltage available at the point of application.

### 242.42(A)(1) Solidly Grounded Systems.
The maximum continuous operating voltage shall be the phase-to-ground voltage of the system.

### 242.42(A)(2) Impedance or Ungrounded System.

The maximum continuous operating voltage shall be the phase-to-phase voltage of the system.

### 242.42(B) Silicon Carbide Types.

The rating of a silicon carbide-type surge arrester shall be not less than 125 percent of the rating specified in 242.42(A).

Informational Note No. 1: For further information on surge arresters, see IEEE C62.11-2012, *Standard for Metal-Oxide Surge Arresters for Alternating-Current Power Circuits (>1 kV)*, and IEEE C62.22-2009, *Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems*.

Informational Note No. 2: The selection of a properly rated metal oxide arrester is based on considerations of maximum continuous operating voltage and the magnitude and duration of overvoltages at the arrester location as affected by phase-to-ground faults, system grounding techniques, switching surges, and other causes. See the manufacturer's application rules for selection of the specific arrester to be used at a particular location.

### 242.44 Number Required.

Where used at a point on a circuit, a surge arrester shall be connected to each ungrounded conductor. A single installation of such surge arresters shall be permitted to protect a number of interconnected circuits if no circuit is exposed to surges while disconnected from the surge arresters.

### 242.46 Location.

Surge arresters shall be permitted to be located indoors or outdoors. Surge arresters shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

### 242.48 Routing of Surge Arrester Equipment Grounding Conductors.

The conductor used to connect the surge arrester to line, bus, or equipment and to an equipment grounding conductor or grounding electrode connection point as provided in 242.50 shall not be any longer than necessary and shall avoid unnecessary bends.

### 242.50 Connection.

The arrester shall be connected to one of the following:

1. (1)

   Grounded service conductor

2. (2)

   Grounding electrode conductor

3. (3)

   Grounding electrode for the service

4. (4)

   Equipment grounding terminal in the service equipment

### 242.52 Surge-Arrester Conductors.

The conductor between the surge arrester and the line, and the surge arrester and the grounding connection, shall not be smaller than 6 AWG copper or aluminum.

### 242.54 Interconnections.

The surge arrester protecting a transformer that supplies a secondary distribution system shall be interconnected as specified in 242.54(A), (B), or (C).

### 242.54(A) Metal Interconnections.
A metal interconnection shall be made to the secondary grounded circuit conductor or the secondary circuit grounding electrode conductor, if, in addition to the direct grounding connection at the surge arrester, the connection complies with 242.54(A)(1) or (A)(2).

### 242.54(A)(1) Additional Grounding Connection.
The grounded conductor of the secondary has a grounding connection elsewhere to a continuous metal underground water piping system. In urban water-pipe areas where there are at least four water-pipe connections on the neutral conductor and not fewer than four such connections in each mile of neutral conductor, the metal interconnection shall be permitted to be made to the secondary neutral conductor with omission of the direct grounding connection at the surge arrester.

### 242.54(A)(2) Multigrounded Neutral System Connection.
The grounded conductor of the secondary system is part of a multigrounded neutral system or static wire of which the primary neutral conductor or static wire has at least four grounding connections in each 1.6 km (1 mile) of line in addition to a grounding connection at each service.

### 242.54(B) Through Spark Gap or Device.
Where the surge arrester grounding electrode conductor is not connected as in 242.54(A), or where the secondary is not grounded as in 242.54(A) but is otherwise grounded as in 250.52, an interconnection shall be made through a spark gap or listed device as required by 242.54(B)(1) or (B)(2).

### 242.54(B)(1) Ungrounded or Unigrounded Primary System.
For ungrounded or unigrounded primary systems, the spark gap for a listed device shall have a 60-Hz breakdown voltage of at least twice the primary circuit voltage but not necessarily more than 10 kV, and there shall be at least one other ground on the grounded conductor of the secondary that is not less than 6.0 m (20 ft) distant from the surge-arrester grounding electrode.

### 242.54(B)(2) Multigrounded Neutral Primary System.
For multigrounded neutral primary systems, the spark gap or listed device shall have a 60-Hz breakdown of not more than 3 kV, and there shall be at least one other ground on the grounded conductor of the secondary that is not less than 6.0 m (20 ft) distant from the surge-arrester grounding electrode.

### 242.54(C) By Special Permission.
An interconnection of the surge-arrester ground and the secondary neutral conductor, other than as provided in 242.54(A) or (B), shall be permitted to be made only by special permission.

### 242.56 Grounding Electrode Conductor Connections and Enclosures.
Except as indicated in this article, surge-arrester grounding electrode conductor connections shall be made as specified in Article 250, Parts III and X. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

## Part IV. Voltage Stabilizing Ground Reference (VSGR) systems.

### 242.68 Listing.
A VSGR shall be a listed device or system composed of listed components.

### 242.70 Short-Circuit Current Rating.
The VSGR shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating.

### 242.71 Voltage Rating.
The rating of the VSGR shall be equal to or greater than the maximum system continuous operating voltage at the point of application.

**242.72 Installation.**
VSGRs shall be installed in accordance with 242.72(A) through (C).

**242.72(A) Service-Supplied Building or Structure.**
VSGR shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91 unless installed in accordance with 230.82(8).

**242.72(B) Feeder-Supplied Building or Structure.**
VSGR shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.

**242.72(C) Separately Derived System.**
VSGR shall be connected on the load side of the first overcurrent device in a separately derived system.

**242.82 Location.**
VSGRs shall be permitted to be located indoors or outdoors and shall be made inaccessible to unqualified persons unless listed for installation in accessible locations.

**242.84 Conductor Size.**
Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

**242.90 Connection Between Conductors.**
VSGR connections shall follow the manufacturer's instructions for the system connections.

**242.92 Grounding Electrode Conductor Connections and Enclosures.**
Except as indicated in this article, VSGR grounding connections shall be made as specified in Article 250, Part III. Grounding electrode conductors installed in metal enclosures shall comply with 250.64(E).

**501.35 Overvoltage ~~Surge~~ Protection.**

**501.35(A) Class I, Division 1.**
Overvoltage protection devices, surge arresters, surge-protective devices, and capacitors shall be installed in enclosures identified for Class I, Division 1 locations. Surge-protective capacitors shall be of a type designed for specific duty.

**501.35(B) Class I, Division 2.**
Overvoltage protection devices, surge arresters and surge-protective devices shall be nonarcing, such as metal-oxide varistor (MOV) sealed type, and surge-protective capacitors shall be of a type designed for specific duty. Enclosures shall be permitted to be of the general-purpose type. Overvoltage ~~Surge~~ protection of types other than described in this paragraph shall be installed in enclosures identified for Class I, Division 1 locations.

**502.35 Overvoltage ~~Surge~~ Protection — Class II, Divisions 1 and 2.**
Overvoltage protection devices, surge arresters and surge-protective devices installed in a Class II, Division 1 location shall be in suitable enclosures. Surge-protective capacitors shall be of a type designed for specific duty.

**551.72(E) Connected Devices.**
The use of autotransformers shall not be permitted. The use of listed overvoltage and surge protective devices shall be permitted.

**Table 490.24 Minimum Clearance of Live Parts**

Note: The values given are the minimum clearance for rigid parts and bare conductors under favorable service conditions. They shall be increased for conductor movement or under unfavorable service conditions or wherever space limitations permit. The selection of the associated impulse withstand voltage for a particular system voltage is determined by the characteristics of the overvoltage ~~surge~~ protective equipment.

## 490.48(A) Design and Documentation.

(12) Overvoltage ~~Surge~~ arresters

**620.51(E) Overvoltage ~~Surge~~ Protection.**
Overvoltage protection shall be provided where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, a legally required system load, or a critical operation power system load, ~~listed surge protection shall be provided.~~

**645.18 Overvoltage ~~Surge~~ Protection for Critical Operations Data Systems.**
Overvoltage ~~Listed surge~~ protection shall be provided for critical operations data systems.

**670.6 Surge Protection.**
Industrial machinery with safety interlock control devices not effectively protected from voltage surges on the incoming supply circuit shall have overvoltage ~~surge~~ protection installed.

**694.7(D) Overvoltage Protection ~~Surge Protective Devices (SPD).~~**
Overvoltage protection ~~A surge protective device~~ shall be installed between a wind electric system and any loads served by the premises electrical system. The ~~surge~~ protective device shall be permitted to be a VSGR, or a Type 3 SPD on the circuit serving a wind electric system, or a Type 2 SPD located anywhere on the load side of the service disconnect. Overvoltage ~~Surge~~ protective devices shall be installed in accordance with Part II of Article 242.

**695.15 Overvoltage ~~Surge~~ Protection.**
Overvoltage ~~A listed surge~~ protection ~~device~~ shall be provided for ~~installed in or on~~ the fire pump controller.

**700.8 Overvoltage ~~Surge~~ Protection.**
Overvoltage protection ~~A listed SPD~~ shall be provided ~~installed in or on~~ for all emergency systems switchboards and panelboards.

**708.20(D) Overvoltage ~~Surge~~ Protection ~~Devices~~.**

Surge protection devices shall be provided at all facility distribution voltage levels

## Public Input No. 3731-NFPA 70-2020 [ Section No. 708.20(D) ]

**(D)** ~~Surge~~ Overvoltage Protection ~~Devices~~ .

Surge ~~protection devices shall be provided~~ -protective devices (SPD) shall be installed in accordance with Part II Article 242 at all facility distribution voltage levels.

## Statement of Problem and Substantiation for Public Input

The purpose of this public input is to correlate and harmonize all of the current sections of the code where “overvoltage protection” is required by:

1. Changing the section titles to “Overvoltage Protection” to properly correlate with Article 242.

2. Correcting the product description to “listed surge-protective device (SPD)” which is defined in Article 100 and correlates with Article 242.

3. Adding a pointer to “Part II. of Article 242” to ensure compliance with all of the requirements for SPDs are met when complying with the rule.

This public input is one of eleven correlating public inputs covering Sections 230.67, 501.35, 502.35, 620.51(E), 645.18, 670.6, 694.7(D), 695.15, 700.8, 708.20(D), and Informative Annex G

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## Public Input No. 2603-NFPA 70-2020 [ Section No. 708.20(F) ]

**(F)** Generator Set.

**(1)** Prime Mover-Driven.

Generator sets driven by a prime mover shall be provided with means for automatically starting the prime mover on failure of the normal service. A time-delay feature permitting a minimum 15-minute setting shall be provided to avoid retransfer in case of short-time reestablishment of the normal source.

**(2)** Power for fuel transfer pumps.

Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the COPS.

**(3)** Dual Supplies.

Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems. Means shall be provided for automatically transferring from one fuel supply to another where dual fuel supplies are used.

**(4)** Battery Power and Dampers.

Where a storage battery is used for control or signal power or as the means of starting the prime mover, it shall be suitable for the purpose and shall be equipped with an automatic charging means independent of the generator set. Where the battery charger is required for the operation of the generator set, it shall be connected to the COPS. Where power is required for the operation of dampers used to ventilate the generator set, the dampers shall be connected to the COPS.

~~**(6)**~~

**(5)** ~~Outdoor Generator Sets.~~

(a) ~~*Permanently Installed Generators and Portable Generators Greater Than 15 kW.* Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18 , and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36 .~~

(b) ~~*Portable Generators 15 kW or Less.* Where a portable generator, rated 15 kW or less, is installed using a flanged inlet or other cord-and plug-type connection, a disconnecting means shall not be required where ungrounded conductors serve or pass through a building or structure.~~

**Means for Connecting Portable or Vehicle-Mounted Generator.**

Where the COPS is supplied by a single generator, a means to connect a portable or vehicle-mounted generator shall be provided.

**(~~7~~ 6 )** On-Site Fuel Supply.

Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided. The on-site fuel supply shall be secured and protected in accordance with the risk assessment.

