Public Comment No. 1653-NFPA 70-2024 [Global Input]

This Global Public Comment is for CMP-13 to review the use of the terms "overcurrent", "overcurrent protective devices" and "overcurrent protection".

Additional Proposed Changes

File Name	Description	Approved
CMP-13_OCPD_TG-4_CMP-10.pdf	CMP-13_OCPD_TG-4 CMP-10	
All_CMP_Comments_Files_from_CMP-10_TG-4.pdf	All CMP Comments Files from CMP-10 TG-4	

Statement of Problem and Substantiation for Public Comment

This Public Comment is submitted on behalf of a Task Group formed under the purview of Code Making Panel 10 consisting of Randy Dollar, Thomas Domitrovich, Jason Doty, Diane Lynch, Alan Manche, Nathan Philips, David Williams, and Danish Zia. This Public Comment, along with other Public Comments, was developed with the goal of improving usability and accuracy on requirements associated with overcurrent protective devices.

The Task Group reviewed all instances of the term "overcurrent", "overcurrent protective devices" and "overcurrent protection" and provided recommended changes to align proposed and current defined terms.

For consistency, the task group chose to use the full defined term "overcurrent protective device" in the title of all sections or subdivisions and the acronym "OCPD" or "OCPDs" when used in the body of each code section.

The term overcurrent protection applies to the application of an overcurrent protective device OCPD, to protect conductors and equipment.

Two documents are attached: One for your specific code panel and the other is a comprehensive document illustrating all of the code-wide comments made by this task group.

The current term "Overcurrent Protective Device, Branch-Circuit" is being deleted and the new defined term "Overcurrent Protective Device (OCPD)" will be used instead.

The following are the proposed terms being submitted to CMP-10.

PC 1639 Overcurrent Protection.
Automatic interruption of an overcurrent

PC 1636 Overcurrent Protective Device (OCPD).
A device capable of providing protection over the full range of overcurrent between its rated current and its interrupting rating. (CMP-10)

Informational Note 1: Prior editions of NFPA 70 included the defined term "branch circuit overcurrent protective device" for overcurrent protective devices suitable for providing protection for service, feeder and branch circuits. This term has been revised to a generalized term of "overcurrent protective device" (OCPD). The specific requirements using this term may include modifiers (such as branch OCPD, feeder OCPD, service OCPD) to specify location or application of the OCPD, or to specify variations (such as supplementary OCPD).

Informational Note 2: See 240.7 for a list of overcurrent protective devices suitable for providing protection for service, feeder, branch circuits and equipment.

Related Item

• Global PI 4050 • PC 1636 • PC 1639

Submitter Information Verification

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Committee: NEC-P13

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-13			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
13	**Article 100**		
	Emerg.Power Supply Systems (EPSS)	overcurrent protection devices	overcurrent protective devices (OCPDs)
	Transfer-Switch B-C Emerg. Ltg.	branch-circuit overcurrent device	branch-circuit overcurrent protective device (OCPD)
13	**Article 130**		
	130.80(C)	overcurrent devices	OCPDs
	130.80(C)	branch-circuit overcurrent device	OCPD
13	**Article 445**		
	445.11	Overcurrent protective Relay	Fine as is
	445.12. Title	Overcurrent Protection	Fine as is
	445.12(A)	Overcurrent protective means	Overcurrent protection means
	445.12(B)	Overcurrent Protection	Fine as is
	445.12(B) (X2)	Overcurrent Device	OCPD
	445.12(C)	Overcurrent Device	OCPD
	445.12(D)	Overcurrent Devices	OCPDs
	445.12(E). (X3)	Overcurrent Devices	OCPDs
	445.13(A). (X2)	Overcurrent Protection	Fine as is
	445.13(B). Title	Overcurrent protection	Fine as is
	445.13(B).	Overcurrent protective device	OCPD
	445.13(B)	Overcurrent Relay	Fine as is
13	**Article 455**		
	455.7	Overcurrent Protection	Fine As Is
	455.7	protected from Overcurrent	shall be provided with overcurrent protection in accordance with
	455.7(A)	Overcurrent Protection	Fine As Is
	455.7(B)	Overcurrent Protection	Fine As Is
13	**Article 480**		
	480.4(B) IN.2	Overcurrent Protection	Fine As Is
	480.6. (X2)	Overcurrent Protection	Fine As Is
	480.7	Overcurrent Device	OCPD
13	**Article 695**		
	695.4(C)	Overcurrent protective devices	OCPDs
	695.4(H). Title	Overcurrent Device Selection	Overcurrent Protective Device Selection
	695.4(H)	Overcurrent Devices	OCPDs

	695.5	Overcurrent Device	OCPD
	695.5	Overcurrent protective devices	OCPDs
	695.5	Overcurrent Protection	Fine as is
	695.6	Overcurrent protective devices	OCPDs
	695.6	Overcurrent Devices	OCPD
	695.6	Overcurrent Protection	Fine as is
	695.7(A)(2)	Overcurrent Devices	OCPDs
	695.7	Overcurrent Protection	Fine as is
13	**Article 700**		
	700.4(F)(8)	Overcurrent protective devices, (OCPD)	OCPDs
	700.6(E)	Overcurrent protective device	OCPD
	700.10(B). (X6)	Overcurrent Protection	Fine as is
	700.10(B)(6)(b)(ii)	Overcurrent protective device	OCPD
	700.10(B)(6)(e)	Overcurrent protective devices	OCPDs
	Art. 700 Part VI	Overcurrent Protection	Fine as is
	700.30.	Branch-circuit overcurrent devices	OCPDs
	700.32(A)	Overcurrent protective devices, (OCPDs)	OCPDs
	700.32(A) In	Overcurrent Protection	Fine as is
	700.32(C)	Overcurrent Devices	OCPDs
13	**Article 701**		
	701.6(C)	Overcurrent protective device	OCPD
	701.10(B)(1). (X5)	Overcurrent Protection	Fine as is
	701.10(B)(1)	Overcurrent protective device	OCPD
	Art. 701. Part IV	Overcurrent Protection	OCPDs
	701.30.	Branch-Circuit Overcurrent devices	Branch-Circuit OCPDs
	701.32(A). (X2)	Overcurrent protective devices, OCPDs	OCPDs
	701.32(B). (X3)	OCPDs	Fine as is
	701.32(C). (X2)	OCPDs	Fine as is
	701.32(C)Ex	Overcurrent Devices	OCPDs
	701.32(C) In 2	OCPD and OCPDs	Fine as is
13	**Article 702**		
	702.5(C)	Overcurrent protective device	OCPD
13	**Article 706**		
	706.15(E)(1)	Overcurrent Device	OCPD
	706.30(B)	Overcurrent Devices	OCPDs

	706.31 Title	Overcurrent Protection	Fine as is
	706.31(A)	shall be protected at the source from overcurrent.	shall be provided with overcurrent protection at the source
	706.31(A)	shall be protected from overcurrent.	shall be provided with overcurrent protection
	706.31(A) In	Overcurrent Device	OCPD
	706.31(B). Title	Overcurrent Device	Overcurrent Protective Device
	706.31(B)	Overcurrent protective devices	OCPDs
	706.31(B)	Overcurrent devices	OCPDs
	706.31(C)	Overcurrent protective devices	OCPDs
	706.31(E)	Overcurrent Protection	Fine as is
	706.33(B)(2)	Overcurrent Device	OCPD
13	**Article 708**		
	708.10(B)	Overcurrent Protection	Fine as is
	708.24(E)	Overcurrent protective device	OCPD
	Art. 708. Part IV	Overcurrent Protection	Fine as is
	708.50.	Feeder- and Branch-circuit overcurrent devices	Feeder- and Branch-circuit OCPDs
	708.52(B)	Overcurrent Devices	OCPDs
	708.54(A)	Overcurrent protective devices, (OCPD)	OCPDs
	708.54(A). (B). (C)	OCPDs	Fine as is
	708.54	Overcurrent Devices	OCPDs

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-1			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
1	**Article 110**		
	110.10.	overcurrent protective devices	OCPDs
	110.10.	circuit protective devices	Fine as is
	110.26(C)(2)	overcurrent devices	OCPD
	110.26(C)(3)	overcurrent devices	OCPD
	110.52	Overcurrent protection	Fine as is
	110.52	Overcurrent	Motor-operated Equipment shall be provided with overcurrent protection
	110.52	Overcurrent	Transformers shall be provided with overcurrent protection

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-2			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
2	**Article 100**		
	Branch Circuit (Branch-Circuit)	overcurrent device	overcurrent protective device (OCPD)
2	**Article 120**		
	120.5(E)	overcurrent device	OCPD
	120.7(B)	overcurrent protective device	OCPD
	120.87(3)	Overcurrent protection	Fine as is
2	**Article 210**		
	210.4(A)	branch-circuit overcurrent protective device, OCPD	Fine as is
	210.4(C)	branch-circuit OCPD	Fine as is
	210.11(B)	branch-circuit OCPD	Fine as is
	210.12(A)	branch-circuit OCPD (X-8)	Fine as is
	210.18	~~overcurrent device~~ OCPD (X-2)	Fine as is
	210.19(A)(1)EX	branch-circuit OCPD	Fine as is
	210.20.	Overcurrent protection	Fine as is
	210.20.	branch-circuit OCPD	Fine as is
	210.20(A)	branch-circuit OCPD	Fine as is
	210.20(C)	branch-circuit OCPD	Fine as is
	T-210.24	Overcurrent protection	Fine as is
2	**Annex D**		
	D3. (X2)	Overcurrent Protection	CMP-2 To review references to OCPD and the revised terms.
	D3a. (X8)	Branch-Circuit OCPD	CMP-2 to Review
	D3a.	Overcurrent Protection	CMP-2 to Review
	D3a. (X2)	Branch-Circuit OCPD	CMP-2 to Review

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-3			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
3	**Article 100**		
	Fault Managed Power.	Overcurrent protection	Fine as is
	Fire Alarm Circuit	Overcurrent device	overcurrent protective device (OCPD)
3	**Article 300**		
	300.5-T	Overcurrent Protection	Fine as is
	300.17(I)	Overcurrent Device	OCPD
	300.28(C)(3). (X5)	Overcurrent Protection	Fine as is
3	**Article 590**		
	590.6(A)	Overcurrent Protection	Fine as is
	590.6(B)	be protected from Overcurrent	shall be provided with overcurrent protection
	590.9. Title	Overcurrent protective device	Fine as is
	590.9(A)	Overcurrent protective devices	OCPDs
	590.9(B) Title	Service Overcurrent protective devices	Fine as is
	590.9(B)	Overcurrent protective devices	OCPDs
3	**Article 721**		
	721.50(A)	Overcurrent	Fine as is
3	**Article 722**		
	722.1	Overcurrent Protection	Fine as is
3	**Article 724**	Class 1	
	724.40(B). (X3)	Overcurrent Devices	OCPDs
	724.40(B). (X2)	Overcurrent Device	OCPD
	724.40(B). (X2)	Overcurrent Protection	Fine as is
	724.43. (X4)	Overcurrent Protection	Fine as is
	724.45	Overcurrent Device	OCPD
	724.45. (X3)	Overcurrent Devices	OCPDs
	724.45(A)	Overcurrent Devices	OCPDs
	724.45(B)	Overcurrent Protection	Fine as is
	724.45(B)	Overcurrent Device	OCPD
	724.45(C). (X2)	Overcurrent protective devices	OCPDs
	724.45(D)	Overcurrent Protection	Fine as is
	724.45(E)	Overcurrent Protection	Fine as is
3	**Article 725**		
	725.1 In	Overcurrent Protection	Fine as is

	725.127	Overcurrent Device	OCPD
3	**Article 760**		
	760.41(B)	Overcurrent protective device	OCPD
	760.41(B)	Overcurrent protection devices	OCPDs
	760.43. (X3)	Overcurrent Protection	Fine as is
	760.45. Title	Overcurrent device	Overcurrent protective device
	760.45	Overcurrent protection devices	OCPDs
	760.45 Ex 1 & 2	Overcurrent Protection	Fine as is
	760.121(B)	Branch-Circuit Overcurrent protective device	OCPD
	760.121(B)	Overcurrent protection devices	OCPDs
	760.127	Overcurrent Protection	Fine as is
	760.127	Overcurrent Device	OCPD
3	**Article 794**		
	794.1	Overcurrent Protection	Fine as is

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-4			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
4	**Article 690**		
	690.2	PV dc Overcurrent protective devices	PV dc OCPDs
	690.8	Overcurrent Device	OCPD and OCPDs
	690.9. Title	Overcurrent Protection	Fine as is
	690.9(A). (X2)	be protected from Overcurrent	shall be provided with overcurrent protection
	690.9(A)(1). Title	Overcurrent Protection	Fine as is
	690.9(A)(1).	Overcurrent protective devices	OCPDs
	690.9(A)(2). Title	Overcurrent Protection	Fine as is
	690.9(A) (2)	be protected from Overcurrent	shall be provided with overcurrent protection
	690.9(A) (2) In	Overcurrent protection	Fine as is
	690.9(A) (2) In	Overcurrent device	OCPD
	690.9(A)(3)	Overcurrent	Fine as is
	690.9(B)	shall be permitted to prevent overcurrent of conductors	Fine as is
	690.9(B)	Overcurrent device	OCPD and OCPDs
	690.9(C)	Overcurrent protective device and Devices	OCPD and OCPDs
	690.31(E)	Overcurrent protective devices	OCPDs
	690.45	Overcurrent protective device	OCPD
	690.45	Overcurrent Device	OCPD
4	**Article 692**		
	692.8. Title	Overcurrent Device	Overcurrent Protective Devices
	692.8	Overcurrent protective device	OCPDs
	692.9	Overcurrent Protection	Fine as is
	692.9	Overcurrent Devices	OCPDs
4	**Article 694**		
	694.7(D)	Overcurrent Device	OCPD
	694.12(B). Title	Overcurrent Device	Overcurrent Protective Device
	694.12(B)(2). Title	Overcurrent Devices	Overcurrent Protective Devices
	694.12(B)(2)	Overcurrent Devices	OCPDs
	694.15	Overcurrent Protection	Fine as is
	694.15	Overcurrent Devices	OCPDs
	694.15 In	Overcurrent Protection	Fine as is
	694.15(B)(1)	Overcurrent Protection	Fine as is
	694.15(C)	Overcurrent Devices	OCPDs

4	**Article 705**		
	705.11(C). Title	Overcurrent Protection	Fine as is
	705.11(C)	be protected from overcurrent	have overcurrent protection
	705.11(C)(1). (1) (2) (3)	Overcurrent protective device	OCPD
	705.11(C)(2)	Overcurrent protection devices	OCPDs
	705.12(A)(2). (X4)	Overcurrent Device	OCPD
	705.12(A)(3)	Overcurrent Devices	OCPDs
	705.12(B)	(Multiple) Overcurrent Device and (s)	OCPD. And OCPDs
	705.12(B)	(Warning labels) Overcurrent Device and (s)	Overcurrent Protective Device and Devices
	705.28(B)Ex.1	Overcurrent Devices	OCPDs
	705.28(B)Ex.3	Overcurrent Device	OCPD
	705.30. Title	Overcurrent Protection	Fine as is
	705.30(A). (X2)	Overcurrent Protection	Fine as is
	705.30(A)	Overcurrent Devices	OCPDs
	705.30.(C)	Overcurrent Devices	OCPDs
	705.30.(F)	Overcurrent Protection	Fine as is
	705.70.	Overcurrent Devices	OCPDs
	705.70.	Overcurrent Protection	Fine as is

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-5			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
5	**Article 100**		
	Ground-Fault Current Path, Effective	overcurrent protective device	overcurrent protective device (OCPD)
	Ground-Fault Protection of Equipment	overcurrent device	overcurrent protective device (OCPD)
5	**Article 200**		
	200.10(E)	overcurrent device	OCPD
5	**Article 250**		
	250.4(A)(5). Title	Overcurrent protective Device	Fine as is
	250.4(A)(5)	Overcurrent Device	OCPD
	250.4(B)(4)	Overcurrent Devices	OCPDs
	250.30(A)(1)	Overcurrent Device	OCPD
	250.30(A)(1)	Overcurrent Devices	OCPDs
	250.32(B)(2). (X4)	Overcurrent Protection	Fine as is
	250.32(C)(2). (X4)	Overcurrent Protection	Fine as is
	250.35(B)	Overcurrent Protection	Fine as is
	250.36(D)	Overcurrent Device	Fine as is
	250.36(E)(1)	Overcurrent Device	OCPD
	250.102(B)(2)	Overcurrent Protection	Fine as is
	250.102(D). (X3)	Overcurrent Devices	OCPDs
	250.118(A)(5)	Overcurrent Devices	OCPDs
	250.118(A)(6)	Overcurrent Devices	OCPDs
	250.118(A)(7)	Overcurrent Devices	OCPDs
	250.122(C)	Overcurrent Device	OCPD
	250.122(F)(1). (X3)	Overcurrent protective device	OCPD
	250.122(G)	Overcurrent Device	OCPD
	250.142. (X2)	Overcurrent Device	OCPD
	250.148	Overcurrent Device	OCPD
	250.164	Overcurrent Device	OCPD
	250.166	Overcurrent Protection	Fine as is
	250.169	Overcurrent Devices	OCPD
5	**Article 270**		
	270.4(A)(5)	Overcurrent Device	OCPD
	270.4(B)(4)	Overcurrent Devices	OCPDs
	270.30(A)(1)	Overcurrent Devices	OCPDs

	270.32(B)(2). (X4)	Overcurrent Protection	Fine as is
	270.32(C)(2). (X4)	Overcurrent Protection	Fine as is
	270.35(B)	Overcurrent Protection	Fine as is
	270.35(B)	Overcurrent protective device	OCPD
	270.36(D)	Overcurrent Device	OCPD
	270.36(E)	Overcurrent Devices	OCPDs
	270.102(C)(2)	Overcurrent Protection	Fine as is
	270.102(D)	Overcurrent Device	OCPDs
	270.114(C)(3)	Overcurrent setting	CMP to review Language based on new terms
	270.118	Overcurrent Devices	OCPDs
	270.142	Overcurrent Devices	OCPDs
	270.148(B)	Overcurrent Device	OCPD
	270.164(B)	Overcurrent Device	OCPD
	270.166(A)	Overcurrent Protection	Fine as is
	270.169	Overcurrent Devices	OCPDs

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-6			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
6	**Article 310**		
	310.10(G).	Overcurrent Protection	Fine as is
	310.15(A)	Overcurrent Protection	Fine as is
	310.16-T	Overcurrent Protection	Fine as is
	310.17-T	Overcurrent Protection	Fine as is
6	**Article 335**		
	335.90.	Overcurrent Protection	Fine as is
6	**Article 382**		
	382.4	Supplementary Overcurrent Protection	Supplementary Overcurrent Protective Device
6	**Article 400**		
	400.16	Overcurrent Protection	Fine as is
	400.16	protected against Overcurrent	shall be provided with overcurrent protection
6	**Article 402**		
	402.14 (X2)	Overcurrent Protection	Fine as is

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-7			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
7	**Article 100**		
	Service Equipment, Mobile Home	overcurrent protective devices	overcurrent protective devices (OCPDs)
7	**Article 545**		
	545.24	Branch-circuit overcurrent protective device	Branch-circuit OCPD
	545.24(B) Title	Branch Circuit Overcurrent Protection Device	Overcurrent protective devices
	545.24(B)	a Branch Circuit Overcurrent Protective Device	an OCPD
7	**Article 547**		
	547.41(A)(6). (X2)	Overcurrent Protection	Fine as is
	547.41(B)	Overcurrent Protection	Fine as is
	547.42	Overcurrent Protection	Fine as is
7	**Article 550**		
	550.11(B). Title	Branch-Circuit protective equipment	Branch-Circuit Overcurrent Protection
	550.11(B)	Overcurrent Protection	Fine as is
	550.11(B)	Branch-Circuit Overcurrent Devices	OCPDs
	550.11(B)	Overcurrent protection size	OCPD rating
	550.15(E)	Branch-circuit overcurrent protective device	OCPD
	550.32	Overcurrent Protection	Fine as is
7	**Article 551**		
	551.31(A)	Overcurrent protective device	OCPD
	551.31(C)	Overcurrent protective device	OCPD
	551.31(D)	Overcurrent Protection	Fine as is
	551.42	Overcurrent Protection	Fine as is
	551.43. Title	Branch-Circuit protection	Branch-Circuit Overcurrent Protection
	551.43(A)	Branch Circuit Overcurrent Devices	Branch-Circuit OCPDs
	551.43(A)(3)	Overcurrent Protection	Fine as is
	551.45(C)	Overcurrent protective device	OCPD
	551.47(Q)	Overcurrent protective device	OCPD
	551.47(R)	Overcurrent Protection	Fine as is
	551.47(S)	Overcurrent Protection	Fine as is
	551.74	Overcurrent Protection	Fine as is
7	**Article 552**		
	552.10.(E) Title	Overcurrent Protection	Fine as is
	552.10(E)(1)	Overcurrent protective devices	OCPDs

	T-552.10(E)(1)	Overcurrent Protection	Fine as is
	552.10(E)(4). (X2)	Overcurrent protective device	OCPD
	552.42(A)	Branch Circuit Overcurrent Devices	OCPDs
	552.42(A)	Overcurrent Protection	Fine as is
	552.45(C)	Overcurrent protective device	OCPD
	552.46(A) IN	Overcurrent Protection	Fine as is
	552.47(P)	Overcurrent protective device	OCPD
	552.47(Q)	Overcurrent Protection	Fine as is
7	**Article 555**		
	555.53	Overcurrent protective device	OCPD
7	**Article 675**		
	675.6	Branch Circuit Overcurrent Protective Device	OCPD
	675.7	Branch Circuit Overcurrent Protective Devices	OCPDs
	675.8	Overcurrent Protection	Fine as is
7	**Article 682**		
	682.15(B)	Feeder Overcurrent protective device	Feeder OCPD

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-8			
CMP	NEC Section (using First Draft of 2026 NEC)	Current Language	"New" Language
8	Article 312		
	312.11. Title	Overcurrent Devices	Overcurrent Protective Device
	312.11	Overcurrent Devices	OCPDs
	312.11(A). (X3)	Overcurrent Device	OCPDs
	312.11(B)	Overcurrent Devices	OCPDs
	312.11(B)(1)	Overcurrent Device	OCPD
8	Article 366		
	366.12	Overcurrent Devices	OCPDs
	366.56(D)	Overcurrent Protection	Fine as is
8	Article 368		
	368.17(A). Title	Overcurrent Protection	Fine as is
	368.17	Overcurrent Protection	Fine as is
	368.17(A)	Protected against Overcurrent	shall be provided with overcurrent protection
	368.17(B). (X2)	Overcurrent Protection	Fine as is
	368.17(B)	Overcurrent Device	OCPD
	368.17(C)	Overcurrent Devices	OCPDs
	368.17(C)Ex.2	Branch-Circuit Overcurrent Device	Branch-Circuit OCPD
	368.17(C)Ex.3	Overcurrent Device	OCPD
	368.17(C)Ex.4	Branch-Circuit overcurrent plug-in device	CMP to review Language based on new terms
	368.17(D). Title	Overcurrent Protection	Fine as is
	368.17(D)	Protected against Overcurrent	shall be provided with overcurrent protection
8	Article 370		
	370.23. Title	Overcurrent Protection	Fine as is
	370.23	Protected against Overcurrent	shall be provided with overcurrent protection
8	Article 371		
	371.17. Title	Overcurrent Protection	Fine as is
	371.17	Overcurrent Protection	Fine as is
	371.17 (A)-(C). Titles	Overcurrent Protection	Fine as is
	371.17(A)-(C)	Protected against Overcurrent	shall be provided with overcurrent protection
	371.17(D)	Protected against Overcurrent	shall be provided with overcurrent protection
	371.17(F)	Overcurrent	shall be provided with overcurrent protection
	371.17(G)	Overcurrent Protection	
	371.17(G)Ex	Overcurrent Protection	Fine as is
	371.17(G)Ex	Overcurrent Device	OCPD

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-9			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
9	**Article 265**		
	265.18	Overcurrent Device	OCPD
	265.20.	Overcurrent Protection	Fine as is
	265.20.	Overcurrent protective devices	OCPDs
	265.20.	Overcurrent Devices	OCPDs
9	**Article 266**		
	266.1	Overcurrent Protection	Fine as is
	266.5	Overcurrent Protection	Fine as is
	266.5	Protected against overcurrent	shall be provided with overcurrent protection
	266.5	Overcurrent Device	OCPD
9	**Article 268**		
	268.2. (X2)	Overcurrent Protection	Fine as is
	268.70(F)	Overcurrent Devices	OCPDs
	268.82. (X4)	Overcurrent Protection	Fine as is
	Art. 268 Part VII	Overcurrent Protection	Fine as is
	268.90.	Overcurrent Device	OCPD
	268.90.	Overcurrent Devices	OCPDs
	268.91	Overcurrent Device	OCPD
	268.92	Overcurrent Devices	OCPDs
	268.93	Overcurrent Device	OCPD
9	**Article 450**		
	450.5 (previously 450.3). (X3)	overcurrent protection	Fine As Is
	450.5(A) and Table. (X3)	overcurrent protection	Fine As Is
	Table 450.5(A) Footnote 2. (X4)	overcurrent device	OCPD
	450.5(B)	overcurrent protection	Fine As Is
	Table 450.5(B) and Table (X2)	overcurrent protection	OCPD
	Table 450.5(B) Footnote 2. (X3)	overcurrent device	OCPD
	Table 450.5(B) Footnote 3	overcurrent protection	OCPD
	450.6(A) Title	overcurrent protection	Fine As Is
	450.6(A) (X3)	overcurrent device	OCPD
	450.6(A) Exception	overcurrent device	OCPD
	450.7(A)(1). (X2)	overcurrent protection	OCPD
	450.7(A)(2). Title	overcurrent protection	Fine As Is

	450.7(A)(2)	overcurrent sensing device	Fine As Is
		overcurrent protection	OCPD
		overcurrent device	OCPD
		branch or feeder protective devices	branch or feeder OCPDs
	450.7(A)(3)	overcurrent device	OCPD
	450.7(B)(2)	overcurrent protection	Fine As Is
	450.7(B)(2)(a)	overcurrent protective device	OCPD
	450.7(B)(2)(b)	overcurrent protection	OCPD
	450.7(B)(2)(b)	overcurrents	Fine As Is
	450.7(B)(2)(b) Exception	overcurrent device	OCPD
	450.8(A). (X2)	overcurrent protection	Fine As Is
	450.8(A)(1)	overcurrent protection	Fine As Is
	450.8(A)(2)	overcurrent protection	Fine As Is
	450.8(A)(3)	protective device	OCPD
	450.8(A)(4)(a)	protective device	OCPD
	450.8(B). Title	Overcurrent Protection	Fine As Is
	450.8(B)	overcurrent device	OCPD
	450.9	overcurrent protection	Fine As Is
	450.9	protective devices (2x)	OCPDs
	450.23(A)(1)(d) Informational Note	overcurrent protection	OCPD
	450.23(B)(1) Informational Note 2	overcurrent protection	OCPD
9	**Article 495**		
	495.62. Title	Overcurrent Protection	Fine As Is
	495.72	Overcurrent Relay	Fine As Is

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-10			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
10	**Article 100**		
	Circuit Breaker	Overcurrent	Fine as is
	Coordination, Selective. (Selective Coordination)	Overcurrent condition	Fine as is
	Coordination, Selective. (Selective Coordination)	overcurrent protective devices	overcurrent protective devices (OCPDs)
	Coordination, Selective. (Selective Coordination)	overcurrents	Fine as is
	Coordination, Selective. (Selective Coordination)	overcurrent protective device	overcurrent protective device (OCPD)
	Current Limiting (as applied to overcurrent protection devices)	overcurrent protection devices	overcurrent protective devices (OCPDs)
	Feeder	final branch-circuit overcurrent protective device	overcurrent protective device (OCPD)
	Fuse	overcurrent protective device	overcurrent protective device (OCPD)
	Fuse	overcurrent	Fine as is
	Fuse, Electronically Actuated	overcurrent protective device	overcurrent protective device (OCPD)
	Fuse, Electronically Actuated	overcurrent	Fine as is
	Overcurrent	Overcurrent protection	Fine as is
	Overcurrent Protective Device, Branch-Circuit	Revise with the term Overcurrent Protective Device. (OCPD)	
	Overcurrent **Protective** Device, Supplementary (need to Revise term with acronym)	overcurrent protective device	overcurrent protective device (OCPD)
	Panelboard	overcurrent devices	overcurrent protective devices (OCPDs)
	Surge-Protective Device (SPD). (X2)	overcurrent device. (X2)	overcurrent protective device (OCPD)
	Switchboard	overcurrent	overcurrent protective devices (OCPDs)
	Tap Conductor	Overcurrent protection	Fine as is
10	**Article 215**		
	215.1	Overcurrent protection	Fine as is
	215.4(A)(1)Ex.1	overcurrent devices protecting the feeders	feeder OCPD
	215.4(A)(1)Ex.3	overcurrent device	OCPD
	215.5 Title	Overcurrent protection	Fine as is
	215.5	Feeders shall be protected against overcurrent	Feeders shall be provided with overcurrent protection in accordance with Article 240, Parts I
	215.5	overcurrent device	OCPD
	215.5Ex	overcurrent device protecting the feeders	feeder OCPDs
	215.5Ex	overcurrent device	OCPD

	215.18(B)	branch circuit overcurrent devices	OCPDs
10	**Article 225**		
	225.40. Title	Overcurrent protective devices	Fine as is
	225.40.	feeder overcurrent device (x2)	feeder OCPD
	225.40.	branch circuit overcurrent devices	Branch circuit OCPDs
	225.42(B)	branch circuit overcurrent devices	OCPDs
10	**Article 230**		
	230.7 Ex.2	Overcurrent protection	Fine as is
	230.42(A)(1)	overcurrent device (X3)	OCPD
	230.82(6)	Overcurrent protection	Fine as is
	230.82(7)	Overcurrent protection	Fine as is
	230.82(8)	Overcurrent protection	Fine as is
	230.82(9)	Overcurrent protection	Fine as is
	230.82(10)	Overcurrent protection	Fine as is
	230 Part VII	Overcurrent protection	Fine as is
	230.90(A)	overcurrent device	OCPD
	230.90(A)Ex.3	overcurrent device	OCPD
	230.90(B)	overcurrent device	OCPD
	230.91	overcurrent device (X2)	OCPD
	230.92	overcurrent device (X4)	OCPDs and OCPD
	230.93	overcurrent device	OCPD
	230.94	overcurrent device (X3)	OCPD
	230.94	Overcurrent protection (X2)	Fine as is
	230.95(A)	overcurrent device	OCPD
	230.95(B)	overcurrent device	OCPD
10	**Article 240**		
	240	Overcurrent Protection	Fine as is
	240.1 (X3)	Overcurrent protection	Fine as is
	240.2	branch-circuit Overcurrent protective devices	~~branch-circuit~~ Overcurrent protective devices
	240.4. Title	Protection of Conductors	Overcurrent Protection of Conductors
	240.4	Protected against overcurrent	shall be provided with overcurrent protection in accordance with
	240.4(B). Title	Overcurrent devices	Overcurrent protective Devices
	240.4(B)	Overcurrent device	OCPD
	240.4(B)	Overcurrent protective device	OCPD

	240.4(C). Title	Overcurrent devices	Overcurrent protective Devices
	240.4(C). (X2)	Overcurrent device.	OCPD
	240.4(D)	Overcurrent Protection	Fine as is
	240.4(D)(1)	Overcurrent protection	Fine as is
	240.4(D)(1)(2)		(a) OCPDs in accordance with 240.7 shall be marked for use with 18 AWG copper conductor (b) Delete (c) change to (b)
	240.4(D)(2)	Overcurrent protection	Fine as is
	240.4(D)(2)(2)		(a) OCPDs in accordance with 240.7 shall be marked for use with 16 AWG copper conductor (b) Delete (c) change to (b)
	240.4(D)(3)	Overcurrent protection	Fine as is
	240.4(D)(3)(2)		~~(a) Fuses and circuit breakers in accordance with 240.7 marked for use with 14 AWG copper-clad aluminum conductor~~ ~~(b) Delete~~
	240.4(D)(3)(2)		OCPDs in accordance with 240.7 shall be marked for use with 14 AWG copper-clad aluminum conductor
	240.4(E)	Protected against overcurrent	shall be permitted to have overcurrent protection in accordance with the following
	240.4(F)	Overcurrent protection	Fine as is
	240.4(F)	Overcurrent protective device	OCPD
	240.4(G). (X2)	Overcurrent protection	Fine as is
	240.4(H)	Protected against overcurrent	shall be provided with overcurrent protection in accordance with
	240.5	Protected against overcurrent	shall be provided with overcurrent protection in accordance with
	240.5(A)	Overcurrent device	OCPD
	240.5(A)	Protected against overcurrent	Fixture wires shall be provided with overcurrent protection in accordance with
	240.5(A)	Supplementary overcurrent protection	Fine as is
	240.5(B) Title	Branch-circuit overcurrent device.	Branch-Circuit Overcurrent protective Devices

	240.9	Protection of conductors against overcurrent	Fine as is
	240.10. Title	Supplementary Overcurrent protection	Fine as is
	240.10.	Supplementary overcurrent protection	Fine as is
	240.10.	Branch-Circuit overcurrent devices	OCPDs
	240.10.	Supplementary overcurrent devices	Supplementary OCPDs
	240.11. (X2)	Feeder overcurrent protective devices.	Feeder OCPDs
	240.11. (X2)	Service overcurrent protective device.	Service OCPD
	240.15(A). Title	Overcurrent device	Overcurrent protective device required
	240.15(A)	Overcurrent device	OCPD
	240.15(A)	Overcurrent trip. Overcurrent relay	Fine as is
	240.15(B) Title	Overcurrent device	Circuit breaker as Overcurrent protective device
	240.16	Branch circuit overcurrent protective devices	OCPDs
	240.21	Overcurrent Protection	Fine as is
	240.21	overcurrent protective device	OCPD
	240.21 (A)	Overcurrent Protection	Fine as is
	240.21 (B)	Overcurrent Protection	Fine as is
	240.21 (B) (1) (1) (b)	Overcurrent device(s)	OCPDs
	240.21 (B) (1) (1) (b)	overcurrent protective device	OCPD
	240.21 (B)(1) (1) (4)	Overcurrent device	OCPD
	240.21 (B) (1)(1) (4) In	Overcurrent Protection	Fine as is
	240.21 (B) (2) (1)	Overcurrent device	OCPD
	240.21 (B) (2) (2)	Overcurrent devices	OCPDs
	240.21 (B) (3) (1)	Overcurrent device	OCPD
	240.21 (B) (3) (2)	Overcurrent device	OCPD
	240.21 (B) (4) (3)	Overcurrent device	OCPD
	240.21 (B) (4) (4)	Overcurrent device	OCPD
	240.21 (B) (4) (4)	Overcurrent devices	OCPDs
	240.21 (B) (5) (2)	Overcurrent device	OCPD
	240.21 (B) (5) (2)	Overcurrent devices	OCPDs
	240.21 (B) (5) (3)	Overcurrent device	OCPD
	240.21 (C). (X2)	Overcurrent Protection	Fine As Is
	240.21 (C) (1). Title	Title change	Overcurrent Protective Device
	240.21 (C) (1)	"...protected by overcurrent protection..."	Fine As Is
	240.21 (C) (1)	Overcurrent protective device	OCPD
	240.21 (C) (2) (1) (b)	Overcurrent device(s)	OCPDs

	240.21 (C) (2) (1) (b)	Overcurrent device	OCPD
	240.21 (C) (2) (4)	Overcurrent device	OCPD
	240.21 (C) (2) (4)	Overcurrent device	OCPD
	240.21 (C) (2) (4)	Overcurrent protection	Fine as is
	240.21 (C) (3) (2)	Overcurrent devices	OCPDs
	240.21 (C) (3) (3)	Overcurrent devices	OCPDs
	240.21 (C) (4) (2)	Overcurrent device	OCPD
	240.21 (C) (4) (2)	Overcurrent devices	OCPDs
	240.21 (C) (4) (3)	Overcurrent device	OCPD
	240.21 (C) (5)	Overcurrent Protection	Fine As Is
	240.21 (C) (6) (1)	Overcurrent device	OCPD
	240.21 (D)	Overcurrent devices	OCPDs
	240.21 (E)	.shall be permitted to be protected against overcurrent.	"..shall be permitted to have overcurrent protection.."
	240.21 (F)	.shall be permitted to be protected against overcurrent.	"..shall be permitted to have overcurrent protection.."
	240.21 (H). (X2)	Overcurrent Protection	Fine As Is
	240.22. (X2)	Overcurrent device	OCPD
	240.24(A)	Supplementary overcurrent protection	Fine as is
	240.24(A). (X4)	Overcurrent protective devices	OCPDs
	240.24(B)	Overcurrent devices	OCPDs
	240.24(B)(1). Title	Feeder overcurrent protective devices	Feeder OCPDs
	240.24(B)(1)	Service overcurrent protective devices	Service OCPDs
	240.24(B)(2). TITLE	Branch-circuit overcurrent protective device	Fine as is
	240.24(B)(2).	Branch-circuit overcurrent protective device	Branch-Circuit OCPD
	240.24(C)	Overcurrent protective devices	OCPDs
	240.24(D)	Overcurrent protective devices	OCPDs
	240.24(E)	Overcurrent protective devices	OCPDs
	240.24(E)	Supplementary overcurrent protection	Fine as is
	240.24(E) (X2)	Overcurrent protective devices	OCPDs
	240.24(F)	Overcurrent protective devices	OCPDs
	240.30(A)	Overcurrent devices	OCPDs
	240.32	Overcurrent devices	OCPDs
	240.33	Overcurrent devices	OCPDs
	240.86	Overcurrent device	OCPD
	240.86(B)	Overcurrent device	OCPD
	240.86(C)	Overcurrent device	OCPD

	240.87	Overcurrent device	OCPD
	240.90.	Overcurrent protection	Fine as is
	240.91(B). (X2)	Overcurrent device	OCPD
	240.92	Overcurrent device	OCPD
	240.92(A)	~~be protected~~	shall be provided with overcurrent protection
	240.92(C)	Overcurrent protection	Fine as is
	240.92(C)(1)(1)	Overcurrent device	OCPD
	240.92(C)(1)(2)	protective devices	Fine as is
	240.92(C)(1)(3)	Overcurrent devices	OCPDs
	240.92(C)(2)(1)	Overcurrent device	OCPD
	240.92(C)(2)(2) (X3)	Overcurrent devices	OCPDs
	240.92(C)(2)(3)	Overcurrent relaying	Fine as is
	240.92(C)(2)(4)	Overcurrent device	OCPD
	240.92(D)	Overcurrent protection	Fine as is
	240.92(D)(2). (X3)	Overcurrent devices	OCPDs
	240.92(D)(4)	Overcurrent device	OCPD
	240.92(E)	Overcurrent device	OCPD
	240.92(E)	Overcurrent protection	Fine as is
10	**Article 242**		
	242.14(ABC)	Overcurrent device	OCPD
	242.16	Overcurrent protection	Branch-circuit OCPD
10	**Article 404**		
	404.5	Overcurrent Devices	OCPDs
10	**Article 408**		
	408.4(A)	Overcurrent device	OCPD
	408.6 (X2)	Overcurrent protection devices	OCPDs
	408.36. Title	Overcurrent protection	Fine as is
	408.36. (X2)	Overcurrent protective device	OCPD
	408.36. (X3)	Overcurrent devices	OCPDs
	408.36(A)	Overcurrent protection	Fine as is
	408.36(B)	Overcurrent protection	Fine as is
	408.36(C)	Overcurrent device	OCPD
	408.36(D)	Overcurrent protection devices	OCPDs
	408.52	Overcurrent devices	OCPDs
	408.54	Overcurrent devices	OCPDs

	408.55	Overcurrent devices	OCPDs

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-11			
CMP	NEC Section (using First Draft of 2026 NEC)	Current Language	"New" Language
11	**Article 409**		
	409.21. TITLE	Overcurrent Protection	Fine as is
	409.21(A)	Overcurrent Protection	Fine as is
	409.21(B)	Protection	Overcurrent protection
	409.21(B)	overcurrent protective device	OCPD
	409.21(B)	Overcurrent Protection	Fine as is
	409.21(C). (X2)	overcurrent protective device	OCPD
	409.104	Overcurrent Devices	OCPDs
11	**Article 430**		
	430.10(A) In.	Overcurrent Device	OCPD
	430.22(G)(1)(1)	Overcurrent Protection	Fine as is
	430.22(G)(1)(2)	Overcurrent Protection	Fine as is
	430.22(G)(2)(1)	Overcurrent Protection	Fine as is
	430.22(G)(2)(2)	Overcurrent Protection	Fine as is
	430.28	Branc-Circuit protective device	OCPD
	430.28	Overcurrent Device	OCPD
	430.51	Overcurrent	Fine as is
	430.53(C)(5)	Overcurrent Protection	Fine as is
	430.55	Overcurrent Protection	Fine as is
	430.61	Overcurrents	Fine as is
	430.62(A)Ex.2	Feeder Overcurrent protective device	Feeder OCDP
	430.62(A)Ex.2	Overcurrent Protection	Fine as is
	430.62(B)	Feeder Overcurrent protective device	Feeder OCDP
	430.63Ex.	Feeder Overcurrent device	Feeder OCDP
	430.63Ex.	Overcurrent Protection	Fine as is
	430.72. Title	Overcurrent Protection	Fine as is
	430.72(A)	protected against overcurrent	shall be provided with overcurrent protection in accordance with
	430.72(A)	Branch-circuit overcurrent protective devices	OCPDs
	430.72(A)	protected against overcurrent	shall be provided with overcurrent protection in accordance with
	430.72(B). (X2)	Overcurrent Protection	Fine as is
	430.72(B)	Overcurrent Device	OCPD

	430.72(B)	Overcurrent Protection	Fine as is
	430.72(B)(1) (X3)	Overcurrent Protection	Fine as is
	430.72(B)(2) Title	Branch-circuit overcurrent protective device	Fine as is
	430.72(B)(2) (X2)	protective devices	OCPDs
	430.72(C)Ex.	Overcurrent Protection	Fine as is
	430.72(C)(3)	Overcurrent Devices	OCPDs
	430.72(C)(4)	Overcurrent Device	OCPD
	430.72(C)(5)	Protection	Overcurrent protection
	430.87	Overcurrent Device	OCPD
	430.94. (X2)	Overcurrent Protection	Fine as is
	430.94. (X3)	Overcurrent protective device	OCPD
	430.109(A)(7)	Overcurrent protection	Fine as is
	430.109(B)	Branch-circuit overcurrent device	branch-circuit OCPD
	430.111(A). (X2)	Overcurrent Device	Fine as is
	430.112 Ex.	Branch circuit protective device	Suggest CMP to Review
	430.206. Title	Overcurrent protection	Fine as is
	430.206(B)(2)	considered to have Overcurrent	Overload
	430.206(C)	Fault-Current protection	Suggest CMP to Review
	430.207	Overcurrent (overload)Relays	Fine as is
	430.207	Overcurrent Relays	Fine as is
11	**Article 440**		
	440.21	Overcurrent	Fine as is
	440.21	Overcurrent Protection	Fine as is
	440.22(B)(2)Ex.	Overcurrent device	OCPD
	440.52(B)	Overcurrent	shall be provided with overcurrent protection
11	**Article 460**		
	460.9. Title	Overcurrent Protection	Fine As Is
	460.9. (X3)	Overcurrent Device	OCPD
	460.25	Overcurrent Protection	Fine As Is
	460.28(B)	Overcurrent Device	OCPD