## Statement of Problem and Substantiation for Public Input

The text in (5) is not being deleted, it is being relocated to 445.18 as proposed in PI-2594

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2594-NFPA 70-2020 [Section No. 445.18] | generator disconnecting means |
| Public Input No. 2598-NFPA 70-2020 [Section No. 700.12(D)(5)] | generator disconnecting means |
| Public Input No. 2600-NFPA 70-2020 [Section No. 701.12(D)(5)] | generator disconnecting means |
| Public Input No. 2601-NFPA 70-2020 [Section No. 702.12] | generator disconnecting means |
| Public Input No. 2598-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 2600-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 2601-NFPA 70-2020 [Section No. 702.12] | |

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## Public Input No. 4175-NFPA 70-2020 [ Section No. 708.20(F)(1) ]

**(1)** Prime Mover-Driven.

Generator sets driven by a prime mover shall be provided with means for automatically starting the prime mover on failure of the normal ~~service~~ power source . A time-delay feature permitting a minimum 15-minute setting shall be provided to avoid retransfer in case of short-time reestablishment of the normal source.

## Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the task group formed under the direction of the Correlating Committee to harmonize terminology across NFPA70, 99, 110, and 111 that relate to emergency and standby power and energy storage. This task group was appointed to identify potential proposed changes to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Correlating Committee.
The task group members are; Alan Manche-Co-Chair, Todd Lottmann Co-Chair, Steve Froemming, David Stymiest, John Kovacik, Chad Kennedy, Duke Schamel, Linda Little, Jason D'Antona, Chris Coache, Mike McCabe, and Chad Beebe. This task group of balanced interests provided the expertise to develop these public inputs covering the harmonization of terms across NFPA70, 99, 110, and 111.
Public Inputs are being submitted in the following sections: Article 100 definitions, 480.2, 517.30 (B)(1), 517.30(B)(3), 517.31(D), 517.31(F), 517.41(B), 692.41(C), 695.3(C)(2), 700.2, 700.12(D)(1), 700.12(D)(2), 700.18, 701.2, 701.12(D)(1), and 708.20(F)(1)
Summary of Changes
These proposed PIs are intended provide consistent use of terms between the NEC®, NFPA 110, 111. These proposed revisions identified correlating terminology issues and looked across all three standards to determine the changes necessary to harmonize key terms. These public inputs were the changes recommended for the NEC by the task group.

Technical Substantiation
The following substantiation is provided for each change separated by section:
Article 100 – Uninterruptible Power Supply definition was revised to align with the NFPA111 definition.
480.2 – definition for storage battery revised to match NFPA855
517.30 (B)(1) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.30(B)(3) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(D) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.31(F) – revised to text to align with references across NEC, NFPA110, and NFPA111
517.41(B) – revised to text to align with references across NEC, NFPA110, and NFPA111
692.41(C) – removed the word power since fuel cell system is a defined term in the NEC
695.3(C)(2) – revised to text to align with references across NEC, NFPA110, and NFPA111
700.2, - Added informational note number 2 to describe the interaction of the terms used in NFPA110 and NFPA111with emergency systems in the NEC. Revised definition for Branch-Circuit Emergency Lighting Transfer Switch to align with terminology in NFPA110 and NFPA111. Added informational note 3 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
700.12(D)(1), - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of "service." This section was revised to say power source to allow other types of sources for the normal power.
700.12(D)(2) – revised wording since legally required standby system and emergency system are defined terms.
700.18 – added the word "system" since emergency system is a defined term
701.2 - Added informational note 2 to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards. It also provides guidance as to which legally required standby systems are considered level 1 due to their critical nature tied to loss of life or serious injury versus the level 2 that is less critical.

701.12(D)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.
708.2 - Added informational note to tie the levels defined in NFPA110 to the systems used in the NEC. This will aid in the interaction of these standards.
708.20(F)(1) - Normal service implies that the normal or primary power source can only be a utility per the NEC definition of “service.” This section was revised to say power source to allow other types of sources for the normal power.

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**Committee:** NEC-P13

## Public Input No. 285-NFPA 70-2020 [ Section No. 708.20(F)(5) ]

**(5)** Outdoor Generator Sets.

(a) *Permanently Installed Generators and Portable Generators Greater Than 15 kW.* Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required for the building or structure where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

(b) *Portable Generators 15 kW or Less.* Where a portable generator, rated 15 kW or less, is installed using a flanged inlet or other cord-and plug-type connection, a disconnecting means shall not be required where ungrounded conductors serve or pass through a building or structure.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| generator_shutdown_means_ecm.pdf | | |

## Statement of Problem and Substantiation for Public Input

Due to the 2017 changes in 445.18, this wording became unclear as to which disconnecting means is being referred to when it says, "an additional disconnecting means shall not be required."

It was the 2017 NEC that introduced a new requirement for generators, 445.18(B), to have 2 means of disconnect for prime mover for any generator greater than 15kW rating. Contractors and engineers are getting confused when emergency systems are being supplied via generator -- as to exactly what disconnecting means shall not be required per 700.12(D)(5). This happens so much so, that an article was written on this very subject in EC&M magazine. I have included a copy of the full article. It helps to illustrate what I'm talking about. Here is a snippet:

https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

"I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional “disconnecting means” is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives."

I also mention this in an article that I wrote, which can be found here:

https://www.ecmag.com/section/codes-standards/exit-lighting-and-emergency-lighting-without-battery-backup-fed-generator

"What Article 700.12(B)(6) speaks of is the disconnecting means for the building and is merely stating that the 445.18(B) disconnecting means for the generator can be used to meet Article 225.31 and 225.32 requirements. The 2017 NEC Handbook confirms this. In my opinion, the sentence should have been written like this:

Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means for the building shall not be required where ungrounded conductors serve or pass through the building or structure.

Article 700.12(B)(6) points to an entirely different Code requirement and has no detrimental effect on 445.18(B). So don't be confused here—generators with greater than a 15-kilowatt rating must still be provided with two 445.18(B) Code-compliant means to shut down the prime mover start controls. This holds true for both interior and exterior generators greater than 15 kilowatts.

And just to recap—if there is a generator enclosure, the second disconnecting means must be located somewhere outside of the generator enclosure."

So adding the five words, "for the building or structure" totally clarifies the meaning of 700.12(D)(5) such that it cannot be confused with the required disconnecting means for generator. Reason for change is clarity.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 265-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 283-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 284-NFPA 70-2020 [Section No. 702.12(A)] | |
| Public Input No. 265-NFPA 70-2020 [Section No. 700.12(D)(5)] | |
| Public Input No. 283-NFPA 70-2020 [Section No. 701.12(D)(5)] | |
| Public Input No. 284-NFPA 70-2020 [Section No. 702.12(A)] | |

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EC&M®



NATIONAL ELECTRICAL CODE

# Generator Shutdown Means

Change to the 2017 NEC requires both exterior and interior generators to have a second means of shutting down the prime mover.

Krista McDonald Biason

MAY 19, 2017

Most of my previous articles have focused on big electrical "system" issues, complex design issues, or issues of controversy — but the topic for this article is a bit different. I want to focus on a single Code requirement — the shutdown requirements for a prime mover (aka, generator). The original intent of this article was to quickly highlight a change in the 2017 NEC, but being a Code nerd I started crosschecking other Sections in the Code to validate alignment of this new directive. Once I started doing this, the "simple" topic became significantly more complex.

Section 445.18 was revised in the 2017 National Electrical Code. In the 2014 version, this section was titled "Disconnecting Means Required for Generators." It is now titled "Disconnecting Means and Shutdown of Prime Movers" and is split into Sections (A) "Disconnecting Means" and (B) "Shutdown of Prime Mover." The general intent of this requirement is very similar to what it was in the 2014 edition with one significant exception. Section 445.18(B) now indicates: "Generators with greater than 15kW rating shall be provided with an additional requirement to shut down the prime mover. This additional shutdown means shall be located outside the equipment room or generator enclosure and shall also meet the requirements of Sec. 445.18(B)(1) and (B)(2)."

What this means is that both exterior and interior generators are required to have a second means of shutting down the prime mover. This second means is to be a remote shutdown (stop) that is not physically located on the prime mover, on the prime mover enclosure, or within the room that the prime mover is located.

I know what you are now saying to yourself. How is this in alignment with Sec. 700.12(B)(6), right? This Section indicates an additional "disconnecting means" is not required if the disconnecting means for the exterior generator is in accordance with Sec. 445.18, is readily accessible, and is within sight of the structure it serves. One could be misled to believe that the additional shutdown means is not required. If you read this Section 27 times, you will realize that 700.12(B)(6) references disconnecting means and not the means to shut down the prime mover. These are two separate objectives.

Article 5.6.5.6 in NFPA 110, "Standard for Emergency and Standby Power Systems" (2016 edition), requires that "All installations shall have a remote manual stop station of a type to prevent inadvertent or unintentional operation located outside the room housing the prime mover, where so installed, or elsewhere on the premises where the prime mover is located outside the building." After reading this Article 43 times, I still think the wording is awkward. The Annex information for the Article states: "For systems located outdoors, the manual shutdown should be located external to the weatherproof enclosure and should be appropriately identified." This helps clarify

that the intent of the Article is that a manual shutdown is required for exterior generators and that the shutdown station cannot be located within the generator enclosure. What the Annex doesn't quite clarify is the statement of "all installations shall have a remote manual stop station" portion. If the commas were relocated, this Article could be interpreted to actually be closely aligned with the changes in Sec. 445.18 of the 2017 NEC. The revisions to 445.18 now indicate that the remote manual stop cannot be located on the enclosure, so that verbiage is more stringent than NFPA 110.

So, after an exhausting analysis of NFPA 70 and NFPA 110, the summary of the "simple" Code change I was hoping to convey is: Both interior and exterior generators require a secondary remote stop, and that remote stop to shut down the prime mover and the remote stop station cannot be located within the same room as the prime mover or located on an exterior generator enclosure. (Note I did say exhausting — not exhaustive search. As with most Code items, once you start down the rabbit hole, there is always another Code reference that will suck you in and add to your analysis.)

**Source URL:** https://www.ecmweb.com/national-electrical-code/article/20902695/generator-shutdown-means

## Public Input No. 3009-NFPA 70-2020 [ Section No. 708.20(F)(5) ]

**(5)** Outdoor Generator Sets.

(a) *Permanently Installed Generators and Portable Generators Greater Than 15 kW.* Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with ~~445~~ 693 .18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

(b) *Portable Generators 15 kW or Less.* Where a portable generator, rated 15 kW or less, is installed using a flanged inlet or other cord-and plug-type connection, a disconnecting means shall not be required where ungrounded conductors serve or pass through a building or structure.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This change aligns this section with an effort to re-organize the alternative energy sources NEC Articles into a series of articles closely located together. This reorganization places all sources alternate sources as follows:

689 On-Site Energy Sources
690 Solar Photovoltaic (PV) Systems
691 Large-Scale Photovoltaic (PV) Systems
692 Fuel Cell Systems
693 Generators
694 Wind Electric Systems
695 Energy Storage Systems
696 Storage Batteries

This public input aligns with changes that movie 445 Generators to 693.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2984-NFPA 70-2020 [Article 445] | |

## Submitter Information Verification

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| **Submittal Date:** | Thu Sep 03 21:23:54 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 2761-NFPA 70-2020 [ Section No. 708.24 ]

**708.24** Transfer Equipment.

**(A)** General.

Transfer equipment, including automatic transfer switches, shall be automatic and identified for emergency use. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and critical operations sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705.

~~Transfer equipment shall not be permitted to be reconditioned.~~

**(B)** Bypass Isolation Switches.

Means shall be permitted to bypass and isolate the transfer equipment. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

**(C)** Automatic Transfer Switches.

Where used with sources that are not inherently synchronized, automatic transfer switches shall comply with 708.24(C)(1) and (C)(2).

(1) Automatic transfer switches shall be listed for emergency use.

(2) Automatic transfer switches shall be electrically operated and mechanically held.