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-12			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
12	**Article 610**		
	610. Part V	Overcurrent Protection	Fine as is
	610.41(A)	Overcurrent Devices	OCPDs
	610.43(A)(1)	Branch Circuit Overcurrent Device	OCPD
	610.53 Title	Overcurrent Protection	Fine as is
	610.53	be protected from Overcurrent	shall be provided with overcurrent protection
	610.53	Overcurrent Devices	OCPDs
	610.53(B)	Branch Circuit Overcurrent Devices	OCPDs
12	**Article 620**		
	620.12(A)(4)	Overcurrent Protection	Fine as is
	620.22(A)(2) Title	Overcurrent protective device	Fine as is
	620.22(A)(2)	Overcurrent Device protecting	branch-circuit OCPD
	620.22(A)(2)	Overcurrent Device	OCPD
	620.22(B)	Overcurrent Device protecting	branch-circuit OCPD
	620.22(B)	Overcurrent Device	OCPD
	620.25 Title	Overcurrent Devices	Overcurrent Protective Devices
	620.25. (X2)	Overcurrent Devices	OCPDs
	620.53	Overcurrent protective device	OCPD
	620.54	Overcurrent protective device	OCPD
	620.55	Overcurrent protective device	OCPD
	Art 620 Part VII	Overcurrent Protection	Fine as is
	620.61	Overcurrent Protection	Fine as is
	620.61(A). (X2)	be protected against Overcurrent	shall be provided with overcurrent protection
	620.62(A)	Overcurrent protective devices, (OCPD)	OCPDs
	620.62(B)	OCPDs	Fine as is
	620.62(C)	OCPDs. And. Overcurrent Devices	Fine as is. And. OCPDs
	620.62	Overcurrent protective devices	OCPDs
	620.65. (X3)	Overcurrent Devices	OCPDs
12	**Article 625**		
	625.60(C). (X4)	Overcurrent Protection	Fine as is
12	**Article 627**		
	627.41	Overcurrent Protection	Fine as is
	627.41(A)	Overcurrent Protection	Fine as is

	627.41(B)	Overcurrent Devices	OCPDs
12	**Article 630**		
	630.12	Overcurrent Protection	Fine as is
	630.12	Overcurrent Device	OCPD
	630.12(A). (X2)	Overcurrent Protection	Fine as is
	630.12(A). (X5)	Overcurrent Device	OCPD
	630.13	Overcurrent Protection	Fine as is
	630.32	Overcurrent Protection	Fine as is
	630.32	Overcurrent Device	OCPD
12	**Article 640**		
	640.9(C)	Overcurrent Protection	Fine as is
	640.22	Overcurrent protection devices	OCPDs
	640.22	Overcurrent Devices	OCPDs
	640.43	Overcurrent protection devices	OCPDs
12	**Article 645**		
	645.27	Overcurrent protective devices, (OCPD)	OCPDs
	645.27	Overcurrent protective devices	OCPDs
12	**Article 646**		
	646.7. (X11)	Overcurrent Protection	Fine as is
12	**Article 647**		
	647.5	Overcurrent Protection	Fine as is
12	**Article 650**		
	650.9	Overcurrent Protection	Fine as is
	650.9	Overcurrent Device	OCPD
12	**Article 660**		
	660.7	Overcurrent Protection	Fine as is
	660.7(A)	Overcurrent protective devices	OCPDs
	660.7(B)	Overcurrent Devices	OCPDs
	660.7(B)	Overcurrent Protection	Fine as is
	660.9	Overcurrent Devices	OCPDs
12	**Article 665**		
	665.24	Overcurrent Protection	Fine as is
12	**Article 668**		
	668.4(C)(2)	Overcurrent Protection	Fine as is
	668.21	Overcurrent Protection	Fine as is

	668.21	Overcurrent Device	OCPD
12	**Article 669**		
	669.9	Overcurrent Protection	Fine as is
	669.9	be protected from Overcurrent	shall be provided with overcurrent protection
12	**Article 670**		
	670.1	Overcurrent Protection	Fine as is
	670.4(B). (X3)	Overcurrent Protection	Fine as is
	670.5. (X4)	Overcurrent Protection	Fine as is
	670.5(C). (X2)	Overcurrent protective device	OCPD
12	**Article 685**		
	685.10.	Overcurrent Devices	OCPDs

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-13			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
13	**Article 100**		
	Emerg.Power Supply Systems (EPSS)	overcurrent protection devices	overcurrent protective devices (OCPDs)
	Transfer-Switch B-C Emerg. Ltg.	branch-circuit overcurrent device	branch-circuit overcurrent protective device (OCPD)
13	**Article 130**		
	130.80(C)	overcurrent devices	OCPDs
	130.80(C)	branch-circuit overcurrent device	OCPD
13	**Article 445**		
	445.11	Overcurrent protective Relay	Fine as is
	445.12. Title	Overcurrent Protection	Fine as is
	445.12(A)	Overcurrent protective means	Overcurrent protection means
	445.12(B)	Overcurrent Protection	Fine as is
	445.12(B) (X2)	Overcurrent Device	OCPD
	445.12(C)	Overcurrent Device	OCPD
	445.12(D)	Overcurrent Devices	OCPDs
	445.12(E). (X3)	Overcurrent Devices	OCPDs
	445.13(A). (X2)	Overcurrent Protection	Fine as is
	445.13(B). Title	Overcurrent protection	Fine as is
	445.13(B).	Overcurrent protective device	OCPD
	445.13(B)	Overcurrent Relay	Fine as is
13	**Article 455**		
	455.7	Overcurrent Protection	Fine As Is
	455.7	protected from Overcurrent	shall be provided with overcurrent protection in accordance with
	455.7(A)	Overcurrent Protection	Fine As Is
	455.7(B)	Overcurrent Protection	Fine As Is
13	**Article 480**		
	480.4(B) IN.2	Overcurrent Protection	Fine As Is
	480.6. (X2)	Overcurrent Protection	Fine As Is
	480.7	Overcurrent Device	OCPD
13	**Article 695**		
	695.4(C)	Overcurrent protective devices	OCPDs
	695.4(H). Title	Overcurrent Device Selection	Overcurrent Protective Device Selection
	695.4(H)	Overcurrent Devices	OCPDs

	695.5	Overcurrent Device	OCPD
	695.5	Overcurrent protective devices	OCPDs
	695.5	Overcurrent Protection	Fine as is
	695.6	Overcurrent protective devices	OCPDs
	695.6	Overcurrent Devices	OCPD
	695.6	Overcurrent Protection	Fine as is
	695.7(A)(2)	Overcurrent Devices	OCPDs
	695.7	Overcurrent Protection	Fine as is
13	**Article 700**		
	700.4(F)(8)	Overcurrent protective devices, (OCPD)	OCPDs
	700.6(E)	Overcurrent protective device	OCPD
	700.10(B). (X6)	Overcurrent Protection	Fine as is
	700.10(B)(6)(b)(ii)	Overcurrent protective device	OCPD
	700.10(B)(6)(e)	Overcurrent protective devices	OCPDs
	Art. 700 Part VI	Overcurrent Protection	Fine as is
	700.30.	Branch-circuit overcurrent devices	OCPDs
	700.32(A)	Overcurrent protective devices, (OCPDs)	OCPDs
	700.32(A) In	Overcurrent Protection	Fine as is
	700.32(C)	Overcurrent Devices	OCPDs
13	**Article 701**		
	701.6(C)	Overcurrent protective device	OCPD
	701.10(B)(1). (X5)	Overcurrent Protection	Fine as is
	701.10(B)(1)	Overcurrent protective device	OCPD
	Art. 701. Part IV	Overcurrent Protection	OCPDs
	701.30.	Branch-Circuit Overcurrent devices	Branch-Circuit OCPDs
	701.32(A). (X2)	Overcurrent protective devices, OCPDs	OCPDs
	701.32(B). (X3)	OCPDs	Fine as is
	701.32(C). (X2)	OCPDs	Fine as is
	701.32(C)Ex	Overcurrent Devices	OCPDs
	701.32(C) In 2	OCPD and OCPDs	Fine as is
13	**Article 702**		
	702.5(C)	Overcurrent protective device	OCPD
13	**Article 706**		
	706.15(E)(1)	Overcurrent Device	OCPD
	706.30(B)	Overcurrent Devices	OCPDs

	706.31 Title	Overcurrent Protection	Fine as is
	706.31(A)	shall be protected at the source from overcurrent.	shall be provided with overcurrent protection at the source
	706.31(A)	shall be protected from overcurrent.	shall be provided with overcurrent protection
	706.31(A) In	Overcurrent Device	OCPD
	706.31(B). Title	Overcurrent Device	Overcurrent Protective Device
	706.31(B)	Overcurrent protective devices	OCPDs
	706.31(B)	Overcurrent devices	OCPDs
	706.31(C)	Overcurrent protective devices	OCPDs
	706.31(E)	Overcurrent Protection	Fine as is
	706.33(B)(2)	Overcurrent Device	OCPD
13	**Article 708**		
	708.10(B)	Overcurrent Protection	Fine as is
	708.24(E)	Overcurrent protective device	OCPD
	Art. 708. Part IV	Overcurrent Protection	Fine as is
	708.50.	Feeder- and Branch-circuit overcurrent devices	Feeder- and Branch-circuit OCPDs
	708.52(B)	Overcurrent Devices	OCPDs
	708.54(A)	Overcurrent protective devices, (OCPD)	OCPDs
	708.54(A). (B). (C)	OCPDs	Fine as is
	708.54	Overcurrent Devices	OCPDs

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-14			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
14	**Article 500**		
	500.30(A)(2)	Branch Circuit Overcurrent Protection	OCPD
	500.30.	Overcurrent Protection	Fine as is
14	**Article 501**		
	501.105(B)(5)	Overcurrent Protection	Fine as is
	501.125(B)(2)	Motor Overcurrent	Fine as is
14	**Article 502**		
	502.120(A)	Overcurrent Devices	OCPDs
	502.120(B)(1)	Overcurrent Devices	OCPDs
	502.125	Motor Overcurrent	Fine as is
14	**Article 505**		
	505.30(A)(2)	Branch Circuit Overcurrent Protection	OCPD
	505.30.	Overcurrent Protection	Fine as is
14	**Article 506**		
	506.30.	Branch Circuit Overcurrent Protection	OCPD
	506.30.	Overcurrent Protection	Fine as is

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-15			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
15	**Article 100**		
	Bull Switch	Overcurrent protection	Fine as is
15	**Article 517**		
	517.17(B)	Overcurrent protective devices	OCPDs
	517.31(G). (X5)	Overcurrent protective devices	OCPDs
	517.31(G)	Overcurrent	Fine as is
	517.33((C). (X5)	Overcurrent protective devices	OCPDs
	517.42(F)	Overcurrent protective devices	OCPDs
	517.42(F)	Overcurrent	Fine as is
	517.73	Overcurrent Protection	Fine as is
	517.73(A)	Overcurrent protective devices	OCPDs
	517.73(B)	Overcurrent protective devices	OCPDs
	517.73(B)	Overcurrent Protection	Fine as is
	517.74(B)	Overcurrent protective devices	OCPDs
	517.160(A)(2)	Overcurrent Protection	Fine as is
	517.160(A)(2)	Overcurrent protective device	OCPD
	517.160(A)(2)	be protected against Overcurrent	be provided with overcurrent protection
	517.160(A)(3)	Overcurrent protective devices	OCPDs
	517.160(B)(1)	Overcurrent protective devices	OCPDs
15	**Article 518**		
	518.7(A)(1)	Overcurrent Protection	Fine as is
	518.17(A)(1) and (2)	Overcurrent Devices	OCPDs
15	**Article 520**		
	520.9	Branch Circuit Overcurrent Device	OCPD
	520.21	Overcurrent protective devices	OCPDs
	520.25. (X3)	Overcurrent Protection	Fine as is
	520.26	Overcurrent protective devices	OCPD
	520.26. (X3)	Overcurrent Protection	Fine as is
	520.27. (X2)	Overcurrent Device	OCPD
	520.44-T	Overcurrent Devices	OCPD
	520.50(C)	Overcurrent Protection	Fine as is
	520.50.	Branch-circuit overcurrent protective device	OCPDs
	520.52	Overcurrent Protection	Fine as is

	520.53(A)	Overcurrent protective devices	OCPDs
	520.53(D)	Overcurrent Protection	Fine as is
	520.54	Overcurrent Devices	OCPDs
	520.54(D)	Overcurrent Device	OCPD
	520.54(D)(1) and (2)	Overcurrent protective devices	OCPD
	520.54(E)	Overcurrent protective device	OCPD
	520.54(E). (X4)	Overcurrent protection device	OCPD
	520.54(E)	Overcurrent Devices	OCPDs
	520.54(K)	Overcurrent Device	OCPD
	520.68	Overcurrent protective device	OCPD
	520.68(3)	Overcurrent Device	OCPD
	520.68(4)	Overcurrent protective device	OCPD
	520.68(6)	Overcurrent Devices	OCPDs
	520.68(C)	Overcurrent Protection	Fine as is
15	**Article 522**		
	522.10(A)(2). (X3)	Overcurrent Devices	OCPDs
	522.10(A)(2	Overcurrent protective device	OCPD
	522.10(B). (X4)	Overcurrent Devices	OCPDs
	522.23. (X3)	Overcurrent Protection	Fine as is
15	**Article 525**		
	525.12	Overcurrent Device	OCPD
	525.23(B)	Overcurrent Device	OCPD
	525.23(C). (X2)	Overcurrent Protection	Fine as is
15	**Article 530**		
	530.9(A)	Branch-circuit overcurrent device	Branch-circuit OCPD
	530.10(C)	Overcurrent Protection	Fine as is
	530.23 and (A)	Overcurrent Protection	Fine as is
	530.23(B)	Overcurrent protective devices	OCPDs
	530.23(D)	Overcurrent Protection	Fine as is
	530.42	Overcurrent Protection	Fine as is
15	**Article 540**		
	540.11(B)	Overcurrent Devices	OCPDs

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-16			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
16	**Article 830**		
	830.15. (X4)	Overcurrent Protection	Fine as is

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-17			
CMP	**NEC Section (using First Draft of 2026 NEC)**	**Current Language**	**"New" Language**
17	**Article 422**		
	422.5(C)	Branch-circuit overcurrent protective device	Branch-Circuit OCPD
	422.11. Title	Overcurrent Protection	Fine as is
	422.11	protected against overcurrent	shall be provided with overcurrent protection
	422.11(A)	Overcurrent Protection	Fine as is
	422.11(A)	Branch-circuit overcurrent protective device	Branch-Circuit OCPD
	422.11(B)	Overcurrent Protection	OCPDs
	422.11(C)	Overcurrent Protection	OCPDs
	422.11(D)	Overcurrent protective devices	OCPDs
	422.11(E)	Overcurrent Protection	Fine as is
	422.11(E)(1)	Overcurrent Protection	Fine as is
	422.11(E)(2)	Overcurrent Protection	Fine as is
	422.11(E)(3)	Overcurrent Protection	OCPD
	422.11(E)(3)	Overcurrent Device	OCPD
	422.11(F)(1)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	422.11(F)(1)	Overcurrent Protective Devices	OCPDs
	422.11(G)	Overcurrent Protective Devices	OCPDs
	422.13	Overcurrent Protection	Fine as is
	422.31(A)	Branch-circuit overcurrent protective device	Branch-Circuit OCPD
	422.60(A)	Overcurrent Protection	Fine as is
	422.62(B)(1). (X2)	Overcurrent protective device	OCPD
17	**Article 424**		
	424.19	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	424.19(A)	Supplementary Overcurrent Protection	Fine as is
	424.19(A)	Supplementary Overcurrent Protection	Fine as is
	424.19(A)	Supplementary Overcurrent Protective Device(s)	Supplementary OCPDs
	424.19(B)	Supplementary Overcurrent Protection	Fine as is
	424.22	Overcurrent Protection	Fine as is
	424.22(A)	Overcurrent Protection	Fine as is
	424.22(A)	protected against overcurrent	"..shall be permitted to have overcurrent protection.."
	424.22(B)	Supplementary Overcurrent Protective Device	Supplementary OCPD
	424.22(C). Title	Overcurrent Protective Devices	Fine as is
	424.22(C)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs

	424.22(C)	Overcurrent Protection	Fine as is
	424.22(C)	Supplementary Overcurrent Protection	Fine as is
	424.22(D) (X2)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	424.22(E). (X3)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	424.72	Overcurrent Protection	Fine as is
	424.72(A)	Overcurrent protective device	OCPD
	424.72(B)	Overcurrent protective device	OCPD
	424.72(C). Title	Supplementary Overcurrent Protective Devices	Fine as is
	424.72(C)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	424.72(C)	Overcurrent Protection	Fine as is
	424.72(D). Title	Supplementary Overcurrent Protective Devices	Fine as is
	424.72(D).	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	424.72(D)	Overcurrent protective device	OCPD
	424.72(E)	Supplementary Overcurrent Protective Devices. (X3)	Supplementary OCPDs
	424.82	Overcurrent protective devices	OCPDs
17	**Article 425**		
	425.19	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	425.19(A). (X2)	Supplementary Overcurrent Protection	Fine as is
	425.19(A)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	425.19(B)	Supplementary Overcurrent Protection	Fine as is
	425.22. Title	Overcurrent Protection	Fine as is
	425.22(A)	Overcurrent Protection	Fine as is
	425.22(A)	protected against overcurrent	"..shall be permitted to have overcurrent protection.."
	425.22(B)	Supplementary Overcurrent Protective Device	Supplementary OCPD
	425.22(C). Title	Overcurrent Protective Devices	Fine as is
	425.22(C)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	425.22(C). (X2)	Supplementary Overcurrent Protection	Fine as is
	425.22(D). Title	Supplementary Overcurrent Protective Devices	Fine as is
	425.22(D). (X2)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	425.22(E) (X3)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	425.72	Overcurrent Protection	Fine as is
	425.72(A)	Overcurrent protective device	OCPD
	425.72(B)	Overcurrent protective device	OCPD
	425.72(C). Title	Supplementary Overcurrent Protective Devices	Fine as is
	425.72(C)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs

	425.72(C)	Overcurrent Protection	Fine as is
	425.72(D)	Overcurrent protection	Fine as is
	425.72(E). Title	Supplementary Overcurrent Protective Devices	Fine as is
	425.72(E)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	425.72(E)	Overcurrent Protective Devices	OCPD
	425.72(F). (X3)	Supplementary Overcurrent Protective Devices	Supplementary OCPDs
	425.82	Overcurrent protective devices	OCPDs
17	**Article 427**		
	427.57	Overcurrent Protection	Fine as is
	427.57	considered protected against Overcurrent	considered to have overcurrent protection
17	**Article 680**		
	680.10.(A)& (B)(2)	Overcurrent protective devices	OCPDs
	680.23(F)(2)	Overcurrent Protection	Fine as is

CMP-10 TG-4 Review of Overcurrent Language for the Articles undeer the purview of CMP-18

CMP	NEC Section (using First Draft of 2026 NEC)	Current Language	"New" Language
18	**Article 393**		
	393.45. Title	Overcurrent …... Protection	Overcurrent Protection ….
	393.45(A)	Overcurrent Protection	Fine as is
18	**Article 406**		
	406.46(F)	Overcurrent Device	OCPD
18	**Article 410**		
	410.59(A)	Branch-circuit overcurrent devices	Branch-Circuit OCPD
	410.153	Overcurrent Protection	Fine as is
18	**Article 600**		
	600.41	Overcurrent	CMP to Review

Public Comment No. 1218-NFPA 70-2024 [Definition: Battery, Stationary Standby. (Stationary Standb...]

Battery, ~~Stationary Standby~~ Standby . (Stationary ~~Standby~~ Battery)

A battery that spends the majority of the time on continuous float charge or in a high state of charge, in readiness for a discharge event. (CMP-13)

Informational Note: Uninterruptible Power Supply (UPS) batteries are an example that falls under this definition.

Statement of Problem and Substantiation for Public Comment

Although I prefer the language of the 2023 NEC, if Article 480 continues to no longer use this term, this definition needs to be changed.

Related Item

- FR 8129

Submitter Information Verification

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Submittal Date: Sat Aug 17 17:26:44 EDT 2024
Committee: NEC-P13

Public Comment No. 1947-NFPA 70-2024 [Definition: Energy Storage System (ESS).]

Energy Storage System (ESS).

One or more devices, assembled together, capable of storing energy to supply electrical energy at a future time. [**855:**3.3.9] (CMP-13)

Informational Note No. 1: An ESS(s) can include but is not limited to batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air). ~~An ESS(s)~~

Informational Note No. 2: A battery ESS differ from a stationary battery installation in that they are evaluated and listed as a complete system that 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 a stationary standby battery installation where a battery spends the majority of the time on continuous float charge or in a high state of charge, in readiness for a discharge event See ANSI/UL 9540, *Standard for Energy Storage Systems and Equipment* .~~

Statement of Problem and Substantiation for Public Comment

Committee discussions in the First Draft Meeting emphasized the need to distinguish between battery ESS that fall under the scope of Article 706, and stationary batteries that would remain under the scope of Article 480. The current Informational Note 2 language ties stationary batteries to a specific function or application, which is not how these are differentiated between battery ESS. The key distinction is in how these systems are evaluated and listed. The proposed change is harmonized with and reinforces the scopes of Articles 480 and 706, where the connection to the relevant standards are made. The reference to UL 9540 is helpful for the specificity of the relevant components (such as multi-mode inverters) that may make up a listed ESS.

The Solar and Storage Industry Forum (SSIF) is a coalition of individuals and organizations convened by the Solar Energy Industry Association (SEIA) to organize, support, and mentor renewable energy industry professionals in codes and standards development . Our objective is to submit industry consensus-based recommendations for changes to the National Electrical Code. We believe that this effort improves the Code-making process by consolidating multiple industry member's points of view into fewer, common proposals. SSIF members are dedicated to continually improving the installation safety of PV and storage systems in the U.S. A list of members can be found here: https://www.seia.org/industry-forum

Related Item

• FR-7524 • PI-3863

Submitter Information Verification

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Submittal Date: Wed Aug 28 12:26:30 EDT 2024
Committee: NEC-P13

Public Comment No. 488-NFPA 70-2024 [Definition: Equipment, Interconnection. (Interconnection Eq...]

Equipment, Interconnection. (Interconnection Equipment)

Equipment that performs protective and control functions that enables power sources, or systems supplied by power sources, to operate in parallel with, separate from, and reconnect to systems supplied by other power sources. (CMP-4)

Additional Proposed Changes

File Name	Description	Approved
CN_135.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 135 appeared in the First Draft Report on First Revision No. 8884.

The Correlating Committee directs the definition of “Equipment, Interconnection” be sent to CMP-13 to review for correlation.

Related Item

• First Revision No. 8884

Submitter Information Verification

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Submittal Date: Tue Jul 30 19:50:35 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 135-NFPA 70-2024 [Definition: Equipment, Interconnection. (Interconnection Eq...]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Wed May 08 15:44:35 EDT 2024

Committee Statement

Committee Statement: The Correlating Committee directs the definition of "Equipment, Interconnection" be sent to CMP-13 to review for correlation.

First Revision No. 8884-NFPA 70-2024 [New Definition after Definition: Equipment.]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 1035-NFPA 70-2024 [Definition: Generator (Generator Set).]

~~Generator (Generator Set).~~ **Generator**

A machine that converts mechanical energy into electrical energy ~~by means of a prime mover and alternator.~~ . Sources of mechanical energy include, but are not limited to, internal combustion engines, wind turbines, water turbines, gas turbines, or steam turbines. (CMP-13)

Statement of Problem and Substantiation for Public Comment

This was submitted as PI 1200. It is a companion proposal to split Article 445 into three parts: General, Generators, Engine-Generator Assemblies. Article 445 originally appeared in the Code in 1937. Before that, generators were covered under the general category of "rotating equipment." In the last couple of Code cycles, sections have been added that apply to engine-generator assemblies. If CMP-13 decides to split Article 445 into three parts, this revision to the definition of "Generator" will be required.

Related Item

- 1200-NFPA 70-2023

Submitter Information Verification

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Submittal Date:	Sun Aug 11 20:54:03 EDT 2024
Committee:	NEC-P13

Public Comment No. 1798-NFPA 70-2024 [Definition: Generator Terminals.]

~~**Generator Terminals.**~~

~~The point of connection for the output conductors on the generator (generator set). (445) (CMP-13)~~

Statement of Problem and Substantiation for Public Comment

This definition, based on the substantiation for Public Input No. 4442-NFPA 70-2023, will have unintended consequences where the generator set has more than one output circuit breaker. For example if the generator set has two output breakers, each rated at half of the generator full load current, the application of this new definition. For example if the generator has a full load current of 600 amps and there are two 300 amp breakers installed in the generator set, the application of this definition will require conductors with an ampacity of 690 amps to be connected to the load side of the 300 amp breakers.
This is based on the substantiation, part of which said:
"This definition is needed to clarify that the generator terminals are the connection point of the output conductors for the whole generator set not just the generator. Examples of "generator terminals" can be power distribution blocks, busbars, circuit breakers, etc."

Related Item

• Public Input No. 4442-NFPA 70-2023 • First Revision No. 7511-NFPA 70-2024

Submitter Information Verification

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Submittal Date: Tue Aug 27 12:51:09 EDT 2024
Committee: NEC-P13

Public Comment No. 1949-NFPA 70-2024 [Definition: Load Management.]

Load Management.

The process within an energy management system that limits the total electrical load on an electrical supply system to a set value by adjusting or controlling ~~the~~ load circuits or individual loads. (CMP-13)

Statement of Problem and Substantiation for Public Comment

Load management can be used to control an individual load or multiple loads. The proposed change better aligns with UL 3141 and EMS in general, as load management can be achieved by the control of circuits feeding loads as well as by controlling the loads themselves.

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Related Item

- FR-8441 • PI-4262 • PI-4295

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Submittal Date: Wed Aug 28 12:33:52 EDT 2024
Committee: NEC-P13

Public Comment No. 1222-NFPA 70-2024 [Definition: Power Control System (PCS).]

Power Control System (PCS).

Equipment that monitors and controls power within an electrical system to prevent overload of ~~an electrical service~~ a service , ~~feeder,~~ conductor, or ~~other~~ power distribution equipment. (CMP-13)

Informational Note: A power control system may control generation, energy storage, loads, circuit controllers, or other equipment to manage power and may contain additional protective functions relative to EMS or grid interconnection functions.

Statement of Problem and Substantiation for Public Comment

This comment seeks to simplify the definition by removing unnecessary words. Obviously the "service" discussed in the definition is electrical, considering that this book is the National Electrical Code. The word "feeder" should be removed because the definition already states "conductor." By including "feeder" along with service, but not including "branch circuit," there is room for debate where there need not be.

Related Item

- FR 7764

Submitter Information Verification

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Committee:	NEC-P13

Public Comment No. 583-NFPA 70-2024 [Definition: Power Control System (PCS).]

Power Control System (PCS).

Equipment that monitors and controls power within an electrical system~~ to prevent overload of an electrical service, feeder, conductor, or other power distribution equipment~~ . (CMP-13)

Informational Note: A power control system may control generation, energy storage, loads, circuit controllers, or other equipment to manage power and may contain additional protective functions relative to EMS or grid interconnection functions.

Statement of Problem and Substantiation for Public Comment

A Power Control System could be employed for reasons other than overload prevention. The NEC shouldn't single out one reason and use that for the definition.

Related Item

- FR 7764

Submitter Information Verification

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Submittal Date: Thu Aug 01 15:40:00 EDT 2024
Committee: NEC-P13

Public Comment No. 584-NFPA 70-2024 [Definition: Switch, Bypass Isolation. (Bypass Isolation Swi...]

Switch, Bypass Isolation. (Bypass Isolation Switch)

A ~~manual, nonautomatic, or automatic operated~~ manually or non-automatically operated device used in conjunction with a transfer switch to provide a means of bypass ~~that directly connects the load conductors to a power source and allows~~ and isolation of the transfer switch for inspection or maintenance. The device may have provisions to ~~be isolated or disconnected.~~ transfer to the other sources while remaining in the bypass/isolation state. The transfer provisions may be manual, non-automatic, or automatic. (CMP-13)

Statement of Problem and Substantiation for Public Comment

This definition is modified so it's clear to the reader that the bypass isolation operation (of the transfer switch) is manual or non-automatic, and that the bypass isolation operation is primarily done for inspection or maintenance. The modified definition also defines the potential transfer capabilities of the bypass isolation switch.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 585-NFPA 70-2024 [Definition: Transfer Switch, Bypass Isolation. (Bypass Isol...]	
Public Comment No. 585-NFPA 70-2024 [Definition: Transfer Switch, Bypass Isolation. (Bypass Isol...]	

Related Item

- FR 7536

Submitter Information Verification

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Submittal Date: Thu Aug 01 15:47:05 EDT 2024
Committee: NEC-P13

Public Comment No. 1156-NFPA 70-2024 [Definition: Transfer Switch, Bypass Isolation. (Bypass Isol...]

Transfer Switch, Bypass Isolation. (Bypass Isolation Transfer Switch)

~~A transfer switch that provides a means to isolate the transfer switch~~ An assembly that includes a transfer switch and bypass isolation switch functionality . (CMP-13)

Statement of Problem and Substantiation for Public Comment

The definition in FR 7643 is incomplete. The revised definition aligns with a new definition being included in UL 1008. Both of the terms “bypass isolation switch” and “transfer switch” are currently defined and a “bypass isolation transfer switch” includes both of these.

Related Item

- FR7463

Submitter Information Verification

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Submittal Date:	Fri Aug 16 09:35:16 EDT 2024
Committee:	NEC-P13

Public Comment No. 585-NFPA 70-2024 [Definition: Transfer Switch, Bypass Isolation. (Bypass Isol...]

Transfer Switch, Bypass Isolation. (Bypass Isolation Transfer Switch)

A ~~transfer switch that provides a means to isolate the transfer switch.~~ device that includes both transfer switch and bypass isolation switch functionality. (CMP-13)

Statement of Problem and Substantiation for Public Comment

The FR 7643 definition for “Transfer Switch, Bypass Isolation” is so vague that it has no meaning.
The definition is modified for clarity. It’s based on functionality and includes two devices that are already defined.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 584-NFPA 70-2024 [Definition: Switch, Bypass Isolation. (Bypass Isolation Swi...]	
Public Comment No. 584-NFPA 70-2024 [Definition: Switch, Bypass Isolation. (Bypass Isolation Swi...]	

Related Item

- FR 7643

Submitter Information Verification

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Submittal Date: Thu Aug 01 16:09:23 EDT 2024
Committee: NEC-P13

Public Comment No. 1959-NFPA 70-2024 [New Definition after Definition: Deploy (Deployed).]

Deutilization Equipment

The opposite of utilization equipment, a plug generation source that draws current form a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current.

Statement of Problem and Substantiation for Public Comment

The fact of the matter is that the NFPA 70, National Electric Code, is a document to prevent Electrical Fires, and the greatest risk of Electrical Fires in the era defined by this electric code is that of anthropogenic climate change. The changes to chapter 625, while are much needed and welcome in enabling vehicle to grid technology, do not go nearly far enough to prevent the imminent fire risk posed, both by the direct results of anthropogenic climate change, but also by the response to that risk by individual people if left uncontrolled.

Chapter 625 attempts to establish and describe vehicle to grid but does so narrowing it into the technology limitations of our time, meanwhile, this is an electric code which will need to serve the fire protection needs of the era between 2026 and 2029, the apex of the battle with climate change. The actual technology which should be enshrined in the National Electric Code should be the ability for safe, boutique, plug and play, prosumer generation technology, which should be technology agnostic, should not be narrowed to a vehicle, and should be backwards compatible to the current built electrical environment and not require expensive upgrades to existing electrical systems. Today we can only conceive of an era in which these devices are vehicles, and that the currents and voltages required in essence require a proto-service entrance, but we are on the precipice of changes such as solid-state batteries which could dramatically shrink the size of equipment which could provide useful power to the grid, and an era in which the efficiency of devices on the market is increasing at such a rate that it is conceivable that by 2029, a cell phone could power all the lights of an entire office.

This is what I attempt to do in my changes, which should be viewed as a set, by pulling the electric vehicle out of these standards to enable future technologies such as cell phone to grid, balcony solar, balcony wind, oven to grid, and gains to grid.

Thank you for your time,

Amethyst O'Connell

(My comments are mine as an individual and should not be misconstrued as representing my companies or my university and it's affiliates.)

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1966-NFPA 70-2024 [Definition: Electric Vehicle Power Export Equipment (EVPE).]	

Related Item

- First Revision No. 8260-NFPA 70-2024 [Section No. 625.22]

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Submittal Date: Wed Aug 28 12:52:29 EDT 2024
Committee: NEC-P13

Public Comment No. 1036-NFPA 70-2024 [New Definition after Definition: Generator (Generator Set).]

Generator, Engine-Generator Assembly (Engine-Generator Assembly)

An assembly that includes an electrical generator, an engine that uses gasoline, LP-gas, natural gas, or diesel, and all the other necessary components to produce electricity.

Statement of Problem and Substantiation for Public Comment

This was submitted as PI 1201. It is a companion proposal to split Article 445 into three parts: General, Generators, Engine-Generator Assemblies. Article 445 originally appeared in the Code in 1937. Before that, generators were covered under the general category of "rotating equipment." In the last couple of Code cycles, sections have been added that apply to engine-generator assemblies. If CMP-13 decides to split Article 445 into three parts, this new definition of "Engine-Generator assemblies" will be required.

Related Item

- 1201-NFPA 70-2023

Submitter Information Verification

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Submittal Date: Sun Aug 11 21:05:11 EDT 2024
Committee: NEC-P13

Public Comment No. 1125-NFPA 70-2024 [Article 130]

~~**Article 130** Energy Management Systems~~

~~**Part I.** General~~

~~**130.1** Scope.~~

~~This article applies to the installation and operation of energy management systems.~~

> ~~Informational Note: Performance provisions in other codes may establish prescriptive requirements in addition to the requirements contained in this article.~~

~~**130.2** Listing Requirements.~~

~~Energy management equipment shall be listed. Equipment providing overload control as covered in Article 130 , Part II shall be listed and labeled as a power control system (PCS).~~

> ~~Informational Note: Evaluations of energy management equipment with PCS are different than evaluations of general energy management equipment. See UL 916, *Energy Management Equipment* , for information on listed energy management equipment, and UL 3141, *Power Control Systems* , for information on listed PCS equipment.~~

~~**130.20** Alternate Power Sources.~~

~~An energy management system shall not override any control necessary to ensure continuity of an alternate power source for the following:~~

(1) ~~Fire pumps~~

(2) ~~Health care facilities~~

(3) ~~Emergency systems~~

(4) ~~Legally required standby systems~~

(5) ~~Critical operations power systems~~

~~**130.30** Load Management.~~

~~Energy management systems shall be permitted to monitor and control electrical loads and sources in accordance with 130.30(A) through 130.30(C) .~~

~~**(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~~

~~**(B)** Disconnection of Power.~~

~~An energy management system shall not cause disconnection of power to the following:~~

(1) ~~Elevators, escalators, moving walks, or stairway lift chairs~~

(2) ~~Positive mechanical ventilation for hazardous (classified) locations~~

(3) ~~Ventilation used to exhaust hazardous gas or reclassify an area~~

(4) ~~Circuits supplying emergency lighting~~

(5) ~~Essential electrical systems in health care facilities~~

~~**(C)** Capacity of Branch Circuit, Feeder, or Service.~~

~~An energy management system shall not cause a branch circuit, feeder, or service to be overloaded.~~

~~**Part II.** EMS for Overload Control~~

~~**130.50** General.~~

~~Part II contains additional requirements for EMS that provide controls required to prevent the overloading of conductors and equipment through the use of a PCS.~~

~~**130.60** Conductors and Equipment~~

~~**(A)** Monitoring and Controls.~~

~~The EMS with PCS shall include monitoring and automatic control devices to prevent overload of conductors and power distribution equipment associated with the EMS with PCS.~~

~~**(B)** Malfunction.~~

~~The EMS with PCS shall transition to a state that prevents overload in response to a failure or malfunction affecting the ability to monitor and control currents within the PCS.~~

> ~~Informational Note: Examples of failure or malfunction are operating conditions where the control system is not able to achieve or maintain the desired setpoint value. Equipment failure, delayed response, or the loss of control or feedback elements are common causes of system malfunction.~~

~~**130.70** Settings.~~

~~**(A)** Current Setpoint.~~

~~The EMS with PCS shall be capable of being set to a current setpoint in amperes for each controlled conductor, controlled source, or controlled load.~~

> ~~Informational Note: Current setpoints may be used for calculating the connected load(s) and or source(s). See 120.7 for application of an EMS with PCS setpoint used in load calculations.~~

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

~~Adjustable settings for overload control functions shall be permitted if access to the settings is limited by at least one of the following:~~

(1) ~~Located behind locked doors accessible only to qualified personnel~~

(2) ~~Software that has password protected access to the adjusting means accessible to qualified personnel only~~

(3) ~~Hardware such as dip switches located behind locked doors or areas requiring a tool for access~~

~~*Exception: Adjustable trip circuit breakers with restricted access, as allowed in 240.6(C) or 240.6(D), shall be permitted.*~~

~~**130.80** Marking and Documentation.~~

~~**(A)** Marking.~~

~~The equipment that supplies the branch circuit, feeder, or service shall be marked with the following information:~~

(1) ~~Current setpoint(s)~~

(2) ~~In other than one- and two-family dwellings, the date of calculation and identification of qualified personnel determining the settings~~

(3) ~~Identification of loads and sources managed by the EMS with PCS~~

(4) ~~The following or equivalent wording: "Circuits within this equipment are controlled by a power control system. The current setpoints shall only be changed by a qualified person."~~

~~The markings shall meet the requirements in 110.21(B) and shall be located such that they are clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.~~

~~**(B)** Documentation.~~

~~A list of the monitoring and control equipment and associated settings that perform the overload control functions shall be documented and readily available.~~

~~Informational Note: Listed EMS with PCS may include specific hardware and software components that are detailed in the documentation included with the listing.~~

~~**(C)** Directory.~~

~~Where the EMS with PCS control equipment is not located within sight of the overcurrent device(s) for the controlled circuit(s), a directory identifying the controlled device(s) and associated circuit(s) shall be posted on the enclosure of the control device(s), disconnect, or branch-circuit overcurrent device.~~

Statement of Problem and Substantiation for Public Comment

This article should not have been relocated to Chapter 1 as it does not contain requirements that are general which is what the title of Chapter 1, General, indicates.

Related Item

• FCR-218

Submitter Information Verification

Submitter Full Name: Palmer Hickman
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Submittal Date: Thu Aug 15 14:09:07 EDT 2024
Committee: NEC-P13

Public Comment No. 1126-NFPA 70-2024 [Article 130]

~~**Article 130** Energy Management Systems~~

~~**Part I.** General~~

~~**130.1** Scope.~~

~~This article applies to the installation and operation of energy management systems.~~

> ~~Informational Note: Performance provisions in other codes may establish prescriptive requirements in addition to the requirements contained in this article.~~

~~**130.2** Listing Requirements.~~

~~Energy management equipment shall be listed. Equipment providing overload control as covered in Article 130 , Part II shall be listed and labeled as a power control system (PCS).~~

> ~~Informational Note: Evaluations of energy management equipment with PCS are different than evaluations of general energy management equipment. See UL 916, *Energy Management Equipment* , for information on listed energy management equipment, and UL 3141, *Power Control Systems* , for information on listed PCS equipment.~~

~~**130.20** Alternate Power Sources.~~

~~An energy management system shall not override any control necessary to ensure continuity of an alternate power source for the following:~~

(1) ~~Fire pumps~~
(2) ~~Health care facilities~~
(3) ~~Emergency systems~~
(4) ~~Legally required standby systems~~
(5) ~~Critical operations power systems~~

~~**130.30** Load Management.~~

~~Energy management systems shall be permitted to monitor and control electrical loads and sources in accordance with 130.30(A) through 130.30(C) .~~

~~**(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~~

~~**(B)** Disconnection of Power.~~

~~An energy management system shall not cause disconnection of power to the following:~~

(1) ~~Elevators, escalators, moving walks, or stairway lift chairs~~
(2) ~~Positive mechanical ventilation for hazardous (classified) locations~~
(3) ~~Ventilation used to exhaust hazardous gas or reclassify an area~~
(4) ~~Circuits supplying emergency lighting~~
(5) ~~Essential electrical systems in health care facilities~~

~~**(C)** Capacity of Branch Circuit, Feeder, or Service.~~

~~An energy management system shall not cause a branch circuit, feeder, or service to be overloaded.~~

~~**Part II.** EMS for Overload Control~~

~~**130.50** General.~~

~~Part II contains additional requirements for EMS that provide controls required to prevent the overloading of conductors and equipment through the use of a PCS.~~

~~**130.60** Conductors and Equipment~~

~~**(A)** Monitoring and Controls.~~

~~The EMS with PCS shall include monitoring and automatic control devices to prevent overload of conductors and power distribution equipment associated with the EMS with PCS.~~

~~**(B)** Malfunction.~~

~~The EMS with PCS shall transition to a state that prevents overload in response to a failure or malfunction affecting the ability to monitor and control currents within the PCS.~~

> ~~Informational Note: Examples of failure or malfunction are operating conditions where the control system is not able to achieve or maintain the desired setpoint value. Equipment failure, delayed response, or the loss of control or feedback elements are common causes of system malfunction.~~

~~**130.70** Settings.~~

~~**(A)** Current Setpoint.~~

~~The EMS with PCS shall be capable of being set to a current setpoint in amperes for each controlled conductor, controlled source, or controlled load.~~

> ~~Informational Note: Current setpoints may be used for calculating the connected load(s) and or source(s). See 120.7 for application of an EMS with PCS setpoint used in load calculations.~~

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

~~Adjustable settings for overload control functions shall be permitted if access to the settings is limited by at least one of the following:~~

(1) ~~Located behind locked doors accessible only to qualified personnel~~

(2) ~~Software that has password protected access to the adjusting means accessible to qualified personnel only~~

(3) ~~Hardware such as dip switches located behind locked doors or areas requiring a tool for access~~

~~*Exception: Adjustable trip circuit breakers with restricted access, as allowed in 240.6(C) or 240.6(D), shall be permitted.*~~

~~**130.80** Marking and Documentation.~~

~~**(A)** Marking.~~

~~The equipment that supplies the branch circuit, feeder, or service shall be marked with the following information:~~

(1) ~~Current setpoint(s)~~

(2) ~~In other than one- and two-family dwellings, the date of calculation and identification of qualified personnel determining the settings~~

(3) ~~Identification of loads and sources managed by the EMS with PCS~~

(4) ~~The following or equivalent wording: "Circuits within this equipment are controlled by a power control system. The current setpoints shall only be changed by a qualified person."~~

~~The markings shall meet the requirements in 110.21(B) and shall be located such that they are clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.~~

~~**(B)** Documentation.~~

~~A list of the monitoring and control equipment and associated settings that perform the overload control functions shall be documented and readily available.~~

~~Informational Note: Listed EMS with PCS may include specific hardware and software components that are detailed in the documentation included with the listing.~~

~~**(C)** Directory.~~

~~Where the EMS with PCS control equipment is not located within sight of the overcurrent device(s) for the controlled circuit(s), a directory identifying the controlled device(s) and associated circuit(s) shall be posted on the enclosure of the control device(s), disconnect, or branch-circuit overcurrent device.~~

Statement of Problem and Substantiation for Public Comment

Relocate this article as Article 601 since its requirements fall within what Chapter 6, Special Equipment, addresses and does not fall with what is covered by Chapter 1 which is titled "General" and therefore should only contain requirements that are general.

Related Item

• FCR-218

Submitter Information Verification

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Submittal Date: Thu Aug 15 14:22:17 EDT 2024
Committee: NEC-P13

Public Comment No. 1978-NFPA 70-2024 [Section No. 130.2]

130.2 Listing Requirements.

Energy management equipment shall be listed. ~~Equipment~~ Energy management equipment providing overload control as covered in Article 130, Part II shall be listed and labeled as a power control system (PCS).

Informational Note: Evaluations of an energy management ~~equipment~~ system with PCS ~~are~~ functionality is different than ~~evaluations of~~ an evaluation of a general energy management ~~equipment~~ system . See UL 916, *Energy Management Equipment*, for information on listed energy management equipment, and UL 3141, *Power Control Systems*, for information on listed PCS equipment.

Statement of Problem and Substantiation for Public Comment

The term "Energy Management" was added to the 2nd sentence of the listing requirement to clarify that the equipment being referenced relates to an energy management function. Additionally, the informative note was revised to keep the terminology consistent when referring to an EMS and EMS with PCS functionality.

Related Item

- FR-8095

Submitter Information Verification

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Submittal Date: Wed Aug 28 13:49:02 EDT 2024
Committee: NEC-P13

Public Comment No. 1903-NFPA 70-2024 [Section No. 130.50]

130.50 General.

Part II contains additional requirements for EMS that provide controls required to prevent the overloading of conductors and equipment through the use of a PCS.

Informational Note: Requirements in Part II are typically addressed by the product listing and documented in the manufacturer's installation instructions.