**(D)** Bypass Isolation Automatic Transfer Switches.

Where loads are supplied by only one automatic transfer switch, the automatic transfer switch shall include a bypass isolation switch to facilitate maintenance as required in 708.6(C) without jeopardizing continuity of power. When the bypass isolation transfer switch is in the bypass mode, either it shall automatically initiate transfer between power sources upon loss of the connected power source or it shall remain actively supervised by a qualified person who can manually initiate a transfer between power sources.

**(E)** Use.

Transfer equipment shall supply only COPS loads.

**(F)** Documentation.

The short-circuit current rating of the transfer equipment, based on the specific overcurrent protective device type and settings protecting the transfer equipment, shall be field marked on the exterior of the transfer equipment.

**(G)** Reconditioning of Transfer Switches.

(1) Meter Mounted Transfer Switches. Meter Mounted Transfer Switches shall not be permitted to be reconditioned.

(2) Transfer switches other than Meter Mounted Transfer Switches. Transfer switches other than Meter Mounted Transfer Switches within the scope of this article shall be permitted to be reconditioned in accordance with 708.24(G)(2)a through 708.24(G)(2)d.

(3) The reconditioning process shall be performed in accordance with instructions provided by the manufacturer.

(4) Reconditioning shall be performed using design qualified parts, verified under applicable standards.

(5) Reconditioned transfer switch shall be listed or field labeled as reconditioned, and previously applied listing marks, if any, within the portions reconditioned shall be removed.

(6) If equipment has been damaged by fire, products of combustion, or water, it shall be specifically evaluated by its manufacturer or a qualified testing laboratory prior to being returned to service.

## Statement of Problem and Substantiation for Public Input

Self-contained transfer switches, such as meter mounted transfer switches, are usually not designed to facilitate replacement of critical components and are generally not considered appropriate for reconditioning. Other, particularly larger, transfer switch equipment is designed in such a way that modular components like power, control, and switching elements can, relatively easily, be replaced. Such equipment usually resembles switchboards or switchgear and consists of a cabinet in which critical components are installed and connected together via distribution components. The NEC allows for switchboards and switchgear to be reconditioned, see 408.8(B), but absolutely prohibits reconditioning of transfer switches and transfer equipment. It seems contradictory to provide switchboards an allowance to be reconditioned while reconditioning of transfer equipment of similar construction is absolutely banned.

NEMA published a white paper, “NEMA Technical Position on Reconditioned Equipment” describing the types of products that should be and should not be reconditioned. Text in the body of this document states, “A manufacturer’s design may create a situation where some equipment may be suitable for reconditioning, even if the NEC or NEMA has indicated that it is generally not suitable for reconditioning. Likewise, equipment that is generally considered suitable for reconditioning may not be suitable for reconditioning in a specific case or based on the specific design.” The statement cited above makes it clear that the OEM has a role in determining if products that they manufacture are appropriate for reconditioning.

A blanket ban on reconditioning has the following effects:

- It penalizes OEMs that have invested in the development of equipment that is suitable for reconditioning.
- It penalizes both OEMs and third-party companies that have developed the expertise, tools, processes, and facilities to safely and reliable recondition this equipment.
- It penalizes the end-user by requiring the purchase of new equipment rather than allowing for a

safe, more cost-effective means to restore and reuse their own equipment.
- It stifles innovation that could lead to the development of equipment and components that may have longer life spans, if reconditioning is an intended step in the equipment's life-cycle.
- It creates more waste and makes it more difficult to meet environmental protection and sustainability goals.

Finally, the text submitted in this PI was adopted from section 408.8 of this code. The term "transfer switch" is specifically used because it is a defined term in article 100 of this code. This PI provides a reasonable allowance for reconditioning only when the process is governed by the manufacture's guidance, use of parts that are design qualified, and certification of safety by a recognized third part evaluation. The guidelines provided in this PI to ensure safety exceed the requirements laid out in the NEC for reconditioning of equipment of similar complexity. In accordance with the stated support of manufacturer discretion in the allowance of reconditioning in NEMA's whitepaper and the similarities between switchboards and transfer equipment, this PI should be accepted.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2753-NFPA 70-2020 [Section No. 700.5] | |
| Public Input No. 2757-NFPA 70-2020 [Section No. 701.5] | |
| Public Input No. 2759-NFPA 70-2020 [Section No. 702.5] | |
| Public Input No. 2753-NFPA 70-2020 [Section No. 700.5] | |
| Public Input No. 2759-NFPA 70-2020 [Section No. 702.5] | |

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**Committee:** NEC-P13

## Public Input No. 3010-NFPA 70-2020 [ Section No. 708.24(A) ]

**(A)** General.

Transfer equipment, including automatic transfer switches, shall be automatic and identified for emergency use. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and critical operations sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of ~~Article 705~~ Parts I, II and IV of Article 689 .

Transfer equipment shall not be permitted to be reconditioned.

## Statement of Problem and Substantiation for Public Input

This public input was prepared by the correlating committee task group focused on alternative energy requirements. This task group consisted of the following members: Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Thomas Domitrovich (CMP 2, CMP 10), Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

The existing language violates the style manual. With the combining of Articles 705, 710 and 712, and moving this new article to 689, this public input brings this section into compliance with the style manual by referencing specific parts within this new Article.

## Submitter Information Verification

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**Submittal Date:** Thu Sep 03 21:28:20 EDT 2020
**Committee:** NEC-P13

# Public Input No. 4531-NFPA 70-2020 [ Section No. 708.24(A) ]

**(A)** General.

Transfer equipment, including automatic transfer switches, shall be automatic and identified for emergency use. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and critical operations sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705.

Transfer equipment shall not be permitted to be reconditioned, unless specifically permitted by another section of this code .

## Statement of Problem and Substantiation for Public Input

Added language for addition to 110.21(A)(2) and new section 517.2

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4496-NFPA 70-2020 [Section No. 110.21(A)(2)] | |
| Public Input No. 4518-NFPA 70-2020 [New Section after 517.1] | |

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**Committee:** NEC-P13

## Public Input No. 455-NFPA 70-2020 [ Section No. 708.24(A) ]

**(A)** General.

Transfer equipment, including automatic transfer switches, shall be automatic, listed, and identified for emergency use. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and critical operations sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705.

Transfer equipment shall not be permitted to be reconditioned.

## Statement of Problem and Substantiation for Public Input

During the 2020 revision cycle CMP-13 added the term "listed" to article 695, 700,701, and 702 as it applied to transfer equipment. The term listed needs to be added to 708.24 to provide correlation throughout the code that all types of transfer equipment shall be listed.

## Submitter Information Verification

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# Public Input No. 757-NFPA 70-2020 [ New Section after 708.30 ]

**TITLE OF NEW CONTENT**

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**708.32 Electromagnetic Pulse (EMP) Protection.** Protection for COPS against the effects of electromagnetic pulses shall be provided at a minimum of Level 3. See 709.7 for levels of electromagnetic pulse protection. This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.
Critical Infrastructure Component/Special Occupancy Permitted Outage Time
Branch banking facilities 10 hours
Critical Operations Power Systems 10 minutes

Data centers 10 minutes
Direct current microgrids 10 hours
Drug stores/distribution centers 10 hours
Electrically driven or controlled irrigation machines 1 week
Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts See facility requirements
Emergency systems 10 hours
Energy storage systems 10 hours
Fire alarm systems 1 week
Fire houses/stations 10 hours
Fire pumps 10 hours
Food processing and storage facilities 10 hours
Fuel cell systems 10 hours
Generators 10 hours
Grocery stores 10 hours
Hardware stores/home centers 10 hours
Healthcare facilities See NFPA 99
Information technology equipment 10 minutes
Interconnected electric power production sources 10 minutes
Jails and prisons 10 minutes
Large-scale photovoltaic (PV) electric supply stations 10 hours
Legally required standby systems 10 hours
Modular data centers 10 minutes
Motor fuel dispensing facilities 1 week
Motors, motor circuits, and controllers See facility requirements
Nuclear reactors 10 seconds
Optional standby systems 1 week
Petrochemical plants/facilities 10 hours
Pharmaceutical plants/facilities 10 hours
Police stations 10 minutes
Solar photovoltaic (PV) systems 10 hours
Stand-alone systems 10 hours
Storage batteries See facility requirements
Transformers See facility requirements
Waste water treatment facilities 10 minutes
Water supply facilities 10 hours
Wind electric systems 10 hours

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849

/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2778-NFPA 70-2020 [ Section No. 708.54 ]

**708.54** Selective Coordination.

~~Critical operations power system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.~~

~~Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.~~

~~*Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*~~

~~Informational Note: See Informational Note Figure 708.54 for an example of how critical operations power system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.~~

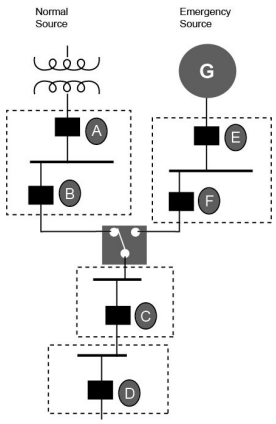
~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~

~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~

~~OCPD F selectively coordinates with OCPD E.~~

~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~

~~**Figure Informational Note Figure 708.54 Critical Operations Power System Selective Coordination.**~~




modify this section to match the changes shown for 700.32.

## Additional Proposed Changes

| File Name | Description | Approved |
|---|---|---|
| 700.32_illustration.pdf | Illustration for clarity showing selective coordination requirements in emergency loads vs. non-emergency loads. | |

## Statement of Problem and Substantiation for Public Input

This change is to correlate with the changes in 700.32.

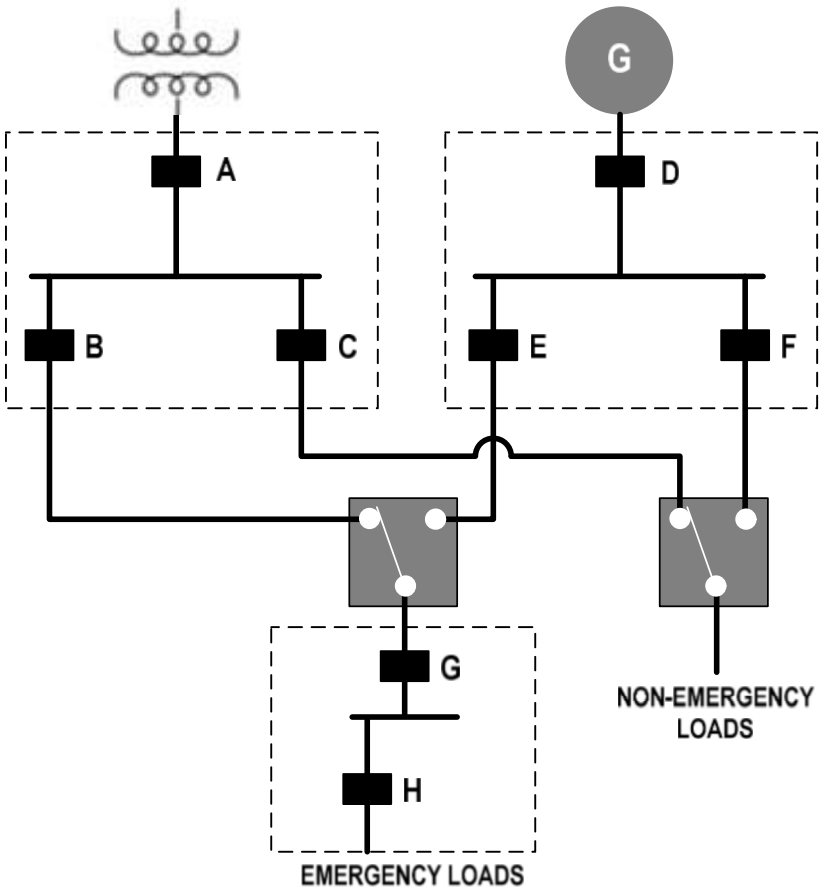
The text of the requirement is inaccurate in that OCPD B must selectively coordinate with downstream devices as it supplies power to emergency loads.

The illustration lacks clarity because it doesn't show non-emergency loads.