Statement of Problem and Substantiation for Public Comment

This PC is intended to better set the context for AHJs that the functional requirements in Part II of Article 130 are largely internal product features addressed in the EMS-PCS listing, e,g, through UL 3141. It should be understood that AHJs can verify compliance to this section through the product listing and its documentation, and that it is not necessary to verify functions in the field.

Related Item

- FR-8095

Submitter Information Verification

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Submittal Date: Tue Aug 27 22:34:06 EDT 2024
Committee: NEC-P13

Public Comment No. 1997-NFPA 70-2024 [Section No. 130.60(A)]

(A) Monitoring and Controls.

The EMS with PCS shall include monitoring and automatic control devices to prevent overload of conductors, power sources, and power distribution equipment associated with the EMS with PCS.

Statement of Problem and Substantiation for Public Comment

The term “power sources” is added to this section to align with the allowance for energy management systems covered in Part II to manage sources as well as loads to prevent overload.

Related Item

• FR 8095

Submitter Information Verification

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Submittal Date: Wed Aug 28 14:44:21 EDT 2024
Committee: NEC-P13

Public Comment No. 844-NFPA 70-2024 [Section No. 130.60(B)]

(B) Malfunction.

The EMS with PCS shall transition to a state that prevents overload in response to a failure or malfunction affecting the ability to monitor and control currents within the PCS.- Where a PCS is used to control overload conditions in circuits other than branch circuits, a malfunction in the PCS control system shall not result in the opening of the overcurrent protective device protecting the circuit.

Informational Note: Examples of failure or malfunction are operating conditions where the control system is not able to achieve or maintain the desired setpoint value. Equipment failure, delayed response, or the loss of control or feedback elements are common causes of system malfunction.

Statement of Problem and Substantiation for Public Comment

Where a PCS is utilized to protect feeder or service conductors from overload conditions, the opening of the OCPD protecting the feeder or within service equipment could have negative implications in occupied buildings or other other processes not related to the PCS. This condition is considered and has been addressed in the second issue of UL 3141. While 130.2 requires all PCS to be listed, not all PCS would meet this requirement since some will only be evaluated for very specific applications such as only controlling current flow in conductors of a branch circuit. For PCS equipment that is intended to provide overload control for feeders and service conductors supplying general loads, this condition will be addressed in the PCS evaluation and will be referenced in the installation instructions. Adding this new language in the NEC will ensure that users of this code know to inquire into the suitability of a particular PCS for the application during this early adoption phase of this technology.

Related Item

- FR-8095

Submitter Information Verification

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Submittal Date:	Tue Aug 06 14:29:40 EDT 2024
Committee:	NEC-P13

Public Comment No. 19-NFPA 70-2024 [Section No. 130.70(B)]

(B) Adjustable Settings.

Adjustable settings for overload control functions shall be permitted if access to the settings is limited by at least one of the following:

(1) Located behind locked doors accessible only to qualified ~~personnel~~ persons

(2) Software that has password protected access to the adjusting means accessible to qualified ~~personnel~~ persons only

(3) Hardware such as dip switches located behind locked doors or areas requiring a tool for access

Exception: Adjustable trip circuit breakers with restricted access, as allowed in 240.6(C) or 240.6(D), shall be permitted.

Statement of Problem and Substantiation for Public Comment

"Qualified personnel" is not a defined term in Article 100, but "qualified person" is. To avoid ambiguity and inconsistency, the term "qualified persons" should be used in this setting. "Persons" is the common plural of "person" most often found in the 2023 Code (110.31(C), 235.404(C), 520.54(K), etc.). Furthermore, "qualified person" is the term used in this first draft, in 130.80, to describe EMS marking requirements.

Related Item

• FR-8095

Submitter Information Verification

Submitter Full Name: Jeff Nicholson
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Submittal Date: Wed Jul 10 11:06:54 EDT 2024
Committee: NEC-P13

Public Comment No. 1904-NFPA 70-2024 [Section No. 130.80(A)]

(A) Marking.

The equipment or circuits that ~~supplies~~ supply the branch circuit, feeder, or service shall be marked with the following information in accordance with its listing :

(1) Current setpoint(s)

(2) In other than one- and two-family dwellings, the date of calculation and identification of qualified personnel determining the settings

(3) Identification of loads and sources managed by the EMS with PCS

(4) The following or equivalent wording: "Circuits within this equipment are controlled by a power control system. The current setpoints shall only be changed by a qualified person."

The markings shall meet the requirements in 110.21(B) and shall be located such that they are clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

Statement of Problem and Substantiation for Public Comment

UL 3141 (EMS-PCS standard) allows the equipment OR the conductors and busbars to be marked. The first draft of 2026 NEC text is more restrictive, and installers could be prevented from having these markings in the most appropriate locations allowed by UL 3141. This revision seeks to align the Article 130.80 and UL 3141 requirements.

Related Item

• FR-8095

Submitter Information Verification

Submitter Full Name: Greg Ball
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Submittal Date: Tue Aug 27 22:38:44 EDT 2024
Committee: NEC-P13

Public Comment No. 24-NFPA 70-2024 [Section No. 130.80(A)]

(A) Marking.

The equipment that supplies the branch circuit, feeder, or service shall be marked with the following information:

(1) Current setpoint(s)

(2) In other than one- and two-family dwellings, the date of calculation and identification of the qualified ~~personnel~~ person determining the settings

(3) Identification of loads and sources managed by the EMS with PCS

(4) The following or equivalent wording: "Circuits within this equipment are controlled by a power control system. The current setpoints shall only be changed by a qualified person.”

The markings shall meet the requirements in 110.21(B) and shall be located such that they are clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

Statement of Problem and Substantiation for Public Comment

"Qualified personnel" is not a defined term in Article 100, but "qualified person" is. To avoid ambiguity and inconsistency, the term "qualified persons" should be used in this setting. "Persons" is the common plural of "person" most often found in the 2023 Code (110.31(C), 235.404(C), 520.54(K), etc.). Furthermore, "qualified person" is the term used elsewhere in this same section to describe EMS marking requirements.

Related Item

• FR-8095

Submitter Information Verification

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Submittal Date: Wed Jul 10 11:48:16 EDT 2024
Committee: NEC-P13

Public Comment No. 1037-NFPA 70-2024 [Article 445]

~~**Article 445** Generators~~ Article 445 Electric Generators and Engine-Generator Assemblies

445.1 Scope.

This article contains installation and other requirements for generators.

445.2 Listing Requirements.

Stationary generators shall be listed.

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

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

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 37-2024, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, for information on the location of generators.

445.11 Marking.

(A) General.

(1) Nameplate.

Each generator shall be provided with an accessible nameplate providing the following:

(1) Manufacturer's name

(2) Rated frequency

(3) Number of phases if ac

(4) Rating in kilowatts or kilovolt-amperes

(5) Power factor

(6) Normal volts and amperes corresponding to the rating

(7) Rated ambient temperature

(2) Neutral Status.

(a) Each generator shall be marked by the manufacturer to indicate whether or not the generator neutral is bonded to its frame.

(b) Where the neutral bonding is modified in the field, additional marking shall be required to indicate whether or not the neutral is bonded to the frame.

(B) Generators Rated more than 15 kW.

Nameplates or manufacturer's instructions shall provide the following information:

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

(2) Generator set power rating category (including but not limited to prime, standby, or continuous)

(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

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 Conductors — Minimum Ampacity and Size.

(A) Overcurrent Protection Not Provided.

The ampacity of the conductors from the generator terminals to the first distribution device(s) containing overcurrent protection shall not be less than 115 percent of the nameplate rating of the generator.

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 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.

(C) Neutral Conductors.

The neutral conductors shall be permitted to be sized in accordance with 120.61. Conductors that carry ground-fault currents shall not be smaller than required by 250.35. Where neutral conductors of dc generators carry ground-fault currents, the neutral conductors shall not be smaller than the minimum required size of the largest conductor.

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.

(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.

The disconnecting means shall be permitted to be located within the generator behind a hinged cover, door, or enclosure panel. Where the generator disconnecting means is located within the generator, a field applied label meeting the requirements of 110.21(B) shall be provided indicating the location of the generator disconnecting means.

(B) 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 system bus. The disconnecting means shall not be required to be located at the generator.

445.19 Emergency Shutdown of 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 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 lockable open in accordance with 110.25.

(B) Remote Emergency Shutdown.

For other than one- and two-family dwelling units, generators with greater than 15 kW rating shall be provided with a remote shutdown device. The remote shutdown device shall comply with all of the following:

(1) Be located outside the equipment room or mounted on the exterior of the generator enclosure

(2) Be at a readily accessible location

(3) Be marked “Generator Emergency Shutdown” and meet the requirements of 110.21(B)

(4) Meet the requirements of 445.19(A)(1) and 445.19(A)(2)

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

For other than cord-and-plug-connected portable generators, an emergency shutdown device shall comply with all of the following:

(1) Be located outside the dwelling unit

(2) Be at a readily accessible location

(3) Be marked “Generator Emergency Shutdown” and meet the requirements of 110.21(B)

(4) Meet requirements of 445.19(A)(1) and 445.19(A)(2)

An emergency shutdown device mounted on the exterior of the generator enclosure shall be permitted to satisfy the requirements of 445.19(C)(1).

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 445.20(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: See 590.7(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.

Additional Proposed Changes

File Name	Description	Approved
Article_445_edits.docx	Proposed rewrite of Article 445	

Statement of Problem and Substantiation for Public Comment

Because of the limitations/difficulty of Terraview, I have included the proposed rewrite of Article 445 as a word document (at the suggestion of Jeffrey Sargent). This was submitted as PI 406. It is a proposal to split Article 445 into three parts: General, Generators, Engine-Generator Assemblies. Article 445 originally appeared in the Code in 1937. Before that, generators were covered under the general category of "rotating equipment." Article 445 was originally written for simple generators and contained the requirements for building a system around them. In the last couple of Code cycles, sections have been added that apply to engine-generator assemblies. Article 445 should be split into three parts in order to categorize the requirements appropriately.

Related Item

- 406-NFPA 70-2023

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Committee: NEC-P13

Article 445 Electric Generators and Engine Generator Assemblies

Part I. General

445.1 Scope.

This article contains installation and other requirements for electric generators and engine generator assemblies.

445.6 Listing.

~~Stationary G~~generators shall be listed.

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

Informational Note 1: See UL 2200, *Standard for Stationary Engine Generator Assemblies*, for additional information

Informational Note 2: See UL 1004-4, *Standard for Electric Generators,* for additional information

445.9 Emergency Shutdown of 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 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**.

(B) Remote Emergency Shutdown.

Commented [ES1]: There are companion PIs to define Electric Generator and to define Engine Generator Assemblies. The definitions follow the definitions in the respective UL standards.

Commented [ES2]: This section is currently 445.19. My thought is that CMP-13 might want this in the General section. If not, it can be left in part III.

For other than one- and two-family dwelling units, 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 at a readily accessible location and shall also meet the requirements of **445.19(A)**(1) and (A)(2).

The remote emergency stop switch shall be permitted to be mounted on the exterior of the generator enclosure. The remote emergency stop switch shall be labeled Generator Emergency Shutdown, and the label shall meet the requirements of **110.21(B)**.

(C) 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 and shall also meet the requirements of **445.19(A)**(1) and (A)(2).

An emergency shutdown device mounted on the exterior of the generator enclosure shall be permitted to satisfy the requirements of this section. The shutdown device shall be marked as the Generator Emergency Shutdown, and the label shall meet the requirements of **110.21(B)**).

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 37-2021, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, for information on the location of generators.

445.11 Marking.

Each generator shall be provided with an accessible 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) Alternator subtransient, transient, synchronous, and zero sequence reactances
- (2) Generator set power rating category (including but not limited to prime, standby, or continuous)
- (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

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

Part II Electric Generators

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.

Part III. Engine Generator Assemblies

445.18 Disconnecting Means.

(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**.

The disconnecting means shall be permitted to be located within the generator behind a hinged cover, door, or enclosure panel. Where the generator disconnecting means is located within the generator, a field applied label meeting the requirements of **110.21(B)** shall be provided indicating the location of the generator disconnecting means.

(B) 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 system bus. The disconnecting means shall not be required to be located at the generator.

445.19 Emergency Shutdown of 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 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**.~~

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

~~For other than one- and two-family dwelling units, 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 at a readily accessible location and shall also meet the requirements of **445.19(A)**(1) and (A)(2).~~

~~The remote emergency stop switch shall be permitted to be mounted on the exterior of the generator enclosure. The remote emergency stop switch shall be labeled Generator Emergency Shutdown, and the label shall meet the requirements of **110.21(B)**.~~

~~**(C) 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 and shall also meet the requirements of **445.19(A)**(1) and (A)(2).~~

Commented [ES3]: Proposal is to move 445.19, from Part III, to 445.9, Part I

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Field Code Changed

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Field Code Changed

~~An emergency shutdown device mounted on the exterior of the generator enclosure shall be permitted to satisfy the requirements of this section. The shutdown device shall be marked as the Generator Emergency Shutdown, and the label shall meet the requirements of **110.21(B)**).~~ **General.**

Field Code Changed

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**.

Field Code Changed

Field Code Changed

(B) Remote Emergency Shutdown.

For other than one- and two-family dwelling units, 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 at a readily accessible location and shall also meet the requirements of **445.19(A)**(1) and (A)(2).

Field Code Changed

The remote emergency stop switch shall be permitted to be mounted on the exterior of the generator enclosure. The remote emergency stop switch shall be labeled Generator Emergency Shutdown, and the label shall meet the requirements of **110.21(B)**.

Field Code Changed

(C) 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 and shall also meet the requirements of **445.19(A)**(1) and (A)(2).

Field Code Changed

An emergency shutdown device mounted on the exterior of the generator enclosure shall be permitted to satisfy the requirements of this section. The shutdown device shall be marked as the Generator Emergency Shutdown, and the label shall meet the requirements of **110.21(B)**).

Field Code Changed

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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 **445.20(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: See **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

Public Comment No. 1633-NFPA 70-2024 [Section No. 445.13]

445.13 Conductors — Minimum Ampacity and Size.

(A) Overcurrent Protection Not Provided.

The ampacity of the conductors from the generator 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.

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.

(C) Neutral Conductors.

The neutral conductors shall be permitted to be sized in accordance with ~~120~~ 2 20 .61. ~~Conductors that carry ground-fault currents shall not be smaller than required by 250.35 . Where~~ Where neutral conductors of dc generators carry ground-fault currents, the neutral conductors shall not be smaller than the minimum required size of the largest conductor.

Statement of Problem and Substantiation for Public Comment

Replace "current" in this requirement at 445.13(A). The ampacity of a conductor is based on current, so removing current gives no direction on how to size the conductor. Now the requirement reads "nameplate rating," which nameplate rating is to be used? Removal of current in this subdivision had no substantiation in a PI or in the committee statement and now is confusing on how to or what to use to determine the ampacity of the conductor from the generator.
The second sentence in first level subdivision (C) Neutral Conductors is removed as it is confusing by placing it here under (C). If this language for ground-fault currents needs to remain it may need to be relocated in a more appropriate location as 250.35(B) is a requirement for the supply-side bonding jumpers not neutral conductors.
Could of been a typo but the reference in (C) should of been 220.61 and not 120.61.

Related Item

• PI-4418 • FR-7551

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Public Comment No. 49-NFPA 70-2024 [Section No. 445.13(C)]

(C) Neutral Conductors.

The neutral conductors shall be permitted to be sized in accordance with ~~120~~ 220 .61. Conductors that carry ground-fault currents shall not be smaller than required by 250.34 or 250. 35. Where neutral conductors of dc generators carry ground-fault currents, the neutral conductors shall not be smaller than the minimum required size of the largest conductor.

Statement of Problem and Substantiation for Public Comment

TYPO should be 220.61, add 250.34 as this applies to portable generators as well

Related Item

- Public Input No. 4418

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Public Comment No. 643-NFPA 70-2024 [Section No. 445.19(A)]

(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 render the prime mover incapable of starting

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

(3) <u>Be located at or adjacent to the local operator panel in a readily accessible location</u>

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

Statement of Problem and Substantiation for Public Comment

There is confusion with the “on-genset” e-stop requirement, especially for sets that are > 15 kW. A common misinterpretation is that the remote e-stop switch is all that’s needed for that case. To correct this situation, added a sub 3 to clarify that there is a requirement to have a local e-stop, and that it must be readily accessible.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 646-NFPA 70-2024 [Section No. 445.19(B)]	
Public Comment No. 646-NFPA 70-2024 [Section No. 445.19(B)]	

Related Item

- FR 7563

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Public Comment No. 646-NFPA 70-2024 [Section No. 445.19(B)]

(B) Remote Emergency Shutdown.

For other than one- and two-family dwelling units, generators with greater than 15 kW rating shall also be provided with a remote shutdown device. The remote shutdown device shall comply with all of the following:

(1) Be located outside the equipment room or mounted on the exterior of the generator enclosure

(2) Be at a readily accessible location

(3) Be marked “Generator Emergency Shutdown” and meet the requirements of 110.21(B)

(4) Meet the requirements of 445.19(A)(1) and 445.19(A)(2)

Statement of Problem and Substantiation for Public Comment

Insert the word “also” after the word “shall” in the first sentence to make it clear that the remote emergency shutdown requirement is in addition to the “on genset” requirement described in 445.19(A).

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 643-NFPA 70-2024 [Section No. 445.19(A)]	
Public Comment No. 643-NFPA 70-2024 [Section No. 445.19(A)]	

Related Item

• FR 7571

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Public Comment No. 1582-NFPA 70-2024 [New Section after 445.20(B)]

TITLE OF NEW CONTENT

Type your content here ...

445.21. Cybersecurity

Generators, located in or directly supplying life safety-related infrastructures, that are connected to a communication network and have the capability to be controlled or permit control of any portion of the premises shall comply with either of the following:

(1) The ability to control the generator is limited to a direct connection through a local nonnetworked interface.

(2) The generator is connected through a networked interface complying with both of the following methods:

a. The generator is identified as being evaluated for cybersecurity.

b. A cybersecurity assessment of the generator is completed and documentation of the assessment and certification is available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, *Cybersecurity Standards series*, UL 2900 *Cybersecurity Standard series*, or the NIST *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1 for assessment requirements.

Informational Note No. 2: Examples used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity is a specialized field requiring constant, vigilant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions. Installation of devices that can be secured is an important first step but not sufficient to guarantee a secure system.

Informational Note No. 4: See NEMA CY70001-2023, *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Informational Note No. 5: Examples of life safety-related infrastructures include, but are not limited to, waste water treatment facilities, water supply facilities, police stations, call centers, financial centers, data centers, and military bases.

Statement of Problem and Substantiation for Public Comment

Let's review the Code Making Panel Statement to resolve Public Input 1245, one sentence at a time.

The first sentence of the Panel Statement "General cybersecurity requirements are widely applicable based on requirements in 110" fails to note that the requirements in 110.3(A)(8) only pertain to life safety equipment. Generators may or may not be considered life safety equipment. There isn't a definition of life safety equipment in Article 100. There is nothing in the NEC that designates generators as life safety equipment. Only if the generator is designated as life safety equipment does 110.3(A)(8) apply!

And if, for some reason, the generator is considered life safety equipment, 110.3(A)(8) has an even more serious issue. Amazingly, 110.3(A)(8) can be met with a simple evaluation, and that evaluation can actually show that the life safety equipment is totally unprotected against cyber attack. 110.3(A)(8) doesn't state that life safety equipment must be protected against cyber attack. It simply states that the life safety system must be evaluated for cybersecurity. YES, YOU READ THAT CORRECTLY, ZERO CYBERSECURITY PROTECTION FOR LIFE SAFETY EQUIPMENT IS ACCEPTABLE IN 110.3(A)(8). The required evaluation could show that there is no protection against cyber attack and still meet the requirements of 110.3(A)(8)!

The second sentence of the Panel Statement "This PI is overly broad in scope as applicable to every generator product" is rectified by the limitation to generators located in or directly supplying life safety-related infrastructures. (Informational Note No. 5 is added, providing examples of life safety-related infrastructures.)

The Panel Statement "even with a five-year interval, would be inadequate in guaranteeing cybersecurity for generator products" is addressed by removal of the 5-year re-assessment.

The final sentence of the Panel Statement "Cybersecurity requirements are most practically applied based on the application in the systems rather than the piece of equipment" is addressed by the limitation to generators installed in or directly supplying life safety-related infrastructure.

Most of the cybersecurity focus has been on IT systems. There has been very little public discussion about cybersecurity for Operational Technology (OT), but cyber attacks on OT occur on almost a daily basis. For an example of just how common cyber attacks on life safety related infrastructure have become, let's look at just the water supply and waste water treatment industry. The DNI (Director of National Intelligence), through the CTIIC (Cyber Threat Intelligence Integration Center) recently released a report of 12 cyber attacks on the industrial control systems of water utilities, water systems, and waste water treatment systems, for the six-month period from November 2023 through April 2024. This report can be found at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.dni.gov/files/CTIIC/documents/products/Recent_Cyber_Attacks_on_US_Infrastructure_Underscore_Vulnerability_of_Crit June2024.pdf&ved=2ahUKEwi5gP7-m4eIAxUakYkEHasyIRQQFnoECB8QAQ&usg=AOvVaw3hJL2DMlRs-CECfmewcXVP

While this example covered attacks on industrial control systems, successful attacks can occur on all electrical equipment that is continuously connected to the internet and even equipment that is only connected to the internet during system updates. (Cyber attacks can lay quiet for years, waiting for an update, and then do their intended damage during the update.) Hackers can easily destroy unprotected equipment and shut down entire unprotected facilities. Our adversaries are continuously mounting cyber attacks on our life safety-related infrastructure. We have the ability, and obligation, to prevent this type of damage to our infrastructure from malicious cyber attacks.

Let’s look at an example of a waste water treatment facility. 110.3(A)(8) requires that a fire alarm system in the waste water treatment facility, because it is life safety equipment, be evaluated in light of cybersecurity. However, there is no requirement for the other non-life safety equipment/systems within or directly supplying the waste water treatment plant, such as generators, which could easily be compromised by a cyber attack. The proposed text in this Public Comment addresses this vulnerability.

Informational Note No. 4 was added to correlate with FR 9040 (110.3(A)(8)), FR 9210 (240.6(D)), and FR 8219 (708.7).

THIS PUBLIC COMMENT SIMPLY REQUIRES THAT GENERATORS, INSTALLED IN ONLY OR DIRECTLY SUPPLYING ONLY LIFE SAFETY-RELATED INFRASTRUCTURES, EITHER NOT BE CONNECTED TO THE INTERNET, OR IF THEY ARE CONNECTED TO THE INTERNET, THAT THEY BE “IDENTIFIED” FOR CYBERSECURITY AND THAT AN ASSESSMENT IS PROVIDED.

Related Item

• PI 1245

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Public Comment No. 1458-NFPA 70-2024 [Section No. 455.3]

455.3 Reconditioned Equipment.

Reconditioned phase converters shall not be ~~installed~~ permitted .

Statement of Problem and Substantiation for Public Comment

This public comment is made to address an issue with the first draft language changes. The proposed language in this first revision allows electrical equipment to be reconditioned in place as the language pertains to the installation process and not to when any equipment is reconditioned in place. With the existing language in this first revision, the only time reconditioned equipment would not be permitted is if it is being installed. The Code does apply to existing equipment when additions or modifications are being made. The proposed language change from "installed" to "permitted" is more inclusive.

Related Item

- FR 7585

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Public Comment No. 1750-NFPA 70-2024 [Section No. 480.1]

480.1 Scope.

This article applies to all installations of stationary batteries having a capacity greater than 3.6 MJ (1 kWh).

Informational Note No. 1: See Article 706 for ~~listed energy storage systems.~~ installations that do not meet the definition of stationary standby batteries. .

Informational Note No. 2: For batteries rated in ampere hours, kWh is equal to the nominal rated voltage times ampere-hour rating divided by 1000. For batteries rated in watts per cell, kWh equals the nameplate watts per cell multiplied by the number of cells divided by 1000 and multiplied by the nameplate minutes rating divided by 60.

Informational Note No. 3: 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 1115, *Recommended Practice for Sizing of Nickel-Cadmium Batteries for Stationary Applications*

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

(5) IEEE 1375, *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, *Batteries for Use in Stationary, and Motive Auxiliary Power 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 1974, *Standard for Evaluation or Repurposing Batteries*

(12) NFPA 855-2026, *Standard for the Installation of Stationary Energy Storage Systems*

(13) IEEE 1184, *Guide for Batteries for Uninterruptible Power Supply Systems*

(14) ICC IFC, *International Fire Code* (IFC)

(15) NFPA 1-2024, *Fire Code*

(16) IEEE 1106, *Recommended Practice for Installation, Maintenance, Testing, and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications*

(17) IEEE 2962, *Recommended Practice for Installation, Operation, Maintenance, Testing, and Replacement of Lithium-ion Batteries for Stationary Applications*

(18) UL 9540, *Energy Storage Systems (ESS) and Equipment*

(19) UL 9540A, *Battery Energy Storage System (ESS) Test Method*

Statement of Problem and Substantiation for Public Comment

The change to Informational Note No. 1 substantially changes the original intent of the note. The change implies that ESS that are not Listed may be installed under Article 480 which was not the intent of the original Code or substantiated.

Related Item

• PI 3820

Submitter Information Verification

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Submittal Date: Tue Aug 27 00:01:45 EDT 2024
Committee: NEC-P13

Public Comment No. 1951-NFPA 70-2024 [Section No. 480.1]

480.1 Scope.

This article applies to all installations of stationary batteries having a capacity greater than 3.6 MJ (1 kWh).

Informational Note No. 1: See Article 706 for listed energy storage systems.

Informational Note No. 2: For batteries rated in ampere hours, kWh is equal to the nominal rated voltage times ampere-hour rating divided by 1000. For batteries rated in watts per cell, kWh equals the nameplate watts per cell multiplied by the number of cells divided by 1000 and multiplied by the nameplate minutes rating divided by 60.

Informational Note No. 3: 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 1115, *Recommended Practice for Sizing of Nickel-Cadmium Batteries for Stationary Applications*

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

(5) IEEE 1375, *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, *Batteries for Use in Stationary, and Motive Auxiliary Power 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 1974, *Standard for Evaluation or Repurposing Batteries*

(12) NFPA 855-2026, *Standard for the Installation of Stationary Energy Storage Systems*

(13) IEEE 1184, *Guide for Batteries for Uninterruptible Power Supply Systems*

(14) ICC IFC, *International Fire Code* (IFC)

(15) NFPA 1-2024, *Fire Code*

(16) IEEE 1106, *Recommended Practice for Installation, Maintenance, Testing, and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications*

(17) IEEE 2962, *Recommended Practice for Installation, Operation, Maintenance, Testing, and Replacement of Lithium-ion Batteries for Stationary Applications*

(18) ~~UL 9540, *Energy Storage Systems (ESS) and Equipment*~~ -

(19) ~~UL 9540A, *Battery Energy Storage System (ESS) Test Method*~~ -

Statement of Problem and Substantiation for Public Comment

UL 9540 is an evaluation of complete ESS, which differ from the stationary batteries that fall under the scope of Article 480. This change is important to not re-introduce confusion over which of the two articles apply.

The Solar and Storage Industry Forum (SSIF) is a coalition of individuals and organizations convened by the Solar Energy Industry Association (SEIA) to organize, support, and mentor renewable energy industry professionals in codes and standards development . Our objective is to submit industry consensus-based recommendations for changes to the National Electrical Code. We believe that this effort improves the Code-making process by consolidating multiple industry member's points of view into fewer, common proposals. SSIF members are dedicated to continually improving the installation safety of PV and storage systems in the U.S. A list of members can be found here: https://www.seia.org/industry-forum

Related Item

• FR-8132 • PI-3820

Submitter Information Verification

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Committee:	NEC-P13

Public Comment No. 1985-NFPA 70-2024 [Section No. 480.2]

480.2 Listing Requirements.

Stationary batteries and battery management equipment shall be listed. This requirement shall not apply to vented lead-acid and nickel-cadmium batteries.

Statement of Problem and Substantiation for Public Comment

This change is consistent with the second draft of NFPA 855 2026 version. The safety risk of both vented lead-acid and nickel-cadmium batteries is similar and recognized by UL in UL 1973 and the NFPA 855 committee. There are no vented nickel-cadmium batteries that are UL 1973 listed and the vast majority of those on the market would not be able to be listed to UL 1973 at this point. There is no recognized safety issues that would be reduced with listing vented lead-acid or nickel-cadmium batteries. Continuing to require vented nickel-cadmium batteries to become listed would essentially cause users to switch out one of the safest chemistries with ones that are less safe.

Related Item

- PI 3831

Submitter Information Verification

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Submittal Date: Wed Aug 28 14:07:28 EDT 2024
Committee: NEC-P13

Public Comment No. 1747-NFPA 70-2024 [Section No. 480.7]

480.7 DC Disconnect Methods.

(A) Disconnecting Means.

A disconnecting means shall be provided for all ungrounded conductors derived from a stationary battery with a voltage over 60 volts dc. A disconnecting means shall be readily accessible and located within sight of the stationary battery.

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 shall be located at a readily accessible location outside the building for emergency use. The disconnect shall be labeled as follows:

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.

(D) Remote Actuation.

Where a disconnecting means located in accordance with 480.7(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, the disconnecting means shall be lockable open 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 as part of the busway system.

(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

Informational Note No. 1: Battery equipment suppliers can provide information about available fault current on specific battery models.

(3) An arc flash label in accordance with acceptable industry practice

Informational Note No. 2: See NFPA *70E*-2024, *Standard for Electrical Safety in the Workplace*, for 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 1 : List item (3) shall not apply to installations where the battery voltages are below 150 volts dc.

Exception 2: List items (2), (3), and (4) shall not apply to

~~*installations where the battery voltages are below 150 volts dc*~~

one- and two-family dwellings .

(G) Identification of Power Sources.

Stationary batteries shall be indicated by 480.7(G)(1) and 480.7(G)(2).

(1) Facilities with Utility Services and Stationary Batteries.

Plaques or directories shall be installed in accordance with 705.10.

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 Comment

Available fault current under (2) and the date it was calculated under (4) is necessary beyond the arch flash justification provided by the committee statement as it may also impact suitability of equipment with respect to short-circuit current ratings. No justification was provided to expand the exception for beyond 1 and 2 family dwellings.

Related Item

- PI 3846

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Submittal Date: Mon Aug 26 23:48:56 EDT 2024
Committee: NEC-P13

Public Comment No. 760-NFPA 70-2024 [Section No. 480.8]

~~**480.8** Grounding of Battery Stands and Conductive Cases.~~

~~Battery systems shall be required to ground conductive battery stands, racks, or cabinets and bond any conductive cases in accordance with Article 250 , Part VIII.~~

Statement of Problem and Substantiation for Public Comment

The requirement, as written, indicates that the "battery system shall be required to ground..." We typically require the installer or owner or other sentient being to do things. How do I require a battery system to perfom an action like bonding metal parts?
Article 250 already does a good enough job on this matter.

Related Item

- FR 7832

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Submittal Date: Sun Aug 04 16:48:40 EDT 2024
Committee: NEC-P13

Public Comment No. 2002-NFPA 70-2024 [Section No. 480.10(F)]

~~**(F)** Piping in Battery Rooms.~~

~~Gas piping shall not be permitted in dedicated battery rooms.~~

Additional Proposed Changes

File Name	Description	Approved
excerpt_from_NFPA_70E_article_320.PNG	Article 320 from 2009 70E	

Statement of Problem and Substantiation for Public Comment

For the 2012 revision of NFPA 70E, there was an effort to remove battery installation requirements and place them in NFPA 70. The 2014 revision of NFPA 70 reflected the requirements that were moved. Looking at the original 70E requirement, it had to do with corrosion resistance of piping. In either case, it is difficult to find any other documents that restrict gas piping in energy storage spaces. There is nothing in NFPA 855 that lists this restriction.

Related Item

- PI 3855

Submitter Information Verification

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Submittal Date: Wed Aug 28 14:55:10 EDT 2024
Committee: NEC-P13

(c) Location of Inlets. Inlets shall be no higher than the tops of the battery cells and outlets at the highest level in the room.

FPN: The maximum hydrogen evolution rate for batteries should be obtained for the condition when the maximum charging current available from a constant current battery charger is applied into a fully charged battery or the current that would be expected from a constant voltage charger in boost/equalize mode. If possible, contact manufacturer for hydrogen evolution rates.

(3) Mechanical Ventilation. Where mechanical ventilation is installed, the following shall be required:

(1) Airflow sensors shall be installed to initiate an alarm if the ventilation fan becomes inoperative.

(2) Control equipment for the exhaust fan shall be located

prevent thermal runaway that can cause cell meltdown, leading to a fire or explosion.

320.5 Battery Room Requirements.

(A) General. The battery room shall be accessible only to authorized personnel and shall be locked when unoccupied.

(1) Battery Rooms or Areas Restricted to Authorized Personnel.

(a) Doors. The battery room and enclosure doors shall open outward. The doors shall be equipped with quick-release, quick-opening hardware.

(b) Foreign Piping. Foreign piping that is not protected against corrosion shall not pass through the battery room.

Public Comment No. 2008-NFPA 70-2024 [Section No. 480.11]

480.11 Vents.

(A) Vented ~~Cells~~ cells for a queous chemistries .

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~~ VRLA 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.

Statement of Problem and Substantiation for Public Comment

These requirements were originally written for lead-acid batteries because they generate a small amount of hydrogen when charging. These are not electrical safety issues and are more accurately discussed in NFPA 855. If these requirements are to stay in this document, the submitted changes provide the required specificity.

Related Item

- PI 3856

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Public Comment No. 1748-NFPA 70-2024 [Section No. 480.12]

480.12 Battery Interconnections.

Flexible cables 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 conditions of use and location. 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 Comment

The proposed change removed the restriction of flexible battery cables to "within the battery enclosure." Removal of this restriction allows the use of flexible cables without restriction or consideration to concerns including situations where the batteries and cells may be separated by significant distance or even in separate rooms.

Related Item

- PI 3857

Submitter Information Verification

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Committee: NEC-P13

Public Comment No. 761-NFPA 70-2024 [Section No. 480.13]

480.13 Ground-Fault Detection.

Battery circuits exceeding 100 volts between the conductors or to ground shall be permitted to operate with ungrounded or impedance grounded ~~conductors~~ systems , provided a ground-fault detector and indicator is installed to monitor for ground faults.

Statement of Problem and Substantiation for Public Comment

Every voltage system has ungrounded conductors. It appears that the target of this is not the ungounded conductors, but the conductors from an ungrounded (or impedance grounded) system.
As currently written, every battery system installation over 100 volts requires ground detectors because they all have ungrounded conductors connected to them.

Related Item

- FR 480.13

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Public Comment No. 1551-NFPA 70-2024 [Section No. 695.7(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 Article 230, Parts III and IV. 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~~ 695 . ~~6~~ 7 (~~1~~ A) - ~~or 230.6~~ (2) .

Exception: The supply conductors within the fire pump room shall not be required to meet ~~230~~ 695 .~~6~~ 7 (~~1~~ A)- ~~or 230.6~~ (2).

Informational Note: See 250.24(D) for routing the grounded conductor to the service equipment.

Statement of Problem and Substantiation for Public Comment

with the introduction of 5 inches of concrete for a 2 hour rating the natural progression would be to protect the conducts on the line side with the same rigor. Routing conductors through the building is about circuit suitability,

Related Item

• Public Input No. 3688

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Submittal Date: Fri Aug 23 17:34:07 EDT 2024
Committee: NEC-P13

Public Comment No. 1839-NFPA 70-2024 [Section No. 695.7(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 Article 230, Parts III and IV. 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 230~~ or 695 . ~~6~~ 7 (A)(2) (d)(1) .

Exception: The supply conductors within the fire pump room shall not be required to meet 230.6(1)- ~~or 230~~ or 695 . ~~6~~ 7 (A)(2) (d)(1) .

Informational Note: See 250.24(D) for routing the grounded conductor to the service equipment.

Statement of Problem and Substantiation for Public Comment

Fire pump circuits supplied by service conductors are subject to the same thermal exposure as feeders when routed through a building. In correlation with the changes made in the First Draft, the same level of protection should be required for these conductors when running through a building.

Related PI or FR: FR 8063

Related Item

• Initial Public Input Number: 3688 for 695.6(A)(2).

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Committee: NEC-P13

Investigation of external fire exposure effects in concrete encased electrical wires

August 26, 2024

Author: Alex Marciano, Applications Engineer

Data Acquisition Engineer: Michael Buffing, Fire Safety Engineering Lead

Table of Contents

Introduction

Circuit integrity of insulated wires and cables is critical during fire events where life-safety may depend on emergency circuits. A few methods are used for circuit integrity during fire events, such as fire-resistant cable systems (UL FHIT Listed), or via concrete encasement for certain runs under specific conditions.

In December 2018, the National Fire Protection Agency Research Foundation published a document titled 'Fire Resistance of Concrete for Electrical Conductors', where the fire resistance and thermal protection of concrete is discussed and synthesized through literature review and gap analysis, and 5 inches thick concrete encasement is suggested to cover all types of concrete for a 2-hour fire resistance rating.

In contrast, a common industry practice is to use 2-inches of concrete encasement, which is currently permitted in specific Articles of the National Electrical Code (NFPA 70), such as in Article 695.6(A)(2)(4)a. This practice might have originated from the allowance for 2-inches of concrete that was deemed adequate for service entrance conductors to be considered outside of the building for mechanical protection purposes. However, 2 inches thick concrete may not provide sufficient insulation to limit heat transmission onto the unexposed surface for thermal protection purposes.

The ASTM E119 acceptance criteria referenced in ACI 216.1-07 as end-point heat transmission is for the unexposed surface temperature limit average on all measuring points of 250°F (121°C) above initial room temperature (ranging from 50°F to 90°F) or for any single point maximum of 325°F (163°C). For circuit integrity purposes, such temperatures may also inadvertently expose wires and cables to temperatures above their rating.

Moreover, the main goal of this investigation is to understand if circuit integrity is maintained when using regular 90°C rated wires inside conduit protected by 2" of concrete encasement while exposed to the ASTM E119 time-temperature curve up to the 2-hour mark.

Concerns

Based on the studies recorded in ACI 216.1-07, concrete thicknesses ranging from 3.6 inches to 5 inches are required to keep the unexposed average surface temperature below 250°F above the initial room temperature. Such a range is dependent upon the type of concrete being used. The effect of slab thicknesses and aggregate type material is depicted in Figure 2.3 of the ACI document, where 2 inches of siliceous aggregate, carbonate aggregate, air-cooled blast-furnace slag, semi-lightweight and lightweight concrete yields less than 1-hour of fire resistance per ASTM 119 acceptance criterion.

Derived from the acceptance criterion, 5-inches of any type of concrete tested yields at least 2-hours of fire resistance. This criterion is normally used for floors, walls, columns, and other building materials; however, it may not be appropriate for energized wires and cables inside conduit-encased concrete.

Arguably, most of the wiring used in concrete-encased electrical circuits is composed of thermoplastic materials, normally with 600V, 90°C (194°F) rated THHN/THWN-2 wire type. The temperature rating of a conductor is at a safe level when the insulated wire is exposed to normal operating conditions up to the current displayed in the appropriate NEC ampacity table (and derated as needed) for a specific size conductor, or even when there is a fault that is protected by an appropriately sized and timed overcurrent protection device. Different insulation materials, curing methods (when applicable), and other construction features of wires and cables allow them to withstand a certain amount of heat before the dielectric is compromised. The insulation may become compromised enough to stop acting as an insulator and start allowing short circuits between the conductors inside conduit.

There appears to be no publicly available study showing circuit integrity testing for electrical wires and cables placed inside of concrete-encased conduits. Instead, by using the end-point heat transmission criterion of ASTM E119, it is assumed that concrete encasement will keep the internal temperature of the conduit low enough for the conductors to perform electrically during a fire emergency. Even if such assumption is correct, circuit integrity may be compromised much before the 2-hour mark as the internal temperature reaches 250°F above ambient before even reaching 1-hour for all types of concrete shown in the ACI 216.1-07 Fig. 2.3, except for insulating concrete, which is slightly above 1-hour.

Investigation method

Sample blocks will be built with three types of concrete used for encasement: silicious, carbonate and lightweight.

A PVC conduit containing wires with NEC-compliant fill ratios will be encased in 2 inches of concrete. The wires will be energized, and a thermocouple will be inserted in the conduit to monitor the internal temperature throughout the test. Another thermocouple will be placed outside to measure room temperature.

The concreted encased and energized wire samples will be placed inside a tube furnace which will then apply heat to the external surface of the concrete tentatively following the 2-hour ASTM E119 time-temperature curve.

Circuit integrity will be monitored and recorded throughout the tests.

Investigation scope

External heat following the 2-hour ASTM E119 time-temperature curve set points applied to the following samples while monitoring internal and external temperatures as well as circuit integrity:

- Silicious concrete block, 2 inches thick, with ¾” PVC conduit containing 5x 8 AWG THHN/THWN-2 wires
- Carbonate concrete block, 2 inches thick, with ¾” PVC conduit containing 5x 8 AWG THHN/THWN-2 wires
- Lightweight concrete block, 2 inches thick, with ¾” PVC conduit containing 5x 8 AWG THHN/THWN-2 wires

Other concrete types / thicknesses, wire types and sizes, conduits, and internal conductor heating due to current effects / ampacity ratings are not within the scope of this investigation.

Equipment and materials

- 3/4” schedule 40 PVC
- 5” schedule 40 PVC
- 8 AWG THHN wire
- Tube furnace and electrical circuit monitoring board (Therm eXpress XST w/ controller) following the ASTM E119 time-temperature curve up to 1850°F
- Thermometer with thermocouple probes with -325°F to 2,290°F range (thermocouple probe type K, Dayton model 36GL08)
- Concrete mix (3 types, silicious, carbonate & lightweight).
    - Silicious: Quickrete Product 1101-60
    - Carbonate: Sakrete 5000 Plus High Strength
    - Lightweight: Sakrete MAXIMIZER
- Concrete release agent (to prevent wall from sticking to the outer PVC pipe used as mold to build the blocks)
- 60-watt light bulbs

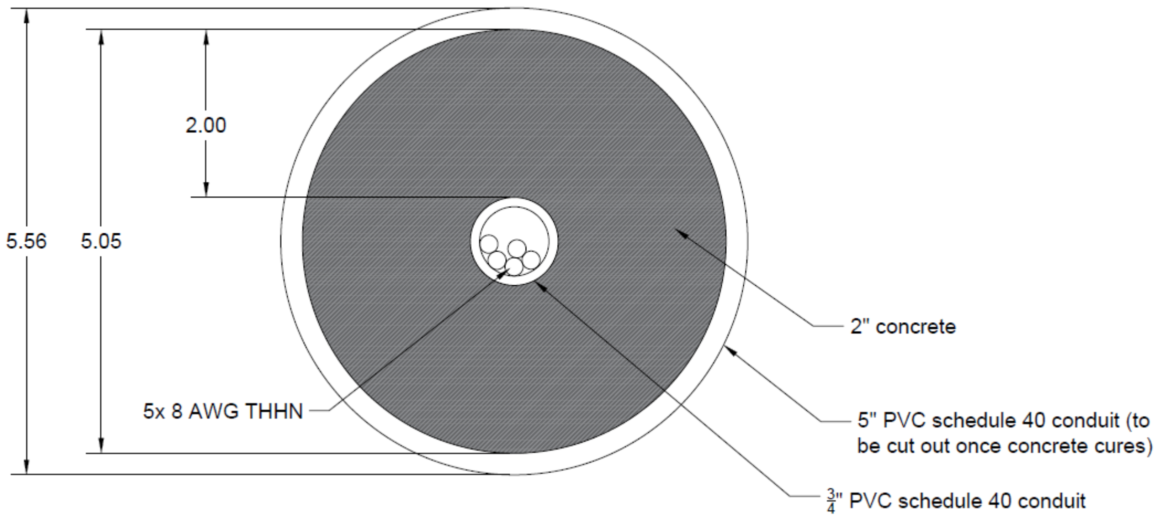

Figure 1 - Profile of concrete encased conduit showing removable external PVC (used as mold).

Figure 2 - Tube Furnace used to heat samples.