See other notes in 700.32 comments.

## Submitter Information Verification

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**Committee:** NEC-P13


G
A
D
B
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E
F
G
H
NON-EMERGENCY
LOADS
EMERGENCY LOADS

## Public Input No. 756-NFPA 70-2020 [ New Section after 708.64 ]

**Article 709**

**Electromagnetic Pulse (EMP) Protection**

**Part I. General**

**709.1 Scope.** This article provides the general requirements for the installation, operation, and maintenance of electromagnetic pulse protection. These requirements shall become effective January 1, 2026.

**709.3 Other Articles.** Equipment, special occupancies, special equipment, and special conditions shall be protected against electromagnetic pulses in accordance with the article in this *Code* that covers the type of equipment, special occupancy, special equipment, or special condition specified in Table 709.3.

**Table 709.3 Other Articles**

| Equipment/Occupancy | Article |
|---|---|
| Critical operations power systems | 708 |
| Direct current microgrids | 712 |
| Electrically driven or controlled irrigation machines | 675 |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | 620 |
| Emergency systems | 700 |
| Energy storage systems | 706 |
| Fire alarm systems | 760 |
| Fire pumps | 695 |
| Fuel cell systems | 692 |
| Generators | 445 |
| Health care facilities | 517 |
| Information technology equipment | 645 |
| Interconnected electric power production sources | 705 |
| Large-scale photovoltaic (PV) electric supply stations | 691 |
| Legally required standby systems | 701 |
| Modular data centers | 646 |
| Motor fuel dispensing facilities | 514 |
| Motors, motor circuits, and controllers | 430 |
| Optional standby systems | 702 |
| Solar photovoltaic (PV) systems | 690 |
| Stand-alone systems | 710 |
| Storage batteries | 480 |
| Transformers | 450 |

| | |
|---|---|
| Wind electric systems | 694 |

**709.5 Additional Occupancies.** The manufacturing, production, transportation, distribution, sales, and business systems of the additional occupancies specified in Table 709.5 shall be protected against electromagnetic pulses at the level shown. See 709.7 for levels of electromagnetic pulse protection.

**Table 709.5 Additional Occupancies**

| Type of additional occupancies | Level of electromagnetic pulse protection |
|---|---|
| Branch banking facilities | Level 2 |
| Data centers | Level 3 |
| Drug stores/distribution centers | Level 2 |
| Fire houses/stations | Level 2 |
| Food processing and storage facilities | Level 2 |
| Grocery stores | Level 2 |
| Hardware stores/home centers | Level 2 |
| Jails and prisons | Level 3 |
| Nuclear reactors | Level 4 |
| Petrochemical plants/facilities | Level 2 |
| Pharmaceutical plants/facilities | Level 2 |
| Police stations | Level 3 |
| Waste water treatment facilities | Level 3 |
| Water supply facilities | Level 2 |

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**709.7 Levels of Electromagnetic Pulse Protection.** Electromagneticpulse protection shall be provided to limit the duration of outages, based upon the criticality of the equipment, special occupancy, special equipment, or special condition.

**(A) Level 1.** EMP protection shall be provided so that outages do not exceed one week.

(1)Spare equipment shall be disconnected from all power, data, antenna, and communication sources.

(2)All equipment that is not being actively used and cannot be disconnected per 709.7 (A)(1), shall be turned off.

(3) Data cables, antenna lines, and power cords shall be protected by surge protective devices suitable for protection against lightning.

(4) At least 3 spares for every surge protective device shall be provided.

(5) A back-up power source shall be provided. It must either be EMP-protected, or be disconnected from the grid. At least one week's worth of on-site fuel or equivalent, such as EMP-protected renewable sources, must be provided and maintained.

(6) Spare electronic parts shall be stored in Faraday containers or wrapped in aluminum foil.

**(B) Level 2.** EMP protection shall be provided so that outages do not exceed 10 hours.

(1) In addition to the requirements of 709.7(A), the requirements of 709.7(B)(2) through 709.7(B)(3) shall be met.

(2) Data cables, antenna lines, and power cords shall be protected by surge protective devices suitable for protection against EMP.

(3) EMP-protected uninterruptible power supplies (UPS) shall be provided and sized for mission critical loads.

**(C) Level 3.** EMP protection shall be provided so that outages do not exceed ten minutes.

(1) In addition to the requirements of 709.7(B), the requirements of 709.7(C)(2) through 709.7(C)(4) shall be met.

(2) Shielding for at least 30dB of protection through 10 GHz shall be provided.

(3) Critical computers, data centers, phone switches, industrial controls and substation controls shall be protected by EMP-shielded racks, rooms, or facilities.

(4) 30 days of EMP-protected on-site fuel or equivalent shall be provided and maintained.

**(D) Level 4.** EMP protection shall be provided so that outages do not exceed ten seconds.

(1) In addition to the requirements of 709.7(C), the requirements of 709.7(D)(2) through 709.7(D)(4) shall be met.

(2) Shielding for at least 80dB of protection through 10 GHz shall be provided.

(3) EMP-protected double-door entryways shall be provided.

(4) Double, back-up, or redundant surge protection shall be provided for critical external lines that enter EMP-protected areas.

**709.9 Design and Documentation.** Electromagnetic pulse protection shall be designed by licensed professional engineers or other qualified persons engaged primarily in the design, installation, or maintenance of EMP-protected electrical systems. The design shall be documented and made available to those authorized to design install, inspect, maintain, and operate the electrical system.

**709.11. Tests and Maintenance.**

**(A) Witness and Conduction of Test.** The electromagnetic pulse protection system shall be performance tested, and witnessed by the authority having jurisdiction, when first installed on site and periodically afterward. This testing shall be conducted by a qualified person(s). A written record of this initial performance testing shall be made and shall be available to the authority having jurisdiction.

**(B) Tested Periodically.** Systems shall be tested periodically on a schedule approved by the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

**(C) Maintenance.** The electromagnetic pulse protection system shall be maintained in accordance with manufacturer instructions and industry standards.

**(D) Written Record of Maintenance.** A written record of maintenance shall be kept and made available to the authority having jurisdiction.

**TITLE OF NEW CONTENT**

Type your content here ...

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, this Public Input has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.
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Branch banking facilities 10 hours
Critical Operations Power Systems 10 minutes
Data centers 10 minutes
Direct current microgrids 10 hours
Drug stores/distribution centers 10 hours
Electrically driven or controlled irrigation machines 1 week
Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts See facility requirements
Emergency systems 10 hours
Energy storage systems 10 hours
Fire alarm systems 1 week
Fire houses/stations 10 hours
Fire pumps 10 hours
Food processing and storage facilities 10 hours
Fuel cell systems 10 hours
Generators 10 hours
Grocery stores 10 hours
Hardware stores/home centers 10 hours
Healthcare facilities See NFPA 99
Information technology equipment 10 minutes
Interconnected electric power production sources 10 minutes
Jails and prisons 10 minutes
Large-scale photovoltaic (PV) electric supply stations 10 hours
Legally required standby systems 10 hours
Modular data centers 10 minutes
Motor fuel dispensing facilities 1 week

Motors, motor circuits, and controllers See facility requirements
Nuclear reactors 10 seconds
Optional standby systems 1 week
Petrochemical plants/facilities 10 hours
Pharmaceutical plants/facilities 10 hours
Police stations 10 minutes
Solar photovoltaic (PV) systems 10 hours
Stand-alone systems 10 hours
Storage batteries See facility requirements
Transformers See facility requirements
Waste water treatment facilities 10 minutes
Water supply facilities 10 hours
Wind electric systems 10 hours

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the "cost" of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, "One Second After", provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment"
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the "protections" in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child's play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 757-NFPA 70-2020 [New Section after 708.30] | |
| Public Input No. 758-NFPA 70-2020 [New Section after 712.72] | |
| Public Input No. 759-NFPA 70-2020 [New Section after 675.17] | |
| Public Input No. 760-NFPA 70-2020 [New Section after 620.6] | |

Public Input No. 761-NFPA 70-2020 [New Section after 700.8]
Public Input No. 762-NFPA 70-2020 [New Section after 706.9]
Public Input No. 763-NFPA 70-2020 [New Section after 760.35(B)]
Public Input No. 764-NFPA 70-2020 [New Section after 695.15]
Public Input No. 765-NFPA 70-2020 [New Section after 692.6]
Public Input No. 766-NFPA 70-2020 [New Section after 445.20(B)]
Public Input No. 767-NFPA 70-2020 [New Section after 517.21]
Public Input No. 768-NFPA 70-2020 [New Section after 645.27]
Public Input No. 769-NFPA 70-2020 [New Section after 705.45(B)]
Public Input No. 770-NFPA 70-2020 [New Section after 691.11]
Public Input No. 771-NFPA 70-2020 [New Section after 701.7(B)]
Public Input No. 772-NFPA 70-2020 [New Section after 646.22]
Public Input No. 773-NFPA 70-2020 [New Section after 514.16]
Public Input No. 774-NFPA 70-2020 [New Section after 430.18]
Public Input No. 775-NFPA 70-2020 [New Section after 702.7(C)]
Public Input No. 776-NFPA 70-2020 [New Section after 690.72]
Public Input No. 777-NFPA 70-2020 [New Section after 710.15(G)]
Public Input No. 778-NFPA 70-2020 [New Section after 480.13]
Public Input No. 779-NFPA 70-2020 [New Section after 450.14]
Public Input No. 780-NFPA 70-2020 [New Definition after Definition: Wind Turbine Output Circui...]
Public Input No. 757-NFPA 70-2020 [New Section after 708.30]
Public Input No. 758-NFPA 70-2020 [New Section after 712.72]
Public Input No. 759-NFPA 70-2020 [New Section after 675.17]
Public Input No. 760-NFPA 70-2020 [New Section after 620.6]
Public Input No. 761-NFPA 70-2020 [New Section after 700.8]
Public Input No. 762-NFPA 70-2020 [New Section after 706.9]
Public Input No. 763-NFPA 70-2020 [New Section after 760.35(B)]
Public Input No. 764-NFPA 70-2020 [New Section after 695.15]
Public Input No. 765-NFPA 70-2020 [New Section after 692.6]
Public Input No. 766-NFPA 70-2020 [New Section after 445.20(B)]
Public Input No. 767-NFPA 70-2020 [New Section after 517.21]
Public Input No. 768-NFPA 70-2020 [New Section after 645.27]
Public Input No. 769-NFPA 70-2020 [New Section after 705.45(B)]
Public Input No. 770-NFPA 70-2020 [New Section after 691.11]
Public Input No. 771-NFPA 70-2020 [New Section after 701.7(B)]
Public Input No. 772-NFPA 70-2020 [New Section after 646.22]
Public Input No. 773-NFPA 70-2020 [New Section after 514.16]
Public Input No. 774-NFPA 70-2020 [New Section after 430.18]
Public Input No. 775-NFPA 70-2020 [New Section after 702.7(C)]
Public Input No. 776-NFPA 70-2020 [New Section after 690.72]
Public Input No. 777-NFPA 70-2020 [New Section after 710.15(G)]
Public Input No. 778-NFPA 70-2020 [New Section after 480.13]
Public Input No. 779-NFPA 70-2020 [New Section after 450.14]

Public Input No. 780-NFPA 70-2020 [New Definition after Definition: Wind Turbine Output Circui...]

## Submitter Information Verification

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**Committee:** NEC-P13

# Public Input No. 2829-NFPA 70-2020 [ Article 712 ]

**Article 712** Direct Current Microgrids

**Part I.** General

**712.1** Scope.

This article applies to direct current microgrids.

**712.2** Definitions.

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

**Direct Current Microgrid (DC Microgrid).**

A direct current microgrid is a power distribution system consisting of more than one interconnected dc power source, supplying dc-dc converter(s), dc load(s), and/or ac load(s) powered by dc-ac inverter(s). A dc microgrid is typically not directly connected to an ac primary source of electricity, but some dc microgrids interconnect via one or more dc-ac bidirectional converters or dc-ac inverters.

Informational Note: Direct current power sources include ac-dc converters (rectifiers), bidirectional dc-ac inverters/converters, photovoltaic systems, wind generators, energy storage systems (including batteries), and fuel cells.

**Grounded, Functionally.**

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

Informational Note: Examples of operational reasons for functionally grounded systems include ground-fault detection and performance-related issues for some power sources.

**Grounded Three-Wire DC System.**

A system with a solid connection or reference-ground between the center point of a bipolar dc power source and the equipment grounding system.

**Grounded Two-Wire DC System**

A system that has a solid connection or reference-ground between one of the current-carrying conductors and the equipment grounding system.

**Nominal Voltage.**

A value assigned to a circuit or system for the purpose of conveniently designating its dc voltage class.

Informational Note: The actual voltage at which a circuit operates can vary from the nominal voltage within a range that permits satisfactory operation of equipment.

**Primary DC Source.**

A source that supplies the majority of the dc load in a dc microgrid.

**Reference-Grounded DC System.**

A system that is not solidly grounded but has a low-resistance electrical reference that maintains voltage to ground in normal operation.

**Ungrounded DC System.**

A system that has no direct or resistive connection between the current-carrying conductors and the equipment grounding system.

**712.3** Other Articles.

Wherever the requirements of other articles of this *Code* and Article 712 differ, the requirements of Article 712 shall apply. DC microgrids interconnected through an inverter or bi-directional converter with ac electric power production sources shall comply with Article 705 .

**712.4** Listing and Labeling.

Any equipment used in the dc circuits of a dc microgrid shall be listed and labeled for dc use.

**712.10** Directory.

**(A)** Source Directory.

A permanent directory denoting all dc electric power sources operating to supply the dc microgrid shall be installed at each source location capable of acting as the primary dc source.

**(B)** Building Directory.

A building supplied by a dc microgrid system shall have a permanent plaque or directory installed outside the building at each service equipment location or at an approved readily visible location. The plaque or directory shall denote the location of each power source disconnecting means on or in the building or be grouped with other plaques or directories for other on-site sources.

*Exception: Multiple power production sources that are grouped at one location shall be permitted to be identified as a group.*

**Part II.** Circuit Requirements

**712.25** Identification of Circuit Conductors.

Ungrounded circuit conductors in dc microgrids shall be identified according to the requirements of 210.5(C)(2) for branch circuits and 215.12(C)(2) for feeders.

**712.30** System Voltage.

The system voltage of a dc microgrid shall be determined by one of the following methods:

(1) The nominal voltage to ground for solidly grounded systems

(2) The nominal voltage to ground for reference-grounded systems

(3) The highest nominal voltage between conductors for resistively grounded dc systems and ungrounded dc systems.

Informational Note: Examples of nominal dc system voltages include but are not limited to 24, 48, 125, 190/380, or 380 volts.

**Part III.** Disconnecting Means

**712.34** DC Source Disconnecting Means.

The output of each dc source shall have a readily accessible disconnecting means that is lockable open in accordance with 110.25 and adjacent to the source.

**712.35** Disconnection of Ungrounded Conductors.

In solidly grounded two- and three-wire systems, the disconnecting means shall simultaneously open all ungrounded conductors. In ungrounded, resistively grounded and reference-grounded systems, such devices shall open all current-carrying conductors.

**712.37** Directional Current Devices.

Disconnecting means shall be listed, shall be marked for use in a single current direction, and shall only be used in the designated current direction.

Informational Note: Examples of directional current devices are magnetically quenched contactors and semiconductor switches in overcurrent devices.

**Part IV.** Wiring Methods

**712.52** System Grounding.

**(A)** General.

Direct-current microgrids shall be grounded in accordance with 250.162 .

**(B)** Over 300 Volts.

DC microgrids operating at voltages greater than 300 volts dc shall be reference-grounded dc systems or functionally grounded dc systems.

**712.55** Ground Fault Detection Equipment.

Ungrounded, reference grounded, or functionally grounded dc microgrids operating at greater than 60 volts dc 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) .

**712.57** Arc Fault Protection.

Where required elsewhere in this *Code* , specific systems within the dc microgrid shall have arc fault protection. The arc fault protection equipment shall be listed.

Informational Note: Section 90.4 applies when suitable equipment for arc fault protection is not available.

**Part V.** Marking

**712.62** Distribution Equipment and Conductors.

Distribution equipment and conductors shall be marked as required elsewhere in this *Code* .

**712.65** Available DC Fault Current.

**(A)** Field Marking.

The available dc fault current on the dc microgrid shall be field marked at the dc source(s). The field marking(s) shall include the date the available fault current calculation was performed and be of sufficient durability to withstand the environment involved.

**(B)** Modifications.

When modifications to the electrical installation occur that affect the available fault current at the dc source, the available fault current shall be verified or recalculated as necessary to ensure the equipment ratings are sufficient for the available fault current at the line terminals of the equipment. The required field marking(s) in 712.65(A) shall indicate the new available fault current and date.

**Part VI.** Protection

**712.70** Overcurrent Protection.

Equipment and conductors connected to more than one electrical source shall have overcurrent protective devices to provide protection from all sources.

**712.72** Interrupting and Short-Circuit Current Ratings.

Consideration shall be given to the contribution of available fault currents from all interconnected power sources for the interrupting ratings and short-circuit current ratings of equipment in the dc microgrid system(s). Overcurrent protective devices and equipment used within a dc microgrid shall have an interrupting rating at nominal circuit voltage or a short-circuit current rating sufficient for the available fault current at the line terminals of the equipment.

**Part VII.** Systems over 1000 Volts

**712.80** General.

Systems with a maximum voltage between conductors of over 1000 volts dc shall comply with Article 490 and other requirements in this *Code* applicable to installations rated over 1000 volts.

## Statement of Problem and Substantiation for Public Input

This Public Input is submitted on behalf of two correlating committee task groups, (Medium Voltage Task Group and Alternative energy Task Group. These two task groups consist of the following members: Medium Voltgage Task Group: Robert Osborne (Chair), Paul Barnhart, Lou Grahor, David Temple, Donny Cook, Dean Hunter, Mike Querry, Roger McDaniel, Dave Burns, Rod Belisle, and Kevin Rogers. Alternative Energy Task group: Thomas Domitrovich (Chair), Derrick Atkins (CMP 5), Greg Ball (CMP 13) Ken Boyce (CMP 1), Bill Brooks (CMP 4), Bruce Campbell, Jason Fisher (CMP 4), Scott Harding (CMP 5), Pete Jackson (CMP 8), David Kendall (CMP 8, CC), Chad Kennedy (CMP 13), Christine Porter (CMP 5, CC), Timothy Windey (CMP 13).

This article is being deleted as part of the effort to combine 705, 710 and 712 to increase useability and provide clarity. This Article is unnecessary since the interconnection of power sources has always been covered under Article 705. The existing Article 712 is confusing in general practice since the majority of power sources used in microgrids are dc sources, but may connect to other sources either through dc connections, or ac connections through a dedicated inverter. It is therefore not practical to try to define a “dc microgrid” as being different from a “microgrid” as defined in 705 since the vast majority of 705 microgrids will involve the connection of dc sources and dc distribution equipment, regardless of the presence of ac connections. The attached word document provides an overview of all of the changes in this effort to assemble a general requirements article for alternative energy applications.

The definition of direct current microgrid was delete to avoid confusion and add clarity . Deletion of this definition will not impact the application of the Code since the definition was only used within this article and the term is not used within other articles including 705. The 705.2 definition for a Microgrid System is sufficient since it covers an AC, DC, or combination of both microgrids. Additionally, unlike the 712 version, this definition does not include informational material.

The term grounded functionally was moved to ARticle 100

The terms grounded Three-Wire DC System and Two-wire DC system were deleted as these terms are not used in the NEC.

The term Nominal Voltage is being deleted as it already existing in Article 100 and is not being used differently in these alternative energy articles.

Deleting the term Primary DC Source as it is unnecessary and could create conflict since the use of the phrase “primary source” sometimes refers to a utility source and may often be ac. Furthermore in applications where there are multiple generation sources operating in parallel there is no method provided in this Code to determine what the “majority” of load is. Often, different sources may have the same ratings.

Deleting the term reference grounded DC system as it is unnecessary and could create conflict since a similar term is used in Article 517, and this term is not substantively used in Article 712, or 705.

Deleted the term ungrounded DC system as it is unnecessary since the term “ungrounded” is defined in Article 100.

712.3 is being deleted as it is not required due to the combining of Article 712 with 705.
712.4 was moved to 705.6.
712.10 is being deleted as this requirement is already included in 705.10. Though there are slight variations in the two sections’ original text, they are not substantial enough to result in different requirements being enforced.
712.25 is being deleted as pointers back to 210 and 215 are not required.
712.30 is being deleted as the voltages in various systems are defined by a calculation based on the technologies used.
712.34 and 712.35 are not unique and are already addressed in the specific source articles as referenced in 705.20.
712.37 is not included as the capabilities of each product are identified as part of their listing. Line and load markings are examples of markings that provide evidence of the capabilities of specific equipment.
712.52 is being deleted and not included in new Article 705 because Article 250 adequately addresses the installation requirements for these applications. Chapters 1 – 4 apply to all of the wiring in a

microgrid that does not fall under the purview of any source system such as PV in Article 690 and Wind as part of Article 694 for example.
712.55 was moved to new 705.75.
712.57 is being deleted as the requirements elsewhere in the NEC are already addressing this as noted in the informational note. This text is not required and is duplicate.
712.62 is being deleted as without specific NEC section references this requirement is vague and not necessary.
712.65 is being deleted as fault current marking requirements are found in each source article such as Article 690, 694 etc.
712.70 is being deleted and not moved to new Article 705 since this subject is already Included in 705.30 language.
712.72 is being deleted as Interrupting rating requirements and SCCR requirements are handled as part of 110.9 and 110.10 of the NEC. All equipment must be able to either interrupt or withstand maximum available fault current as required by the NEC. The definitions of fault current and fault current, available add the clarity necessary for proper application of electrical equipment in any system.
Part VII is being replaced with new Part IV of new article 705 which was created by the Medium Voltage task group in combination with the Alternative Energy Task group.

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## Public Input No. 900-NFPA 70-2020 [ Section No. 712.1 ]

**712.1** Scope.

This article applies to direct current microgrids.

Informational Note: For additional information about microgrids see NECA 417- 2019, *Recommended Practice for Designing, Installing, Operating, and Maintaining Microgrids.*

## Statement of Problem and Substantiation for Public Input

The proposed informational note provides users with a reference that assists with increasing understanding of microgrid installations and how they work. Many in the electrical field are not very familiar with these systems. As these installations become more common, this quality performance standard provides valuable insight that assists with this understanding.

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## Public Input No. 3961-NFPA 70-2020 [ Section No. 712.2 ]

(Relocate all definitions in the 712. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**712. 2** Definitions.

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

**Direct Current Microgrid (DC Microgrid).**

A direct current microgrid is a power distribution system consisting of more than one interconnected dc power source, supplying dc-dc converter(s), dc load(s), and/or ac load(s) powered by dc-ac inverter(s). A dc microgrid is typically not directly connected to an ac primary source of electricity, but some dc microgrids interconnect via one or more dc-ac bidirectional converters or dc-ac inverters.

Informational Note: Direct current power sources include ac-dc converters (rectifiers), bidirectional dc-ac inverters/converters, photovoltaic systems, wind generators, energy storage systems (including batteries), and fuel cells.

**Grounded, Functionally.**

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

Informational Note: Examples of operational reasons for functionally grounded systems include ground-fault detection and performance-related issues for some power sources.

**Grounded Three-Wire DC System.**

A system with a solid connection or reference-ground between the center point of a bipolar dc power source and the equipment grounding system.

**Grounded Two-Wire DC System**

A system that has a solid connection or reference-ground between one of the current-carrying conductors and the equipment grounding system.