Premises

Simply applying the ASTM E119 time-temperature curve on the exposed concrete surface, using the end-point heat transmission criterion and expecting it to determine 2-hour wire and cable circuit integrity success elicits the following considerations:

1) The wire or cable material must withstand the heat without insulation failure for 2-hours for all types of only 2 inches thick concrete, despite the already available documentation from ACI and NFPA Research Foundation showing that a minimum of 3.6 inches to 5.0 inches of concrete would be required to do so (depending on aggregate/concrete type).
2) While the concrete exterior walls are eventually exposed to a temperature upwards of 1850°F within 2-hours, the wire and cable within the unexposed surface are subject to temperature exposure of approximately 320°F within less than 1-hour for all types of concrete except insulating concrete, which per the ACI document, delays temperature rise to slightly over 1-hour per end-point heat transmission criterion (insulating concrete not tested during this investigation as it is not within the scope).
3) Arguably, most wire and cable used commercially in these environments are rated to much lower temperatures than 320°F.
4) There is no consideration for any additional heat that's generated by the effects of electron flow on the resistive conductors (not within the scope of this investigation).

Thermoplastic materials used in wire and cable insulation may not provide proper dielectric protection under a 320°F heat (250°F above ambient as found in the ASTM E119 criterion, considering 70°F ambient) or higher (~320°F is just the exposure level at which point the ASTM E119 acceptance criterion is met due to the temperature rise on the unexposed surface, temperature keeps rising when less than the prescribed concrete thickness is used). This is certainly a temperature that is well above the normal rating for most conductors used in these environments, notably THHN/THWN-2 90°C (195°F), which is widely available commercially.

Based on preliminary testing conducted in our laboratory in 2023, on the wire alone when exposed directly to heat, 14 AWG THHN/THWN-2 insulated conductors suffer from dielectric breakdown / melting at temperatures around 375°F after a few minutes of exposure, at which point the conductor is permanently damaged and circuit integrity is compromised. When the effects of the external temperature transmission through the concrete slab cause the inside of the conduit to reach temperatures close to 375°F, the circuit should fail.

It is expected that circuit integrity for wires inside of 2-inch encased concrete will be compromised much before the 2-hour mark for all types of concrete due to the performance of insulation materials at elevated temperatures that will certainly be exposed to higher than the rated temperature of most conductors used in these environments.

Testing setup and results

The concrete blocks seen in Figure 3 were created and left to cure for a minimum of 28 days prior to the beginning of the tests.

Figure 3 – Fully cured concrete blocks

The wires were placed inside the conduit and energized at 120V while connected to the data acquisition system, protected by a 1 Amp fuse, and connected to a light bulb. Two thermocouples were used, one for recording ambient temperature near the data acquisition device and the second as seen in Figure 4 was placed inside the PVC conduit next to the wires. The tube furnace shown in Figure 7 was powered up and programmed to follow the ASTM E119 time-temperature curve up to 2-hours. Figure 6 shows the data acquisition device that monitors and acquires voltage, current, and temperature information.

Figure 4 - Thermocouple and wires inside conduit and inside tube furnace

Figure 5 - Tube furnace containing the concrete block and wires

Figure 6 - Data acquisition device connected to light bulbs as the load

The tests were conducted until the light bulb turned off. The fuse was then checked to confirm that circuit integrity was compromised. After the circuit failed, the oven was then turned off. The samples were left in the oven until they cooled enough to be handled. The concrete blocks were then opened to investigate and record the appearance of the concrete and the wires.

Of note is the fact that the tube furnace power output was not powerful enough to follow the ASTM E119 time-temperature curve given the concrete volume needed heating. Due to this, the external temperature exposure is less severe than what it would have been in a full-scale furnace. This lagging effect can be seen in Figure 7. Circuit integrity should be compromised more quickly on a furnace that is powerful enough to follow the ASTM E119 time-temperature curve.

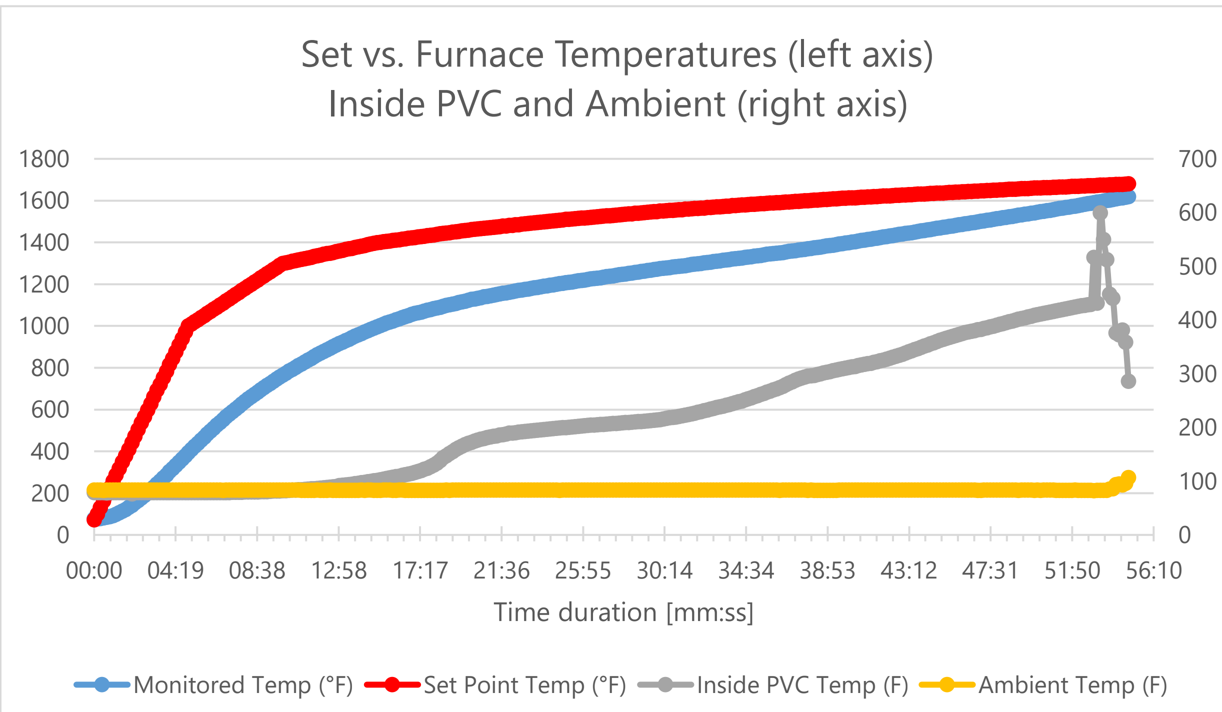

Figure 7 - Set point temperature per ASTM E119 vs. actual furnace temperature

Results for test #1: Siliceous concrete block

This test was conducted on July 22, 2024. Circuit integrity failed at approximately 54 minutes as seen in Figure 8, when the voltage dropped from ~120V to 0V, and the light went out. Erratic behavior on the temperature measured by the thermocouple probe inside the PVC can be noticed starting at 53 minutes, most likely due to grounding faults induced by the insulation starting to fail and shorting the probe next to the wires.

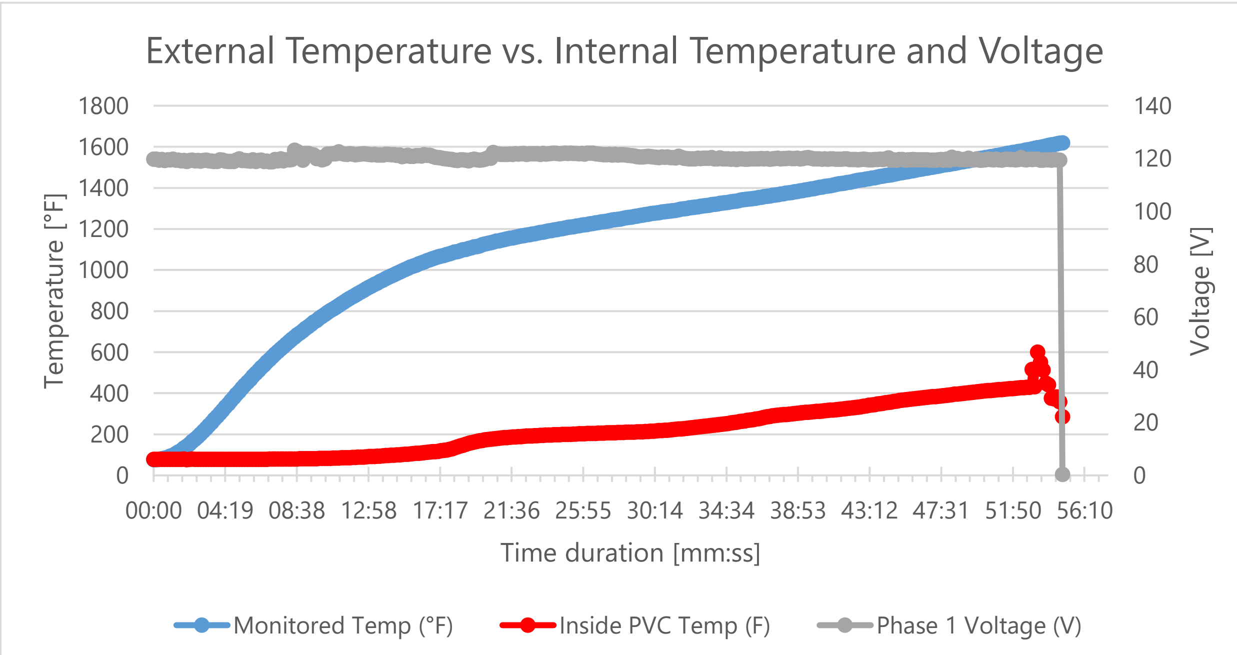

Figure 8 - Measured external temperature vs. internal temperature and Voltage Chart (Siliceous)

Figure 9 - Siliceous concrete block appearance after the test

Figure 10 – Silicious concrete block opened after the test showing heat damage to the insulation

Results for test #2: Carbonate concrete block

This test was conducted on July 25, 2024. Circuit integrity also failed at approximately 54 minutes as seen in Figure 11.

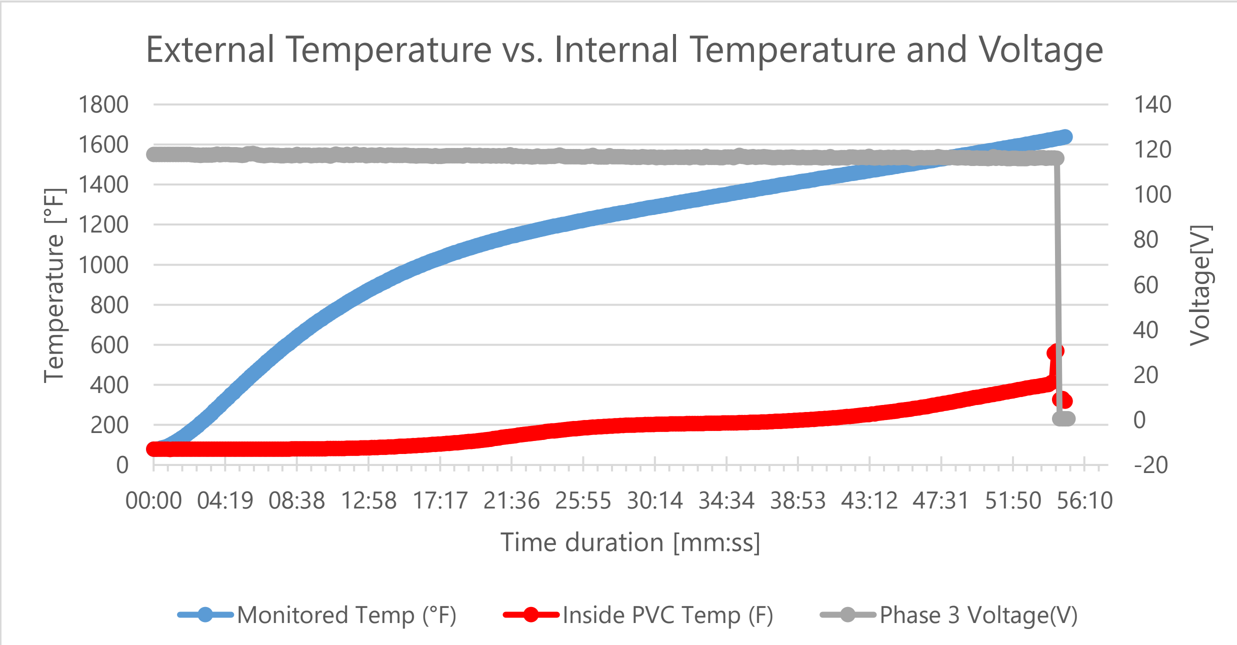

Figure 11 - Measured external temperature vs. internal temperature and Voltage Chart (Carbonate)

Figure 12 - Carbonate concrete block appearance after the test

Figure 13 - Carbonate concrete block opened after the test showing heat damage to the insulation

<u>Results for test #3: Lightweight concrete block</u>

This test was conducted on July 26, 2024. Circuit integrity failed at approximately 61 minutes as seen in Figure 11.

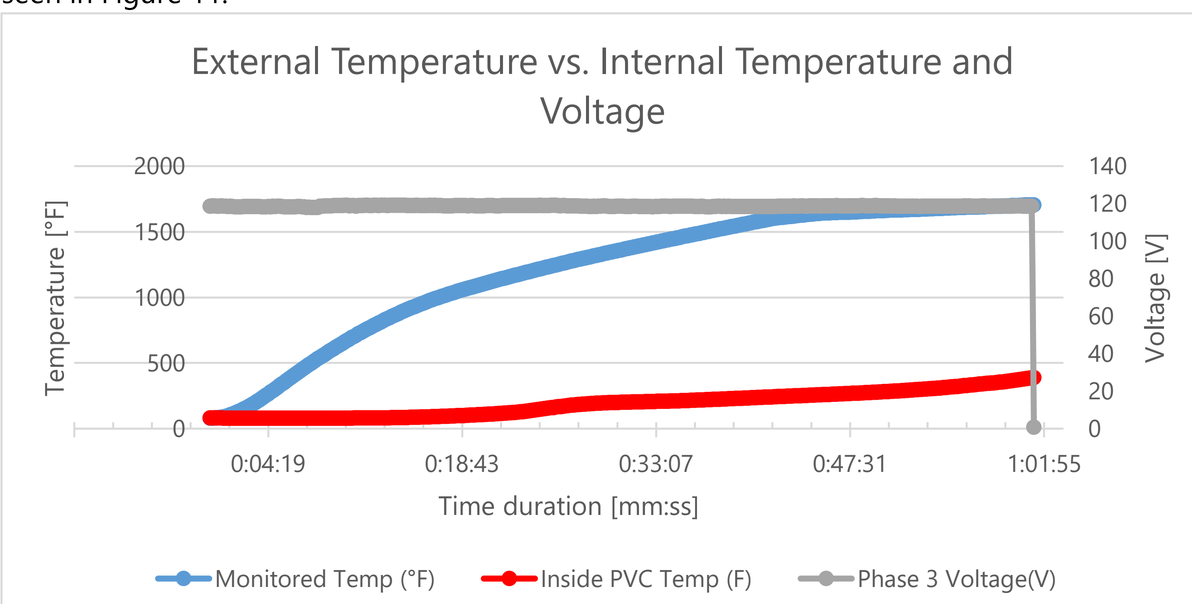

Figure 14 - Measured external temperature vs. internal temperature and Voltage Chart (Lightweight)

Figure 15 - Lightweight concrete block appearance after the test

Conclusion

Circuit integrity was compromised and failed near the 1-hour mark for wires contained and protected by the three types of 2” thick concrete blocks evaluated, demonstrating that the initial assessments and concerns were valid. It is expected that testing using a full-scale furnace would be more severe and yield faster circuit integrity failures since the tube furnace used for this investigation lacked enough power to follow the ASTM E119 time-temperature curve without the actual temperature lagging the set points.

2” thick concrete may provide enough physical support to consider conductors as outside of the building for service entry (the word ‘may’ is used because mechanical protection validation is outside the scope of this investigation), nonetheless, testing conducted here clearly shows that 2” thick concrete does not provide enough thermal barrier to be considered as a solution to circuit integrity during a 2-hour fire as portrayed in the ASTM E119 time-temperature curve.

The minimum slab thicknesses shown in Table 1 below may allow for working circuits inside conduit, however, the conductors should be adequately rated for the temperature exposure of approximately 320°F (250°F above ambient) or 160°C, in line with the requirements of NFPA 70 Article 310.14 (3) which states ‘*no conductor shall be used in such a manner that its operating temperature exceeds that designated for the type of insulated conductor involved*’. This means that at least 200°C rated conductors such as type FEP, FEPB, PFA or SA should be used inside concrete encased conduits to avoid exposure to temperatures above the conductor’s rating. Furthermore, a minimum slab thickness of 5 inches covers all types of concrete for 2-hours resistance per ASTM E119 acceptance criterion.

Table 1 – Data shown in this table was obtained from NFPA Research Foundation 'Fire Resistance of Concrete for Electrical Conductors' Page 6, Table 1

Concrete Type	Minimum Slab Thickness (inches) for Fire Resistance of		
	1-hour	1 ½ hours	2 hours
Siliceous	3.5	4.3	5.0
Carbonate	3.2	4.0	4.6
Sand-lightweight	2.7	3.3	3.8
Lightweight	2.5	3.1	3.6

The findings in this investigation corroborate with the data located in the cited NFPA Research Foundation and ACI documents. The following NFPA 70 public inputs were created last year, for the 2026 cycle, to trigger change in the code to make it safer and prompt the industry to consider more appropriate concrete encasement thicknesses and properly rated conductors:

- Public input number 3688 on Article 695.6(A)(2)
- Public input number 3697 on Article 695.14(F)(1)
- Public input number 3707 on Article 700.10 (D)(2)(5)
- Public input number 3716 on Article 708.10(C)(2)(4)

Suggested clarification to Article 230.6 has also been made under Public Input 3770, to clearly address that consideration for conductors outside the building is meant for mechanical protection only (not for circuit integrity purposes).

Referenced documents

ACI 216.1-07 / TMS-0216-07 American Concrete Institute 'Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies', year 2007.

NFPA 70 National Electrical Code (NEC), 2023 Version.

NFPA Research Foundation 'Fire Resistance of Concrete for Electrical Conductors', year 2018.

ASTM E119 Standard Methods for Fire Tests of Building Construction and Materials, year 2016.

Public Comment No. 1059-NFPA 70-2024 [Section No. 695.7(A)(2)]

(2) Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.5(B) or conductors that connect directly to an on-site standby generator shall comply with 695.7(A)(2)(a) through 695.7(A)(2)(d).

(a) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(b) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(c) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(d) *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 concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway that has been evaluated by a licensed professional engineer to provide a 2-hour fire rating .

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

Informational Note: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 1: See UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

Informational Note No. 2: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 3: 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. 4: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system.

Informational Note No. 5: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 6: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

Exception to (d): 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
CONCRETE_VOLUME_ESTIMATE.pdf	Concrete Volume Estimate	

Statement of Problem and Substantiation for Public Comment

The 2" requirement for concrete has been working and installers are familiar with the associated technical challenges. The increase to a 5" requirement adds 4x the volume of concrete and associated weight within the structure. A concrete element of that volume needs structural evaluation to ensure there is not an increased risk of structural failure due to the addition of the concrete. If not evaluated, this creates a enhanced risk of structural failures. If a structural evaluation will be needed in either case, add that new requirement to the existing 2" encasement standard. This addresses the risk of improper thermal protection of this critical infrastructure during a fire, while not creating a new risk of overloaded structural installations and the corresponding risk to the electrical infrastructure.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1055-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1060-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1061-NFPA 70-2024 [Section No. 708.10(C)(2)]	
Public Comment No. 1055-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1060-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1061-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

- FR-8063

Submitter Information Verification

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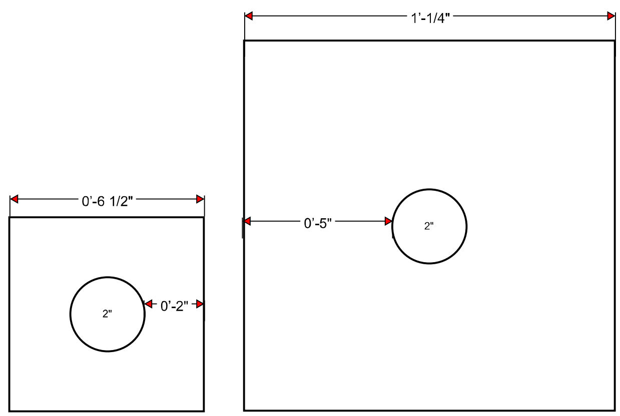
Submittal Date:	Tue Aug 13 11:58:28 EDT 2024
Committee:	NEC-P13



2" encasement around 2" conduit

42 sq in total area
conduit is 5 sq inches
volume of concrete = 37 sq in

5" encasement around 2" conduit

154 sq in total area
conduit is 5 sq inches
volume of concrete = 149 sq in

the 5" requirement is 149sqin of concrete over 37sqin - that corresponds to a 4X increase in concrete volume necessary to meet the requirements

Public Comment No. 1563-NFPA 70-2024 [Section No. 695.7(A)(2)]

(2) Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.5(B) or conductors that connect directly to an on-site standby generator shall comply with 695.7(A)(2)(a) through 695.7(A)(2)(d).

(a) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(b) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(c) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(d) *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~~ covered in concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway.

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design.*~~

(2) The

~~selection shall be documented and stamped by the professional engineer.~~

~~Informational Note: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

~~The~~

-
- cable or raceway is part of a listed fire-resistive cable system.

  Informational Note No. 1: See UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables* , for one method of defining a fire-resistive cable system.

  Informational Note No. 2: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

  Informational Note No. 3: The listing organization provides information for fire-resistive cable systems on proper installation requirements to maintain the fire rating.

- The cable or raceway is protected by a listed electrical circuit protective system.

  Informational Note No. 4: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems* , for one method of defining an electrical circuit protective system.

  Informational Note No. 5: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

  Informational Note No. 6: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

Exception to (d): 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
Review_of_FPRF_Report_August_20_2024.pdf	Technical Review of NFPA Research Report - "Fire Resistance of Concrete for Electrical Conductors" - review by Dr. Jeff Packer	

Statement of Problem and Substantiation for Public Comment

These changes that have been proposed would increase the requirement from 2" to 5", which an increase of 150%. To make a change this drastic to the code, technical substantiation should be provided that is not only robust and conclusive, but also shows actual testing of the use case that is in question. Unfortunately, the public input did not provide this, but instead provides a document that has been inaccurately titled a "research report."

The NFPA Research Foundation report, "Fire Resistance of Concrete for Electrical Conductors," does not constitute empirical research and does not provide any actual test results or original research. It would be more accurately titled as a literature review. It lays out goals to provide a literature review, a gap analysis, and a final report. It only accomplishes the first of these goals in any significant way.

The stated purpose of the report was to identify gaps and recommend additional work that needs to be done to fill those gaps. In the end, the authors didn't identify the gaps in knowledge. Usually, a report like this recommends additional specific research that needs to be done. It does not draw conclusions about code changes. This report takes this leap and draws conclusions without recommending any specific research.

The "Final Report" consists of 1 paragraph where bold statements are provided that are drastic leaps as conclusions related to electrical conductors, given that none of the data in literature review provided any testing of electrical conductors, raceways, or systems. The literature review discusses the fire resistance of requirements of different codes that are for structural members. Structural members are tested for fire resistance with the load it is intended to carry, because this affects the fire resistance rating. The electrical raceways carrying the electrical conductors would not be stressed with a structural load, which means that they would be able to achieve a longer fire resistance rating with a thinner amount of concrete.

The fact that the literature review focuses on structural members under load, should make any conclusions inadmissible to this issue. The one accurate statement that the report does make is found in the final sentence, when it says that "more research in the form of modeling or experimental testing may be necessary, if further substantiation is required."
To provide an additional opinion on this report and the proposed code changes, I contacted Dr. Jeffrey Packer, PhD, DSC, PEng, of the University of Toronto. Dr. Packer is a widely published professor of engineering and a prolific researcher on structural loading and fire resistance. Dr. Packer provided the attached response

to the question of whether the NFPA report "Fire Resistance of Concrete for Electrical Conductors" provided technical support for these code changes. Please carefully consider his response and expert analysis.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1565-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1847-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1848-NFPA 70-2024 [Section No. 708.10(C)(2)]	
Public Comment No. 1565-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1847-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1848-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

- FR 8063

Submitter Information Verification

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Committee: NEC-P13

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August 20, 2024

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REVIEW of "Fire Resistance of Concrete for Electrical Conductors"

by Caitlyn Peterson, Fire Protection Research Foundation, December 2018

The author does not appear to be an expert on the design of concrete structures for fire resistance, and the investigation is based on articles procured from a web search (likely by keywords). Apart from technical misunderstandings (described below), there are a disconcerting number of English errors indicating that the report was not checked.

It is well-known that the resistance of a concrete member or element, under a standard (e.g. ISO) fire, is a function of a number of parameters: the concrete cover (i.e. insulation); the type of concrete; type of concrete element (i.e. slab, versus column, beam or wall); and reinforcement within (plain, rebar or fiber). The author, however, "discovers" such truisms regarding fire resistance by browsing many documents.

The report is presented as a hodge-podge of "information" all together. For example, considering a 2-hour fire rating, Tables 6 and 7 present the required overall dimensions of a member (3.6 to 5 inches for slabs, 9 to 10 inches for columns), whereas Tables 8 and 9 then present the required minimum cover of a member (0.75 to 1 inch for slabs, 0.75 to 1.25 inches for beams). This confusion between the overall dimension(s) and the concrete cover is inherent throughout this report.

In the "Information Gap Analysis", page 20, the third bullet concludes that … "A 2-inch thickness does not always equate to a 2-hour fire rating". Of course it does not; 2 inches of concrete cover is what is intended. This naivety is reiterated on pages 21 and 23. The relevant clauses from the NEC 2017 Edition Requirements for Feeder Protection are reproduced in Figure 5 (page 21) and the highlighted parts are quite acceptable – except the wording should be improved to be more explicit. Part (d)(1) should state … "The cable or raceway is encased on any side by a minimum of 50 mm (2 in.) of concrete cover."

Changes to the proposed code clauses, reflecting the above, are provided separately. Key is that the word "cover" be explicitly stated, and "encasement" be avoided. With 2 inches of concrete cover, the minimum member (e.g. slab) thickness would be 4 inches + the diameter of the electrical conductor/conduit.

In my opinion, this Peterson/FPRA report does not constitute technical research and does not provide sufficient technical justification to make substantive code changes.

Professor Jeffrey A. Packer, PhD, DSc, PEng
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Canada

Public Comment No. 1578-NFPA 70-2024 [Section No. 695.7(A)(2)]

(2) Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.5(B) or conductors that connect directly to an on-site standby generator shall comply with 695.7(A)(2)(a) through 695.7(A)(2)(d).

(a) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(b) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(c) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(d) *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 concrete with a minimum thickness of ~~127~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

~~Informational Note: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 1: See UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables* , for one method of defining a fire-resistive cable system.

Informational Note No. 2: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 3: 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. 4: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems* , for one method of defining an electrical circuit protective system.

Informational Note No. 5: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 6: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

Exception to (d): 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 Comment

Although difficult to see in Terraview, this comment seeks to remove the added Informational Note and reverse the requirement for concrete encasement from 5" back to 2".
The substantiation is based on a report that was obviously not peer reviewed, nor did it contain any test data. In fact, the last line of the reprt states "More research in the form of modeling or experimental testing may be necessary, if further substantiation is required." This "research" report is not research at all, it is a literature review of various online sources.

The very first paragraph of this report should cause the reader to raise an eybrow and question its veracity. It reads: "Different codes and standards have been developed in order to ensure the safety of
buildings and their occupants. The National Electric [sic] Code (NEC) provides the requirements and parameters for electrical equipment. Within the NEC, fire safety and protection is referenced in many sections. In terms of fire protection equipment, such as fire pumps and emergency systems, the electrical feeder associated with these systems needs to be protected from the thermal effects of fire. The 2017 edition of the National Electric [sic] Code (NEC) allows conductors to be installed under 2-inches of concrete to provide this thermal protection. This is stated in several places including sections in Articles 230, 695, 700, and 708. This is intended to provide a 2 hour fire rating equivalent to locating the conductor outside of the building.

Not only does the author (shockingly) not know the name of the National Electrical Code, the author is incorrect in their assumptions. The concrete encasement contemplated in Article 230 was never to protect the conductors from a fire within the building , they are to protect the building from a FIRE CREATED FROM the conductors! This is why the requirement for a disconnect at the point of entrance has been in the NEC since its creation in 1897. In fact, that concept predates the NEC itself and goes back to at least October 19th, 1881 in a meeting of the New York Board of Fire Underwriters. We want service conductors (the target of Article 230) outside of the building because their ground-fault and short-circuit protection far exceeds that allowed by the NEC, and there is no way to manually disconnect them. The requirement in Article 230 has nothing to do with this issue.
The author of the "research" paper is somewhat correct, however, when they refer to Articles 695, 700, and 708. Those articles do indeed provide protection requirements to protect the conductors, however, they were never intended to provide a particular fire-resistance rating (be it one hour, two hours, or any other number). This can be verified by a quick review of those sections prior to the 2017 NEC. Those editions indicated that 2" of concrete was sufficient. That was changed in 2017, however, although no testing was performed and no data was submitted. As indicated in the negative votes, the practice of having 2" concrete encasement is decades old (my books only go back to the 1950s, and it was in the NEC at that time) and has an impeccable track record. There are still no documented problems from having these conductors encased in 2" of concrete, as, once gain, expressed in the negative voting to the 2026 public input.
There was a time when a change like this would have been laughed out of the room if it was not accompanied by testing data. Did the submitted ever test the temperature of conductors inside of a raceway subjected to the ASTM E119 test? If so, where are the results? This is reminiscant of the rooftop temperature adder that was added to Article 310 back in 2011. It was added as a result of bad science and it took good science to undo it. Why is this committee willing to make the same mistake? A change like this should be driven by good science, not a poorly written literature review like the one that this change is based on (and that is being considered for inclusion as an Informational Note).

Related Public Comments for This Document

Related Comment	Relationship

Public Comment No. 1600-NFPA 70-2024 [Section No. 695.14(F)]
Public Comment No. 1601-NFPA 70-2024 [Section No. 700.10(D)(2)]
Public Comment No. 1602-NFPA 70-2024 [Section No. 708.10(C)(2)]

Related Item

- FR 8063

Submitter Information Verification

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Submittal Date:	Sat Aug 24 11:16:39 EDT 2024
Committee:	NEC-P13

Public Comment No. 1818-NFPA 70-2024 [Section No. 695.7(A)(2)]

(2) Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.5(B) or conductors that connect directly to an on-site standby generator shall comply with 695.7(A)(2)(a) through 695.7(A)(2)(d).

(a) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(b) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(c) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(d) *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 ~~concrete with~~ a minimum ~~thickness of 127 mm (5 in.) measured from each point on the surface of the cable or raceway.~~

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

~~Informational Note: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

50 mm (2 in.) of concrete.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 1: See UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

Informational Note No. 2: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 3: 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. 4: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system.

Informational Note No. 5: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 6: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

Exception to (d): 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
Public_Comment_Attachment_for_NEC_695.7_A_2_1_FR-8063_695.14_F_1_FR-8065_700.10_D_2_5_FR-8078_and_708.10_C_2_4_FR-8080_.pdf		

Statement of Problem and Substantiation for Public Comment

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 Fire Resistance of Concrete for Electrical Conductors (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used "because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours" and by "making the requirement 5 inches you remove the need to specify the type of concrete to use". The author's conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author's conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment). In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.

The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the “heat transmission” end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.

The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, “Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture,” and PCA Publication T-140, Fire Resistance of Reinforced Concrete Floors.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the “fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)”. Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.

The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between “a 2-hour fire resistance rating of a structural member, such as a wall” and “a 2-hour fire rating of an electrical circuit, such as a conduit with wires”. Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1829-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1832-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1835-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

• FR-8063 • FR-8065 • FR-8078 • FR-8080

Submitter Information Verification

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Submittal Date:	Tue Aug 27 14:57:19 EDT 2024
Committee:	NEC-P13

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 *Fire Resistance of Concrete for Electrical Conductors* (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – *Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing* as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used “because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours” and by “making the requirement 5 inches you remove the need to specify the type of concrete to use”. The author’s conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author’s conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

> Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. <u>Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading</u>

> conditions (tension cracks associated with bending moment). In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.
>
> The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the "heat transmission" end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.
>
> The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, "Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture," and PCA Publication T-140, *Fire Resistance of Reinforced Concrete Floors*.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the "fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)". Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

> Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.
>
> The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire

resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between “a 2-hour fire resistance rating of a structural member, such as a wall” and “a 2-hour fire rating of an electrical circuit, such as a conduit with wires”. Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Public Comment No. 1827-NFPA 70-2024 [Section No. 695.7(A)(2)]

(2) Feeders.

Fire pump supply conductors on the load side of the final disconnecting means and overcurrent device(s) permitted by 695.5(B) or conductors that connect directly to an on-site standby generator shall comply with 695.7(A)(2)(a) through 695.7(A)(2)(d).

(a) *Independent Routing.* The conductors shall be kept entirely independent of all other wiring.

(b) *Associated Fire Pump Loads.* The conductors shall supply only loads that are directly associated with the fire pump system.

(c) *Protection from Potential Damage.* The conductors shall be protected from potential damage by fire, structural failure, or operational accident.

(d) *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 concrete with a minimum thickness of 127 mm (5 in.) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

Informational Note: See Fire Protection Research Foundation Report FPRF-2018-16, “Fire Resistance of Concrete for Electrical Conductors,” for information about concrete fire resistance.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 1: See UL 2196, *Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

Informational Note No. 2: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 3: 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. 4: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system.

Informational Note No. 5: See UL *Guide Information for Electrical Circuit Integrity Systems* (FHIT) for identifying the system and its installation limitations to maintain a minimum 2-hour fire-resistive rating.

Informational Note No. 6: The listing organization provides information for electrical circuit protective systems on proper installation requirements to maintain the fire rating.

Exception to (d): 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 Comment

There wasn't any technical substantiation or results of subsequent testing provided by the submitter of the public input to justify the increase of the concrete encasement from 2 (two) inches to 5 (five) inches. ASTM E119 deals with testing of structural building components such as the following information: Giving a structure a fire rating is quite simple: in the case that a material maintains structural integrity for 30 minutes, it will have a fire rating of 30 minutes; or, if the structure lasts for 1 hour, it will have a rating of 1 hour.

The time-temperature curve simply allows engineers to understand the heat capacity for materials over some time, but the specific temperatures are not included as part of the fire rating. In general, structures and materials that last over 1 hour are viewed as being quite reliable.
We are not trying to give the cables or raceways a fire rating. Before we add such a radical change to fire pump emergency circuit, and critical operation power system circuits in raceways and cables, testing data must be provided for accurate protection. The submitter of the public input even stated that he felt even five inches of concrete may not be enough encapsulation. This change can radically change installation in under-slab installations and in-slab installations in many commercial and industrial installations. Again, without proper technical substantiation. The NEC Panel should not be required to guess at whether this change will provide proper protection but should have the test data provided for this change. We dealt with similar proposed changes a few cycles ago when I was on Panel 3 and Panel 13, again, without proper technical substantiation. A similar proposed change was dealt with at the NFPA Annual Meeting and ultimately was rejected based on the lack of technical substantiation.

Related Item

• FR-8063

Submitter Information Verification

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Committee:	NEC-P13

Public Comment No. 1948-NFPA 70-2024 [Section No. 695.12(C)]

(C) Stationary ~~Standby~~ Batteries.

~~Stationary standby batteries~~ Stationary 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.

Statement of Problem and Substantiation for Public Comment

The term "standby" should be deleted to correlate with first revisions made in Article 480.

Related Item

• FR-7612 • FR-8129 • FR-8132 • FR-7808 • FR-7812 • FR-7830 • FR-7823 • FR-7822 • FR-7836

Submitter Information Verification

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Submittal Date: Wed Aug 28 12:30:15 EDT 2024
Committee: NEC-P13

Public Comment No. 1055-NFPA 70-2024 [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 No. 1: See NFPA 20-2025, *Standard for the Installation of Stationary Pumps for Fire Protection*, 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 concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway that has been evaluated by a licensed professional engineer to provide a 2-hour fire rating .

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

Informational Note No. 2: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors" for information about concrete fire resistance.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 3: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 4: 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. 5: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems*, for testing requirements for circuit protective systems.

Informational Note No. 6: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft.

Informational Note No. 7: 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
CONCRETE_VOLUME_ESTIMATE.pdf	Concrete volume calculation 2" vs 5"	

Statement of Problem and Substantiation for Public Comment

The 2" requirement for concrete has been working and installers are familiar with the associated technical challenges. The increase to a 5" requirement adds 4x the volume of concrete and associated weight within the structure. A concrete element of that volume needs structural evaluation to ensure there is not an increased risk of structural failure due to the addition of the concrete. If not evaluated, this creates a enhanced risk of structural failures. If a structural evaluation will be needed in either case, add that new requirement to the existing 2" encasement standard. This addresses the risk of improper thermal protection of this critical infrastructure during a fire, while not creating a new risk of overloaded structural installations and the corresponding risk to the electrical infrastructure.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1061-NFPA 70-2024 [Section No. 708.10(C)(2)]	
Public Comment No. 1060-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1059-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1059-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1060-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1061-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

- FR-8065

Submitter Information Verification

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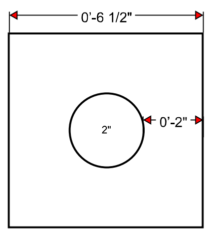
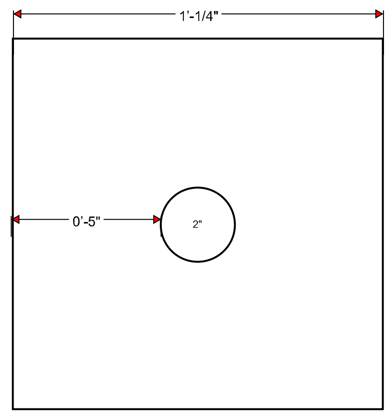
Submittal Date: Tue Aug 13 09:18:29 EDT 2024
Committee: NEC-P13





2" encasement around 2" conduit

42 sq in total area
conduit is 5 sq inches
volume of concrete = 37 sq in

5" encasement around 2" conduit

154 sq in total area
conduit is 5 sq inches
volume of concrete = 149 sq in

the 5" requirement is 149sqin of concrete over 37sqin - that corresponds to a 4X increase in concrete volume necessary to meet the requirements

Public Comment No. 1600-NFPA 70-2024 [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 No. 1: See NFPA 20-2025, *Standard for the Installation of Stationary Pumps for Fire Protection*, 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 concrete with a minimum thickness of ~~127~~ 50 mm (~~5~~ 2 in.) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

~~Informational Note No. 2: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors" for information about concrete fire resistance.~~

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 3: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 4: 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. 5: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems*, for testing requirements for circuit protective systems.

Informational Note No. 6: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft.

Informational Note No. 7: 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 Comment

Although difficult to see in Terraview, this comment seeks to remove the added Informational Note and reverse the requirement for concrete encasement from 5" back to 2".
The substantiation is based on a report that was obviously not peer reviewed, nor did it contain any test data. In fact, the last line of the reprt states "More research in the form of modeling or experimental testing may be necessary, if further substantiation is required." This "research" report is not research at all, it is a literature review of various online sources.

The very first paragraph of this report should cause the reader to raise an eybrow and question its veracity. It reads: "Different codes and standards have been developed in order to ensure the safety of
buildings and their occupants. The National Electric [sic] Code (NEC) provides the requirements and parameters for electrical equipment. Within the NEC, fire safety and protection is referenced in many sections. In terms of fire protection equipment, such as fire pumps and emergency systems, the electrical feeder associated with these systems needs to be protected from the thermal effects of fire. The 2017 edition of the National Electric [sic] Code (NEC) allows conductors to be installed under 2-inches of concrete to provide this thermal protection. This is stated in several places including sections in Articles 230, 695, 700, and 708. This is intended to provide a 2 hour fire rating equivalent to locating the conductor outside of the building.

Not only does the author (shockingly) not know the name of the National Electrical Code, the author is incorrect in their assumptions. The concrete encasement contemplated in Article 230 was never to protect the conductors from a fire within the building , they are to protect the building from a FIRE CREATED FROM the conductors! This is why the requirement for a disconnect at the point of entrance has been in the NEC since its creation in 1897. In fact, that concept predates the NEC itself and goes back to at least October 19th, 1881 in a meeting of the New York Board of Fire Underwriters. We want service conductors (the target of Article 230) outside of the building because their ground-fault and short-circuit protection far exceeds that allowed by the NEC, and there is no way to manually disconnect them. The requirement in Article 230 has nothing to do with this issue.
The author of the "research" paper is somewhat correct, however, when they refer to Articles 695, 700, and 708. Those articles do indeed provide protection requirements to protect the conductors, however, they were never intended to provide a particular fire-resistance rating (be it one hour, two hours, or any other number). This can be verified by a quick review of those sections prior to the 2017 NEC. Those editions indicated that 2" of concrete was sufficient. That was changed in 2017, however, although no testing was performed and no data was submitted. As indicated in the negative votes, the practice of having 2" concrete encasement is decades old (my books only go back to the 1950s, and it was in the NEC at that time) and has an impeccable track record. There are still no documented problems from having these conductors encased in 2" of concrete, as, once gain, expressed in the negative voting to the 2026 public input.
There was a time when a change like this would have been laughed out of the room if it was not accompanied by testing data. Did the submitted ever test the temperature of conductors inside of a raceway subjected to the ASTM E119 test? If so, where are the results? This is reminiscant of the rooftop temperature adder that was added to Article 310 back in 2011. It was added as a result of bad science and it took good science to undo it. Why is this committee willing to make the same mistake? A change like this should be driven by good science, not a poorly written literature review like the one that this change is based on (and that is being considered for inclusion as an Informational Note).

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1578-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1601-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1602-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

- FR 8065

Submitter Information Verification

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Submittal Date: Sat Aug 24 13:43:01 EDT 2024
Committee: NEC-P13

Public Comment No. 1829-NFPA 70-2024 [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 No. 1: See NFPA 20-2025, *Standard for the Installation of Stationary Pumps for Fire Protection*, 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 ~~concrete with~~ in a minimum ~~thickness of 127 mm (5 in.) measured from each point on the surface of the cable or raceway.~~

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

~~Informational Note No. 2: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors" for information about concrete fire resistance.~~

50 mm (2 in.) of concrete.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 3: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 4: 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. 5: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems*, for testing requirements for circuit protective systems.

Informational Note No. 6: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft.

Informational Note No. 7: 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
Public_Comment_Attachment_for_NEC_695.7_A_2_1_FR-8063_695.14_F_1_FR-8065_700.10_D_2_5_FR-8078_and_708.10_C_2_4_FR-8080_.pdf		

Statement of Problem and Substantiation for Public Comment

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 Fire Resistance of Concrete for Electrical Conductors (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used "because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours" and by "making the requirement 5 inches you remove the need to specify the type of concrete to use". The author's conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author's conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment). In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.

The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the “heat transmission” end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.

The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, “Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture,” and PCA Publication T-140, Fire Resistance of Reinforced Concrete Floors.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the “fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)”. Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.

The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between “a 2-hour fire resistance rating of a structural member, such as a wall” and “a 2-hour fire rating of an electrical circuit, such as a conduit with wires”. Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1818-NFPA 70-2024 [Section No. 695.7(A)(2)]	Identical comment
Public Comment No. 1832-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1835-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

• FR-8063 • FR-8065 • FR-8078 • FR-8080

Submitter Information Verification

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Committee: NEC-P13

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 *Fire Resistance of Concrete for Electrical Conductors* (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – *Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing* as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used "because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours" and by "making the requirement 5 inches you remove the need to specify the type of concrete to use". The author's conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author's conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

> Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. <u>Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading</u>

> <u>conditions (tension cracks associated with bending moment).</u> In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.
>
> The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the "heat transmission" end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.
>
> The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, "Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture," and PCA Publication T-140, *Fire Resistance of Reinforced Concrete Floors*.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the "fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)". Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

> Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.
>
> <u>The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire</u>

resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between “a 2-hour fire resistance rating of a structural member, such as a wall” and “a 2-hour fire rating of an electrical circuit, such as a conduit with wires”. Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Public Comment No. 1847-NFPA 70-2024 [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 No. 1: See NFPA 20-2025, *Standard for the Installation of Stationary Pumps for Fire Protection*, 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 concrete~~ covered in concrete with a minimum thickness of ~~127~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway.

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design.*~~

The

~~*selection shall be documented and stamped by the professional engineer.*~~

~~Informational Note No. 2: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors" for information about concrete fire resistance.~~

~~The~~

(2)

cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 3: See UL 2196-2017, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables , for testing requirements for fire-resistive cables.

Informational Note No. 4: 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. 5: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems* , for testing requirements for circuit protective systems.

Informational Note No. 6: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft.

Informational Note No. 7: 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
Review_of_FPRF_Report_August_20_2024.pdf	Technical Review of NFPA Research Report - "Fire Resistance of Concrete for Electrical Conductors" - review by Dr. Jeff Packer	

Statement of Problem and Substantiation for Public Comment

These changes that have been proposed would increase the requirement from 2" to 5", which an increase of 150%. To make a change this drastic to the code, technical substantiation should be provided that is not only robust and conclusive, but also shows actual testing of the use case that is in question. Unfortunately, the public input did not provide this, but instead provides a document that has been inaccurately titled a "research report."

The NFPA Research Foundation report, "Fire Resistance of Concrete for Electrical Conductors," does not constitute empirical research and does not provide any actual test results or original research. It would be more accurately titled as a literature review. It lays out goals to provide a literature review, a gap analysis, and a final report. It only accomplishes the first of these goals in any significant way.

The stated purpose of the report was to identify gaps and recommend additional work that needs to be done to fill those gaps. In the end, the authors didn't identify the gaps in knowledge. Usually, a report like this recommends additional specific research that needs to be done. It does not draw conclusions about code changes. This report takes this leap and draws conclusions without recommending any specific research.

The "Final Report" consists of 1 paragraph where bold statements are provided that are drastic leaps as conclusions related to electrical conductors, given that none of the data in literature review provided any testing of electrical conductors, raceways, or systems. The literature review discusses the fire resistance of requirements of different codes that are for structural members. Structural members are tested for fire resistance with the load it is intended to carry, because this affects the fire resistance rating. The electrical raceways carrying the electrical conductors would not be stressed with a structural load, which means that they would be able to achieve a longer fire resistance rating with a thinner amount of concrete.
The fact that the literature review focuses on structural members under load, should make any conclusions inadmissible to this issue. The one accurate statement that the report does make is found in the final sentence, when it says that "more research in the form of modeling or experimental testing may be necessary, if further substantiation is required."

To provide an additional opinion on this report and the proposed code changes, I contacted Dr. Jeffrey Packer, PhD, DSC, PEng, of the University of Toronto. Dr. Packer is a widely published professor of engineering and a prolific researcher on structural loading and fire resistance. Dr. Packer provided the attached response to the question of whether the NFPA report "Fire Resistance of Concrete for Electrical Conductors" provided technical support for these code changes. Please carefully consider his response and expert analysis.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1563-NFPA 70-2024 [Section No. 695.7(A)(2)]	

Public Comment No. 1565-NFPA 70-2024 [Section No. 700.10(D)(2)]
Public Comment No. 1848-NFPA 70-2024 [Section No. 708.10(C)(2)]
Public Comment No. 1563-NFPA 70-2024 [Section No. 695.7(A)(2)]
Public Comment No. 1565-NFPA 70-2024 [Section No. 700.10(D)(2)]
Public Comment No. 1848-NFPA 70-2024 [Section No. 708.10(C)(2)]

Related Item

- FR 8065

Submitter Information Verification

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REVIEW of "Fire Resistance of Concrete for Electrical Conductors"

by Caitlyn Peterson, Fire Protection Research Foundation, December 2018

The author does not appear to be an expert on the design of concrete structures for fire resistance, and the investigation is based on articles procured from a web search (likely by keywords). Apart from technical misunderstandings (described below), there are a disconcerting number of English errors indicating that the report was not checked.

It is well-known that the resistance of a concrete member or element, under a standard (e.g. ISO) fire, is a function of a number of parameters: the concrete cover (i.e. insulation); the type of concrete; type of concrete element (i.e. slab, versus column, beam or wall); and reinforcement within (plain, rebar or fiber). The author, however, "discovers" such truisms regarding fire resistance by browsing many documents.

The report is presented as a hodge-podge of "information" all together. For example, considering a 2-hour fire rating, Tables 6 and 7 present the required <u>overall dimensions</u> of a member (3.6 to 5 inches for slabs, 9 to 10 inches for columns), whereas Tables 8 and 9 then present the required <u>minimum cover</u> of a member (0.75 to 1 inch for slabs, 0.75 to 1.25 inches for beams). This confusion between the overall dimension(s) and the concrete cover is inherent throughout this report.

In the "Information Gap Analysis", page 20, the third bullet concludes that … "A 2-inch thickness does not always equate to a 2-hour fire rating". Of course it does not; 2 inches of concrete cover is what is intended. This naivety is reiterated on pages 21 and 23. The relevant clauses from the NEC 2017 Edition Requirements for Feeder Protection are reproduced in Figure 5 (page 21) and the highlighted parts are quite acceptable – except the wording should be improved to be more explicit. Part (d)(1) should state … "The cable or raceway is encased on any side by a minimum of 50 mm (2 in.) of concrete <u>cover</u>."

Changes to the proposed code clauses, reflecting the above, are provided separately. Key is that the word "cover" be explicitly stated, and "encasement" be avoided. With 2 inches of concrete cover, the minimum member (e.g. slab) thickness would be 4 inches + the diameter of the electrical conductor/conduit.

In my opinion, this Peterson/FPRA report does not constitute technical research and does not provide sufficient technical justification to make substantive code changes.

Professor Jeffrey A. Packer, PhD, DSc, PEng
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Canada

Public Comment No. 581-NFPA 70-2024 [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 unintentional broken, disconnected, or shorted wires. Loss of integrity shall start the generator(s).

Informational Note No. 1: See NFPA 20-2025, *Standard for the Installation of Stationary Pumps for Fire Protection*, 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 concrete with a minimum thickness of 127 mm (5 in.) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

Informational Note No. 2: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors" for information about concrete fire resistance.

(2) The cable or raceway is part of a listed fire-resistive cable system.

Informational Note No. 3: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 4: 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. 5: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems*, for testing requirements for circuit protective systems.

Informational Note No. 6: Electrical circuit protective systems could include, but are not limited to, thermal barriers or a protective shaft.

Informational Note No. 7: 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 Comment

The word "unintentional" is inserted before the phrase "...broken, disconnected, or shorted wires" for added clarity.
The generator control wiring could be temporarily disconnected or shorted for a service-related event. The proposed language makes it clear that the integrity monitoring requirement is for unintentional events.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 580-NFPA 70-2024 [Section No. 700.10(D)(4)]	
Public Comment No. 580-NFPA 70-2024 [Section No. 700.10(D)(4)]	

Related Item

- FR 8065

Submitter Information Verification

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Submittal Date: Thu Aug 01 12:27:12 EDT 2024
Committee: NEC-P13

Public Comment No. 1584-NFPA 70-2024 [New Section after 695.15]

TITLE OF NEW CONTENT

695.16. Cybersecurity

Fire Pumps, located in life safety-related infrastructures, that are connected to a communication network and have the capability to be controlled or permit control of any portion of the premises shall comply with either of the following:

(1) The ability to control the fire pump is limited to a direct connection through a local nonnetworked interface.

(2) The fire pump is connected through a networked interface complying with both of the following methods:

a. The fire pump is identified as being evaluated for cybersecurity.

b. A cybersecurity assessment of the fire pump is completed and documentation of the assessment and certification is available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, *Cybersecurity Standards series*, UL 2900 *Cybersecurity Standard series*, or the NIST *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1 for assessment requirements.

Informational Note No. 2: Examples used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity is a specialized field requiring constant, vigilant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions. Installation of devices that can be secured is an important first step but not sufficient to guarantee a secure system.

Informational Note No. 4: See NEMA CY70001-2023, *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Informational Note No. 5: Examples of life safety-related infrastructures include, but are not limited to, waste water treatment facilities, water supply facilities, police stations, call centers, financial centers, data centers, and military bases.

Statement of Problem and Substantiation for Public Comment

Let's review the Code Making Panel Statement to resolve Public Input 1251, one sentence at a time.

The first sentence of the Panel Statement "General cybersecurity requirements are widely applicable based on requirements in 110" fails to note that 110.3(A)(8) has a serious issue. Amazingly, 110.3(A)(8), can be met with a simple evaluation, and that evalution can actually show that the life safety equipment is totally unprotected against cyber attack. 110.3(A)(8) DOESN'T STATE THAT LIFE SAFETY EQUIPMENT MUST BE PROTECTED AGAINST CYBER ATTACK. IT SIMPLY STATES THAT THE LIFE SAFETY SYSTEM MUST BE EVALUATED FOR CYBERSECURITY. YES, YOU READ THAT CORRECTLY, ZERO CYBERSECURITY PROTECTION FOR LIFE SAFETY EQUIPMENT IS ACCEPTABLE IN 110.3(A)(8). THE REQUIRED EVALUATION COULD SHOW THAT THERE IS NO PROTECTION AGAINST CYBER ATTACK AND STILL MEET THE REQUIREMENTS OF 110.3(A)(8)!

The Panel Statement "even with a five-year interval, would be inadequate in guaranteeing cybersecurity for fire pump products" is addressed by removal of the 5-year re-assessment.

The final sentence of the Panel Statement "Cybersecurity requirements are most practically applied based on the application in the systems rather than the piece of equipment" is addressed by the limitation to fire pumps installed in life safety-related infrastructure. (Informational Note No. 5 is added, providing examples of life safety-related infrastructure.)

Most of the cybersecurity focus has been on IT systems. There has been very little public discussion about cybersecurity for Operational Technology (OT), but cyber attacks on OT occur on almost a daily basis. For an example of just how common cyber attacks on life safety related infrastructure have become, let's look at just the water supply and waste water treatment industry. The DNI (Director of National Intelligence), through the CTIIC (Cyber Threat Intelligence Integration Center) recently released a report of 12 cyber attacks on the industrial control systems of water utilities, water systems, and waste water treatment systems, for the six-month period from November 2023 through April 2024. This report can be found at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.dni.gov/files/CTIIC/documents/products/Recent_Cyber_Attacks_on_US_Infrastructure_Underscore_Vulnerability_of_Crit June2024.pdf&ved=2ahUKEwi5gP7-m4eIAxUakYkEHasyIRQQFnoECB8QAQ&usg=AOvVaw3hJL2DMlRs-CECfmewcXVP

While this example covered attacks on industrial control systems, successful attacks can occur on all electrical equipment that is continuously connected to the internet and even equipment that is only connected to the internet during system updates. (Cyber attacks can lay quiet for years, waiting for an update, and then do their intended damage during the update.)

Hackers can easily destroy unprotected equipment and shut down entire unprotected facilities. Our adversaries are continuously mounting cyber attacks on our life safety-related infrastructure. We have the ability, and obligation, to prevent this type of damage to our infrastructure from malicious cyber attacks.

Informational Note No. 4 was added to correlate with FR 9040 (110.3(A)(8)), FR 9210 (240.6(D)), and FR 8219 (708.7).

THIS PUBLIC COMMENT SIMPLY REQUIRES THAT FIRE PUMPS, INSTALLED ONLY IN LIFE SAFETY-RELATED INFRASTRUCTURES, EITHER NOT BE CONNECTED TO THE INTERNET, OR IF THEY ARE CONNECTED TO THE INTERNET, THAT THEY BE "IDENTIFIED" FOR CYBERSECURITY AND THAT AN ASSESSMENT IS PROVIDED.

Related Item

- PI 1251

Submitter Information Verification

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Committee:	NEC-P13

Public Comment No. 167-NFPA 70-2024 [Section No. 700.3]

700.3 Reconditioned Equipment.

Reconditioned transfer switches shall not be ~~installed~~ permitted .

Statement of Problem and Substantiation for Public Comment

This public comment is made to address an issue with the first draft language changes. The proposed language in this first revision allows electrical equipment to be reconditioned in place as the language pertains to the installation process and not to when any equipment is reconditioned in place. With the existing language in this first revision, the only time reconditioned equipment would not be permitted is if it is being installed. The Code does apply to existing equipment when additions or modifications are being made. The proposed language change from "installed" to "permitted" is more inclusive.

Related Item

- FR 7658

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Submittal Date: Tue Jul 23 14:06:13 EDT 2024
Committee: NEC-P13

Public Comment No. 1135-NFPA 70-2024 [Section No. 700.4]

700.4 Commissioning and Maintenance.

(A) ~~Commissioning Witness Test.~~
The authority having jurisdiction shall conduct or witness the commissioning of the complete system ~~upon installation and periodically afterward~~ .

Informational Note:

~~See~~

See NECA 90, *Standard for Commissioning Building Electrical Systems* .

(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) Servicing.~~

~~Emergency system equipment shall be maintained in accordance with manufacturer instructions and industry standards.~~

~~(D) Record Keeping.~~

~~A written record shall be kept of such tests and maintenance and made available to those authorized to design, install, inspect, maintain, and operate the system.~~

~~(E)~~ Testing Under Load.

Means for testing all emergency lighting and power systems during maximum anticipated load conditions shall be provided.

Informational Note:

~~See~~

See ~~NFPA 110~~ NFPA 110 -2025, *Standard for Emergency and Standby Power Systems* , for information on testing and maintenance of emergency power supply systems (EPSSs).

(~~F~~ C) Temporary Source of Power for Servicing of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for servicing, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power that shall be available for the duration of the servicing. The permanent switching means to connect a portable or temporary alternate source of power shall comply with the following:

Temporary Source of Power for Servicing of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for servicing, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power that shall be available for the duration of the servicing. 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) The switching means, including the interlocks, shall be listed and provided with mechanical or mechanical and electrical interlocking to 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 permanent connection point for the temporary generator shall be located outdoors and shall not have cables from the connection point to the temporary generator routed through exterior windows, doors, or similar openings.

(7) A permanent label shall be field applied at the permanent connection point to identify the system voltage, maximum amperage, short-circuit current rating of the load side of equipment supplied, and ungrounded conductor identification in accordance with 210.5.

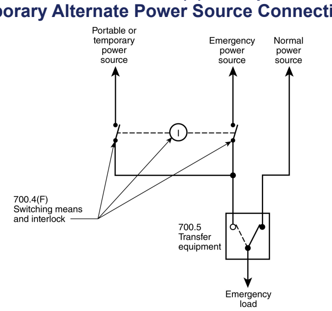
(8) The installation of a portable or temporary power source shall include an overcurrent protective device (OCPD) to provide equivalent protection for the emergency system and, at a minimum, provide sufficient power to emergency and other selected loads served.

(9) Section 700.10(D)(4)(b) shall not apply.

It shall be permissible to use manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to use the switching means for connection of a load bank.

Informational Note: See Figure Informational Note 700.4(F) for one example of many possible methods to achieve the requirements of 700.4(F).

Figure Informational Note 700.4(F) Example of Portable or Temporary Alternate Power Source Connection.



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 Comment

NFPA 70B is the standard for maintenance. NFPA 70 does not need to cover maintenance of the system other then including any necessary provisions for maintenance to be performed in the future, such as including the switching means for connection of a temporary alternate source.

Related Item

• FR-8172, PI-1671, PI-1276, FR-7672, FR-7675, FR-7676

Submitter Information Verification

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Submittal Date: Thu Aug 15 21:48:33 EDT 2024
Committee: NEC-P13

Public Comment No. 2055-NFPA 70-2024 [Section No. 700.4]

700.4 Commissioning and ~~Maintenance~~ Servicing .

(A) Commissioning Witness Test.

The authority having jurisdiction shall conduct or witness the commissioning of the complete system upon installation and periodically afterward.

Informational Note: See NECA 90, *Standard for Commissioning Building Electrical Systems*.

(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) Servicing.

Emergency system equipment shall be maintained in accordance with manufacturer instructions and industry standards.

(D) Record Keeping.

A written record shall be kept of such tests and ~~maintenance~~ servicing and made available to those authorized to design, install, inspect, maintain, and operate the system.

(E) Testing Under Load.

Means for testing all emergency lighting and power systems during maximum anticipated load conditions shall be provided.

Informational Note: See NFPA 110-2025, *Standard for Emergency and Standby Power Systems*, for information on testing and maintenance of emergency power supply systems (EPSSs).

(F) Temporary Source of Power for Servicing of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for servicing, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power that shall be available for the duration of the servicing. 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) The switching means, including the interlocks, shall be listed and provided with mechanical or mechanical and electrical interlocking to 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 permanent connection point for the temporary generator shall be located outdoors and shall not have cables from the connection point to the temporary generator routed through exterior windows, doors, or similar openings.

(7) A permanent label shall be field applied at the permanent connection point to identify the system voltage, maximum amperage, short-circuit current rating of the load side of equipment supplied, and ungrounded conductor identification in accordance with 210.5.

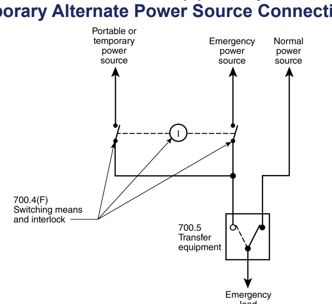
(8) The installation of a portable or temporary power source shall include an overcurrent protective device (OCPD) to provide equivalent protection for the emergency system and, at a minimum, provide sufficient power to emergency and other selected loads served.

(9) Section 700.10(D)(4)(b) shall not apply.

It shall be permissible to use manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to use the switching means for connection of a load bank.

Informational Note: See Figure Informational Note 700.4(F) for one example of many possible methods to achieve the requirements of 700.4(F).

Figure Informational Note 700.4(F) Example of Portable or Temporary Alternate Power Source Connection.



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 Comment

The term "maintenance" should be changed to "servicing" to correlate with revisions in this section.

Related Item

• FR-8172 • FR-7675

Submitter Information Verification

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Committee:	NEC-P13

Public Comment No. 1134-NFPA 70-2024 [Section No. 700.4(A)]

(A)
Commissioning . Witness . Test Testing .

The authority having jurisdiction shall conduct or witness the ~~commissioning~~ testing of the complete system upon installation ~~and periodically afterward~~ .

~~Informational Note: See NECA 90, *Standard for Commissioning Building Electrical Systems* .~~

Statement of Problem and Substantiation for Public Comment

Commissioning, especially of large standby systems can require multiple days. The process requires specialized knowledge and training that a dedicated commissioning authority would posses, but an AHJ may not. Requiring an AHJ to witness the full commissioning is also impractical because of the potential amount of time involved. Witnessing final acceptance testing to demonstrate proper operation should be sufficient. The requirement to commission or test the system "periodically" after the initial commissioning or testing is not specific, not enforceable, and many AHJs will be unwilling to return to witness or conduct any additional testing. If Commissioning is changed to witness testing the Informational Note is not needed.

Related Item

- PI-1671

Submitter Information Verification

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Submittal Date: Thu Aug 15 21:44:03 EDT 2024
Committee: NEC-P13

Public Comment No. 837-NFPA 70-2024 [Section No. 700.4(A)]

(A) Commissioning Witness Test.

The authority having jurisdiction shall conduct or witness the commissioning of the ~~complete~~ completed system upon installation and periodically afterward.

Informational Note: See NECA 90, *Standard for Commissioning Building Electrical Systems*.

Statement of Problem and Substantiation for Public Comment

This comment seeks to change "complete" to "completed." As indicated in PI 1671, the commissioning of a large or complex emergency system is a process that can take months to complete and is far too vast for an AHJ to witness of perform. Although I much prefer the previous language of simply witnessing the test, changing "complete" to completed" at least indicates that the AHJ need not witness the entire process, only the completed installation.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 840-NFPA 70-2024 [Section No. 701.4(A)]	

Related Item

- PI 1671

Submitter Information Verification

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Public Comment No. 1138-NFPA 70-2024 [Section No. 700.4(D)]

(D) Record Keeping.

A written or digital record shall be kept of such tests and maintenance and made available to those authorized to design, install, inspect, maintain, and operate the system.

Statement of Problem and Substantiation for Public Comment

The universal understanding of written to include digital is not substantiated by the committee. Adding "digital" clarifies that what is "written" can be either on paper or done on a computer.

Related Item

- PI-2496

Submitter Information Verification

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Committee:	NEC-P13

Public Comment No. 577-NFPA 70-2024 [Section No. 700.4(D)]

(D) Record Keeping.

A ~~written~~ record shall be kept of such tests and maintenance and made available to those authorized to design, install, inspect, maintain, and operate the system.

Statement of Problem and Substantiation for Public Comment

Since the subsection title “Written Record Keeping” was changed to “Record Keeping” (via FR 7675), then for consistency we must strike “written” from the text body. It’s also not reasonable (in this digital age) to require written records for all system installations.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 578-NFPA 70-2024 [Section No. 701.4(D)]	
Public Comment No. 578-NFPA 70-2024 [Section No. 701.4(D)]	
Public Comment No. 579-NFPA 70-2024 [Section No. 708.6]	

Related Item

- FR 7675

Submitter Information Verification

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Submittal Date: Thu Aug 01 11:55:04 EDT 2024
Committee: NEC-P13

Public Comment No. 999-NFPA 70-2024 [Section No. 700.4(D)]

(D) Record Keeping.

A written record shall be kept of such tests and maintenance~~ and made available to those authorized to design, install, inspect, maintain, and operate the system~~ .

Statement of Problem and Substantiation for Public Comment

The list of individuals that require access to records of testing is far too broad. Facility operators should be left with some discretion as to who has access to records of commissioning and settings of vital systems. Someone performing routine cleaning is maintaining a system in keeping with manufacturers instructions, but does not require access to records of commissioning and testing.

Related Item

- FR 7675

Submitter Information Verification

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Submittal Date:	Sat Aug 10 12:14:53 EDT 2024
Committee:	NEC-P13

Public Comment No. 648-NFPA 70-2024 [Section No. 700.4(F)]

(F) Temporary Source of Power for Servicing of the Alternate Source of Power.

If the emergency system relies on a single alternate source of power, which will be disabled for servicing, the emergency system shall include permanent switching means to connect a portable or temporary alternate source of power that shall be available for the duration of the servicing. 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. If the permanent emergency power source is part of a separately derived system, means shall be provided for the portable or temporary alternate source of power to meet the grounding requirements of 250.30.

(4) The switching means, including the interlocks, shall be listed and provided with mechanical or mechanical and electrical interlocking to 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 permanent connection point for the temporary generator shall be located outdoors and shall not have cables from the connection point to the temporary generator routed through exterior windows, doors, or similar openings.

(7) A permanent label shall be field applied at the permanent connection point to identify the system voltage, maximum amperage, short-circuit current rating of the load side of equipment supplied, and ungrounded conductor identification in accordance with 210.5.

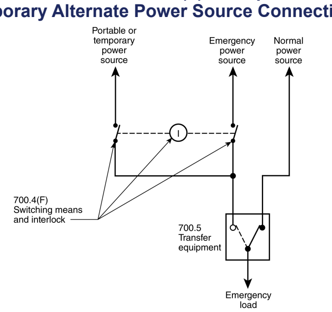
(8) The installation of a portable or temporary power source shall include an overcurrent protective device (OCPD) to provide equivalent protection for the emergency system and, at a minimum, provide sufficient power to emergency and other selected loads served.

(9) Section 700.10(D)(4)(b) shall not apply.

It shall be permissible to use manual switching to switch from the permanent source of power to the portable or temporary alternate source of power and to use the switching means for connection of a load bank.

Informational Note: See Figure Informational Note 700.4(F) for one example of many possible methods to achieve the requirements of 700.4(F).

Figure Informational Note 700.4(F) Example of Portable or Temporary Alternate Power Source Connection.



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
NEC_Public_Input_700.3_F_2024-08-08.pptx	Supporting One-Line Diagrams	

Statement of Problem and Substantiation for Public Comment

If separately derived systems are used with a 3-pole switching means between the permanent generator set and the temporary generator set, there can be a neutral bonding jumper issue (where there are either multiple jumpers or no jumpers) for the emergency source. This can cause problems with ground fault sensing. To correct this issue, a requirement should be added to (3) to make sure that emergency system designers take the grounding requirements of 250.30 into account with their designs.

Please reference the attached diagrams, which illustrate the issue at hand along with a potential way of solving. These diagrams could go into the NEC Handbook and NFPA Link.

Related Item

• FR 7676

Submitter Information Verification

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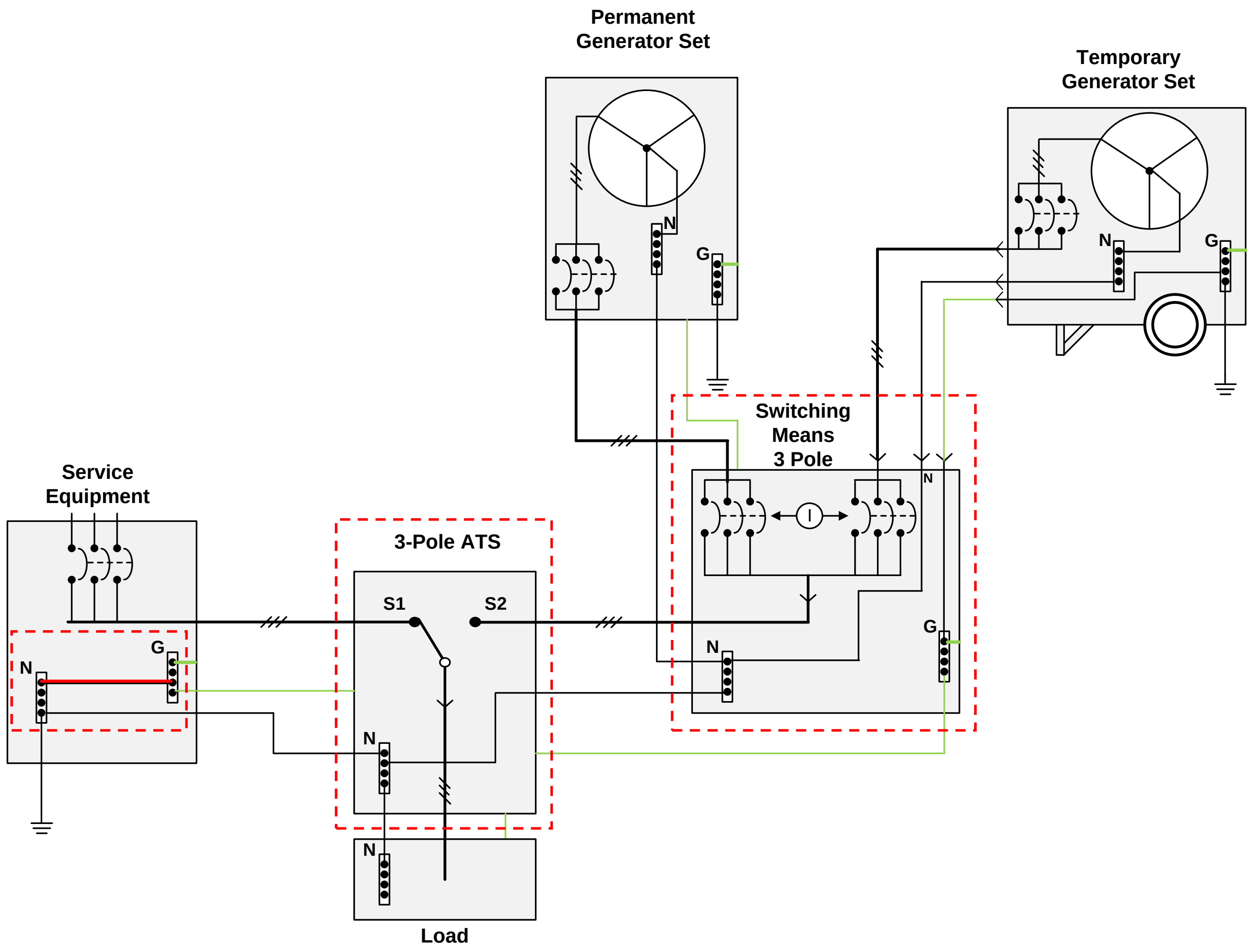
Submittal Date:	Fri Aug 02 09:14:53 EDT 2024
Committee:	NEC-P13

Temporary Source of Power 700.3(F)

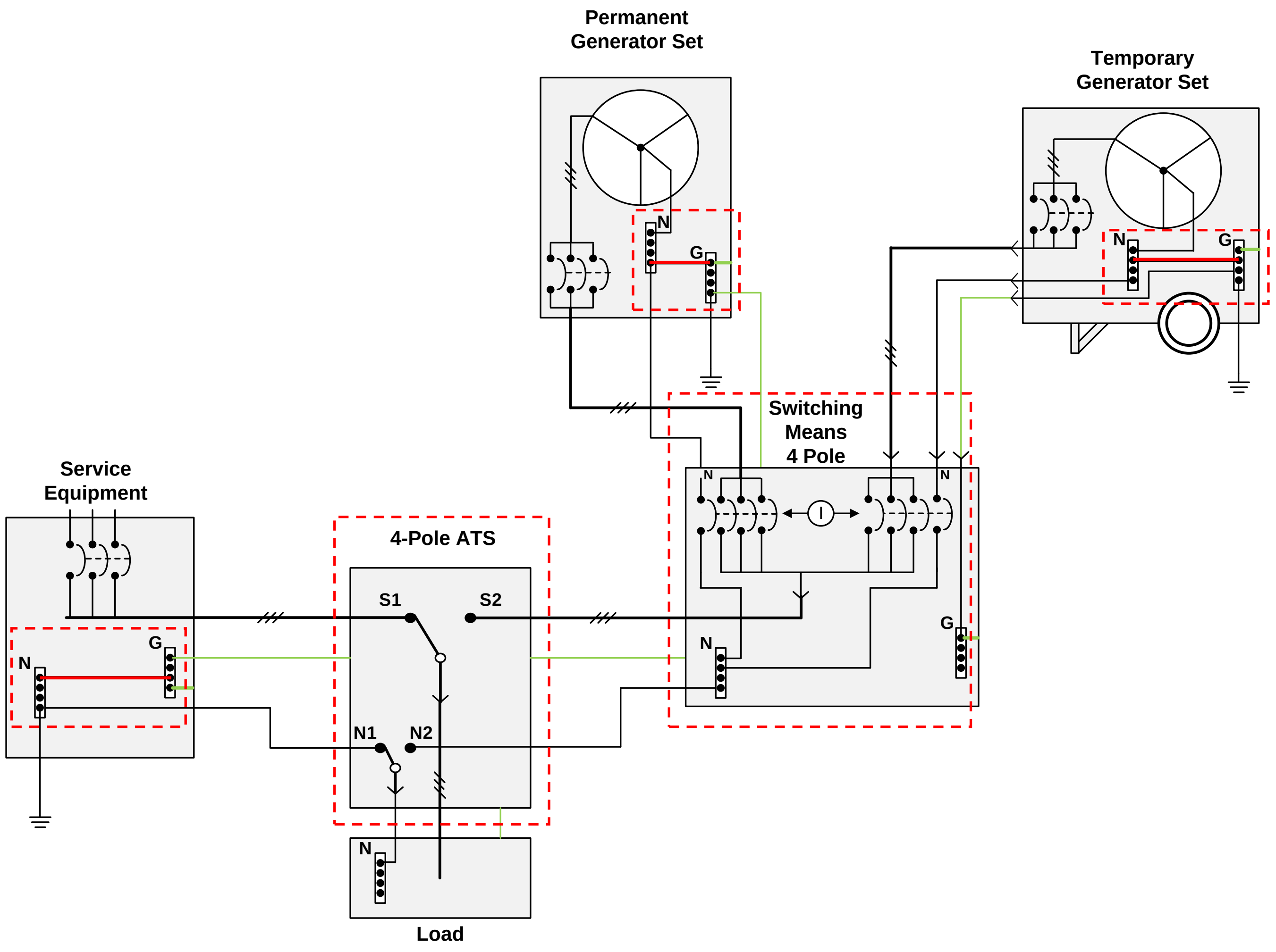
Non-Separately Derived Systems



- Neutral to Ground Bonding Jumper at Service Equipment
- 3-Pole ATS
- 3-Pole Switching Means

Temporary Source of Power 700.3(F)

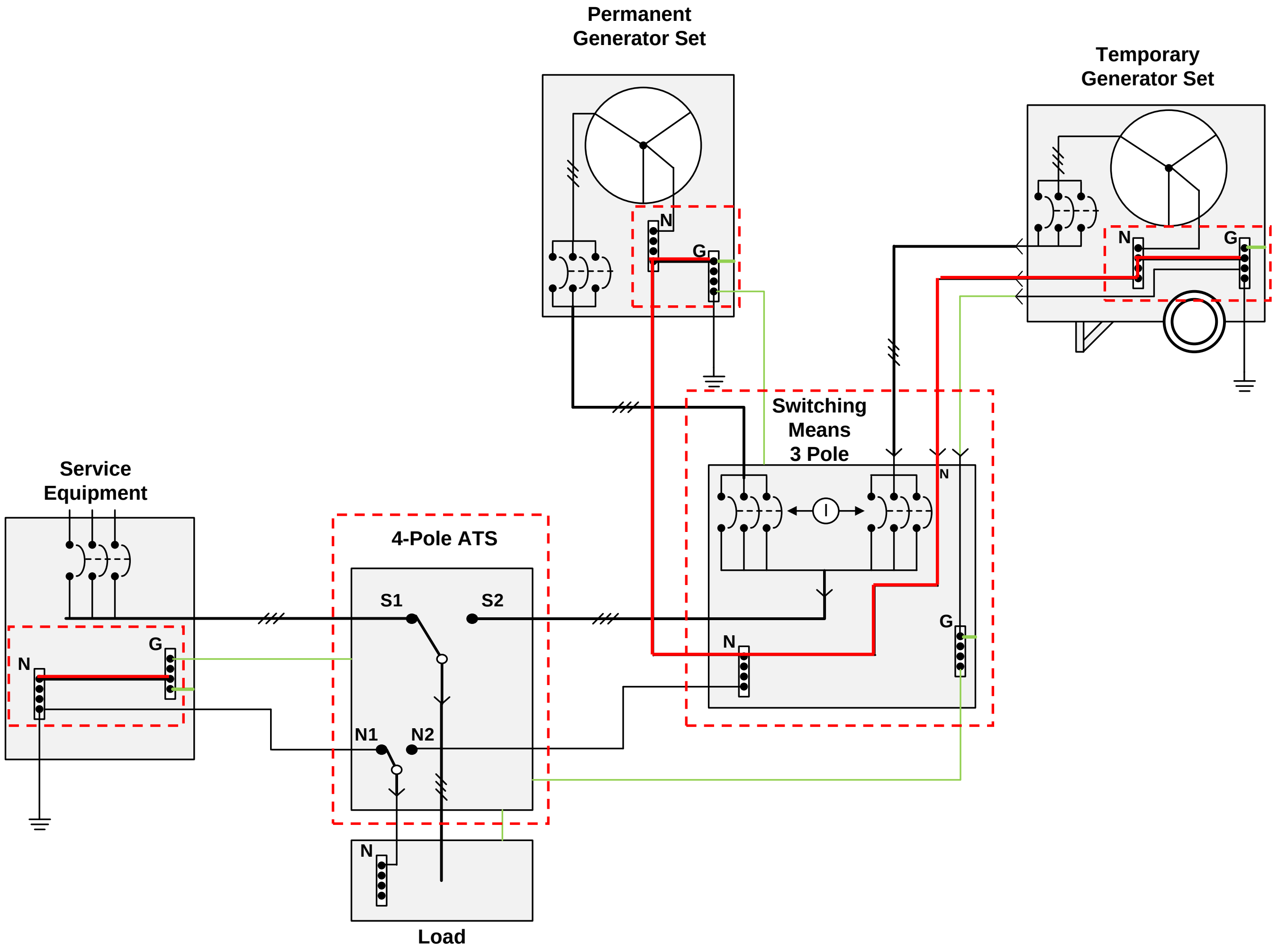
Separately Derived Systems



- Neutral to Ground Bonding Jumper at Service Equipment
- Neutral to Ground Bonding Jumper at Permanent Generator
- 4-Pole ATS
- 4-Pole Switching Means
- When Temporary Genset is used, Neutral to Ground Bonding Jumper at Temporary Genset

Temporary Source of Power 700.3(F)

Separately Derived Systems - Misapplication



- Neutral to Ground Bonding Jumper at Service Equipment
- Neutral to Ground Bonding Jumper at Permanent Generator
- 4-Pole ATS
- 3-Pole Switching Means
- When Temporary Genset is used, Neutral to Ground Bonding Jumper at Temporary Genset
- Multiple or No Neutral Bonding Jumper on Generators (Multiple Jumpers Shown).

Temporary Source of Power 700.3(F)

Proposed Change

700.3(F)(3) The connection point for the portable or temporary alternate source shall be marked with the phase rotation and system bonding requirements. If the permanent emergency power source is a separately derived system, means shall be provided for the portable or temporary alternate source of power to meet the grounding requirements of 250.30.

Public Comment No. 516-NFPA 70-2024 [Section No. 700.5]

700.5 Capacity and Rating.

(A) Rating.

The emergency system equipment shall be suitable for the available fault current at its terminals.

(B) Capacity.

An emergency system shall have adequate capacity in accordance with Article 120, Parts I through IV 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.

(C) Selective Load Management.

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 load management (that includes automatic selective load pickup and load shedding) is provided as needed to ensure adequate power to the following in order of priority:

(1) Emergency circuits

(2) Legally required standby circuits

(3) Optional standby circuits

(D) Parallel Operation.

Parallel operation of the emergency source(s) shall consist of the sources specified in 700.5(D)(1) and 700.5(D)(2).

(1) Normal Source.

The emergency source shall be permitted to operate in parallel with the normal source in compliance with Article 705, Part I or Part II 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 in accordance with 700.7(A).

Parallel operation shall be permitted for satisfying the test requirements of 700.4(B), provided all other conditions of 700.4 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.

Additional Proposed Changes

File Name	Description	Approved
CN_194.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 194 appeared in the First Draft Report on First Revision No. 7679.

The requirements in this section are redundant with 110.10 and should be revised or removed.
General requirements contained in Chapters 1 through 4 should not be
repeated in other articles. See NEC Style Manual Section 4.1.1.

Related Item

• First Revision No. 7679

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
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Submittal Date: Tue Jul 30 22:49:32 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 194-NFPA 70-2024 [Section No. 700.5]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Thu May 09 10:56:16 EDT 2024

Committee Statement

Committee Statement: The requirements in this section are redundant with 110.10 and should be revised or removed. General requirements contained in Chapters 1 through 4 should not be repeated in other articles. See NEC Style Manual Section 4.1.1.

First Revision No. 7679-NFPA 70-2024 [Section No. 700.4]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 574-NFPA 70-2024 [Sections 700.5(A), 700.5(B)]

Sections 700.5(A), 700.5(B)

(A) Rating.

The emergency system equipment ratings shall ~~be suitable for the~~ meet or exceed the performance requirements for the installation. Ratings shall include (but not be limited to) voltage, power (kW or kVA), and available fault current ~~at its terminals~~ capability .

(B) Capacity.

An emergency system shall have adequate capacity in accordance with Article 120, Parts I through IV- ~~or by another approved method~~ . The system capacity shall be sufficient for the rapid load changes- ~~and transient~~ , transient power, and energy requirements associated with any expected loads.

Statement of Problem and Substantiation for Public Comment

For 700.5(A): Since the title for section 700.5 is "Capacity and Rating," and the title for subsection 700.5(A) is "Rating", then it makes sense to have rating requirements in addition to "available fault current capability" under this subsection.
For 700.5(B) Capacity: Deleted "or by another approved method" in the first sentence since it is vague and has no real meaning. Also corrected a couple of minor grammar issues in the second sentence.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 575-NFPA 70-2024 [Sections 701.5(A), 701.5(B)]	
Public Comment No. 575-NFPA 70-2024 [Sections 701.5(A), 701.5(B)]	

Related Item

- FR 7679

Submitter Information Verification

Submitter Full Name: Timothy Windey
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Submittal Date: Thu Aug 01 11:20:24 EDT 2024
Committee: NEC-P13

Public Comment No. 1205-NFPA 70-2024 [Section No. 700.6(C)]

(C)~~– Redundant Transfer Equipment.~~

~~If emergency loads are supplied by a single feeder, the emergency power system shall include redundant transfer equipment or a bypass isolation transfer switch~~

Bypass and Isolation .

Means shall be provided to bypass and isolate the transfer equipment to facilitate maintenance as required in 700.4(C) without jeopardizing continuity of power. ~~If the redundant transfer equipment or bypass isolation switch is manual (or nonautomatic~~ Inadvertent parallel operation shall be prevented.

Informational Note: Bypass isolation switches and bypass isolation transfer switches are examples of such means.

If the bypass means is manual (non-automatic), then it shall be actively supervised by a qualified person when the primary (automatic) transfer equipment is disabled for servicing and maintenance.~~- When redundant transfer equipment is used, a means shall be provided to disconnect the transfer switch from all supply side sources. Inadvertent parallel operation shall be prevented.~~

Exception: The requirement for ~~redundancy with~~ bypass and isolation of the transfer equipment shall not apply where any of the following conditions exist:

(1) All processes that rely on the emergency system source are capable of being disabled during servicing and maintenance activities without jeopardizing the safety to human life.

(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 shall be permitted to be substituted for the emergency system.

(4) A written emergency plan that includes mitigation actions and responsibilities for qualified persons to address the recognized site hazards for the duration of the servicing and maintenance or repair activities shall be developed and implemented. The emergency plan shall be made available to the authority having jurisdiction.

Statement of Problem and Substantiation for Public Comment

As written, FR 7681 creates confusion and possibly eliminates the use of bypass isolation switches. The proposed revisions clarify the basic requirement for bypass and isolation and clearly identify the specific requirements for this equipment.

Related Item

- FR7681

Submitter Information Verification

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Submittal Date: Sat Aug 17 01:08:45 EDT 2024

Committee: NEC-P13

Public Comment No. 1772-NFPA 70-2024 [Section No. 700.6(C)]

(C) Redundant Transfer Equipment.

If emergency loads are supplied ~~by a single feeder~~ for an occupancy listed in 700.10(D)(1) , the emergency power system shall include redundant transfer equipment or a bypass isolation transfer switch to facilitate maintenance as required in 700.4(C) without jeopardizing continuity of power. If the redundant transfer equipment or bypass isolation switch is manual (or nonautomatic), then it shall be actively supervised by a qualified person when the primary (automatic) transfer equipment is disabled for servicing and maintenance. When redundant transfer equipment is used, a means shall be provided to disconnect the transfer switch from all supply side sources. Inadvertent parallel operation shall be prevented.

~~Exception: The requirement for redundancy with the transfer equipment shall not apply where any of the following conditions exist:~~

(1) ~~All processes that rely on the emergency system source are capable of being disabled during servicing and maintenance activities without jeopardizing the safety to human life.~~

(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 shall be permitted to be substituted for the emergency system.~~

(4) ~~A written emergency plan that includes mitigation actions and responsibilities for qualified persons to address the recognized site hazards for the duration of the servicing and maintenance or repair activities shall be developed and implemented. The emergency plan shall be made available to the authority having jurisdiction.~~

Statement of Problem and Substantiation for Public Comment

The modified text vastly improved the requirements in this section. The previous text was not practical. A user of the code could always be relieved of this specific section by using any one of the exceptions. Second, requiring a bypass isolation switch for small single-story building with two to three emergency lighting circuits would be excessive and no justification or substantiation exists for bypass isolation type switches.

Related Item

- PI-3435, PI-1330

Submitter Information Verification

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Affiliation: IEC Codes and Standards

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Submittal Date: Tue Aug 27 09:59:17 EDT 2024

Committee: NEC-P13

Public Comment No. 2056-NFPA 70-2024 [Section No. 700.6(C)]

(C) Redundant Transfer Equipment.

If emergency loads are supplied by a single feeder, the emergency power system shall include redundant transfer equipment or a bypass isolation transfer switch to facilitate maintenance as required in 700.4(C) without jeopardizing continuity of power. If the redundant transfer equipment or bypass isolation switch is manual (or nonautomatic), then it shall be actively supervised by a qualified person when the primary (automatic) transfer equipment is disabled for servicing ~~and maintenance~~ . When redundant transfer equipment is used, a means shall be provided to disconnect the transfer switch from all supply side sources. Inadvertent parallel operation shall be prevented.