**Nominal Voltage.**

A value assigned to a circuit or system for the purpose of conveniently designating its dc voltage class.

Informational Note: The actual voltage at which a circuit operates can vary from the nominal voltage within a range that permits satisfactory operation of equipment.

**Primary DC Source.**

A source that supplies the majority of the dc load in a dc microgrid.

**Reference-Grounded DC System.**

A system that is not solidly grounded but has a low-resistance electrical reference that maintains voltage to ground in normal operation.

**Ungrounded DC System.**

A system that has no direct or resistive connection between the current-carrying conductors and the equipment grounding system.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.

Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

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# Public Input No. 2894-NFPA 70-2020 [ New Section after 712.4 ]

**712.8 Commissioning.**

Direct current microgrid systems shall be commissioned upon installation per 110.17 to verify operation and safety.

## Statement of Problem and Substantiation for Public Input

Common requirements for device and system commissioning are being proposed to Article 110 in PI 2844 that will help drive consistency in the actions necessary prior to devices and systems being placed into service. This public input is part of a series of revisions proposed throughout the code to include commissioning where system verification is warranted.

Microgrid systems require setup and initial performance verification for devices and equipment necessary for proper system operation and safety to confirm the installation. In addition to verifying operational controls and sequence of operation, this revision also adds clarity that overcurrent and protective devices must have settings that have been adjusted and verified when inspected by the AHJ. The requirement to include as-built documentation and a record of the actions taken to correct any shortcomings will enhance the safety of those who will operate, maintain, and service the equipment.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 2844-NFPA 70-2020 [New Section after 110.16] | |
| Public Input No. 2884-NFPA 70-2020 [New Section after 705.50] | |
| Public Input No. 2887-NFPA 70-2020 [Definition: Commissioning.] | |
| Public Input No. 2884-NFPA 70-2020 [New Section after 705.50] | |

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**Committee:** NEC-P13

## Public Input No. 4510-NFPA 70-2020 [ Section No. 712.25 ]

**712.25** Identification of Circuit Conductors.

~~Ungrounded circuit~~ Circuit conductors in dc microgrids that are not solidly grounded shall be identified according to the requirements of 210.5(C)(2) for branch circuits and 215.12(C)(2) for feeders.

## Statement of Problem and Substantiation for Public Input

There is a semantic conflict between Art. 690 and this article. This section refers to “ungrounded conductors” as following 210.5(C)(2). In many cases, one of the conductors in the circuit will be “reference grounded.” or "functionally grounded." It is not an ungrounded conductor subject to the red and black default color code in Art. 210. So now, suppose the negative (and therefore black) wire on a PV supplied microgrid is functionally grounded, and in accordance with 690.31(B)(1) it is, indeed, not colored white. When it arrives at the microgrid it is powering, now it might become a white wire. This PI resolves the question. It should, in fact, remain a black wire, and this PI makes it so.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4522-NFPA 70-2020 [ Section No. 712.35 ]

**712.35** Disconnection of Ungrounded Conductors.

In solidly grounded two- and three-wire systems, the disconnecting means shall simultaneously open all ungrounded conductors. In ungrounded, resistively grounded, functionally grounded, and reference-grounded systems, such devices shall open all current-carrying conductors.

## Statement of Problem and Substantiation for Public Input

This rule fails to include one of the more common sort of but not solidly grounded systems, namely PV systems covered in Art. 690. It may be that one or more of the items on the list can go away, but functional grounding must stay.

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**Committee:** NEC-P13

## Public Input No. 4533-NFPA 70-2020 [ Section No. 712.55 ]

**712.55** Ground Fault Detection Equipment.

Ungrounded, reference grounded, or functionally grounded dc microgrids operating at greater than 60 volts dc 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), or in accordance with any marking rules that apply to the power source equipment . .

## Statement of Problem and Substantiation for Public Input

There is a problem with the reference to 250.167(C) because it points to the list of dc grounding systems in NFPA 70E, none of which describe the usual sources of dc microgrid power, especially PV. A PV system will have this protection by 690.41(B), and it will not correspond to any marking protocol in NFPA 70E or otherwise, This PI simply leaves the ball in the hands of the relevant Chapter 6 article.

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# Public Input No. 758-NFPA 70-2020 [ New Section after 712.72 ]

**TITLE OF NEW CONTENT**

Type your content here ...

**712.74 Electromagnetic Pulse (EMP) Protection.** Protection for direct current microgrids against the effects of electromagnetic pulses shall be provided at a minimum of Level 2. See 709.7 for levels of electromagnetic pulse protection.

*Exception: The requirements of 709.7(A)(5) and 709.7(B)(3) shall not apply.*

This requirement shall become effective January 1, 2026.

## Statement of Problem and Substantiation for Public Input

A devastating electromagnetic pulse (EMP), caused by a sun-spot or a nuclear bomb exploded high in the atmosphere, can impress 50,000 volts per meter on unprotected electrical and electronic equipment. It is similar to a radio wave impressing a very small voltage on a radio antenna, only orders of magnitude larger. The problem is that a significant EMP will fry every electrical/electronic component or piece of equipment that is not protected.

The EMP won't directly harm or injure people, but because there is no longer a working electrical infrastructure, which may take years to repair/rebuild, people will die from the lack of clean water, medicine, food, fuel, and eventual rioting due to the breakdown of society. Unclassified studies, referenced at the end of this substantiation, have estimated from 66% to 90% of the US population will die within one year if a significant sun spot were to occur or if a nuclear explosion were to occur 25 to 250 miles over the Midwest.

Our US military already "hardens" systems/buildings so that our country's critical defensive capabilities are not completely destroyed. There are two major methods of protecting electrical/electronic systems. The first is that surge protective devices are installed on all "incoming" power and communications cables, shunting overvoltages to ground. The second is that Faraday cages are installed around equipment/rooms, preventing the EMP from reaching critical equipment/components.

The NEC® needs to address EMP protection for equipment, systems and special occupancies that are critical to our survival. Electrical and electronic equipment can and must be protected, as has been achieved by our military. Unfortunately, there are no requirements to protect civilian electrical and electronic equipment/systems from EMPs.

The NEC Correlating Committee has informally advised that an EMP Protection Article, if passed and adopted into the NEC®, would be most appropriately located after Article 708 (COPS). Thus, Public Input 756 has suggested a new Article 709 under jurisdiction of CMP 13, which already has purview over Emergency Systems (Article 700), Legally Required Standby Systems (Article 701), Optional Standby Systems (Article 702), and Critical Operations Power Systems (Article 708).

Levels of protection and associated protection requirements listed in the Public Input(s) are based upon the unclassified National Cybersecurity and Communications Integration Center report "Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment". This study explains electromagnetic pulses and provides the necessary protective measures. It also contains estimates of the costs associated with properly protecting our electrical infrastructure.
The following table contains critical infrastructure components/special occupancies and the maximum time for outages caused by an EMP. Electrical components/infrastructure that is not functioning for periods longer than shown in this table may begin to cause injury or death to people and harm to society/economy.

| Critical Infrastructure Component/Special Occupancy | Permitted Outage Time |
|---|---|
| Branch banking facilities | 10 hours |
| Critical Operations Power Systems | 10 minutes |
| Data centers | 10 minutes |
| Direct current microgrids | 10 hours |
| Drug stores/distribution centers | 10 hours |
| Electrically driven or controlled irrigation machines | 1 week |
| Elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts | See facility requirements |
| Emergency systems | 10 hours |
| Energy storage systems | 10 hours |
| Fire alarm systems | 1 week |
| Fire houses/stations | 10 hours |
| Fire pumps | 10 hours |
| Food processing and storage facilities | 10 hours |
| Fuel cell systems | 10 hours |
| Generators | 10 hours |
| Grocery stores | 10 hours |
| Hardware stores/home centers | 10 hours |
| Healthcare facilities | See NFPA 99 |
| Information technology equipment | 10 minutes |
| Interconnected electric power production sources | 10 minutes |
| Jails and prisons | 10 minutes |
| Large-scale photovoltaic (PV) electric supply stations | 10 hours |
| Legally required standby systems | 10 hours |
| Modular data centers | 10 minutes |
| Motor fuel dispensing facilities | 1 week |
| Motors, motor circuits, and controllers | See facility requirements |
| Nuclear reactors | 10 seconds |
| Optional standby systems | 1 week |
| Petrochemical plants/facilities | 10 hours |
| Pharmaceutical plants/facilities | 10 hours |
| Police stations | 10 minutes |
| Solar photovoltaic (PV) systems | 10 hours |
| Stand-alone systems | 10 hours |
| Storage batteries | See facility requirements |
| Transformers | See facility requirements |
| Waste water treatment facilities | 10 minutes |
| Water supply facilities | 10 hours |
| Wind electric systems | 10 hours |

An effectivity date of January 1, 2026 is chosen to allow time for engineering and industry to adequately pan and prepare for the required changes.

Opponents of EMP protection requirements will likely charge that it is too costly to protect our critical infrastructure, and that the NEC® is not a war-time document. A close reading of 90.1 reveals that there is no mention of the “cost” of safeguarding persons and property. Neither does 90.1 mention that safeguarding persons and property is only required during peacetime. Additionally, a significant EMP event, caused by a sunspot, would be an act of God, not an act of war.

The novel, “One Second After”, provides an understanding of what happens when the majority of all unprotected electrical and electronic equipment/systems is destroyed during an EMP event. An audio version of this book is available in two parts, for free, on YouTube.

This link provides the unclassified report “Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment”
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&
ved=2ahUKEwjQhp2-77DoAhXBHM0KHboOB2QQFjACegQIBRAC&url=https%3A%2F
%2Fwww.cisa.gov%2Fsites%2Fdefault%2Ffiles%2Fpublications%2F19_0307_CISA_EMP-Protection-Resilience-Guidelines.pdf&usg=AOvVaw2n7jLtJAUJtOJKHPMqWsTE

This link provides the study predicting up to 90% of our population could die from an EMP event
http://www.firstempcommission.org/uploads/1/1/9/5/119571849
/nuclear_emp_attack_scenarios_and_combined-arms_cyber_warfare_by_peter_pry_july_2017.pdf

This link provides unclassified guidelines for facility EMP protection
https://info.publicintelligence.net/DHS-FacilitiesGuidelinesEMP.pdf

These links provide Parts 1 and 2 of a national plan for EMP protection.
https://interferencetechnology.com/a-national-plan-for-emp-protection-part-1/
https://interferencetechnology.com/national-plan-emp-protection-part-2-protection-buildings/

We have all just witnessed the chaos and pain caused by not having the “protections” in place to quickly defeat the Covid-19 virus. As unfortunate, costly, painful, and deadly as Covid-19 was, it would be child’s play when compared to a significant EMP event if our critical electrical/electronic infrastructure remains unprotected. Quite simply, NEC® requirements to protect electrical and electronic equipment from an EMP event, could literally save millions of American lives.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |
| Public Input No. 756-NFPA 70-2020 [New Section after 708.64] | |

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3965-NFPA 70-2020 [ Section No. 750.2 ]

(Relocate all definitions in the 750. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

**750. 2** Definitions.

**Control.**

This definition shall apply only within this article.

The predetermined process of connecting, disconnecting, increasing, or reducing electric power.

**Energy Management System.**

This definition shall apply within this article and throughout the *Code*.

A system consisting of any of the following: a monitor(s), communications equipment, a controller(s), a timer(s), or other device(s) that monitors and/or controls an electrical load or a power production or storage source.

**Monitor.**

This definition shall apply only within this article.

An electrical or electronic means to observe, record, or detect the operation or condition of the electric power system or apparatus.

## Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

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**Committee:** NEC-P13

## Public Input No. 451-NFPA 70-2020 [ Section No. 750.2 ]

**750.2** Definitions.

~~**Control.**~~

~~This definition shall~~

**The definitions in this section** **apply only**

~~within~~

**to** **this article.**

**Control.**

The predetermined process of connecting, disconnecting, increasing, or reducing electric power.