Exception: The requirement for redundancy with the transfer equipment shall not apply where any of the following conditions exist:

(1) All processes that rely on the emergency system source are capable of being disabled during servicing and maintenance activities without jeopardizing the safety to human life.

(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 shall be permitted to be substituted for the emergency system.

(4) A written emergency plan that includes mitigation actions and responsibilities for qualified persons to address the recognized site hazards for the duration of the servicing and maintenance or repair activities shall be developed and implemented. The emergency plan shall be made available to the authority having jurisdiction.

Statement of Problem and Substantiation for Public Comment

The term "and maintenance" should be deleted to correlate with the definition of servicing.

Related Item

- FR-7681

Submitter Information Verification

Submitter Full Name: Daniel Neeser
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Submittal Date: Wed Aug 28 17:26:01 EDT 2024
Committee: NEC-P13

Public Comment No. 1060-NFPA 70-2024 [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: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems,* for one method of defining an electrical circuit protective system. The 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 and is available from the certification body.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

(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 concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or ~~raceway~~ raceway that has been evaluated by a licensed professional engineer to provide a 2-hour fire rating .

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

Informational Note No. 3: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.

Additional Proposed Changes

File Name	Description	Approved
CONCRETE_VOLUME_ESTIMATE.pdf	Concrete Volumes Estimate	

Statement of Problem and Substantiation for Public Comment

The 2" requirement for concrete has been working and installers are familiar with the associated technical challenges. The increase to a 5" requirement adds 4x the volume of concrete and associated weight within the structure. A concrete element of that volume needs structural evaluation to ensure there is not an increased risk of structural failure due to the addition of the concrete. If not evaluated, this creates a enhanced risk of structural failures. If a structural evaluation will be needed in either case, add that new requirement to the existing 2" encasement standard. This addresses the risk of improper thermal protection of this critical infrastructure during a fire, while not creating a new risk of overloaded structural installations and the corresponding risk to the electrical infrastructure.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1055-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1059-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1061-NFPA 70-2024 [Section No. 708.10(C)(2)]	
Public Comment No. 1055-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1059-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1061-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

- FR 8078

Submitter Information Verification

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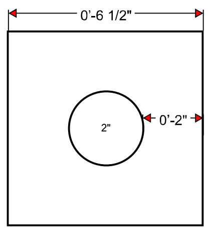
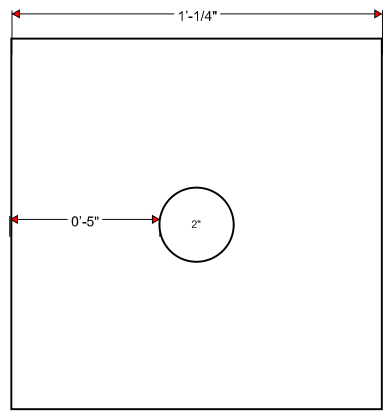
Submittal Date: Tue Aug 13 12:02:27 EDT 2024
Committee: NEC-P13





2" encasement around 2" conduit

42 sq in total area
conduit is 5 sq inches
volume of concrete = 37 sq in

5" encasement around 2" conduit

154 sq in total area
conduit is 5 sq inches
volume of concrete = 149 sq in

the 5" requirement is 149sqin of concrete over 37sqin - that corresponds to a 4X increase in concrete volume necessary to meet the requirements

Public Comment No. 1565-NFPA 70-2024 [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: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems,* for one method of defining an electrical circuit protective system. The 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 and is available from the certification body.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

(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~~ covered in concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway.

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

~~Informational Note No. 3: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

Additional Proposed Changes

File Name	Description	Approved
Review_of_FPRF_Report_August_20_2024.pdf	Technical Review of NFPA Research Report - "Fire Resistance of Concrete for Electrical Conductors" - review by Dr. Jeff Packer	

Statement of Problem and Substantiation for Public Comment

As with FR 8063, these changes that have been proposed would increase the requirement from 2" to 5", which an increase of 150%. To make a change this drastic to the code, technical substantiation should be provided that is not only robust and conclusive, but also shows actual testing of the use case that is in question. Unfortunately, the public input did not provide this, but instead provides a document that has been inaccurately titled a "research report."

The NFPA Research Foundation report, "Fire Resistance of Concrete for Electrical Conductors," does not constitute empirical research and does not provide any actual test results or original research. It would be more accurately titled as a literature review. It lays out goals to provide a literature review, a gap analysis, and a final report. It only accomplishes the first of these goals in any significant way.

The stated purpose of the report was to identify gaps and recommend additional work that needs to be done to fill those gaps. In the end, the authors didn't identify the gaps in knowledge. Usually, a report like this recommends additional specific research that needs to be done. It does not draw conclusions about code changes. This report takes this leap and draws conclusions without recommending any specific research.

The "Final Report" consists of 1 paragraph where bold statements are provided that are drastic leaps as conclusions related to electrical conductors, given that none of the data in literature review provided any testing of electrical conductors, raceways, or systems. The literature review discusses the fire resistance of requirements of different codes that are for structural members. Structural members are tested for fire resistance with the load it is intended to carry, because this affects the fire resistance rating. The electrical raceways carrying the electrical conductors would not be stressed with a structural load, which means that they would be able to achieve a longer fire resistance rating with a thinner amount of concrete.

The fact that the literature review focuses on structural members under load, should make any conclusions inadmissible to this issue. The one accurate statement that the report does make is found in the final sentence, when it says that "more research in the form of modeling or experimental testing may be necessary, if further substantiation is required."

To provide an additional opinion on this report and the proposed code changes, I contacted Dr. Jeffrey Packer, PhD, DSC, PEng, of the University of Toronto. Dr. Packer is a widely published professor of engineering and a prolific researcher on structural loading and fire resistance. Dr. Packer provided the attached response to the question of whether the NFPA report "Fire Resistance of Concrete for Electrical Conductors" provided technical support for these code changes. Please carefully consider his response and expert analysis.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1563-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1847-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1848-NFPA 70-2024 [Section No. 708.10(C)(2)]	
Public Comment No. 1563-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1847-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1848-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

- FR 8078

Submitter Information Verification

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Committee:	NEC-P13

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REVIEW of "Fire Resistance of Concrete for Electrical Conductors"

by Caitlyn Peterson, Fire Protection Research Foundation, December 2018

The author does not appear to be an expert on the design of concrete structures for fire resistance, and the investigation is based on articles procured from a web search (likely by keywords). Apart from technical misunderstandings (described below), there are a disconcerting number of English errors indicating that the report was not checked.

It is well-known that the resistance of a concrete member or element, under a standard (e.g. ISO) fire, is a function of a number of parameters: the concrete cover (i.e. insulation); the type of concrete; type of concrete element (i.e. slab, versus column, beam or wall); and reinforcement within (plain, rebar or fiber). The author, however, "discovers" such truisms regarding fire resistance by browsing many documents.

The report is presented as a hodge-podge of "information" all together. For example, considering a 2-hour fire rating, Tables 6 and 7 present the required overall dimensions of a member (3.6 to 5 inches for slabs, 9 to 10 inches for columns), whereas Tables 8 and 9 then present the required minimum cover of a member (0.75 to 1 inch for slabs, 0.75 to 1.25 inches for beams). This confusion between the overall dimension(s) and the concrete cover is inherent throughout this report.

In the "Information Gap Analysis", page 20, the third bullet concludes that … "A 2-inch thickness does not always equate to a 2-hour fire rating". Of course it does not; 2 inches of concrete cover is what is intended. This naivety is reiterated on pages 21 and 23. The relevant clauses from the NEC 2017 Edition Requirements for Feeder Protection are reproduced in Figure 5 (page 21) and the highlighted parts are quite acceptable – except the wording should be improved to be more explicit. Part (d)(1) should state … "The cable or raceway is encased on any side by a minimum of 50 mm (2 in.) of concrete cover."

Changes to the proposed code clauses, reflecting the above, are provided separately. Key is that the word "cover" be explicitly stated, and "encasement" be avoided. With 2 inches of concrete cover, the minimum member (e.g. slab) thickness would be 4 inches + the diameter of the electrical conductor/conduit.

In my opinion, this Peterson/FPRA report does not constitute technical research and does not provide sufficient technical justification to make substantive code changes.

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Public Comment No. 1601-NFPA 70-2024 [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: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems,* for one method of defining an electrical circuit protective system. The 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 and is available from the certification body.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

(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 concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

~~Informational Note No. 3: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

Statement of Problem and Substantiation for Public Comment

Although difficult to see in Terraview, this comment seeks to remove the added Informational Note and reverse the requirement for concrete encasement from 5" back to 2".
The substantiation is based on a report that was obviously not peer reviewed, nor did it contain any test data. In fact, the last line of the reprt states "More research in the form of modeling or experimental testing may be necessary, if further substantiation is required." This "research" report is not research at all, it is a literature review of various online sources.

The very first paragraph of this report should cause the reader to raise an eybrow and question its veracity. It reads: "Different codes and standards have been developed in order to ensure the safety of
buildings and their occupants. The National Electric [sic] Code (NEC) provides the requirements and parameters for electrical equipment. Within the NEC, fire safety and protection is referenced in many sections. In terms of fire protection equipment, such as fire pumps and emergency systems, the electrical feeder associated with these systems needs to be protected from the thermal effects of fire. The 2017 edition of the National Electric [sic] Code (NEC) allows conductors to be installed under 2-inches of concrete to provide this thermal protection. This is stated in several places including sections in Articles 230, 695, 700, and 708. This is intended to provide a 2 hour fire rating equivalent to locating the conductor outside of the building.

Not only does the author (shockingly) not know the name of the National Electrical Code, the author is incorrect in their assumptions. The concrete encasement contemplated in Article 230 was never to protect the conductors from a fire within the building , they are to protect the building from a FIRE CREATED FROM the conductors! This is why the requirement for a disconnect at the point of entrance has been in the NEC since its creation in 1897. In fact, that concept predates the NEC itself and goes back to at least October 19th, 1881 in a meeting of the New York Board of Fire Underwriters. We want service conductors (the target of Article 230) outside of the building because their ground-fault and short-circuit protection far exceeds that allowed by the NEC, and there is no way to manually disconnect them. The requirement in Article 230 has nothing to do with this issue.
The author of the "research" paper is somewhat correct, however, when they refer to Articles 695, 700, and 708. Those articles do indeed provide protection requirements to protect the conductors, however, they were never intended to provide a particular fire-resistance rating (be it one hour, two hours, or any other number). This can be verified by a quick review of those sections prior to the 2017 NEC. Those editions indicated that 2" of concrete was sufficient. That was changed in 2017, however, although no testing was performed and no data was submitted. As indicated in the negative votes, the practice of having 2" concrete encasement is decades old (my books only go back to the 1950s, and it was in the NEC at that time) and has an impeccable track record. There are still no documented problems from having these conductors encased in 2" of concrete, as, once gain, expressed in the negative voting to the 2026 public input.
There was a time when a change like this would have been laughed out of the room if it was not accompanied by testing data. Did the submitted ever test the temperature of conductors inside of a raceway subjected to the ASTM E119 test? If so, where are the results? This is reminiscant of the rooftop temperature adder that was added to Article 310 back in 2011. It was added as a result of bad science and it took good science to undo it. Why is this committee willing to make the same mistake? A change like this should be driven by good science, not a poorly written literature review like the one that this change is based on (and that is being considered for inclusion as an Informational Note).

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1578-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1600-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1602-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

- FR 8078

Submitter Information Verification

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Submittal Date: Sat Aug 24 13:45:00 EDT 2024

Committee: NEC-P13

Public Comment No. 1832-NFPA 70-2024 [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: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems,* for one method of defining an electrical circuit protective system. The 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 and is available from the certification body.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

(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 ~~concrete with~~ a minimum ~~thickness~~ of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) ~~measured from each point on the surface~~ of ~~the cable or raceway.~~

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~Exception No. 2: Alternative thicknesses of~~

(1) concrete

~~shall be permitted to be selected by a licensed professional engineer qualified in such design~~

(1) .

~~The selection shall be documented and stamped by the professional engineer.~~

(1)

~~Informational Note No. 3: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

Additional Proposed Changes

File Name	Description	Approved
Public_Comment_Attachment_for_NEC_695.7_A_2_1_FR-8063_695.14_F_1_FR-8065_700.10_D_2_5_FR-8078_and_708.10_C_2_4_FR-8080_.pdf		

Statement of Problem and Substantiation for Public Comment

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 Fire Resistance of Concrete for Electrical Conductors (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used "because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours" and by "making the requirement 5 inches you remove the need to specify the type of concrete to use". The author's conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author's conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment). In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.

The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the "heat transmission" end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.

The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, "Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture," and PCA Publication T-140, Fire Resistance of Reinforced Concrete Floors.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the "fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)". Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.

The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between "a 2-hour fire resistance rating of a structural member, such as a wall" and "a 2-hour fire rating of an electrical circuit, such as a conduit with wires". Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1818-NFPA 70-2024 [Section No. 695.7(A)(2)]	Identical comment
Public Comment No. 1829-NFPA 70-2024 [Section No. 695.14(F)]	Identical comment
Public Comment No. 1835-NFPA 70-2024 [Section No. 708.10(C)(2)]	

Related Item

• FR-8063 • FR-8065 • FR-8078 • FR-8080

Submitter Information Verification

Submitter Full Name:	Christopher Hallock
Organization:	Performance Based Fire Protection Engineering
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Submittal Date:	Tue Aug 27 16:17:27 EDT 2024
Committee:	NEC-P13

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 *Fire Resistance of Concrete for Electrical Conductors* (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – *Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing* as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used "because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours" and by "making the requirement 5 inches you remove the need to specify the type of concrete to use". The author's conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author's conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

> Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. <u>Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading</u>

> conditions (tension cracks associated with bending moment). In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.
>
> The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the “heat transmission” end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.
>
> The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, “Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture,” and PCA Publication T-140, *Fire Resistance of Reinforced Concrete Floors*.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the “fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)”. Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

> Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.
>
> The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire

resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between “a 2-hour fire resistance rating of a structural member, such as a wall” and “a 2-hour fire rating of an electrical circuit, such as a conduit with wires”. Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Public Comment No. 1836-NFPA 70-2024 [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: See UL 1724, *Fire Tests for Electrical Circuit Protection Systems,* for one method of defining an electrical circuit protective system. The 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 and is available from the certification body.

(3) The cable or raceway is a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for one method of defining a fire-resistive cable system.

(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 concrete with a minimum thickness of 127 mm (5 in.) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

Informational Note No. 3: See Fire Protection Research Foundation Report FPRF-2018-16, “Fire Resistance of Concrete for Electrical Conductors,” for information about concrete fire resistance.

Statement of Problem and Substantiation for Public Comment

There wasn't any technical substantiation or results of subsequent testing provided by the submitter of the public input to justify the increase of the concrete encasement from 2 (two) inches to 5 (five) inches. ASTM E119 deals with testing of structural building components such as the following information: Giving a structure a fire rating is quite simple: in the case that a material maintains structural integrity for 30 minutes, it will have a fire rating of 30 minutes; or, if the structure lasts for 1 hour, it will have a rating of 1 hour.

The time-temperature curve simply allows engineers to understand the heat capacity for materials over some time, but the specific temperatures are not included as part of the fire rating. In general, structures and materials that last over 1 hour are viewed as being quite reliable.
We are not trying to give the cables or raceways a fire rating. Before we add such a radical change to fire pump emergency circuit, and critical operation power system circuits in raceways and cables, testing data must be provided for accurate protection. The submitter of the public input even stated that he felt even five inches of concrete may not be enough encapsulation. This change can radically change installation in under-slab installations and in-slab installations in many commercial and industrial installations. Again, without proper technical substantiation. The NEC Panel should not be required to guess at whether this change will provide proper protection but should have the test data provided for this change. We dealt with similar proposed changes a few cycles ago when I was on Panel 3 and Panel 13, again, without proper technical substantiation. A similar proposed change was dealt with at the NFPA Annual Meeting and ultimately was rejected based on the lack of technical substantiation.

Related Item

• FR-8078

Submitter Information Verification

Submitter Full Name: Mark Ode
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Submittal Date: Tue Aug 27 16:25:26 EDT 2024
Committee: NEC-P13

Public Comment No. 580-NFPA 70-2024 [Section No. 700.10(D)(4)]

(4) Source Control Wiring.

(a) Control conductors installed between the emergency power supply system/stored-energy power supply system (EPSS/SEPSS) and transfer equipment or control systems 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).

(b) The integrity of source control wiring shall be monitored for unintentional broken, disconnected, or shorted wires. Loss of integrity shall result in the following actions:

(3) *Generators* . Shall start the generator(s).

(4) *All other sources* . Shall be considered a system malfunction and initiate the designated signal(s) in 700.7(A) .

Statement of Problem and Substantiation for Public Comment

The word “unintentional” is inserted before the phrase “...broken, disconnected, or shorted wires” for added clarity.
The source control wiring could be temporarily disconnected or shorted for a service-related event. The proposed language makes it clear that the integrity monitoring requirement is for unintentional events.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 581-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 581-NFPA 70-2024 [Section No. 695.14(F)]	

Related Item

- FR 8177

Submitter Information Verification

Submitter Full Name: Timothy Windey
Organization: Cummins Power Generation
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Submittal Date: Thu Aug 01 12:19:32 EDT 2024
Committee: NEC-P13

Public Comment No. 1841-NFPA 70-2024 [Section No. 700.11]

700.11 Wiring, Class-2 and Class -4 Powered Emergency Lighting Systems.

(A) General.

Line voltage supply wiring and installation of Class 2 and Class 4 emergency lighting control devices shall comply with 700.10. Class 2 and Class 4 emergency circuits shall comply with 700.11(B) through 700.11(D).

(B) 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 Class 2 and Class 4 emergency circuits shall be permanently marked as a component of an emergency circuit or system.

(2) Exposed cable, cable tray, or raceway systems shall be permanently marked to be identified as a component of an emergency circuit or system, within 900 mm (3 ft) of each connector and at intervals not to exceed 7.6 m (25 ft).

(C) Separation of Circuits.

Class 2 and Class 4 emergency circuits shall be wired in a listed, jacketed cable or with one of the wiring methods of Chapter 3. If installed alongside nonemergency Class 2 or Class 4 circuits that are bundled, Class 2 and Class 4 emergency circuits shall be bundled separately from non-emergency circuits . If installed alongside nonemergency Class 2 or Class 4 circuits that are not bundled, Class 2 and Class 4 emergency circuits shall be separated from non-emergency circuits by a nonconductive sleeve or nonconductive barrier from all other ~~Class 2~~ non-emergency circuits. Separation from other circuits shall comply with 725.136 and 726 . 136 .

(D) Protection.

Wiring shall comply with the requirements of 300.4 and be installed in a raceway, armored or metal-clad cable, or cable tray.

Exception No. 1: Section 700.11(D) shall not apply to wiring that does not exceed 1.83 m (6 ft) in length and that terminates at an emergency luminaire or an emergency lighting control device.

Exception No. 2: Section 700.11(D) shall not apply to locked rooms or locked enclosures that are accessible only to qualified persons.

Informational Note: Locked rooms accessible only to qualified persons include locked telecommunications rooms, locked electrical equipment rooms, or other access-controlled areas.

Statement of Problem and Substantiation for Public Comment

Class 4 Fault Managed Power (FMP) systems provide high-efficiency transmission of power using active safety monitors that can remove energy from the line before a fault can cause injury or fire. This seems counterintuitive, as these systems are permitted by the NEC to employ up to 450 Volts peak. However, by being required to detect both line to ground and line to line faults and disconnect power to them within milliseconds, these systems prevent ventricular fibrillation in the event of a guarding failure. Further, they are required to detect arc faults, overcurrent conditions, and short circuit conditions and must disconnect power before a fire can start. Class 4 systems can discriminate between a cable fault and valid utilization equipment current draw, so they are not prone to false tripping caused by unexpected load current patterns. These systems are required to undergo a Functional Safety evaluation as a standard part of the listing process, similar to those that apply to automotive and industrial safety critical systems, to ensure that component failures will not compromise safety.
Class 4 circuits are not permitted to exceed the risk of ventricular fibrillation, nor the risk of fire presented by Class 2 circuits, and in many cases present a risk FAR lower than that of a Class 2 circuit. For this reason, the 2023 NEC permitted these systems to utilize their own Class 4 wiring methods based on Class 2 circuits. The primary differences between Class 4 and Class 2 wiring center on insulation characteristics required by the higher peak voltage limit. Where a Class 2 cable is typically rated for 300V (shall be 150V minimum), a Class 4 cable must be rated to 450V.
The higher voltage employed by Class 4 FMP systems result in lower currents and compatibility with higher efficiency DC power conversion equipment as well as energy storage systems. This has generated significant interest in emergency power systems that employ Class 4 FMP as an emergency power distribution method. This public comment is in response to the panel’s concerns during the First Draft phase around the proposed changes to Article 700 to permit Class 4 FMP in a manner similar to Class 2 circuits.
Public Input 4347 proposed a combined “Limited Energy Emergency Lighting System” section, which combined Class 2, Class 3, and Class 4 emergency lighting systems into a single set of requirements. It’s clear now, though, that that caused more confusion than necessary. This public comment removes Class 3 to reduce confusion and more clearly articulates the separation requirements in a manner consistent with Article 722.
Class 4 FMP wiring methods are specified in Article 722, Part III. Class 2 and Class 4 circuits are permitted to be installed together in Article 722, so it is only sensible that they be permitted to be installed without separation when used to provide emergency power. The proposed language does, however, continue to require separation between emergency and non-emergency circuits. Otherwise, the current 2023 NEC, as well as the 2026 NEC First Draft, treat Class 2 and Class 4 circuits nearly identically, with the key difference being the listing requirements for the cables themselves.
The proposed addition of 700.28 intends to underscore that just because a system is listed as a Class 4 circuit, it must also be listed for any emergency power functions it provides. The Class 4 listing standard (UL 1400) requires the system to remain safe at all times, similar to UL 2108 which covers Low Voltage Lighting Systems. A UL 924 or similar listing is required to ensure reliability as stated in the scope of UL 924: “The basic requirements for protection against risk of fire, electric shock, and injury for some equipment within the scope of this standard are addressed in other standards. The primary role of UL 924 in these cases is to validate compliance with emergency system functionality and performance expectations.”

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1844-NFPA 70-2024 [New Section after 700.27]	

Related Item

- PI 4347

Submitter Information Verification

Submitter Full Name: Jason Potterf
Organization: Cisco
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Submittal Date: Tue Aug 27 16:46:58 EDT 2024

Committee:	NEC-P13

Public Comment No. 1065-NFPA 70-2024 [Section No. 700.11(D)]

(D) Protection.

Wiring shall comply with the requirements of 300.4 and be installed in a raceway, armored or metal-clad cable, or cable tray.

Exception No. 1: ~~Section 700.11(D)~~ The requirement for installation in a raceway, armored cable, or cable tray shall not apply to wiring that does not exceed 1.83 m (6 ft) in length and that terminates at an emergency luminaire or an emergency lighting control device.

Exception No. 2: ~~Section 700.11(D)~~ The requirement for installation in a raceway, armored cable, or cable tray shall not apply to locked rooms or locked enclosures that are accessible only to qualified persons.

Informational Note: Locked rooms accessible only to qualified persons include locked telecommunications rooms, locked electrical equipment rooms, or other access-controlled areas.

Statement of Problem and Substantiation for Public Comment

The exemptions currently cover all requirements in 300.4. I believe the intent was to exempt the installation from the requirement to be in a raceway under the conditions listed. Exempting Class 2 wiring from the entirety of the requirements in 300.4 in any circumstance reduces the reliability of the system.

Related Item

- PI 4240

Submitter Information Verification

Submitter Full Name: Matthew Grover
Organization: Kings Electric Services
Affiliation: IEC
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Submittal Date: Tue Aug 13 12:31:34 EDT 2024
Committee: NEC-P13

Public Comment No. 1133-NFPA 70-2024 [Section No. 700.11(D)]

(D) Protection.

Wiring shall comply with the requirements of 300.4 ~~and be installed in a raceway, armored or metal-clad cable, or cable tray~~ .

~~*Exception No. 1: Section 700.11(D) shall not apply to wiring that does not exceed 1.83 m (6 ft) in length and that terminates at an emergency luminaire or an emergency lighting control device.*~~

~~*Exception No. 2: Section 700.11(D) shall not apply to locked rooms or locked enclosures that are accessible only to qualified persons.*~~

~~*Informational Note: Locked rooms accessible only to qualified persons include locked telecommunications rooms, locked electrical equipment rooms, or other access-controlled areas.*~~

Statement of Problem and Substantiation for Public Comment

It is unclear why wiring not subject to physical damage would require armor or installation in a raceway. This presents an obstacle to installation and requires a greater level of protection than is required for line voltage or class 1 circuits. The exceptions would not apply with this revision as we don't believe the intent was to exempt the wiring methods from the totality of requirements contained in 300.4.

Related Item

- PI-4240

Submitter Information Verification

Submitter Full Name:	David Hittinger
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Submittal Date:	Thu Aug 15 21:40:56 EDT 2024
Committee:	NEC-P13

Public Comment No. 517-NFPA 70-2024 [Section No. 700.12(A)]

(A) Power Source Duration.

Power source duration shall be selected based upon the type of occupancy.

Informational Note: Considerations of the duration for an emergency power source include the following:

(1) For minimum duration, as for evacuation of a theater

(2) For longer duration, as for supplying emergency power and lighting due to an indefinite period of current failure from trouble either inside or outside the building

Additional Proposed Changes

File Name	Description	Approved
CN_195.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 195 appeared in the First Draft Report on First Revision No. 7692.

The informational note should be reviewed for compliance with the NEC Style Manual Section 2.1.10.2. Informational notes should not contain requirements, make interpretations, or make recommendations.

Related Item

• First Revision No. 7692

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
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Submittal Date: Tue Jul 30 22:51:10 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 195-NFPA 70-2024 [Section No. 700.12(A)]

Submitter Information Verification

Committee: NEC-AAC

Submittal Date: Thu May 09 10:57:43 EDT 2024

Committee Statement

Committee Statement: The informational note should be reviewed for compliance with the NEC Style Manual Section 2.1.10.2. Informational notes should not contain requirements, make interpretations, or make recommendations.

First Revision No. 7692-NFPA 70-2024 [Section No. 700.12(A)]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 839-NFPA 70-2024 [Section No. 700.12(A)]

~~**(A)** Power Source Duration.~~

~~Power source duration shall be selected based upon the type of occupancy.~~

~~Informational Note: Considerations of the duration for an emergency power source include the following:~~

(1) ~~For minimum duration, as for evacuation of a theater~~

(2) ~~For longer duration, as for supplying emergency power and lighting due to an indefinite period of current failure from trouble either inside or outside the building~~

Statement of Problem and Substantiation for Public Comment

This does not contain any requirements that can be easily enforced. The NEC is not a design specification, nor is it intended to be. This issue is already handled (in an enforceable manner) in 700.12(C), including an Informational Note to provide extra guidance to the design community.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 841-NFPA 70-2024 [Section No. 701.12(A)]	

Related Item

- FR 7692

Submitter Information Verification

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Submittal Date: Tue Aug 06 13:21:46 EDT 2024
Committee: NEC-P13

Public Comment No. 1406-NFPA 70-2024 [Section No. 700.12(D)(4)]

(4) Outdoor Generator Sets.

An outdoor-housed generator set shall be equipped with a disconnecting means in accordance with 445.18. ~~When~~ If the disconnecting means is not readily accessible or is not located within sight of the building or structure supplied, an additional disconnecting means shall be required where ungrounded conductors serve or pass through the building or structure supplied. The disconnecting means shall meet the requirements of 225.36 for voltages not over 1000 V ac, 1500 V dc or 267 . 31(C) for voltages over 1000 V ac, 1500 V dc nominal .

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 Comment

FR-8176 modified the requirements for outdoor generator sets found in 700.12(D)(4) to clarify the disconnecting means requirement. As written, the type of disconnecting means shall meet the requirements of 225.36 in all cases. Section 225.36 specifically addresses the type of disconnecting means for voltage not over 1000 V ac, 1500 V dc, but these requirements are not appropriate when the system voltage is over 1000 V ac. This public comment adds a reference to 267.31(C) to properly select the type of disconnecting means for voltages over 1000 V ac, 1500 V dc nominal. This public comment also corrects the word “when” to the more proper word “if”.

Related Item

• FR-8176

Submitter Information Verification

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Submittal Date: Thu Aug 22 14:02:32 EDT 2024
Committee: NEC-P13

Public Comment No. 518-NFPA 70-2024 [Section No. 700.12(D)(4)]

(4) Outdoor Generator Sets.

An outdoor-housed generator set shall be equipped with a disconnecting means in accordance with 445.18. When the disconnecting means is not readily accessible or is not located within sight of the building or structure supplied, an additional disconnecting means shall be required where ungrounded conductors serve or pass through the building or structure supplied. 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
CN_196.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 196 appeared in the First Draft Report on First Revision No. 8176.

This section should be reviewed for compliance with NEC Style Manual Section 3.5.4. The use of "when" is limited to the expression of time and should be replaced with "if" for condition- based statements. See FR 8194, Section 701.12(D)(3) for similar requirements which replaced "when" with "if" in compliance with the NEC Style Manual.

Related Item

• First Revision No. 8176

Submitter Information Verification

Submitter Full Name: CC Notes
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Submittal Date: Tue Jul 30 22:53:03 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 196-NFPA 70-2024 [Section No. 700.12(D)(4)]

Submitter Information Verification

Committee: NEC-AAC

Submittal Date: Thu May 09 10:59:17 EDT 2024

Committee Statement

Committee Statement: This section should be reviewed for compliance with NEC Style Manual Section 3.5.4. The use of “when” is limited to the expression of time and should be replaced with “if” for condition- based statements. See FR 8194, Section 701.12(D)(3) for similar requirements which replaced “when” with “if” in compliance with the NEC Style Manual.

First Revision No. 8176-NFPA 70-2024 [Section No. 700.12(D)(4)]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters

1 Not Returned

11 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.

Bowmer, Trevor N.

Hickman, Palmer L.

Holub, Richard A.

Jackson, Peter D.

Kendall, David H.

Manche, Alan

Osborne, Robert D.

Porter, Christine T.

Schultheis, Timothy James

Williams, David A.

Public Comment No. 776-NFPA 70-2024 [Section No. 700.12(D)(4)]

(4) Outdoor Generator Sets.

An outdoor-housed generator set shall be equipped with a disconnecting means in accordance with 445.18. ~~When the disconnecting means is not readily accessible or is not located within sight of the building or structure supplied, an additional disconnecting means shall~~ An additional disconnecting means, meeting the requirements of 225.36, shall be required where ungrounded conductors serve or pass through the building or structure supplied ~~. The disconnecting means shall meet the requirements of 225.36 .~~ when:

(1) the disconnecting means is not readily accessible, and

(2) the disconnecting means is not located within sight of the building or structure supplied.

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 Comment

The first draft revision is an improvement over the original text, in that it makes the requirement clearer and in positive language. This revision is attempting to improve the requirement grammatically.

Related Item

- FR

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Committee: NEC-P13

Public Comment No. 1150-NFPA 70-2024 [Section No. 700.12(H)]

(H) Battery-Equipped Emergency Luminaires.

(1) Listing.

All battery-equipped emergency luminaires shall be listed. <u>Luminaires that use battery equipped lamps that are not directly wired to the branch circuit shall not be considered battery-equipped emergency luminaires.</u>

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.

Informational Note No. 2: Unit equipment is a type of battery-equipped emergency luminaire.

<u>Informational Note No. 3: Lamps that are directly wired are evaluated to ANSI/UL 1598C as luminaire retrofit kits and to ANSI/UL 924 as emergency lighting equipment and are provided with lead wires or wiring terminals for direct connection to the branch circuit.</u>

(2) Installation.

Battery-equipped emergency luminaires shall be installed in accordance with the following:

(1) Battery-equipped emergency luminaires shall be permanently fixed in place (i.e., not portable). <u>Listed lamps that contain batteries and battery packs used in emergency luminaires shall be directly wired to the branch circuit.</u>

(2) Wiring to each luminaire shall be installed in accordance with the requirements of any of the wiring methods in Chapter 3 unless otherwise specified in Part II, IV, or V of 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 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 if that circuit is equipped with means to monitor the status of that area’s normal lighting branch circuit ahead of any local switches.

   c. A separate branch circuit originating from the same panelboard as one or more normal lighting circuits. This separate branch circuit disconnecting means shall be provided with a lock-on feature.

(4) The branch circuit that feeds battery-equipped emergency luminaires shall be clearly identified at the distribution panel.

(5) Emergency luminaires that obtain power from a battery-equipped emergency luminaire shall be wired to the battery-equipped emergency luminaires as required in Part II, IV, or V of this article.

(6) Remote luminaires providing lighting for the exterior of an exit door shall be permitted to be supplied by the battery-equipped emergency luminaire serving the area immediately inside the exit door.

Statement of Problem and Substantiation for Public Comment

There are now lamps on the market that contain batteries and charging/transfer circuits in addition to a light source.

Some of these lamps are provided with leads for direct connection to the branch circuit as required by UL 924; similar to the requirements that apply to UL 924 listed emergency battery packs. Such lamps are listed as Luminaire retrofits to UL 1598C and are additionally listed to UL 924 as emergency lighting. Direct wiring helps to ensure that such lamps are not inadvertently replaced with non-battery equipped lamps because the direct wiring connections are generally not accessible to routine maintenance personnel and would thus help preclude unauthorized replacement.

However, there are also battery containing lamps that are not listed as luminaire retrofits, but rather as self-ballasted lamps to UL 1993. While such battery containing lamps are suitable for auxiliary lighting use, they cannot be listed to UL 924 as emergency lighting. This is because such lamps are intended to be readily replaceable and therefore electrically connect only via lampholders. Accordingly, there is nothing to prevent these lamps being inadvertently replaced with lamps not equipped with batteries. If a non-battery equipped lamp is installed, emergency lighting system reliability is ignored, and emergency egress lighting is lost. Such replacement would likely occur during normal facility maintenance without AHJ knowledge. These lamps are listed as self-ballasted, Light-emitting-diode Type lamps, to UL 1993. The UL guide card for this listing category (OOLV) states: “These products have not been investigated for use in emergency lighting equipment or exit signs.”

The suggested revisions are intended to clarify which battery containing lamps are suitable for emergency lighting.

<u>Related Item</u>

• PI 3431

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Submittal Date: Fri Aug 16 06:59:03 EDT 2024
Committee: NEC-P13

Public Comment No. 1585-NFPA 70-2024 [New Section after 700.12(H)(2)]

TITLE OF NEW CONTENT

Type your content here ...

700.13. Cybersecurity

Emergency systems, located in life safety-related infrastructures, that are connected to a communication network and have the capability to be controlled or permit control of any portion of the premises shall comply with either of the following:

(1) The ability to control the emergency system is limited to a direct connection through a local nonnetworked interface.

(2) The emergency system is connected through a networked interface complying with both of the following methods:

a. The emergency system is identified as being evaluated for cybersecurity.

b. A cybersecurity assessment of the emergency system is completed and documentation of the assessment and certification is available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, *Cybersecurity Standards series*, UL 2900 *Cybersecurity Standard series*, or the NIST *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1 for assessment requirements.

Informational Note No. 2: Examples used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity is a specialized field requiring constant, vigilant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions. Installation of devices that can be secured is an important first step but not sufficient to guarantee a secure system.

Informational Note No. 4: See NEMA CY70001-2023, *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Informational Note No. 5: Examples of life safety-related infrastructures include, but are not limited to, waste water treatment facilities, water supply facilities, police stations, call centers, financial centers, data centers, and military bases.

Statement of Problem and Substantiation for Public Comment

Let's review the Code Making Panel Statement to resolve Public Input 1252, one sentence at a time.

The first sentence of the Panel Statement "General cybersecurity requirements are widely applicable based on requirements in 110" fails to note that 110.3(A)(8) has a serious issue. Amazingly, 110.3(A)(8), can be met with a simple evaluation, and that evaluation can actually show that the life safety equipment is totally unprotected against cyber attack. 110.3(A)(8) doesn't state that life safety equipment must be protected against cyber attack. It simply states that the life safety system must be evaluated for cybersecurity. YES, YOU READ THAT CORRECTLY, ZERO CYBERSECURITY PROTECTION FOR LIFE SAFETY EQUIPMENT IS ACCEPTABLE IN 110.3(A)(8). THE REQUIRED EVALUATION COULD SHOW THAT THERE IS NO PROTECTION AGAINST CYBER ATTACK AND STILL MEET THE REQUIREMENTS OF 110.3(A)(8)!

The second sentence "This PI is overly broad in scope as applicable to every emergency system" is addressed by the limitation to emergency systems located in life safety-related infrastructure. (Informational Note No. 5 is added, providing examples of life safety-related infrastructure.)

The Panel Statement ending with "even with a five-year interval, would be inadequate in guaranteeing cybersecurity for fire pump products" is addressed by removal of the 5-year re-assessment.

Informational Note No. 4 was added to correlate with FR 9040 (110.3(A)(8)), FR 9210 (240.6(D)), and FR 8219 (708.7).

Most of the cybersecurity focus has been on IT systems. There has been very little public discussion about cybersecurity for Operational Technology (OT), but cyber attacks on OT occur on almost a daily basis.

For an example of just how common cyber attacks on life safety related infrastructure have become, let's look at just the water supply and waste water treatment industry. The DNI (Director of National Intelligence), through the CTIIC (Cyber Threat Intelligence Integration Center) recently released a report of 12 cyber attacks on the industrial control systems of water utilities, water systems, and waste water treatment systems, for the six-month period from November 2023 through April 2024. This report can be found at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.dni.gov/files/CTIIC/documents/products/Recent_Cyber_Attacks_on_US_Infrastructure_Underscore_Vulnerability_of_Crit June2024.pdf&ved=2ahUKEwi5gP7-m4eIAxUakYkEHasyIRQQFnoECB8QAQ&usg=AOvVaw3hJL2DMlRs-CECfmewcXVP

While this example covered attacks on industrial control systems, successful attacks can occur on all electrical equipment that is continuously connected to the internet and even equipment that is only connected to the internet during system updates. (Cyber attacks can lay quiet for years, waiting for an update, and then do their intended damage during the update.)

Hackers can easily destroy unprotected equipment and shut down entire unprotected facilities. Our adversaries are continuously mounting cyber attacks on our life safety-related infrastructure. We have the ability, and obligation, to prevent this type of damage to our infrastructure from malicious cyber attacks.

THIS PUBLIC COMMENT SIMPLY REQUIRES THAT EMERGENCY SYSTEMS, LOCATED ONLY IN LIFE SAFETY-RELATED INFRASTRUCTURES, EITHER NOT BE CONNECTED TO THE INTERNET, OR IF THEY ARE CONNECTED TO THE INTERNET, THAT THEY BE "IDENTIFIED" FOR CYBERSECURITY AND THAT AN ASSESSMENT IS PROVIDED.

Related Item

- PI 1252

Submitter Information Verification

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Submittal Date:	Sat Aug 24 12:43:28 EDT 2024
Committee:	NEC-P13

Public Comment No. 1797-NFPA 70-2024 [Section No. 700.24]

700.24 Luminaires with Control Inputs That Provide Emergency Illumination.

Luminaires with control inputs that provide emergency illumination shall comply with 700.24(A) or 700.24(B).

(A) Directly Controlled Emergency Luminaire (DCEL).

Where emergency illumination is provided by one or more DCELs that, upon loss of normal power, respond to an external active control signal on their control input from a listed ELCD to establish the required emergency illumination level, such DCELs shall be listed for use in emergency systems.

(B) Directly Controlled Luminaire (DCL).

Where emergency illumination is provided by one or more DCLs by disconnection of their control input by a listed ELCD upon loss of normal power, such DCLs shall not be required to be listed for use in emergency systems. If a DCL has configurable behavior for control input disconnection, it shall be set to provide ~~full luminaire output upon~~ the required emergency illumination level upon control input disconnection.

Statement of Problem and Substantiation for Public Comment

The proposed re-write of 700.24 adds clarity and the beneficial addition of the new "Directly Controlled Luminaire (DCL)" term to help differentiate luminaires that do and do not require an emergency listing. However, a small change in the wording could have a big impact on systems installed under the 2023 NEC. The original 2023 NEC text stated "Luminaires that are energized to the required emergency illumination level by disconnection of their control input by a listed emergency lighting control device shall not be required to be listed for use in emergency systems." The First Draft 2026 NEC text changes the requirement from "required emergency illumination level" to simply "full luminaire output" which may not always be the same thing.

For instance, a system could be designed to allow all luminaires inside a building to be emergency lights, resulting in a more even illumination of the building during an emergency. Excepting these fixtures from emergency listing is critical to this deployment method as it allows all fixtures to aid in an emergency without restricting fixture selection to just listed emergency luminaires. The energy storage requirement (via battery or generator fuel) would be made onerous by this change if these fixtures had to operate at full luminaire output for the full required duration. These systems are currently permitted to dim the emergency fixtures to increase runtime in the 2023 NEC, and this public comment seeks to restore that permission to the Second Draft of 2026 NEC.

Related Item

- FR 8178

Submitter Information Verification

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Submittal Date:	Tue Aug 27 12:40:07 EDT 2024
Committee:	NEC-P13

Public Comment No. 1844-NFPA 70-2024 [New Section after 700.27]

700.28 Class 4 Powered Emergency Lighting Systems.

Class 4 Fault Managed Power (FMP) Transmitters and Class 4 FMP Receivers installed as a component of an emergency lighting system shall be listed as emergency power equipment. Devices that combine control signals with Class 4 emergency power on a single circuit shall be listed as emergency lighting control devices.

Informational Note: An example of a device combining control signals with Class 4 emergency power sources is a Class 4 Fault Managed Power Transmitter capable of supplying power and communicating on the same conductors.

Statement of Problem and Substantiation for Public Comment

Class 4 Fault Managed Power (FMP) systems provide high-efficiency transmission of power using active safety monitors that can remove energy from the line before a fault can cause injury or fire. This seems counterintuitive, as these systems are permitted by the NEC to employ up to 450 Volts peak. However, by being required to detect both line to ground and line to line faults and disconnect power to them within milliseconds, these systems prevent ventricular fibrillation in the event of a guarding failure. Further, they are required to detect arc faults, overcurrent conditions, and short circuit conditions and must disconnect power before a fire can start. Class 4 systems can discriminate between a cable fault and valid utilization equipment current draw, so they are not prone to false tripping caused by unexpected load current patterns. These systems are required to undergo a Functional Safety evaluation as a standard part of the listing process, similar to those that apply to automotive and industrial safety critical systems, to ensure that component failures will not compromise safety.

Class 4 circuits are not permitted to exceed the risk of ventricular fibrillation, nor the risk of fire presented by Class 2 circuits, and in many cases present a risk FAR lower than that of a Class 2 circuit. For this reason, the 2023 NEC permitted these systems to utilize their own Class 4 wiring methods based on Class 2 circuits. The primary differences between Class 4 and Class 2 wiring center on insulation characteristics required by the higher peak voltage limit. Where a Class 2 cable is typically rated for 300V (shall be 150V minimum), a Class 4 cable must be rated to 450V.

The higher voltage employed by Class 4 FMP systems result in lower currents and compatibility with higher efficiency DC power conversion equipment as well as energy storage systems. This has generated significant interest in emergency power systems that employ Class 4 FMP as an emergency power distribution method. This public comment is in response to the panel's concerns during the First Draft phase around the proposed changes to Article 700 to permit Class 4 FMP in a manner similar to Class 2 circuits.

Public Input 4347 proposed a combined "Limited Energy Emergency Lighting System" section, which combined Class 2, Class 3, and Class 4 emergency lighting systems into a single set of requirements. It's clear now, though, that that caused more confusion than necessary. This public comment removes Class 3 to reduce confusion and more clearly articulates the separation requirements in a manner consistent with Article 722.

Class 4 FMP wiring methods are specified in Article 722, Part III. Class 2 and Class 4 circuits are permitted to be installed together in Article 722, so it is only sensible that they be permitted to be installed without separation when used to provide emergency power. The proposed language does, however, continue to require separation between emergency and non-emergency circuits. Otherwise, the current 2023 NEC, as well as the 2026 NEC First Draft, treat Class 2 and Class 4 circuits nearly identically, with the key difference being the listing requirements for the cables themselves.

The proposed addition of 700.28 intends to underscore that just because a system is listed as a Class 4 circuit, it must also be listed for any emergency power functions it provides. The Class 4 listing standard (UL 1400) requires the system to remain safe at all times, similar to UL 2108 which covers Low Voltage Lighting Systems. A UL 924 or similar listing is required to ensure reliability as stated in the scope of UL 924: "The basic requirements for protection against risk of fire, electric shock, and injury for some equipment within the scope of this standard are addressed in other standards. The primary role of UL 924 in these cases is to validate compliance with emergency system functionality and performance expectations."

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1841-NFPA 70-2024 [Section No. 700.11]	Same issue / substantiation

Related Item

- PI 4347

Submitter Information Verification

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Submittal Date: Tue Aug 27 16:57:07 EDT 2024
Committee: NEC-P13

Public Comment No. 1945-NFPA 70-2024 [Section No. 700.32]

700.32 Selective Coordination.

(A) General.

Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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.

~~Informational Note: See NECA 700, *Standard for Installing Overcurrent Protection to Achieve Selective Coordination* , for additional information on how to achieve selective coordination.~~

(B) Replacements.

Where emergency system(s) OCPDs or normal system OCPDs that supply emergency load(s) are replaced, they shall be reevaluated to ensure selective coordination of the emergency system(s) is maintained with all supply-side and load-side OCPDs.

(C) Modifications.

If modifications, additions, or deletions to the emergency system(s) or the normal system supplying the emergency load(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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 No. 1 : See NECA 700, *Standard for Installing Overcurrent Protection to Achieve Selective Coordination* , for additional information on how to achieve selective coordination.

Informational Note No. 2: See Figure Informational Note 700.32 for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

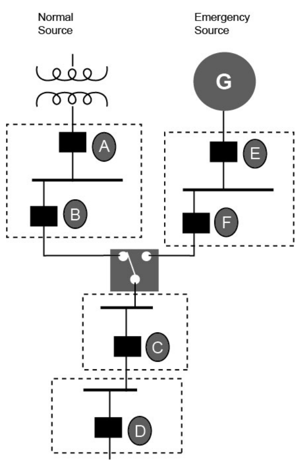
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.

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 700.32 Emergency System Selective Coordination.



Statement of Problem and Substantiation for Public Comment

The added information note should be relocated to the end of the section and become new Information Note No. 1 with the existing information note revised to Informational Note No. 2. to correlate with a similar revision in 701.32 as it applies to the entire section.

This is the only revision, the underlined text in Terra is in error.

Related Item

• FR-8180 • FR-8200

Submitter Information Verification

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Submittal Date: Wed Aug 28 12:18:43 EDT 2024
Committee: NEC-P13

Public Comment No. 1057-NFPA 70-2024 [Section No. 700.32(B)]

(B) Replacements.

Where emergency system(s) OCPDs or normal system OCPDs that supply emergency load(s) are replaced, they shall be reevaluated to ensure selective coordination of the emergency system(s) is maintained with all supply-side and load-side OCPDs.<u>The selective coordination shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second.</u>

Statement of Problem and Substantiation for Public Comment

Selective coordination is next to impossible to achieve in the instantaneous region below 0.1 second

<u>Related Item</u>

- FR-8182

Submitter Information Verification

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Submittal Date: Tue Aug 13 09:51:52 EDT 2024
Committee: NEC-P13

Public Comment No. 998-NFPA 70-2024 [Section No. 700.32(B)]

(B) Replacements.

Where emergency system(s) OCPDs or normal system OCPDs that supply emergency load(s) are replaced, they shall be reevaluated to ensure selective coordination of the emergency system(s) is maintained with all supply-side and load-side OCPDs.

Exception No. 1: reevaluation shall not be required when OCPDs are replaced in kind.

Statement of Problem and Substantiation for Public Comment

The requirement to "reevaluate" is not specific and may be interpreted to require a full system coordination study to be performed even in the case of in kind device replacement. For example swapping out a failed fuse with an identical device should not require a system reevaluation. A reevaluation does nothing to increase the reliability or safety of the system in such a case.

Related Item

- FR 8182

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Committee:	NEC-P13

Public Comment No. 169-NFPA 70-2024 [Section No. 701.3]

701.3 Reconditioned Equipment.

Reconditioned transfer switches shall not be ~~installed~~ permitted .

Statement of Problem and Substantiation for Public Comment

This public comment is made to address an issue with the first draft language changes. The proposed language in this first revision allows electrical equipment to be reconditioned in place as the language pertains to the installation process and not to when any equipment is reconditioned in place. With the existing language in this first revision, the only time reconditioned equipment would not be permitted is if it is being installed. The Code does apply to existing equipment when additions or modifications are being made. The proposed language change from "installed" to "permitted" is more inclusive.

Related Item

- FR 7734

Submitter Information Verification

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Submittal Date: Tue Jul 23 14:17:14 EDT 2024
Committee: NEC-P13

Public Comment No. 1137-NFPA 70-2024 [Section No. 701.4]

701.4
Commissioning , and Maintenance .

(A)

~~Commissioning~~

Commissioning Witness Test.

The authority having jurisdiction shall conduct or witness the commissioning of the complete system upon installation.

Informational Note:

~~See~~

See NECA 90, *Standard for Commissioning Building Electrical Systems* .

~~(E)~~

(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) Servicing.~~

~~Legally required standby system equipment shall be maintained in accordance with manufacturer instructions and industry standards.~~

~~(D) Record Keeping.~~

~~A written record shall be kept on such tests and maintenance and made available upon request to those authorized to design, install, inspect, maintain, and operate the system.~~

~~(E)~~

Testing Under Load.

Means for testing legally required standby systems during maximum anticipated load conditions shall be provided.

Informational Note: See

~~NFPA 110~~

NFPA 110 -2025, *Standard for Emergency and Standby Power Systems* , for information on testing and maintenance of emergency power supply systems (EPSSs).

Statement of Problem and Substantiation for Public Comment

NFPA 70B is the standard for maintenance. NFPA 70 does not need to cover maintenance of the system other then including any necessary provisions for maintenance to be performed in the future.

Related Item

- FR-7730

Submitter Information Verification

Submitter Full Name: David Hittinger
Organization: Independent Electrical Contractors
Affiliation: IEC Codes and Standards
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 15 21:57:59 EDT 2024
Committee: NEC-P13

Public Comment No. 1136-NFPA 70-2024 [Section No. 701.4(A)]

(A) ~~Commissioning~~ Witness ~~Test~~ Testing .
The authority having jurisdiction shall conduct or witness ~~the commissioning~~ testing of the complete system upon installation.

~~Informational Note: See NECA 90, *Standard for Commissioning Building Electrical Systems* .~~

Statement of Problem and Substantiation for Public Comment

Commissioning, especially of large standby systems can require multiple days. The process requires specialized knowledge and training that a dedicated commissioning authority would posses, but an AHJ may not. Requiring an AHJ to witness the full commissioning is also impractical because of the potential amount of time involved. Witnessing final acceptance testing to demonstrate proper operation should be sufficient. The requirement to commission or test the system "periodically" after the initial commissioning or testing is not specific, not enforceable, and many AHJs will be unwilling to return to witness or conduct any additional testing. If Commissioning is changed to witness testing the Informational Note is not needed.

Related Item

- PI-1675

Submitter Information Verification

Submitter Full Name:	David Hittinger
Organization:	Independent Electrical Contractors
Affiliation:	IEC Codes and Standards
Street Address:	
City:	
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Zip:	
Submittal Date:	Thu Aug 15 21:54:13 EDT 2024
Committee:	NEC-P13

Public Comment No. 519-NFPA 70-2024 [Section No. 701.4(A)]

(A) Commissioning Witness Test.

The authority having jurisdiction shall conduct or witness the commissioning of the complete system upon installation.

Informational Note: See NECA 90, *Standard for Commissioning Building Electrical Systems*.

Additional Proposed Changes

File Name	Description	Approved
CN_197.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 197 appeared in the First Draft Report on First Revision No. 7730.

The reference provided in the informational note should also include an explanation for the reference. See NEC Style Manual Section 2.1.10.3.

Related Item

- First Revision No. 7730

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jul 30 22:54:19 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 197-NFPA 70-2024 [Section No. 701.4(A)]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Thu May 09 11:00:36 EDT 2024

Committee Statement

Committee Statement: The reference provided in the informational note should also include an explanation for the reference. See NEC Style Manual Section 2.1.10.3.

First Revision No. 7730-NFPA 70-2024 [Section No. 701.3]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 840-NFPA 70-2024 [Section No. 701.4(A)]

(A) Commissioning Witness Test.

The authority having jurisdiction shall conduct or witness the commissioning of the ~~complete~~ completed system upon installation.

Informational Note: See NECA 90, *Standard for Commissioning Building Electrical Systems*.

Statement of Problem and Substantiation for Public Comment

This comment seeks to change "complete" to "completed." As indicated in PI 1671, the commissioning of a large or complex emergency system is a process that can take months to complete and is far too vast for an AHJ to witness of perform. Although I much prefer the previous language of simply witnessing the test, changing "complete" to completed" at least indicates that the AHJ need not witness the entire process, only the completed installation.
See companion comment to Article 700.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 837-NFPA 70-2024 [Section No. 700.4(A)]	

Related Item

- PI 1675

Submitter Information Verification

Submitter Full Name:	Ryan Jackson
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City:	
State:	
Zip:	
Submittal Date:	Tue Aug 06 13:30:11 EDT 2024
Committee:	NEC-P13

Public Comment No. 1003-NFPA 70-2024 [Section No. 701.4(D)]

(D) Record Keeping.

A written record shall be kept on such tests and maintenance ~~and made available upon request to those authorized to design, install, inspect, maintain, and operate the system~~ .

Statement of Problem and Substantiation for Public Comment

The list of individuals that require access to records of testing is far too broad. Facility operators should be left with some discretion as to who has access to records of commissioning and settings of vital systems. Someone performing routine cleaning is maintaining a system in keeping with manufacturers instructions, but does not require access to records of commissioning and testing.

Related Item

- FR 7730

Submitter Information Verification

Submitter Full Name: Matthew Grover
Organization: Kings Electric Services
Affiliation: IEC
Street Address:
City:
State:
Zip:
Submittal Date: Sat Aug 10 13:48:49 EDT 2024
Committee: NEC-P13

Public Comment No. 1139-NFPA 70-2024 [Section No. 701.4(D)]

(D) Record Keeping.

A written or digital record shall be kept on such tests and maintenance and made available upon request to those authorized to design, install, inspect, maintain, and operate the system.

Statement of Problem and Substantiation for Public Comment

The universal understanding of written to include digital is not substantiated by the committee. Adding "digital" clarifies that what is "written" can be either on paper or done on a computer.

Related Item

- PI-2498

Submitter Information Verification

Submitter Full Name:	David Hittinger
Organization:	Independent Electrical Contractors
Affiliation:	IEC Codes and Standards
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Aug 15 22:05:59 EDT 2024
Committee:	NEC-P13

Public Comment No. 2060-NFPA 70-2024 [Section No. 701.4(D)]

(D) Record Keeping.

A written record shall be kept on such tests and ~~maintenance~~ servicing and made available upon request to those authorized to design, install, inspect, maintain, and operate the system.

Statement of Problem and Substantiation for Public Comment

The term "maintenance" should be changed to "servicing" to correlate with revisions in this section.

Related Item

- FR-7730

Submitter Information Verification

Submitter Full Name: Daniel Neeser
Organization: Eaton Bussmann Division
Street Address:
City:
State:
Zip:

Submittal Date: Wed Aug 28 17:29:58 EDT 2024
Committee: NEC-P13

Public Comment No. 578-NFPA 70-2024 [Section No. 701.4(D)]

(D) Record Keeping.

A ~~written~~ record shall be kept on such tests and maintenance and made available upon request to those authorized to design, install, inspect, maintain, and operate the system.

Statement of Problem and Substantiation for Public Comment

Since the subsection title “Written Record Keeping” was changed to “Record Keeping” (via FR 7730), then for consistency we must strike “written” from the text body. It’s also not reasonable (in this digital age) to require written records for all system installations.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 577-NFPA 70-2024 [Section No. 700.4(D)]	
Public Comment No. 577-NFPA 70-2024 [Section No. 700.4(D)]	

Related Item

- FR 7730

Submitter Information Verification

Submitter Full Name: Timothy Windey
Organization: Cummins Power Generation
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 01 12:04:48 EDT 2024
Committee: NEC-P13

Public Comment No. 575-NFPA 70-2024 [Sections 701.5(A), 701.5(B)]

Sections 701.5(A), 701.5(B)

(A) Rating.

Legally required standby system equipment ~~shall be suitable for the available fault current at its terminals.~~ ratings shall meet or exceed the performance requirements for the installation. Ratings shall include (but not be limited to) voltage, power (kW or kVA), and available fault current capability.

(B) Capacity.

A legally required standby system shall have adequate capacity in accordance with Article 120, Parts I through ~~IV or by another approved method~~ IV . The system capacity shall be sufficient for the rapid load changes ~~and transient~~ , transient power, and energy requirements associated with any expected loads.

Statement of Problem and Substantiation for Public Comment

For 701.5(A): Since the title for section 701.5 is “Capacity and Rating,” and the title for subsection 701.5(A) is “Rating”, then it makes sense to have rating requirements in addition to “available fault current capability” under this subsection.
For 701.5(B) Capacity: Deleted “or by another approved method” in the first sentence since it is vague and has no real meaning. Also corrected a couple of minor grammar issues in the second sentence.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 574-NFPA 70-2024 [Sections 700.5(A), 700.5(B)]	
Public Comment No. 574-NFPA 70-2024 [Sections 700.5(A), 700.5(B)]	

Related Item

- FR 7711

Submitter Information Verification

Submitter Full Name: Timothy Windey
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City:
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Submittal Date: Thu Aug 01 11:34:59 EDT 2024
Committee: NEC-P13

Public Comment No. 1206-NFPA 70-2024 [Section No. 701.6(C)]

(C) ~~Redundant Transfer Equipment.~~

~~If redundant transfer equipment is used, a means shall be provided to disconnect the transfer switch from all supply and load side sources~~

Bypass and Isolation.

Means shall be permitted to bypass and isolate the transfer equipment to facilitate maintenance without jeopardizing continuity of power . Inadvertent parallel operation shall be prevented.-

Informational Note: Bypass isolation switches and bypass isolation transfer switches are examples of such means.

Statement of Problem and Substantiation for Public Comment

As written, FR 8205 creates confusion and possibly eliminates the use of bypass isolation switches. The proposed revisions clarify the basic requirement for bypass and isolation and clearly identify the specific requirements for this equipment.

Related Item

- FR8205

Submitter Information Verification

Submitter Full Name: Megan Hayes
Organization: NEMA
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City:
State:
Zip:

Submittal Date: Sat Aug 17 01:18:13 EDT 2024
Committee: NEC-P13

Public Comment No. 1943-NFPA 70-2024 [Section No. 701.6(C)]

(C) Redundant Transfer Equipment.

If redundant transfer equipment or a bypass isolation transfer switch is used, a means shall be provided to disconnect the transfer switch from all supply and load side sources. Inadvertent parallel operation shall be prevented.

Statement of Problem and Substantiation for Public Comment

The addition of bypass isolation transfer switch correlates with revisions in 700.6 and 708.24(C)

Related Item

- FR-8205

Submitter Information Verification

Submitter Full Name: Daniel Neeser
Organization: Eatons Bussmann Division
Street Address:
City:
State:
Zip:

Submittal Date: Wed Aug 28 12:06:25 EDT 2024
Committee: NEC-P13

Public Comment No. 1586-NFPA 70-2024 [New Section after 701.9]

TITLE OF NEW CONTENT

Type your content here ...

701.10. Cybersecurity

Legally required standby systems, located in or directly supplying life safety-related infrastructures, that are connected to a communication network and have the capability to be controlled or permit control of any portion of the premises shall comply with either of the following:

(1) The ability to control the legally required standby system is limited to a direct connection through a local nonnetworked interface.

(2) The legally required standby system is connected through a networked interface complying with both of the following methods:

a. The legally required standby system is identified as being evaluated for cybersecurity.

b. A cybersecurity assessment of the legally required standby system is completed and documentation of the assessment and certification is available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, *Cybersecurity Standards series*, UL 2900 *Cybersecurity Standard series*, or the NIST *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1 for assessment requirements.

Informational Note No. 2: Examples used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity is a specialized field requiring constant, vigilant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions. Installation of devices that can be secured is an important first step but not sufficient to guarantee a secure system.

Informational Note No. 4: See NEMA CY70001-2023, *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Informational Note No. 5: Examples of life safety-related infrastructures include, but are not limited to, waste water treatment facilities, water supply facilities, police stations, call centers, financial centers, data centers, and military bases.

Statement of Problem and Substantiation for Public Comment

Let's review the Code Making Panel Statement to resolve Public Input 1253, one sentence at a time.

The first sentence of the Panel Statement "General cybersecurity requirements are widely applicable based on requirements in 110" fails to note that 110.3(A)(8) has a serious issue. Amazingly, 110.3(A)(8) can be met with a simple evaluation, and that evaluation can actually show that the life safety equipment is totally unprotected against cyber attack. 110.3(A)(8) DOESN'T STATE THAT LIFE SAFETY EQUIPMENT MUST BE PROTECTED AGAINST CYBER ATTACK. IT SIMPLY STATES THAT THE LIFE SAFETY SYSTEM MUST BE EVALUATED FOR CYBERSECURITY. YES, YOU READ THAT CORRECTLY, ZERO CYBERSECURITY PROTECTION FOR LIFE SAFETY EQUIPMENT IS ACCEPTABLE IN 110.3(A)(8). THE REQUIRED EVALUATION COULD SHOW THAT THERE IS NO PROTECTION AGAINST CYBER ATTACK AND STILL MEET THE REQUIREMENTS OF 110.3(A)(8)!

The second sentence of the Panel Statement "This PI is overly broad in scope as applicable to every legally required standby system" is rectified by the limitation to legally required standby systems located in or directly supplying life safety-related infrastructures. (Informational Note No. 5 is added, providing examples of life safety-related infrastructures.)

The Panel Statement ending with "even with a five-year interval, would be inadequate in guaranteeing cybersecurity for legally required standby systems" is addressed by removal of the 5-year re-assessment.

Most of the cybersecurity focus has been on IT systems. There has been very little public discussion about cybersecurity for Operational Technology (OT), but cyber attacks on OT occur on almost a daily basis. For an example of just how common cyber attacks on life safety related infrastructure have become, let's look at just the water supply and waste water treatment industry. The DNI (Director of National Intelligence), through the CTIIC (Cyber Threat Intelligence Integration Center) recently released a report of 12 cyber attacks on the industrial control systems of water utilities, water systems, and waste water treatment systems, for the six-month period from November 2023 through April 2024. This report can be found at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.dni.gov/files/CTIIC/documents/products/Recent_Cyber_Attacks_on_US_Infrastructure_Underscore_Vulnerability_of_Crit June2024.pdf&ved=2ahUKEwi5gP7-m4eIAxUakYkEHasyIRQQFnoECB8QAQ&usg=AOvVaw3hJL2DMlRs-CECfmewcXVP

While this example covered attacks on industrial control systems, successful attacks can occur on all electrical equipment that is continuously connected to the internet and even equipment that is only connected to the internet during system updates. (Cyber attacks can lay quiet for years, waiting for an update, and then do their intended damage during the update.)

Hackers can easily destroy unprotected equipment and shut down entire unprotected facilities. Our adversaries are continuously mounting cyber attacks on our life safety-related infrastructure. We have the ability, and obligation, to prevent this type of damage to our infrastructure from malicious cyber attacks.

Informational Note No. 4 was added to correlate with FR 9040 (110.3(A)(8)), FR 9210 (240.6(D)), and FR 8219 (708.7).

THIS PUBLIC COMMENT SIMPLY REQUIRES THAT LEGALLY REQUIRED STANDBY SYSTEMS, INSTALLED IN OR DIRECTLY SUPPLYING ONLY LIFE SAFETY-RELATED INFRASTRUCTURES, EITHER NOT BE CONNECTED TO THE INTERNET, OR IF THEY ARE CONNECTED TO THE INTERNET, THAT THEY BE "IDENTIFIED" FOR CYBERSECURITY AND THAT AN ASSESSMENT IS PROVIDED.

Related Item

- PI 1253

Submitter Information Verification

Submitter Full Name: Vincent Saporita
Organization: Saporita Consulting
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City:
State:
Zip:
Submittal Date: Sat Aug 24 12:52:10 EDT 2024
Committee: NEC-P13

Public Comment No. 520-NFPA 70-2024 [Section No. 701.9]

701.9 Surge Protection.

A listed SPD shall be installed in or on all legally required standby system switchgear, switchboards, and panelboards.

Additional Proposed Changes

File Name	Description	Approved
CN_198.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 198 appeared in the First Draft Report on First Revision No. 7702.

The use of the phrase "in or on" should be reviewed for clarity and consideration given to similar requirements such as 230.67(B) which uses the phrase "integral or located immediately adjacent". Sections 700.9 and 708.8 should also be included in the review.

Related Item

- First Revision No. 7702

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jul 30 22:55:30 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 198-NFPA 70-2024 [Section No. 701.9]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Thu May 09 11:02:12 EDT 2024

Committee Statement

Committee Statement: The use of the phrase "in or on" should be reviewed for clarity and consideration given to similar requirements such as 230.67(B) which uses the phrase "integral or located immediately adjacent". Sections 700.9 and 708.8 should also be included in the review.

First Revision No. 7702-NFPA 70-2024 [New Section after 701.7]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 521-NFPA 70-2024 [Section No. 701.12(A)]

(A) Power Source Duration.

Power source duration shall be selected based upon the type of occupancy.

Informational Note: Considerations of the duration of an emergency power source include the following:

(1) For minimum duration, as for evacuation of a theater

(2) For longer duration, as for supplying emergency power and lighting due to an indefinite period of current failure from trouble either inside or outside the building

Additional Proposed Changes

File Name	Description	Approved
CN_199.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 199 appeared in the First Draft Report on First Revision No. 8206.

The informational note should be reviewed for compliance with NEC Style Manual Section 2.1.10.2. Informational notes should not contain requirements, make interpretations, or make recommendations. The informational note should also be reviewed relative to aligning terminology on the type of power being supplied with the scope of Article 701.

Related Item

• First Revision No. 8206

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:

Submittal Date: Tue Jul 30 22:56:40 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 199-NFPA 70-2024 [Section No. 701.12(A)]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Thu May 09 11:04:17 EDT 2024

Committee Statement

Committee Statement: The informational note should be reviewed for compliance with NEC Style Manual Section 2.1.10.2. Informational notes should not contain requirements, make interpretations, or make recommendations. The informational note should also be reviewed relative to aligning terminology on the type of power being supplied with the scope of Article 701.

First Revision No. 8206-NFPA 70-2024 [Sections 701.12(A), 701.12(B)]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 841-NFPA 70-2024 [Section No. 701.12(A)]

~~**(A)** Power Source Duration.~~

~~Power source duration shall be selected based upon the type of occupancy.~~

~~Informational Note: Considerations of the duration of an emergency power source include the following:~~

(1) ~~For minimum duration, as for evacuation of a theater~~

(2) ~~For longer duration, as for supplying emergency power and lighting due to an indefinite period of current failure from trouble either inside or outside the building~~

Statement of Problem and Substantiation for Public Comment

See comment to 700.12.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 839-NFPA 70-2024 [Section No. 700.12(A)]	Same issue

Related Item

- FR 8206

Submitter Information Verification

Submitter Full Name: Ryan Jackson
Organization: Self-employed
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 06 13:33:16 EDT 2024
Committee: NEC-P13

Public Comment No. 1408-NFPA 70-2024 [Section No. 701.12(D)(3)]

(3) Outdoor Generator Sets.

An outdoor-housed generator set shall be equipped with a disconnecting means in accordance with 445.18. If the disconnecting means is not readily accessible or is not located within sight of the building or structure supplied, an additional disconnecting means shall be required where ungrounded conductors serve or pass through the building or structure supplied. The disconnecting means shall meet the requirements of 225.36 <u>for voltages not over 1000 V ac, 1500 V dc or 267 . 31(C) for voltages over 1000 V ac, 1500 V dc nominal .</u>

Statement of Problem and Substantiation for Public Comment

FR-8194 modified the requirements for outdoor generator sets found in 701.12(D)(3) to clarify the disconnecting means requirement. As written, the type of disconnecting means shall meet the requirements of 225.36 in all cases. Section 225.36 specifically addresses the type of disconnecting means for voltage not over 1000 V ac, 1500 V dc, but these requirements are not appropriate when the system voltage is over 1000 V ac. This public comment adds a reference to 267.31(C) to properly select the type of disconnecting means for voltages over 1000 V ac, 1500 V dc nominal.

Related Item

- FR-8194

Submitter Information Verification

Submitter Full Name: Paul Barnhart
Organization: UL LLC Solutions
Street Address:
City:
State:
Zip:

Submittal Date: Thu Aug 22 14:07:50 EDT 2024
Committee: NEC-P13

Public Comment No. 522-NFPA 70-2024 [Section No. 701.12(F)]

(F) Separate Service.

Where approved by the authority having jurisdiction as suitable for use as a legally required standby source of power, an additional service shall be permitted with 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.

Additional Proposed Changes

File Name	Description	Approved
CN_200.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 200 appeared in the First Draft Report on First Revision No. 8198.

This section should be reviewed for compliance with NEC Style Manual Section 3.5.4. The use of “where” is limited to the expression of location and should be replaced with “if” for condition- based statements. Additionally, the use of the term “suitable” should be reviewed in respect to this section being based on approval by the AHJ.

Related Item

• First Revision No. 8198

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jul 30 22:57:54 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 200-NFPA 70-2024 [Section No. 701.12(F)]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Thu May 09 11:05:47 EDT 2024

Committee Statement

Committee Statement: This section should be reviewed for compliance with NEC Style Manual Section 3.5.4. The use of “where” is limited to the expression of location and should be replaced with “if” for condition- based statements. Additionally, the use of the term “suitable” should be reviewed in respect to this section being based on approval by the AHJ.

First Revision No. 8198-NFPA 70-2024 [Section No. 701.12(F)]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 1008-NFPA 70-2024 [Section No. 701.32(B)]

(B) Replacements.

Where legally required standby ~~OCPDs or~~ OCPDs or normal system OCPDs that supply legally required standby load(s) are replaced, they shall be reevaluated to ensure selective coordination of the legally required standby system is maintained with all supply-side and load-side OCPDs.

Exception No. 1: reevaluation shall not be required when OCPDs are replaced in kind.

Statement of Problem and Substantiation for Public Comment

The requirement to "reevaluate" is not specific and may be interpreted to require a full system coordination study to be performed even in the case of in kind device replacement. For example swapping out a failed fuse with an identical device should not require a system reevaluation. A reevaluation does nothing to increase the reliability or safety of the system in such a case.

Related Item

- FR 8201

Submitter Information Verification

Submitter Full Name: Matthew Grover
Organization: Kings Electric Services
Affiliation: IEC
Street Address:
City:
State:
Zip:

Submittal Date: Sat Aug 10 14:13:37 EDT 2024
Committee: NEC-P13

Public Comment No. 213-NFPA 70-2024 [Section No. 702.3]

702.3 Reconditioned Equipment.

Reconditioned transfer switches shall not be ~~installed~~ <u>permitted</u> .

Statement of Problem and Substantiation for Public Comment

This public comment is made to address an issue with the first draft language changes. The proposed language in this first revision allows electrical equipment to be reconditioned in place as the language pertains to the installation process and not to when any equipment is reconditioned in place. With the existing language in this first revision, the only time reconditioned equipment would not be permitted is if it is being installed. The Code does apply to existing equipment when additions or modifications are being made. The proposed language change from "installed" to "permitted" is more inclusive.

Related Item

- FR 7746

Submitter Information Verification

Submitter Full Name: Thomas Domitrovich

Organization: Eaton Corporation

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jul 24 07:55:14 EDT 2024

Committee: NEC-P13

Public Comment No. 1944-NFPA 70-2024 [Section No. 702.4(A)]

(A) System Capacity.

(1) Manual and Nonautomatic Load Connection.

If the connection of load is manual or nonautomatic, 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.

Multimode inverter-based systems requiring manual intervention to select among loads connected in excess of their capacity are permitted to meet the requirements of this section.

Informational Note 1 : Manual and nonautomatic transfer equipment require human intervention.

Informational Note 2: Multimode-inverter based systems often function primarily as interactive systems and while they may be capable of providing standby supply continuity within their capacity, they otherwise default to require human intervention for control of loads and/or settings. Multimode inverters are listed to control the voltage and frequency within prescribed limits and ratings and to cease operation safely when outside of those limits.

(2) Automatic Load Connection.

If the connection of load is automatic, an optional standby system shall comply with 702.4(A)(2)(a) or 702.4(A)(2)(b) in accordance with Article 120, Parts I through IV or by another approved method.

(a) *Full Load.* The standby source shall be capable of supplying the full load that is automatically connected.

(b) *Energy Management System (EMS).* Where a system is employed in accordance with 130.30 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 EMS.

Statement of Problem and Substantiation for Public Comment

In its rejection of PI 4142 proposing a path for multi-mode inverter- based systems through 702.4(A)(2), CMP-13 made clear that there is a fundamental conflict in creating an allowance for systems sold as providing automatic load connection that has potential human intervention built into its functionality. While not directly a safety issue, there is a consumer protection objective to ensure consumers are fully aware of the limitations of such systems and understand the user controls available to them.

This PC instead links these multi-mode inverter-based systems that employ human intervention – whether it be load selection, manual connection, or control over the connection type settings – to the requirements for manual and non-automatic load connection. This approach achieves several objectives:

- Recognizes that even though in many instances the multi-mode inverter-based systems may be able to provide supply continuity in the event of a grid outage, they are understood to at times require human intervention to reconfigure loads for standby operation.
- Helps to ensure customer expectations are properly set by the systems' classification in Article 702, with compliance documentation, and in installation manuals (which are NRTL controlled).
- Avoids diluting requirements in 702.4(A)(2) for systems designed to provide automatic load connection without occasional user control or intervention.
- Accommodates a technology that is indeed different from the traditional optional standby system in that its primary application is grid interactive >99% of the time.
- Re-establishes a path in the NEC for an existing popular, cost-effective, and safe consumer option that was not governed by Article 702 prior to the 2023 edition. (The removal of a pathway through Article 710 was not based on a safety concern, yet created a challenge for addressing a multi-mode application within Article 702.)

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Related Item

• FR-7744 • PI-4142

Submitter Information Verification

Submitter Full Name: Evelyn Butler
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Affiliation: SSIF
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Submittal Date: Wed Aug 28 12:14:04 EDT 2024
Committee: NEC-P13

Public Comment No. 1204-NFPA 70-2024 [Section No. 702.4(A)(2)]

(2) Automatic Load Connection.

If the connection of load is automatic, an optional standby system shall comply with 702.4(A)(2)(a) or 702.4(A)(2)(b) in accordance with Article 120, Parts I through IV or by another approved method.

(a) *Full Load.* The standby source shall be capable of supplying the full load that is automatically connected.

(b) *Energy Management System (EMS).* Where a system is employed in accordance with ~~130.30 that~~ Article 130, Part II that will automatically manage the connected load, the standby source shall have a minimum capacity ~~sufficient~~ equal to ~~supply the maximum load that will be connected by the EMS~~ the EMS current setpoint in accordance with 130.70.

Informational Note: EMS with PCS functionality is typically used to control loads at the branch circuit, feeder distribution level, or combination of both to prevent branch circuits, feeders, standby sources, and equipment from being overloaded upon connection of the load onto the standby source .

Statement of Problem and Substantiation for Public Comment

Updating to the correct reference pointer to Article 120 in 702.4(A)(2).

702.4(B)(2)(b) is editorial modified to provide clarity on the requirement that the optional source have a minimum capacity that is equal to the current setpoint of the EMS where a listed EMS with PCS is used to prevent the standby source, conductors, and equipment from being overloaded. The requirements for prevention of overload is handled through the appropriate standards.

A new informational note provides clarity that the EMS could be used at the branch circuit or feeder distribution level to remove a load or group of loads from the standby source.

Related Item

- FR7744

Submitter Information Verification

Submitter Full Name: Megan Hayes
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Submittal Date: Sat Aug 17 00:55:55 EDT 2024
Committee: NEC-P13

Public Comment No. 1954-NFPA 70-2024 [Section No. 702.5(A)]

(A) General.

Interconnection, interlocking device, or transfer equipment shall be required for all standby systems subject to the requirements of this article. 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~~ power source 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 Comment

Several First Revisions have been made to Article 702 to clarify that it may apply to power sources other than engine generators. This exception should not be equipment specific. For example, mobile and/or portable battery ESS are being deployed for temporary power and disaster-relief applications.

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Related Item

• FR-8208 • PI-1926

Submitter Information Verification

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Submittal Date: Wed Aug 28 12:45:28 EDT 2024
Committee: NEC-P13

Public Comment No. 1630-NFPA 70-2024 [Section No. 702.7(A)]

(A) Standby.

(1) One- and Two-Family Dwelling Units.

For one- and two-family dwelling units, a ~~sign~~ plaque or directory shall be ~~placed at the~~ located adjacent to the disconnecting means required in 225.41 and 230.70(A)(2) 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 445.19(C).

(2) Other Than One- and Two-Family Dwelling Units.

A ~~sign shall be placed at the~~ plaque or directory shall be located adjacent to the service equipment for other than one- and two-family dwellings that indicates the type and location of each on-site optional standby power source.

Statement of Problem and Substantiation for Public Comment

First item the panel needs to review is FR-9155 where 230.85 emergency disconnect was deleted and now is referred to only in the marking requirements and to make sure referencing 230.70(A)(2) is correct or necessary.
Second item is to change and remove "sign" and "placed" to the language shown in this PC. This revised language correlates with the requirements in 230.70(D) and 225.41(B), that requires a plaque or directory located adjacent to the service equipment when other energy source disconnects are used.
Third item is to suggest that the title of 702.7 Signs be changed to Markings. 702.7 currently allows not just signs but also labels and also refers to 110.21 which is titled Markings. Marking, being a more general term, could include signs, labels, plaques, and/or directories if the requirement needed to include a choice for identification of other disconnects. Leaving the title as Signs could be too restrictive and could be looked at as a conflict with using a label, plaque or directory.

Related Item

• FR-9155 • FR-8211

Submitter Information Verification

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Submittal Date: Sun Aug 25 15:29:26 EDT 2024
Committee: NEC-P13

Public Comment No. 1587-NFPA 70-2024 [New Section after 702.7(C)]

TITLE OF NEW CONTENT

Type your content here ...

702.8. Cybersecurity

Optional standby systems, located in or directly supplying life safety-related infrastructures, that are connected to a communication network and have the capability to be controlled or permit control of any portion of the premises shall comply with either of the following:

(1) The ability to control the optional standby system is limited to a direct connection through a local nonnetworked interface.

(2) The optional standby system is connected through a networked interface complying with both of the following methods:

a. The optional standby system is identified as being evaluated for cybersecurity.

b. A cybersecurity assessment of the optional standby system is completed and documentation of the assessment and certification is available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, *Cybersecurity Standards series*, UL 2900 *Cybersecurity Standard series*, or the NIST *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1 for assessment requirements.

Informational Note No. 2: Examples used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity is a specialized field requiring constant, vigilant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions. Installation of devices that can be secured is an important first step but not sufficient to guarantee a secure system.

Informational Note No. 4: See NEMA CY70001-2023, *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Informational Note No. 5: Examples of life safety-related infrastructures include, but are not limited to, waste water treatment facilities, water supply facilities, police stations, call centers, financial centers, data centers, and military bases.

Statement of Problem and Substantiation for Public Comment

Let's review the Code Making Panel Statement to resolve Public Input 1254, one sentence at a time.

The first sentence of the Panel Statement "General cybersecurity requirements are widely applicable based on requirements in 110" fails to note that the requirements in 110.3(A)(8) only pertain to life safety equipment. Optional standby systems are not life safety equipment. There isn't a definition of life safety equipment in Article 100. There is nothing in the NEC that designates optional standby systems as life safety equipment. Only if the optional standby system is designated as life safety equipment does 110.3(A)(8) apply!

And if, for some reason, the optional standby system is considered to be life safety equipment, 110.3(A)(8) has an even more serious issue. Amazingly, 110.3(A)(8) can be met with a simple evaluation, and that evaluation can actually show that the life safety equipment is totally unprotected against cyber attack. 110.3(A)(8) DOESN'T STATE THAT LIFE SAFETY EQUIPMENT MUST BE PROTECTED AGAINST CYBER ATTACK. IT SIMPLY STATES THAT THE LIFE SAFETY SYSTEM MUST BE EVALUATED FOR CYBERSECURITY. YES, YOU READ THAT CORRECTLY, ZERO CYBERSECURITY PROTECTION FOR LIFE SAFETY EQUIPMENT IS ACCEPTABLE IN 110.3(A)(8). THE REQUIRED EVALUATION COULD SHOW THAT THERE IS NO PROTECTION AGAINST CYBER ATTACK AND STILL MEET THE REQUIREMENTS OF 110.3(A)(8)!

The second sentence of the Panel Statement "This PI is overly broad in scope as applicable to every optional standby system" is rectified by the limitation to energy storage systems located in or directly supplying life safety-related infrastructures. (Informational Note No. 5 is added, providing examples of life safety-related infrastructure.)

The Panel Statement ending with "even with a five-year interval, would be inadequate in guaranteeing cybersecurity for optional standby systems" is addressed by removal of the 5-year re-assessment.

Most of the cybersecurity focus has been on IT systems. There has been very little public discussion about cybersecurity for Operational Technology (OT), but cyber attacks on OT occur on almost a daily basis. For an example of just how common cyber attacks on life safety related infrastructure have become, let's look at just the water supply and waste water treatment industry. The DNI (Director of National Intelligence), through the CTIIC (Cyber Threat Intelligence Integration Center) recently released a report of 12 cyber attacks on the industrial control systems of water utilities, water systems, and waste water treatment systems, for the six-month period from November 2023 through April 2024. This report can be found at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.dni.gov/files/CTIIC/documents/products/Recent_Cyber_Attacks_on_US_Infrastructure_Underscore_Vulnerability_of_Crit June2024.pdf&ved=2ahUKEwi5gP7-m4eIAxUakYkEHasyIRQQFnoECB8QAQ&usg=AOvVaw3hJL2DMlRs-CECfmewcXVP

While this example covered attacks on industrial control systems, successful attacks can occur on all electrical equipment that is continuously connected to the internet and even equipment that is only connected to the internet during system updates. (Cyber attacks can lay quiet for years, waiting for an update, and then do their intended damage during the update.)

Hackers can easily destroy unprotected equipment and shut down entire unprotected facilities. Our adversaries are continuously mounting cyber attacks on our life safety-related infrastructure. We have the ability, and obligation, to prevent this type of damage to our infrastructure from malicious cyber attacks.

Let's look at an example of a waste water treatment facility. 110.3(A)(8) currently requires that a fire alarm system in the waste water treatment facility, because it is life safety equipment, be evaluated in light of cybersecurity. However, there is no requirement for the other non-life safety equipment/systems within or directly supplying the waste water treatment plant, such as optional standby systems, which could easily be compromised by a cyber attack. The proposed text in this Public Comment addresses this vulnerability.

Informational Note No. 4 was added to correlate with FR 9040 (110.3(A)(8)), FR 9210 (240.6(D)), and FR 8219 (708.7).

THIS PUBLIC COMMENT SIMPLY REQUIRES THAT OPTIONAL STANDBY SYSTEMS, INSTALLED IN ONLY OR DIRECTLY SUPPLYING ONLY LIFE SAFETY-RELATED INFRASTRUCTURES, EITHER NOT BE CONNECTED TO THE INTERNET, OR IF THEY ARE CONNECTED TO THE INTERNET, THAT THEY BE "IDENTIFIED" FOR CYBERSECURITY AND THAT AN ASSESSMENT IS PROVIDED.

Related Item

- PI 1254

Submitter Information Verification

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Submittal Date:	Sat Aug 24 13:00:58 EDT 2024
Committee:	NEC-P13

Public Comment No. 1410-NFPA 70-2024 [Section No. 702.12(A)]

(A) Portable Generators Greater Than 15 kW and Permanently Installed Generators.

An outdoor housed generator set shall be equipped with a disconnecting means in accordance with 445.18. ~~When~~ If the disconnecting means is not readily accessible or is not located within sight of the building or structure supplied, an additional disconnecting means shall be required where ungrounded conductors serve or pass through the building or structure supplied. The disconnecting means shall meet the requirements of 225.36 for voltages not over 1000 V ac, 1500 V dc or 267 . 31(C) for voltages over 1000 V ac, 1500 V dc nominal .

Statement of Problem and Substantiation for Public Comment

FR-8212 modified the requirements for outdoor generator sets found in 702.12(A) to clarify the disconnecting means requirement. As written, the type of disconnecting means shall meet the requirements of 225.36 in all cases. Section 225.36 specifically addresses the type of disconnecting means for voltage not over 1000 V ac, 1500 V dc, but these requirements are not appropriate when the system voltage is over 1000 V ac. This public comment adds a reference to 267.31(C) to properly select the type of disconnecting means for voltages over 1000 V ac, 1500 V dc nominal. This public comment also corrects the word “when” to the more proper word “if”.

Related Item

- FR-8212

Submitter Information Verification

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Submittal Date: Thu Aug 22 14:12:48 EDT 2024
Committee: NEC-P13

Public Comment No. 523-NFPA 70-2024 [Section No. 702.12(A)]

(A) Portable Generators Greater Than 15 kW and Permanently Installed Generators.

An outdoor housed generator set shall be equipped with a disconnecting means in accordance with 445.18. When the disconnecting means is not readily accessible or is not located within sight of the building or structure supplied, an additional disconnecting means shall be required where ungrounded conductors serve or pass through the building or structure supplied. The disconnecting means shall meet the requirements of 225.36.

Additional Proposed Changes

File Name	Description	Approved
CN_201.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 201 appeared in the First Draft Report on First Revision No. 8212.

This section should be reviewed for compliance with NEC Style Manual Section 3.5.4. The use of “when” is limited to the expression of time and should be replaced with “if” for condition- based statements. See FR 8194, Section 701.12(D)(3) for similar requirements which replaced “when” with “if” in compliance with the NEC Style Manual.

Related Item

- First Revision No. 8212

Submitter Information Verification

Submitter Full Name: CC Notes
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Submittal Date: Tue Jul 30 23:00:08 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 201-NFPA 70-2024 [Section No. 702.12(A)]

Submitter Information Verification

Committee: NEC-AAC

Submittal Date: Thu May 09 11:10:28 EDT 2024

Committee Statement

Committee Statement: This section should be reviewed for compliance with NEC Style Manual Section 3.5.4. The use of “when” is limited to the expression of time and should be replaced with “if” for condition- based statements. See FR 8194, Section 701.12(D)(3) for similar requirements which replaced “when” with “if” in compliance with the NEC Style Manual.

First Revision No. 8212-NFPA 70-2024 [Section No. 702.12(A)]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 1953-NFPA 70-2024 [Section No. 706.2]

706.2 Listing.

Energy storage systems shall be listed.

Informational Note: See UL 9540, *Energy Storage Systems and Equipment* , for more information.

Statement of Problem and Substantiation for Public Comment

This informational note strengthens the connection to the established standard for ESS. Several precedents for linking an NEC-defined system or type of equipment exist, and this addition complements other First Revisions aimed at clarifying the distinction between stationary batteries that fall under the scope of Article 480, and ESS that are more appropriately installed using the provisions in Article 706. See 700.12(E)(1)(1) for an example of an Informational Note used to link a defined equipment type to its corresponding product safety standard, i.e. UL 1778.

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Related Item

• FR-8149 • PI-2831 • PI-2829

Submitter Information Verification

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Submittal Date: Wed Aug 28 12:42:50 EDT 2024
Committee: NEC-P13

Public Comment No. 823-NFPA 70-2024 [New Section after 706.3]

706.XX Qualified Person

The installation and maintenance of ESS equipment and all associated wiring and interconnections shall be performed only by qualified persons.

Informational Note 1: See Article 100 for the definition of qualified person.

Informational Note 2: See NFPA 855-2026, Standard for the Installation of Stationary Energy Storage Systems, for the definition of qualified person.