**Energy Management System.**

~~This definition shall apply within this article and throughout the~~ *Code* ~~.~~

A system consisting of any of the following: a monitor(s), communications equipment, a controller(s), a timer(s), or other device(s) that monitors and/or controls an electrical load or a power production or storage source.

**Monitor.**

~~This definition shall apply only within this article.~~

An electrical or electronic means to observe, record, or detect the operation or condition of the electric power system or apparatus.

## Statement of Problem and Substantiation for Public Input

Add the reference that the defined terms in the dot 2 section apply only to this article corrects this issue and removes redundant text.

## Submitter Information Verification

**Submitter Full Name:** David Hittinger
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**Submittal Date:** Sun Feb 09 07:13:29 EST 2020
**Committee:** NEC-P13

## Public Input No. 1951-NFPA 70-2020 [ New Definition after Definition: Monitor. ]

**750.6 Listing.**

Energy management systems shall be listed under one of the following conditions:

(1) Listed as a complete energy management system.

(2) Listed as a kit for field installation in switch or overcurrent device enclosures.

(3) Identified as a recognized component of a field installed accessory kit as part of the listed equipment.

## Statement of Problem and Substantiation for Public Input

As currently written, the NEC only requires a listing on energy management systems that are installed in accordance with 312.8(B). The same requirements should apply to any energy management system installed in accordance with Article 750. Energy management systems or load management systems are commonly installed with optional standby systems like generators, mircogrids, and energy storage systems, and some of these systems are not listed. These systems use monitors, contactors and relays, or other devices to control the load on the optional standby source. Without a listing requirement, an installer can design their own energy management system with a field assembly of unlisted parts that have not be evaluated for safety by an approved testing laboratory.

## Submitter Information Verification

**Submitter Full Name:** Brian Baughman
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**Submittal Date:** Mon Jul 20 14:32:34 EDT 2020
**Committee:** NEC-P13

## Public Input No. 2605-NFPA 70-2020 [ Section No. 750.30(A) ]

**(A)** Load Shedding Controls.

An energy management system shall not override the load shedding controls put in place to ensure the minimum electrical capacity for the following:

(1) ~~Fire pumps~~

(2) ~~Emergency systems~~

(3) ~~Legally required standby systems~~

(4) ~~Critical operations power systems~~

(5) Essential Power Supply System circuit in accordance with NFPA 110

(6) Stored Energy Power Supply System circuit in accordance with NFPA 111

(7) Fuel cell power supply system circuit (when used as a power source for power system type 750.30(A)(4) through 750.30(A)(9).

(8) Essential Electrical System circuits in accordance with Article 517, or any of its sub-system branches as follows;

(9) Life Safety Branch

(10) Critical Branch

(11) Equipment Branch

(12) Equipment Branch A

(13) Equipment Branch B

(14) Fire pump circuit in accordance with Article 695.

(15) Emergency system circuit in accordance with Article 700.

(16) Legally required standby system circuit in accordance with Article 701.

(17) Optional standby system circuit in accordance with Article 702.

(18) Critical operations power system circuit in accordance with Article 708.

(19) Parallel power production system circuit in accordance with Article 705, when used as a power source for power system type 750.30(A)(4) through 750.30(A)(9).

## Statement of Problem and Substantiation for Public Input

1) The intent to disallow the energy management system from adversely impacting any load shed controls meant for the preservation of vital power systems types had not yet encompassed all the code recognized types of power systems deemed as emergency, essential or critical, nor the alternate power sources that supply them.
2) The Optional Standby Power System type has an owner-deemed need for preservation that was not yet recognized by this text as being due consideration to its preservation as well.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 2640-NFPA 70-2020 [ Section No. 750.30(B) ]

**(B)**– Automated Reduction or Disconnection of Power.

~~An energy~~ Energy management system shall not be permitted to ~~cause~~ cause automated reduction or disconnection of power to the following:

(1) Alarm and Alerting Systems

(2) Monitoring Systems

(3) Control Systems

Exception : branch level per-unit control systems

(4) Communication System

(5) Battery Charging Systems

Exception : charging equipment not encompassed by design; e.g. cord and plug portable devices applied to receptacles per end-user discretion

(6) Generator Accessories

(7) Refrigerators, freezers, refrigerated storage, and freezer storage

(8) Elevators, escalators, moving walks, or stairway lift chairs

~~Positive mechanical~~
(9) Automatic Doors used for building egress

(10) Mechanical ventilation for : hazardous (classified) locations

- ~~Ventilation used to exhaust hazardous gas or reclassify an area~~
- ~~Circuits supplying emergency lighting~~
~~, other hazardous applications, smoke evacuation, and life safety applications.~~

~~(11) Circuits supplying lighting in accordance with one of the following;~~

~~(i) Emergency system circuit in accordance with Article 700 .~~

~~(ii) Life Safety Branch circuit of an Essential Electrical System in accordance with Article 517 and NFPA 99.~~

~~(iii) Critical Branch circuit of an Essential Electrical System in accordance with Article 517 and NFPA 99.~~

~~(iv) Critical Operations Power system circuit in accordance with Article 708.~~

~~Exception; An energy management system shall not be disallowed from controlling power to a lighting load if UL 924 devices, or other listed fail-safe control equipment where acceptable, is used to restore power upon any of the following events;~~

~~(a) Alarm system events or other monitored events required by either: the applicable code, the authority having jurisdiction, the owner, or the engineer.~~

~~(b) Circuit power loss event or signal from a power loss monitoring system.~~

~~Informational Note 1: If UL 924 or other listed fail-safe control equipment were to fail to function due to select core failure modes, they shall operate lights to an on status or result in an alarm condition. Likelihood of failure scenarios are considered in the system design provisions.~~

~~Informational Note 2: an energy management system may utilize occupancy sensors, vacancy sensors, daylight sensors, or other sensors as elements of conditional switching schemes.~~

~~(12) Essential electrical systems in health care facilities~~

~~Exception; equipment used to heat or cool conditioned spaces shall be permitted to be controlled by an energy management system in accordance with Article 517 and NFPA~~

~~99~~ .

~~(13) Critical Operations Power systems.~~

~~Exception; equipment used to heat or cool conditioned spaces shall be permitted to be controlled by an energy management system in accordance with Article 708.~~

## Statement of Problem and Substantiation for Public Input

1) Prohibition to control-off emergency powered equipment categorically, on the basis that the control equipment may have an energy management function, does not allow latitude for reasonable standard industry practices of controlling certain equipment that happens to be powered through emergency, essential or critical power. Examples include but may not be limited to the control of: heating and cooling equipment, luminaires.
2) No allowance has been made for normal industry practice that make use of fail-safe devices such as those UL 924 listed. Nor, what standard industry practices would consider an appropriate use of occupancy sensors, vacancy sensors, daylight sensors, etc.
3) The use of the term "disconnection of power" limits this code text's application to only power-off scenarios and does not indicate constraints or guidance on other forms of reducing power to equipment such as dimming, or variable speed controls, etc.
4) Other applications for equipment categories were missing, that should not be power off by an energy management system, whether or not the loads are powered through emergency, essential or critical power.

## Submitter Information Verification

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**Submittal Date:** Wed Aug 26 11:26:45 EDT 2020
**Committee:** NEC-P13

## Public Input No. 1952-NFPA 70-2020 [ Section No. 750.50 ]

**750.~~50~~** ~~Field Markings~~ 50 Directory .

Where an energy management system is employed to control electrical power through the use of a remote means, a directory identifying the controlled device(s) and circuit(s) shall be posted on the enclosure of the controller, disconnect, or branch-circuit overcurrent device.

Informational Note: The use of the term *remote* is intended to convey that a controller can be operated via another means or location through communications without a direct operator interface with the controlled device.

## Statement of Problem and Substantiation for Public Input

The term "Directory" is more appropriate for the title of 750.50 and provides clarity to the code. The parent text of this section requires a directory of controlled devices or branch circuits for energy management systems. The term "field markings" is too ambiguous for code enforcement.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 3734-NFPA 70-2020 [ Section No. G(B) ]

**(B)** Power Supply.

The SCADA system power supply shall comply with (B)(1) through (B)(3):

(1) The power supply shall be provided with a direct-current station battery system, rated between 24 and 125 volts dc, with a 72-hour capacity.

(2) The batteries of the SCADA system shall be separate from the batteries for other electrical systems.

(3) The power supply shall be provided with a properly installed and listed surge-protective device (~~TVSS)~~ SPD) in accordance with Part II of Article 242 at its terminals with a direct low-impedance path to ground. Protected and unprotected circuits shall be physically separated to prevent coupling.

## Statement of Problem and Substantiation for Public Input

The purpose of this public input is to correlate and harmonize all of the current sections of the code where “overvoltage protection” is required by:

1. Changing the section titles to “Overvoltage Protection” to properly correlate with Article 242.

2. Correcting the product description to “listed surge-protective device (SPD)” which is defined in Article 100 and correlates with Article 242.

3. Adding a pointer to “Part II. of Article 242” to ensure compliance with all of the requirements for SPDs are met when complying with the rule.

This public input is one of eleven correlating public inputs covering Sections 230.67, 501.35, 502.35, 620.51(E), 645.18, 670.6, 694.7(D), 695.15, 700.8, 708.20(D), and Informative Annex G.

## Submitter Information Verification

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**Committee:** NEC-P13

## Public Input No. 4234-NFPA 70-2020 [ New Part after II. ]

**706.12 ESS Emergency Shutdown**

ESS shall include an emergency shutdown function to cease the export of power from the ESS to premises wiring of other systems in accordance with 706.12(A) through (M).

**706.12(A) Initiation Device**

The initiation device(s) shall plainly indicate whether in the “off” or “on” position. The “off” position of the device(s) shall perform the ESS emergency shutdown function.

Informational Note: An initiation device are often equipment such as service disconnecting means, ESS disconnecting means, or other switches including remote controls.

**706.12(B) Location**

(1) For one-family and two-family dwellings an initiation device(s) shall be located at a readily accessible location outside the building.

(2) Where multiple ESS are installed on a single premises, 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 emergency shutdown of all ESS on the premises or building served..

**706.12(C) Marking**

An ESS emergency shutdown switch shall have a label that includes the following wording located on or no more than 1 m (3 ft) from the switch:

ENERGY STORAGE SYSTEM EMERGENCY SHUTDOWN

The label shall be reflective, with all letters capitalized and having a minimum height of 9.5 mm (3⁄8 in.) in white on red background.

## Statement of Problem and Substantiation for Public Input

This proposal is part of a broader effort to align disconnect requirements with those found for other power sources elsewhere in this Code. This effort is intended to ensure that the characteristics of disconnecting means are tailored to the intended end user. Similar work has been done within Article 690, that largely forms the basis for these requirements as stated here.

The end users for these disconnects could generally be categorized as:
1. Firefighters/emergency personnel, or
2. Qualified service/maintenance personnel

The disconnecting or isolating means should therefore address the functional requirements unique to each group. As with PV systems, firefighters require an easily identifiable and readily accessible means to de-energize circuits (especially those that could be concealed within walls etc.) from onsite power sources. This new section seeks to require that function while recognizing that this “emergency” operation can be accomplished through means that may not meet requirements for other purposes, such as repair. With the increase in multiple onsite power sources allowances for equipment that can “cease to energize”, without necessarily requiring full isolation of circuit wiring, is an important allowance that is needed to allow manufacturers to develop and list solutions whereby a firefighter could shutdown multiple onsite sources with a single initiation device. This is the reason this new section is suggested. Additional sections are provided to address requirements for other conditions such as the isolation of equipment for installation and service.

The format and content for this and related inputs is largely inspired by the previous work done by stakeholders, including fire service representatives, in Articles 690.12, 694.23, and 445.18(B), (C), and (D) as some of the concerns are similar in nature.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.
This collaborative effort has resulted in the consensus development of numerous solar-related Public Input proposals for consideration. The list of task group members indicates those individuals who have contributed to the development of various Public Inputs in nine different tasks groups. A consensus process was used to develop each Public Input, therefore this list does not necessarily indicate that each individual or their representative organization participated in or has agreed with every proposed Public Input submitted under the PVIF effort. Each participant has agreed that any original proposal that they submitted and which was subsequently improved by our process is assigned as original and / or improved work to PVIF for submittal and release to NFPA as a proposed Public Input.
Members of the PVIF's effort include the following representatives. Note that those noted below participated in specific task groups and not necessarily all task groups on specific items proposed. Each member is at their discretion to individually comment on PI's as they deem appropriate and their inclusion here is not necessarily an endorsement of all the PI's submitted.
Evelyn Butler, SEIA; Jason Fisher, SEIA; Ward Bower, Ward Bower Innovations LLC/SEIA; Joseph Cain, P.E., SEIA; Bill Brooks, PVICC; John Berdner, PVICC, Rebekah Hren, Solar Energy International; Brian Mehalic, Solar Energy International; Mark Rodriguez, Sunrun; Paul Joyce, Sunrun; Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4256-NFPA 70-2020 [Section No. 706.15] | |
| Public Input No. 4251-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4251-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4256-NFPA 70-2020 [Section No. 706.15] | |
| Public Input No. 4567-NFPA 70-2020 [Section No. 706.31] | |

## Submitter Information Verification

**Submitter Full Name:** Evelyn Butler

| | |
|---|---|
| **Organization:** | Solar Energy Industries Assn |
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| **Street Address:** | |
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| **Zip:** | |
| **Submittal Date:** | Thu Sep 10 07:37:30 EDT 2020 |
| **Committee:** | NEC-P13 |

## Public Input No. 4251-NFPA 70-2020 [ New Part after II. ]

**706.13 ESS Disconnecting Means**

Means shall be provided to disconnect the ESS from all wiring systems including other power systems, utilization equipment and its associated premises wiring.

706.13(A) Location

The ESS disconnecting means shall be installed at a readily accessible location.

**706.13(B) Marking**

Each ESS system disconnecting means shall plainly indicate whether in the open (off) or closed (on) position and be permanently marked “ESS DISCONNECT” or equivalent. The disconnecting means shall be marked to indicate the following:

(1) Maximum Voltage

(2) Available fault current derived from the ESS

(3) An arc-flash label applied in accordance with acceptable industry practice

(4) Date the calculation was performed

*Exception: List items (1), (2), (3), and (4) shall not apply to one- and two-family dwellings.*

For ESS disconnecting means where the line and load terminals may be energized in the open position, the device shall 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

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

**706.13(C) Maximum Number of Disconnects.**

Each energy storage system disconnecting means 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. A single disconnecting means shall be permitted for the combined output of one or more ESS.

Informational Note: See article 705 for additional requirements pertaining to the interconnection of one or more ESS with other power sources.

**706.13(D) Ratings.**

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

**706.13(E) Type of Disconnect.**

The ESS disconnecting means shall simultaneously disconnect the system conductors that are not solidly grounded from all conductors of other wiring systems. The disconnecting means or its remote operating device or the enclosure providing access to the disconnecting means shall be capable of being locked in accordance with 110.25. The ESS disconnecting means shall be one of the following:

(1) A manually operable switch or circuit breaker

(1) A connector meeting the requirements of 690.33(D)(1) or (D)(3)

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

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

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

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

## Statement of Problem and Substantiation for Public Input

This proposal is part of a broader effort to align disconnect requirements for energy storage equipment and systems with those found for other power sources elsewhere in this Code. This effort is intended to ensure that the characteristics of disconnecting means are tailored to the intended end user. Similar work has been done within Article 690, that largely forms the basis for these requirements as stated here.

The end users for these disconnects could generally be categorized as:
1. Firefighters/emergency personnel, or
2. Qualified service/maintenance personnel

The mandatory language applying to the disconnecting or isolating means should address the functional requirements unique to each group. As with PV systems, firefighters require an easily identifiable and readily accessible means to de-energize circuits (especially those that could be concealed within walls etc.) from onsite power sources but other users, such as electrical workers, will require disconnection and isolation equipment that could have different locational and functional requirements. There may be cases where a disconnect requirement in one section also meets the requirements in another section, such as a system disconnect that also meets the emergency shutdown requirement.

This new section is intended to rework the existing 706.15 with requirements for the disconnection of the energy storage system from other systems. These requirements largely mirror 690.13 requirements for PV systems. They intend to provide clear and practical requirements for the isolation of the output of an entire ESS from other systems. Since control of power sources is critical for safety, these disconnecting means require ready access, clear markings, and locking provisions in all cases, while not prescribing a specific location for the disconnect. This is advised due to the variety of different applications and the fact that the location a clearly identifiable means of disconnection for a source should be determined by the specific application and AHJ(s) involved.

The PV Industry Forum (PVIF) is a collaborative initiative of several organizations dedicated to continually improving the installation safety of PV systems in the U.S. The organizations are the Solar Energy Industry Association (SEIA), the PV Industry Codes Council (PVICC), Solar Energy International (SEI), the Interstate Renewable Energy Council (IREC), and the Large-Scale Solar Association (LSA). This coalition has come together to organize, convene, support and mentor solar industry professionals through the NEC public input process, which is open to all solar industry participants.

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Brian Ewing, Swinerton; Sumana Seshadri, Swinerton; Christian Eder, Fronius USA; Isaac Opalinsky, SunPower; Chris Fox, SunPower; James Cormican, RBI Solar; Dave Compaan, RBI Solar; Shawn Shaw, Natural Power; Cody Oram, Vivint Solar; Greg Elvestad, Vivint Solar; Mike Weimer, Westwood Professional Services; Doug Mutcher, Westwood Professional Services; Jeff Wang, Staubli; Colleen O'Brien, UL; John Doty, UL; Laurie Florence, UL; Tim Zgonena, UL ; Gokul Kalyan, FTC Solar; Ali Sedaghat, FTC Solar; K.C. Radford, Radian Generation; Jan Dominguez, LG Electronics; Klaus Nicolaedis, Unirac Inc.; Leif Cook, Core Development Group; Martin Herzfeld, Herzfeld; Dave Click, esaSolar; Sean White, principal; Kate Collardson, BayWa r.e. Solar Systems; Bryan Holland, NEMA; Jack Lyons, NEMA; Mike Stone, NEMA; Evan Martin, BURNDY; Terry McKinch, Mortenson; Jason Bobruk, SolarEdge Technologies; Reid ; train, Savion; Charlie Dearie, McCalmont Engineering; Sumanth Lokanath, Ray Illuminati LLC; Yann Schwarz, Esdec Inc.; Joseph Armano, PanelClaw, Inc.; Michael Heinrich, PanelClaw, Inc.; Steve Wurmlinger, SMA Solar Technology AG; Thomas Wegener, SMA Solar Technology AG; Chris Flueckiger, Key Renewables; Matt Piantedosi, Ridgeline Energy Analytics; Samantha Doshi, Intertek; Kyle Breuning, Tesla; Charles Picard, Tesla; Steve Connolly, Tesla; Greg Ball, Tesla; Jake West, Tesla; Jamie Daggett, DNV GL; MinWah Leung, DNV GL; Bob White, Fimer SpA; Marvin Hamon, Pure Power Engineering; Milton Nogueira, Roof Tech; Peter Seidel, First Solar; Jason Smolko, Copperweld;

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 4234-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4256-NFPA 70-2020 [Section No. 706.15] | |
| Public Input No. 4234-NFPA 70-2020 [New Part after II.] | |
| Public Input No. 4256-NFPA 70-2020 [Section No. 706.15] | |

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**Committee:** NEC-P13

## Public Input No. 3849-NFPA 70-2020 [ New Part after IV. ]

**TITLE OF NEW CONTENT**

**706.30 Wiring Systems.** All raceway and cable wiring methods included in Chapter 3 of this Code, other wiring systems and fittings specifically listed for use in Energy Storage Systems , and wiring as part of a listed system shall be permitted. Where wiring devices with integral enclosures are used, sufficient length of cable shall be provided to facilitate replacement

## Statement of Problem and Substantiation for Public Input

This Public Input is submitted on behalf of a Correlating Committee Long-Range Planning Task Group consisting of Robert Osborne (Chair), Paul Barnhart, Lou Grahor, David Temple, Donny Cook, Dean Hunter, Mike Querry, Roger McDaniel, Dave Burns, Rod Belisle, and Kevin Rogers. This Public Input, along with other companion Public Inputs, was developed with the goal of improving usability and providing a platform to increase the focus on requirements associated with Medium or High Voltage.

This Task Group's initial tasks were to establish a demarcation for what can be referred to as Medium or High Voltage. The recommendation has been to establish this threshold as being equipment rated over 1000 Vac, 1500 Vdc.

Using these limits, the Task Group set out to identify a structure to better align requirements, improve consistency in approach, improve usability, and create the opportunity for Code Making Panels to have an increased focus on higher voltage applications

This proposed change provides consistency in the Alternative Energy articles in order to address the wiring system(s) and/or method(s) that could be encountered within or as a part of the system (solar, wind or energy storage) installation. By adding the reference back to Chapter 3, the new text will correlate with the existing language found in NEC 692.31 for "Wiring Systems" for Fuel Cell Systems and provide direction to the installer, so that regardless of the voltage, all wiring systems and methods would comply with the applicable Chapter 3 Article.

## Related Public Inputs for This Document

| Related Input | Relationship |
|---|---|
| Public Input No. 3728-NFPA 70-2020 [Global Input] | Companion Public Input (Articles 245 and 495) |
| Public Input No. 3765-NFPA 70-2020 [New Section after 250.194(B)] | Companion Public Input (Article 255) |
| Public Input No. 3772-NFPA 70-2020 [New Section after 110.79] | Companion Public Input (Article 115) |
| Public Input No. 3815-NFPA 70-2020 [New Section after 200.11] | Companion Public Input (Article 205) |
| Public Input No. 3819-NFPA 70-2020 [Global Input] | Companion Public Input (Article 235) |
| Public Input No. 3827-NFPA 70-2020 [Global Input] | Companion Public Input (Article 305) |
| Public Input No. 3838-NFPA 70-2020 [Section No. 690.31(A)] | Companion Public Input (Section 690.31(A)) |
| Public Input No. 3846-NFPA 70-2020 [Section No. 694.30(A)] | Companion Public Input (Section 694.30(A)) |

Public Input No. 3728-NFPA 70-2020 [Global Input]

Public Input No. 3765-NFPA 70-2020 [New Section after 250.194(B)]

Public Input No. 3772-NFPA 70-2020 [New Section after 110.79]

Public Input No. 3815-NFPA 70-2020 [New Section after 200.11]

Public Input No. 3819-NFPA 70-2020 [Global Input]

Public Input No. 3827-NFPA 70-2020 [Global Input]

Public Input No. 3838-NFPA 70-2020 [Section No. 690.31(A)]

Public Input No. 3846-NFPA 70-2020 [Section No. 694.30(A)]

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**Committee:** NEC-P13

# Public Input No. 2591-NFPA 70-2020 [ Part V. ]

**Part V.** System Performance and Analysis

**Informational Note: IEEE 3006.8-2018 Recommended Practice for Analyzing Reliability Data for Equipment Used in Industrial and Commercial Power Systems** This recommended practice describes data supporting the reliability evaluation of existing industrial and commercial power systems.

## Statement of Problem and Substantiation for Public Input

This recommended practice describes data supporting the reliability evaluation of existing industrial and commercial power systems. It is likely to be of greatest value to the power-oriented engineer with limited experience in the area of reliability. It can also be an aid to all engineers responsible for the electrical design of industrial and commercial power systems.

See: https://standards.ieee.org/standard/3006_8-2018.html

## Submitter Information Verification

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# Public Input No. 4214-NFPA 70-2020 [ Definition: Diversion Charge Controller. ]

**480.2 Diversion Charge Controller.**

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

## Statement of Problem and Substantiation for Public Input

It is no longer necessary to address individual components of these systems in Article 706.. Correlates with PI to add this language to Article 480.

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