Statement of Problem and Substantiation for Public Comment

The justification to remove this requirement from the NEC that requires personnel be qualified within the NEC currently, is incorrect.
Along with inserting this requirement back into the NEC, adding a second informational note may be needed to keep this requirement in 706.
Adding informational note #2 to refer to NFPA 855 Standard for the Installation of Stationary Energy Storage Systems for the definition of Qualified Person which states the following: One who has skills, knowledge, and training related to the construction and operation of energy storage systems and electrical equipment and installations and has received safety training to recognize, avoid, and mitigate the hazards involved.
This definition adds training, operation and to mitigate the hazards involved with energy storage systems which is above and beyond what the definition from the NEC provides.
As a reminder of why this requirement originally was added to Article 706 the following statement was used, “The installation and maintenance of energy storage systems must be performed by persons trained specifically in the unique requirements and hazards of these systems. Improper installation and/or maintenance can result a catastrophic failure."
This language, that qualified personnel need the extra training and qualifications to perform this type of work on ESS, should remain in this Article.

Related Item

- FR-7899

Submitter Information Verification

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Submittal Date:	Mon Aug 05 17:57:59 EDT 2024
Committee:	NEC-P13

Public Comment No. 1952-NFPA 70-2024 [Section No. 706.3]

706.3 Reconditioned Equipment.

Reconditioned energy storage systems shall not be installed.

Reconditioned equipment is permitted where replacing components of an energy storage system.

Informational Note: See NFPA 855-2023, *Standard for the Installation of Stationary Energy Storage Systems* , for guidance on the repair, repurposing or refurbishing of specific ESS components.

Statement of Problem and Substantiation for Public Comment

The proposed change does not change the requirement preventing the installation of a complete reconditioned ESS. The addition addresses requirements and guidance for components that are likely to be replaced within the ESS equipment. NFPA 855 provides significant detail governing the repurposing and refurbishing of various ESS components. The addition also prevents a perceived conflict between the NEC and NFPA 855.

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Related Item

• FR-8150 • PI-633

Submitter Information Verification

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Submittal Date: Wed Aug 28 12:39:09 EDT 2024
Committee: NEC-P13

Public Comment No. 2062-NFPA 70-2024 [Section No. 706.7]

706.7 Commissioning and ~~Maintenance~~ Servicing .

(A) Commissioning.

ESSs shall be commissioned upon installation in accordance with manufacturer's instructions.

Informational Note: See NFPA 855-2026, *Standard for the Installation of Stationary Energy Storage Systems*, for information related to the commissioning of ESSs.

(B) ~~Maintenance~~ Servicing .

ESSs shall be maintained in proper and safe operating condition. The required ~~maintenance shall~~ servicing shall be in accordance with the manufacturer's requirements and industry standards. In other than one- and two-family dwelling units, a written record of the system ~~maintenance shall~~ servicing shall be kept and shall include records of servicing ~~and replacements~~ necessary to maintain the system in proper and safe operating condition.

Informational Note: See NFPA 70B-2023, *Standard for Electrical Equipment Maintenance*, or ANSI/NETA ATS, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*, for information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program.

Statement of Problem and Substantiation for Public Comment

The term "maintenance" should be changed to "servicing" to correlate with revisions in this section

Related Item

- FR-8155

Submitter Information Verification

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Submittal Date: Wed Aug 28 17:33:13 EDT 2024
Committee: NEC-P13

Public Comment No. 843-NFPA 70-2024 [Section No. 706.7]

~~**706.7** Commissioning and Maintenance.~~

~~**(A)** Commissioning.~~

~~ESSs shall be commissioned upon installation in accordance with manufacturer's instructions.~~

~~Informational Note: See NFPA 855-2026, *Standard for the Installation of Stationary Energy Storage Systems* , for information related to the commissioning of ESSs.~~

~~**(B)** Maintenance.~~

~~ESSs shall be maintained in proper and safe operating condition. The required maintenance shall be in accordance with the manufacturer's requirements and industry standards. In other than one- and two-family dwelling units, a written record of the system maintenance shall be kept and shall include records of servicing and replacements necessary to maintain the system in proper and safe operating condition.~~

~~Informational Note: See NFPA 70B-2023, *Standard for Electrical Equipment Maintenance* , or ANSI/NETA ATS, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems* , for information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program.~~

Statement of Problem and Substantiation for Public Comment

706.7(A) is a repeat of 110.3(B) and therefore violates 4.1.1 of the NEC Style Manual. See 90.3
706.7(B) is material that is outside the socpe of the NEC. See 90.2, particularly the failed at attempt at adding maintenance to the scope for the 2026 edition.

Related Item

• FR 8153 • FR 8155

Submitter Information Verification

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Submittal Date: Tue Aug 06 14:04:59 EDT 2024
Committee: NEC-P13

Public Comment No. 1281-NFPA 70-2024 [Section No. 706.7(A)]

(A) Commissioning.

ESSs shall be ~~commissioned upon installation~~ evaluated for their proper operation by the system installer in accordance with the manufacturer's instructions.

Informational Note: See NFPA 855-2026, *Standard for the Installation of Stationary Energy Storage Systems*, for information related to the commissioning of ESSs in other than one- and two-family dwellings .

Statement of Problem and Substantiation for Public Comment

There is a need to further clarify that commissioning does not require a witness test by the AHJ, particularly since the use of this term in this code predominantly includes witness testing. The proposed text is taken directly from the 2023 Edition of NFPA 855, Section 6.1.4.1. There are no proposed changes to the 2026 Edition of NFPA 855. The AHJ would still have authority to request documentation on commissioning as described in the manufacturer's instructions.

The informational note is modified to align with NFPA 855, which does not offer any information in Chapter 15 for commissioning ESS installed at one- and two-family dwellings. For other than one- and two-family guidance is available in NFPA 855.

Related Item

- PI 1374

Submitter Information Verification

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Submittal Date: Mon Aug 19 16:04:25 EDT 2024
Committee: NEC-P13

Public Comment No. 1958-NFPA 70-2024 [Section No. 706.7(A)]

(A) Commissioning.

ESSs shall be commissioned upon installation in accordance with manufacturer's instructions. Where not elsewhere required by this code, the authority having jurisdiction shall not be required to conduct or witness the commissioning of the ESS.

Informational Note: See NFPA 855-2026, *Standard for the Installation of Stationary Energy Storage Systems*, for information related to the commissioning of ESSs in other than one- and two-family dwellings .

Statement of Problem and Substantiation for Public Comment

There is a need to further clarify that commissioning does not require a witness test by the AHJ, particularly since the use of this term in this code predominantly includes witness testing. The proposed text is taken directly from the 2023 Edition of NFPA 855, Section 6.1.4.1. There are no proposed changes to the 2026 Edition of NFPA 855. The AHJ would still have authority to request documentation on commissioning as described in the manufacturer's instructions.

The informational note is modified to align with NFPA 855, which does not offer any information in Chapter 15 for commissioning ESS installed at one- and two-family dwellings. For other than one- and two-family guidance is available in NFPA 855.

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Related Item

• FR-8153 • PI-1374

Submitter Information Verification

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Submittal Date:	Wed Aug 28 12:52:01 EDT 2024
Committee:	NEC-P13

Public Comment No. 1589-NFPA 70-2024 [New Section after 706.9]

TITLE OF NEW CONTENT

Type your content here ...

706.10. Cybersecurity

Energy storage systems, located in or directly supplying life safety-related infrastructures, that are connected to a communication network and have the capability to be controlled or permit control of any portion of the premises shall comply with either of the following:

(1) The ability to control the energy storage system is limited to a direct connection through a local nonnetworked interface.

(2) The energy storage system is connected through a networked interface complying with both of the following methods:

a. The energy storage system is identified as being evaluated for cybersecurity.

b. A cybersecurity assessment of the energy storage system is completed and documentation of the assessment and certification is available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, *Cybersecurity Standards series*, UL 2900 *Cybersecurity Standard series*, or the NIST *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1 for assessment requirements.

Informational Note No. 2: Examples used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity is a specialized field requiring constant, vigilant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions. Installation of devices that can be secured is an important first step but not sufficient to guarantee a secure system.

Informational Note No. 4: See NEMA CY70001-2023, *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Informational Note No. 5: Examples of life safety-related infrastructures include, but are not limited to, waste water treatment facilities, water supply facilities, police stations, call centers, financial centers, data centers, and military bases.

Statement of Problem and Substantiation for Public Comment

Let's review the Code Making Panel Statement to resolve Public Input 1256, one sentence at a time.

The first sentence of the Panel Statement "General cybersecurity requirements are widely applicable based on requirements in 110" fails to note that the requirements in 110.3(A)(8) only pertain to life safety equipment. Energy storage systems are not life safety equipment. There isn't a definition of life safety equipment in Article 100. There is nothing in the NEC that designates energy storage systems as life safety equipment. Only if the energy storage system is designated as life safety equipment does 110.3(A)(8) apply!

And if, for some reason, the energy storage system is considered to be life safety equipment, 110.3(A)(8) has an even more serious issue. Amazingly, 110.3(A)(8) can be met with a simple evaluation, and that evaluation can actually show that the life safety equipment is totally unprotected against cyber attack. 110.3(A)(8) DOESN'T STATE THAT LIFE SAFETY EQUIPMENT MUST BE PROTECTED AGAINST CYBER ATTACK. IT SIMPLY STATES THAT THE LIFE SAFETY SYSTEM MUST BE EVALUATED FOR CYBERSECURITY. YES, YOU READ THAT CORRECTLY, ZERO CYBERSECURITY PROTECTION FOR LIFE SAFETY EQUIPMENT IS ACCEPTABLE IN 110.3(A)(8). THE REQUIRED EVALUATION COULD SHOW THAT THERE IS NO PROTECTION AGAINST CYBER ATTACK AND STILL MEET THE REQUIREMENTS OF 110.3(A)(8)!

The second sentence of the Panel Statement "This PI is overly broad in scope as applicable to every energy storage system" is rectified by the limitation to energy storage systems located in or directly supplying life safety-related infrastructures. (Informational Note No. 5 is added, providing examples of life safety-related infrastructure.)

The Panel Statement "even with a five-year interval, would be inadequate in guaranteeing cybersecurity for energy storage systemss" is addressed by removal of the 5-year re-assessment.

Most of the cybersecurity focus has been on IT systems. There has been very little public discussion about cybersecurity for Operational Technology (OT), but cyber attacks on OT occur on almost a daily basis. For an example of just how common cyber attacks on life safety related infrastructure have become, let's look at just the water supply and waste water treatment industry. The DNI (Director of National Intelligence), through the CTIIC (Cyber Threat Intelligence Integration Center) recently released a report of 12 cyber attacks on the industrial control systems of water utilities, water systems, and waste water treatment systems, for the six-month period from November 2023 through April 2024. This report can be found at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.dni.gov/files/CTIIC/documents/products/Recent_Cyber_Attacks_on_US_Infrastructure_Underscore_Vulnerability_of_Crit June2024.pdf&ved=2ahUKEwi5gP7-m4eIAxUakYkEHasyIRQQFnoECB8QAQ&usg=AOvVaw3hJL2DMlRs-CECfmewcXVP

While this example covered attacks on industrial control systems, successful attacks can occur on all electrical equipment that is continuously connected to the internet and even equipment that is only connected to the internet during system updates. (Cyber attacks can lay quiet for years, waiting for an update, and then do their intended damage during the update.)

Hackers can easily destroy unprotected equipment and shut down entire unprotected facilities. Our adversaries are continuously mounting cyber attacks on our life safety-related infrastructure. We have the ability, and obligation, to prevent this type of damage to our infrastructure from malicious cyber attacks.

Let's look at an example of a waste water treatment facility. 110.3(A)(8) currently requires that a fire alarm system in the waste water treatment facility, because it is life safety equipment, be evaluated in light of cybersecurity. However, there is no requirement for the other non-life safety equipment/systems within or directly supplying the waste water treatment plant, such as energy storage systems, which could easily be compromised by a cyber attack. The proposed text in this Public Comment addresses this vulnerability.

Informational Note No. 4 was added to correlate with FR 9040 (110.3(A)(8)), FR 9210 (240.6(D)), and FR 8219 (708.7).

THIS PUBLIC COMMENT SIMPLY REQUIRES THAT ENERGY STORAGE SYSTEMS, INSTALLED IN ONLY OR DIRECTLY SUPPLYING ONLY LIFE SAFETY-RELATED INFRASTRUCTURES, EITHER NOT BE CONNECTED TO THE INTERNET, OR IF THEY ARE CONNECTED TO THE INTERNET, THAT THEY BE “IDENTIFIED” FOR CYBERSECURITY AND THAT AN ASSESSMENT IS PROVIDED.

Related Item

- PI 1256

Submitter Information Verification

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Submittal Date: Sat Aug 24 13:08:05 EDT 2024
Committee: NEC-P13

Public Comment No. 1749-NFPA 70-2024 [New Section after 706.15]

706.16 Connection to Energy Sources.

The connection of an ESS to sources of energy shall comply with 706.16(A) through (B).

(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.

Statement of Problem and Substantiation for Public Comment

Rationale: 706.16 (A) and (B) are unique requirements in the Code. No substantiation in the committee statement was provided for their removal.

Related Item

- PI 3030, 334, 3854, 2062

Submitter Information Verification

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Submittal Date: Mon Aug 26 23:59:50 EDT 2024
Committee: NEC-P13

Public Comment No. 1905-NFPA 70-2024 [Sections 706.15(A), 706.15(B), 706.15(C)]

Sections 706.15(A), 706.15(B), 706.15(C)

(A) 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~~ in accordance with 705.20 and the requirements in this article .

(B) Location and Control.

The disconnecting means shall ~~be readily accessible and shall~~ comply with one or more of the following:

(1) Located within the ESS

(2) Located within sight and within 3 m (10 ft) from the ESS

(3) Where not located within sight of the ESS, the disconnecting means shall be lockable open in accordance with 110.25, or the enclosure providing access to the disconnecting means shall be capable of being locked closed.

Where controls to activate the disconnecting means of an ESS are used and are not located within sight of the ESS, the disconnecting means shall be lockable in accordance with 110.25, and the location of the controls shall be marked on the disconnecting means.

For one- and two-family dwellings, an ESS shall include an emergency shutdown function to cease the export of power from the ESS to premises wiring of other systems. An initiation device(s) shall be located at a readily accessible location outside the building and shall plainly indicate whether in the "off" or "on" position. The "off" position of the device(s) shall perform the ESS emergency shutdown function.

(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 as follows:

“ENERGY STORAGE SYSTEM DISCONNECT”

The disconnecting means shall be legibly marked in the field to indicate the following:

(1) Nominal ESS output 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: See NFPA *70E*-2024, *Standard for Electrical Safety in the Workplace*, for industry practices for equipment labeling. This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, and arc-flash boundaries, as well as minimum required levels of personal protective equipment.

Informational Note No. 2: ESS electronics could include inverters or other types of power conversion equipment.

~~For ESS disconnecting means where the line and load terminals could 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 Comment

Article 705.20 for interconnected source disconnecting means was re-formatted in the 2026 First Draft to facilitate simpler reference by the individual power source articles, and to minimize inconsistency with disconnecting means requirements. This approach allows the power source articles to focus only on requirements specific to the technology or application. Other individual source disconnecting means articles were updated with these changes in mind.

The changes proposed remove redundancies between the first draft of 706.15(A) through (C) and the first draft of 705.20. The 2023 language of 705.20 was also reviewed to confirm that these changes would not leave out requirements if the changes in the first draft of 705.20 are not adopted.

In (A), 705.20 is referenced for requirements and the phrase “from all wiring systems…. “ is deleted as it is covered in the 705.20 lead paragraph.
In (B), “readily accessible” is deleted as it is covered in 705.20(A)
In (C), marking requirements are removed that are covered in 705.20(F) and (G).

Related Item

• FR-8734 • PI 4469 • PI 2942

Submitter Information Verification

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Submittal Date: Tue Aug 27 22:44:01 EDT 2024
Committee: NEC-P13

Public Comment No. 1956-NFPA 70-2024 [Section No. 706.15(B)]

(B) Location and Control.

The disconnecting means shall be readily accessible and shall comply with one or more of the following:

(1) Located within the ESS

(2) Located within sight ~~and within 3 m (10 ft)~~ from the ESS

(3) Where not located within sight of the ESS, the disconnecting means shall be lockable open in accordance with 110.25, or the enclosure providing access to the disconnecting means shall be capable of being locked closed.

Where controls to activate the disconnecting means of an ESS are used and are not located within sight of the ESS, the disconnecting means shall be lockable in accordance with 110.25, and the location of the controls shall be marked on the disconnecting means.

For one- and two-family dwellings, an ESS shall include an emergency shutdown function to cease the export of power from the ESS to premises wiring of other systems. An initiation device(s) shall be located at a readily accessible location outside the building and shall plainly indicate whether in the "off" or "on" position. The "off" position of the device(s) shall perform the ESS emergency shutdown function.

Statement of Problem and Substantiation for Public Comment

Requirements for within sight are outlined in 110.29.

The Solar and Storage Industry Forum (SSIF) is a coalition of individuals and organizations convened by the Solar Energy Industry Association (SEIA) to organize, support, and mentor renewable energy industry professionals in codes and standards development . Our objective is to submit industry consensus-based recommendations for changes to the National Electrical Code. We believe that this effort improves the Code-making process by consolidating multiple industry member's points of view into fewer, common proposals. SSIF members are dedicated to continually improving the installation safety of PV and storage systems in the U.S. A list of members can be found here: https://www.seia.org/industry-forum

Related Item

• FR-8158 • PI-266

Submitter Information Verification

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Submittal Date: Wed Aug 28 12:47:38 EDT 2024
Committee: NEC-P13

Public Comment No. 1906-NFPA 70-2024 [Section No. 706.15(D)]

(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.

<u>Exception: These requirements do not apply to the AC output circuits connecting an energy storage system to premises distribution wiring or equipment.</u>

Statement of Problem and Substantiation for Public Comment

Over 70 large jurisdictions misinterpret this article and require extra disconnects on the AC output circuits of ESS where AC and DC components are fully integrated into a single enclosure. These are the circuits connecting the ESS to the premises distribution panels.

The substantiation history of this article outlines that this requirement was meant to address a safety concern of ESS with multiple discrete components that may be separated from each other by partitions. The original focus was the safety concerns of high dc fault current from a separate battery, but it evolved to consider other components of a multi-component ESS. As noted in the FR from 2020 cited below, these requirements were never intended to be applied to the final output AC circuits connecting to premises wiring.

Text from the Substantiation for Proposal FR-8942-NFPA 70-2018 [2020 NEC Article 706.15(D)]
"…The output circuit from an ESS should be allowed to pass through a wall or be routed as appropriate without any additional requirements not otherwise addressed elsewhere in the Code…When constructing large ESS, equipment may be located in different areas. In other than self-contained ES systems, storage components (i.e. battery) may be installed in rooms or buildings that are separate from other equipment in the ESS. We propose this new language to address this situation…"

<u>Related Item</u>

- PI 3027

Submitter Information Verification

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Submittal Date: Tue Aug 27 22:52:42 EDT 2024
Committee: NEC-P13

Public Comment No. 525-NFPA 70-2024 [Section No. 706.15(E)(2)]

(2) Disconnection of Series Battery Circuits.

Battery circuits exceeding 240 volts dc nominal between conductors or to ground 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 if covered in the listing.

Additional Proposed Changes

File Name	Description	Approved
CN_202.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 202 appeared in the First Draft Report on First Revision No. 8171.

The requirements for “non-load-break bolted or plug-in disconnects” in the second sentence should be reviewed for correlation with 706.2.

Related Item

• First Revision No. 8171

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
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City:
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Submittal Date: Tue Jul 30 23:03:11 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 202-NFPA 70-2024 [Section No. 706.15(E)(2)]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Thu May 09 11:12:03 EDT 2024

Committee Statement

Committee Statement: The requirements for "non-load-break bolted or plug-in disconnects" in the second sentence should be reviewed for correlation with 706.2.

First Revision No. 8171-NFPA 70-2024 [Section No. 706.15(E)(2)]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 524-NFPA 70-2024 [Section No. 706.20]

706.20 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 855-2026, *Standard for the Installation of Stationary Energy Storage Systems*, for technology-specific guidance. Not all ESS technologies require ventilation.

Informational Note No. 2: See IEEE 1635-2018/ASHRAE Guideline 21-2018, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*, as a source for design of ventilation of batteries.

(B) 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.

Additional Proposed Changes

File Name	Description	Approved
CN_203.pdf		

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 203 appeared in the First Draft Report on First Revision No. 8164.

The requirements in this section should be reviewed for correlation with 706.2 and 110.3(B).
General requirements contained in Chapters 1 through 4 should not be
repeated in other articles. See NEC Style Manual Section 4.1.1.

Related Item

- First Revision No. 8164

Submitter Information Verification

Submitter Full Name: CC Notes
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Submittal Date: Tue Jul 30 23:01:26 EDT 2024
Committee: NEC-P13

Correlating Committee Note No. 203-NFPA 70-2024 [Section No. 706.20]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Thu May 09 11:13:32 EDT 2024

Committee Statement

Committee Statement: The requirements in this section should be reviewed for correlation with 706.2 and 110.3(B). General requirements contained in Chapters 1 through 4 should not be repeated in other articles. See NEC Style Manual Section 4.1.1.

First Revision No. 8164-NFPA 70-2024 [Section No. 706.20]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 576-NFPA 70-2024 [Section No. 706.30(B)]

(B) Conductor Ampacity.

The ampacity of the output circuit conductors of the ESS(s) connected to the wiring system serving the loads to be serviced by the system shall not be less than the greater of the nameplate(s)-rated circuit current as determined in accordance with 706.30(A)(1) or the rating of the ESS(s) overcurrent protective device(s).

Exception: Fuses used solely for short circuit protection shall not apply.

Statement of Problem and Substantiation for Public Comment

Reasoning - Large BESS containers don't always come with fusing for overload protection - but most come with fuses that provide short circuit protection. These fuses are significantly larger then the calculated nameplate max current output of the BESS or the max nameplate rating of the PCS. Adherence to this code as currently adopted would require significant upsizing of the conductors as essentially the conductors would be required to handle short circuit current and not max nominal current.

Related Item

- FR-8166

Submitter Information Verification

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Submittal Date: Thu Aug 01 11:44:27 EDT 2024
Committee: NEC-P13

Public Comment No. 1995-NFPA 70-2024 [Section No. 706.51]

706.51 Flywheel ESS (FESS).

Flywheel ESS (FESS) using flywheels as the storage mechanism shall also comply with all of the following:

(1) FESS shall ~~not~~

(2) be ~~used for one- or two-family dwelling units.~~

~~Informational Note No. 1: 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, therefore, are not suitable for residential-type applications.~~

(3) ~~FESS shall be~~ provided with bearing monitoring and controls that can identify bearing wear or damage to avoid catastrophic failure.

Informational Note No. 2: The bearing monitoring controls should be evaluated as part of the listing evaluation.

(4) FESS shall be provided with a containment means to contain moving parts that could break from the system upon catastrophic failure.

Informational Note No. 3: The containment means should be evaluated as part of the listing evaluation.

(5) The spin-down time of the FESS shall be provided in the maintenance documentation.

Statement of Problem and Substantiation for Public Comment

This entire section relates to mechanical safety, not electrical safety. Energy storage systems safety is the purview of NFPA 855 which covers non-electrical safety more thoroughly and more accurately than this section. At a minimum, the first item should be removed because it is possible to engineer flywheels that would be safe for residential use if the guidance of NFPA 855 chapter 13 is followed.

Related Item

• PI 3822

Submitter Information Verification

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Submittal Date: Wed Aug 28 14:40:53 EDT 2024
Committee: NEC-P13

Public Comment No. 2064-NFPA 70-2024 [Section No. 708.6]

708.6 ~~Testing and Maintenance~~ Commisioning and Servicing .

(A) Conduct or Witness Test.

The authority having jurisdiction shall conduct or witness a test of the complete system upon installation and periodically afterward.

(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~~ Servicing .

The authority having jurisdiction shall require a documented ~~preventive maintenance~~ servicing program for critical operations power systems.

Informational Note: See NFPA 70B-2023, *Standard for Electrical Equipment Maintenance*, for information concerning maintenance.

(D) ~~Written~~ Record Keeping .

A written record shall be kept of such tests and ~~maintenance~~ servicing and made available to those authorized to design, install, inspect, maintain, and operate the system.

(E) Testing Under Load.

Means for testing all critical power systems during maximum anticipated load conditions shall be provided.

Informational Note: See NFPA 110-2025, *Standard for Emergency and Standby Power Systems*, for information concerning testing and maintenance of emergency power supply systems (EPSSs) that are also applicable to COPS.

Statement of Problem and Substantiation for Public Comment

Revisions are made to correlate with similar requirements in 700.4 and 701.4, with regards to commission, servicing and record keeping.

Related Item

- FR-8218

Submitter Information Verification

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Submittal Date: Wed Aug 28 17:37:36 EDT 2024

Committee: NEC-P13

Public Comment No. 579-NFPA 70-2024 [Section No. 708.6]

708.6 ~~Testing~~ 6 Commissioning and Maintenance.

(A) Conduct or Witness Test.

The authority having jurisdiction shall conduct or witness a test of the complete system upon installation and periodically afterward.

(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 authority having jurisdiction shall require a documented preventive maintenance program for critical operations power systems.

Informational Note: See NFPA 70B-2023, *Standard for Electrical Equipment Maintenance*, for information concerning maintenance.

(D) ~~Written~~ Record Keeping .

A ~~written~~ record shall be kept of such tests and maintenance and made available to those authorized to design, install, inspect, maintain, and operate the system.

(E) Testing Under Load.

Means for testing all critical power systems during maximum anticipated load conditions shall be provided.

Informational Note: See NFPA 110-2025, *Standard for Emergency and Standby Power Systems*, for information concerning testing and maintenance of emergency power supply systems (EPSSs) that are also applicable to COPS.

Statement of Problem and Substantiation for Public Comment

To be consistent with articles 700 and 701, the section title for 708.6 must be changed from “Testing and Maintenance” to “Commissioning and Maintenance”. In addition, the subsection title for (D) must be changed from “Written Record” to “Record Keeping” for the same reason. Finally, we must strike “written” from the text body for consistency with the other sections. It’s also not reasonable (in this digital age) to require written records for all system installations.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 577-NFPA 70-2024 [Section No. 700.4(D)]	

Related Item

- FR 8218

Submitter Information Verification

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Submittal Date: Thu Aug 01 12:07:10 EDT 2024
Committee: NEC-P13

Public Comment No. 1132-NFPA 70-2024 [Section No. 708.6(D)]

(D) Written Record.

A written or digital record shall be kept of such tests and maintenance ~~and made available to those authorized to design, install, inspect, maintain, and operate the system~~ .

Statement of Problem and Substantiation for Public Comment

With the importance of COPS systems, literally critical by definition, making records of testing available to a large number of people is a safety concern. Such records may contain specific information about system settings and redundancies and may expose vulnerabilities in the system. The operators of such systems should have broad discretion to restrict access to this information to protect the security of the system. Inspection, maintenance, and installation can involve a large cohort of people that do not require access to all records related to system testing and maintenance. A digital record is in keeping with common practices. Written is not necessarily understood to encompass digital, and many AHJs currently treat digital records and drawings as distinct from physical, printed records.

Related Item

- FR-8218

Submitter Information Verification

Submitter Full Name:	David Hittinger
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Submittal Date:	Thu Aug 15 21:37:45 EDT 2024
Committee:	NEC-P13

Public Comment No. 1131-NFPA 70-2024 [Section No. 708.7]

708.7 Cybersecurity.

COPS that are connected to a communication network and have the capability to permit control of any portion of the premises COPS shall comply with either of the following:

(1) The ~~ability to control the~~ system ~~is limited to a direct connection through a local nonnetworked interface.~~

~~It is connected through a networked interface complying with one of the following methods:~~

~~The system~~

~~(1) and associated software are identified as being evaluated for cybersecurity.~~

~~(1) A cybersecurity assessment is conducted on the connected system to determine vulnerabilities to cyberattacks.~~

~~The cybersecurity assessment shall be conducted when the system configuration changes and at not more than 5-year intervals.~~

~~Documentation of the evaluation, assessment, and certification shall be made available to those authorized to inspect, operate, and maintain the system.~~

Informational Note No. 1: See ANSI/ISA 62443, Cybersecurity Standards series; UL 2900, Cybersecurity Standards series; or the NIST Framework for Improving Critical infrastructure Cybersecurity, Version 1.1, for assessment requirements.

Informational Note No. 2: Examples of the commissioning certification used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity may require constant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions.

Informational Note No. 4: See NEMA CY 10000 *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Statement of Problem and Substantiation for Public Comment

Nonnetworked systems still present vulnerabilities to cyberattacks carried out through direct access to the system and should not be exempted from the requirements applied to networked systems. Testing on a 5 year schedule is almost certainly insufficient and requiring them may cause necessary assessments to be delayed by providing a false sense of security. The frequency of assessments is best determined by those expert in cybersecurity concerns. Making documentation of any assessments readily available decreases security. Any records should eb tightly controlled and determining who should have access is best determined by experts in cybersecurity.

Related Item

• FR-8219

Submitter Information Verification

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Submittal Date: Thu Aug 15 21:31:43 EDT 2024
Committee: NEC-P13

Public Comment No. 1148-NFPA 70-2024 [Section No. 708.7]

708.7 Cybersecurity.

COPS that are connected to a communication network and have the capability to permit control of any portion of the premises COPS shall comply with either of the following:

(1) The ability to control the system is limited to a direct connection through a local nonnetworked interface.

(2) It is connected through a networked interface complying with one of the following methods:

  (3) The system and associated software are identified as being evaluated for cybersecurity.

  (4) A cybersecurity assessment is conducted on the connected system to determine vulnerabilities to cyberattacks.

The cybersecurity assessment shall be conducted when the system configuration changes and at not more than 5-year intervals.

Documentation of the evaluation, assessment, and certification shall be made available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, Cybersecurity Standards series; UL 2900, Cybersecurity Standards series; or the NIST Framework for Improving Critical infrastructure Cybersecurity, Version 1.1, for assessment requirements.

Informational Note No. 2: Examples of the commissioning certification used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity may require constant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions.

Informational Note No. 4: See NEMA CY ~~10000~~ 70001-2023 *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Statement of Problem and Substantiation for Public Comment

Submitting this Public Comment to fix an incorrect NEMA document number in the Public Input. This NEMA document number matches the one that is now published.

Related Item

• PI 3434 • FR 8219

Submitter Information Verification

Submitter Full Name: Megan Hayes

Organization: NEMA

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City:

State:

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Submittal Date: Fri Aug 16 06:53:44 EDT 2024

Committee: NEC-P13

Public Comment No. 1465-NFPA 70-2024 [Section No. 708.7]

708.7 Cybersecurity.

COPS that are connected to a communication network and have the capability to permit control of any portion of the premises COPS shall comply with either of the following:

(1) The ability to control the system is limited to a direct connection through a local ~~nonnetworked~~ non-networked interface.

(2) It is connected through a networked interface complying with one of the following methods:

(3) The system and associated software are identified as being evaluated for cybersecurity.

(4) A cybersecurity risk assessment is conducted on the connected system to determine vulnerabilities to cyberattacks.

The cybersecurity risk assessment shall be conducted when the system configuration changes and at not more than ~~5~~ 1 -year intervals.

Documentation of the evaluation, assessment, and certification shall be made available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, Cybersecurity Standards series; UL 2900, Cybersecurity Standards series; or the NIST Framework for Improving Critical infrastructure Cybersecurity, Version 1.1, for assessment requirements.

Informational Note No. 2: Examples of the commissioning certification used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity may require constant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions.

Informational Note No. 4: See NEMA CY 10000 *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Statement of Problem and Substantiation for Public Comment

This public comment is submitted on behalf of the NFPA Cybersecurity Advisory Committee.

This comment adds the word "risk" in front of the word "assessment" (and seeks to change the frequency of the assessment). However, Terra has shown two parts (a) & (b) as new text. This is not correct as only one word was added in this area.

A “cybersecurity assessment” is a vague requirement, where as a “cybersecurity risk assessment” is a defined, established, and recognized process in the cybersecurity industry. This PC seeks to add specificity, by using a term that aligns with industry standards and practices. The frequency of the cybersecurity risk assessment is revised to 1 year to align with industry practices such associated with UL 2900 and Payment Card Industry Data Security Standard (PCI DSS), which require yearly certification. Another example, Cloud Security Alliance Common Control Matrix (CSA-CCM) requires annual audits and assurance assessments.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1464-NFPA 70-2024 [Section No. 240.6(D)]	Similar Proposal
Public Comment No. 1464-NFPA 70-2024 [Section No. 240.6(D)]	

Related Item

• PI-4139 • FR-8219

Submitter Information Verification

Submitter Full Name: Michael Pallett
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Submittal Date: Fri Aug 23 09:39:48 EDT 2024
Committee: NEC-P13

Public Comment No. 1544-NFPA 70-2024 [Section No. 708.7]

708.7 Cybersecurity.

COPS that are connected to a communication network and have the capability to permit control of any portion of the premises COPS shall comply with either of the following:

(1) The ability to control the system is limited to a direct connection through a local nonnetworked interface.

(2) It is connected through a networked interface complying with one of the following methods:

(3) <u>The system and associated software are identified as being evaluated for cybersecurity.</u>

(4) <u>A cybersecurity assessment is conducted on the connected system to determine vulnerabilities to cyberattacks.</u>

~~The cybersecurity assessment shall be conducted when the system configuration changes and at not more than 5-year intervals.~~

Documentation of the evaluation, assessment, and certification shall be made available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, Cybersecurity Standards series; UL 2900, Cybersecurity Standards series; or the NIST Framework for Improving Critical infrastructure Cybersecurity, Version 1.1, for assessment requirements.

Informational Note No. 2: Examples of the commissioning certification used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity may require constant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions.

Informational Note No. 4: See NEMA CY 10000 *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure*, for recommendations on how to meet this requirement.

Statement of Problem and Substantiation for Public Comment

PI 4136 resulted in FR 8219. The committee statement stated "The removal of system changes and 5 year interval allows the user to conduct adequately timed assessments according to their needs." which implies my proposal to strike the 5 year interval language was accepted, but the FR does not reflect this. This may have been a clerical error, but I am submitting this PC to allow the panel to address this issue. My substantiation has not changed since I authored PI 4136 and it appears as though my reasoning was accepted by the panel at the First Draft.

Related Item

• PI 4136 • FR 8219

Submitter Information Verification

Submitter Full Name: Jason Potterf
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Affiliation: ESTA
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City:
State:
Zip:

Submittal Date: Fri Aug 23 17:23:13 EDT 2024
Committee: NEC-P13

Public Comment No. 1591-NFPA 70-2024 [Section No. 708.7]

708.7 Cybersecurity.

COPS that are connected to a communication network and have the capability to permit control of any portion of the premises COPS shall comply with either of the following:

(1) The ability to control the system is limited to a direct connection through a local nonnetworked interface.

(2) It is connected through a networked interface complying with ~~one~~ both of the following methods:

(3) The system and associated software are identified as being evaluated for cybersecurity.

(4) A cybersecurity assessment is conducted on the connected system to determine vulnerabilities to cyberattacks.

~~The cybersecurity assessment shall be conducted when the system configuration changes and at not more than 5-year intervals.~~

Documentation of the evaluation, assessment, and certification shall be made available to those authorized to inspect, operate, and maintain the system.

Informational Note No. 1: See ANSI/ISA 62443, Cybersecurity Standards series; UL 2900, Cybersecurity Standards series; or the NIST Framework for Improving Critical infrastructure Cybersecurity, Version 1.1, for assessment requirements.

Informational Note No. 2: Examples of the commissioning certification used to demonstrate the system has been investigated for cybersecurity vulnerabilities could be one of the following:

(1) The ISA Security Compliance Institute (ISCI) conformity assessment program

(2) Certification of compliance by a nationally recognized test laboratory

(3) Manufacturer certification for the specific type and brand of system provided

Informational Note No. 3: Cybersecurity may require constant attention to security vulnerabilities that could arise due to software defects, system configuration changes, or user interactions.

Informational Note No. 4: See NEMA CY 10000 *Cybersecurity Implementation Guidance for Connected Electrical Infrastructure* , for recommendations on how to meet this requirement.

Statement of Problem and Substantiation for Public Comment

Let's review the Code Making Panel Statement to resolve Public Input 1241, one sentence at a time.

The first sentence of the Panel Statement is "The removal of manufacturer certification has not been adequately substantiated". It is addressed in this Public Comment by keeping the manufacturer certification. Manufacturer certification remains in (3).

The second sentence of the Panel Statement is "Evaluation, assessment, and certification support compliance with the definition of identification in Article 100". One can't argue with this Panel Statement as it is also supported by this Public Comment.

EXISTING REQUIREMENTS HAVE NO TEETH. They allow for the installation to be vulnerable to cyber hacking by simply performing an assessment. That assessment, unfortunately, could actually show the system to be vulnerable to cyber attack. This Public Input removes that vulnerability. It requires a critical operations power system to be both "identified" for cybersecurity and for an "assessment" to be completed.

Why is it so important to require actual cybersecurity protection? Because, if the system is not protected, a hacker could easily destroy equipment or shut down the entire facility. A CYBERSECURITY ASSESSMENT, MEETING THE REQUIREMENTS OF 708.7, SHOWING AN UNPROTECTED SYSTEM, THAT SITS IN THE PLANT ENGINEER'S DESK DRAWER, WILL NOT PREVENT EQUIPMENT FROM BEING DESTROYED OR AN UNPLANNED BLACKOUT OF THE ENTIRE FACILITY.

The 5-year assessment is removed because, as is noted in new Informational Note No. 3 "Cybersecurity may require constant attention to security vulnerabilities".

Most of the cybersecurity focus has been on IT systems. There has been very little public discussion about cybersecurity for Operational Technology (OT), but cyber attacks on OT occur on almost a daily basis. For an example of just how common cyber attacks on life safety related infrastructure have become, let's look at just the water supply and waste water treatment industry. The DNI (Director of National Intelligence), through the CTIIC (Cyber Threat Intelligence Integration Center) recently released a report of 12 cyber attacks on the industrial control systems of water utilities, water systems, and waste water treatment systems, for the six-month period from November 2023 through April 2024. This report can be found at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.dni.gov/files/CTIIC/documents/products/Recent_Cyber_Attacks_on_US_Infrastructure_Underscore_Vulnerability_of_Crit June2024.pdf&ved=2ahUKEwi5gP7-m4eIAxUakYkEHasyIRQQFnoECB8QAQ&usg=AOvVaw3hJL2DMlRs-CECfmewcXVP

While this example covered attacks on industrial control systems, successful attacks can occur on all electrical equipment that is continuously connected to the internet and even equipment that is only connected to the internet during system updates. (Cyber attacks can lay quiet for years, waiting for an update, and then do their intended damage during the update.)

Hackers can easily destroy unprotected equipment and shut down entire unprotected facilities. Our adversaries are continuously mounting cyber attacks on our life safety-related infrastructure. We have the ability, and obligation, to prevent this type of damage to our infrastructure from malicious cyber attacks.

THIS PUBLIC COMMENT SIMPLY REQUIRES THAT CRITICAL OPERATIONS POWER SYSTEMS EITHER NOT BE CONNECTED TO THE INTERNET, OR IF THEY ARE CONNECTED TO THE INTERNET, THAT THEY BE "IDENTIFIED" FOR CYBERSECURITY AND THAT AN ASSESSMENT IS PROVIDED.

Related Item

• PI 1241

Submitter Information Verification

Submitter Full Name: Vincent Saporita
Organization: Saporita Consulting
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City:
State:
Zip:
Submittal Date: Sat Aug 24 13:13:43 EDT 2024
Committee: NEC-P13

Public Comment No. 1604-NFPA 70-2024 [Section No. 708.10(C)(1)]

(1) Protection Against Physical Damage.

The wiring of the COPS system shall be protected against physical damage. Only the following wiring methods shall be permitted:

(1) Rigid metal conduit, intermediate metal conduit ~~, Type MI, or non-interlocked Type MC~~ or Type MI cable

(2) Where encased in not less than 50 mm (2 in.) of concrete, any of the following wiring methods:

- (3) Schedule 40 or Schedule 80 rigid polyvinyl chloride conduit (PVC)
- (4) Reinforced thermosetting resin conduit (RTRC)
- (5) Electrical metallic tubing (EMT)
- (6) Flexible nonmetallic or jacketed metallic raceways
- (7) Jacketed metallic cable assemblies listed for installation in concrete

(8) Where provisions must be made for flexibility at equipment connection, one or more of the following:

- (9) Flexible metal fittings
- (10) Flexible metal conduit with listed fittings
- (11) Liquidtight flexible metal conduit with listed fittings

Statement of Problem and Substantiation for Public Comment

The inclusion of MC cable in this section is based on the fact that the Product Safety Standard (which is not really a standard, but an Outline of Investigation) for MI cable does not have a crush test requirement. This is true, but that is a flaw in the Outline, not reason to create new allowances in the NEC.
Did the submitter provide any data that shows that non-interlocking MC cable is equitable to MI cable in this regard? The substantiation insinuates that it is, but where is the testing?

Related Item

- FR 8213

Submitter Information Verification

Submitter Full Name: Ryan Jackson
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Affiliation: Steel Tube Institute
Street Address:
City:
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Zip:

Submittal Date: Sat Aug 24 13:50:38 EDT 2024
Committee: NEC-P13

Public Comment No. 1635-NFPA 70-2024 [Section No. 708.10(C)(1)]

(1) Protection Against Physical Damage.

The wiring of the COPS system shall be protected against physical damage. Only the following wiring methods shall be permitted:

(1) Rigid metal conduit, intermediate metal conduit, Type MI, or non-interlocked Type MC cable

(2) Where encased ~~in not less than~~ by a minimum cover of 50 mm (2 in.) of concrete, any of the following wiring methods shall be permitted :

- (3) Schedule 40 or Schedule 80 rigid polyvinyl chloride conduit (PVC)
- (4) Reinforced thermosetting resin conduit (RTRC)
- (5) Electrical metallic tubing (EMT)
- (6) Flexible nonmetallic or jacketed metallic raceways
- (7) Jacketed metallic cable assemblies listed for installation in concrete

(8) Where provisions must be made for flexibility at equipment connection, one or more of the following shall be permitted :

- (9) Flexible metal fittings
- (10) Flexible metal conduit with listed fittings
- (11) Liquidtight flexible metal conduit with listed fittings

Statement of Problem and Substantiation for Public Comment

The permissive rule language "shall be permitted" should remain in these requirements at 708.10(C)(1)(2)and(3).
As per 90.5(B) the term "shall be permitted" describes options or alternative methods which is what this requirement is allowing, in the choice of different options for wiring methods.

Second addition in this PC is to add "minimum cover" for encasing the wiring methods that are listed, in concrete. As stated in the current language it is not clear that the wiring method needs at least 2 inches of cover or just buried in 2 inch thick concrete.
Note Terra underlined all of the list items, while no changes were made there.

Related Item

• PI-3794 • FR-8213

Submitter Information Verification

Submitter Full Name: Darryl Hill
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Submittal Date: Sun Aug 25 20:16:13 EDT 2024
Committee: NEC-P13

Public Comment No. 1061-NFPA 70-2024 [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 No. 1: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system, by establishing a rating when tested. 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 a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 3: 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 concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or ~~raceway~~ raceway that has been evaluated by a licensed professional engineer to provide a 2-hour fire rating .

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

Informational Note No. 4: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.

Additional Proposed Changes

File Name	Description	Approved
CONCRETE_VOLUME_ESTIMATE.pdf	Concrete Volumes Estimate	

Statement of Problem and Substantiation for Public Comment

The 2" requirement for concrete has been working and installers are familiar with the associated technical challenges. The increase to a 5" requirement adds 4x the volume of concrete and associated weight within the structure. A concrete element of that volume needs structural evaluation to ensure there is not an increased risk of structural failure due to the addition of the concrete. If not evaluated, this creates a enhanced risk of structural failures. If a structural evaluation will be needed in either case, add that new requirement to the existing 2" encasement standard. This addresses the risk of improper thermal protection of this critical infrastructure during a fire, while not creating a new risk of overloaded structural installations and the corresponding risk to the electrical infrastructure.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1059-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1060-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1055-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1055-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1059-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1060-NFPA 70-2024 [Section No. 700.10(D)(2)]	

Related Item

- FR 8080

Submitter Information Verification

Submitter Full Name: Samuel Fopma
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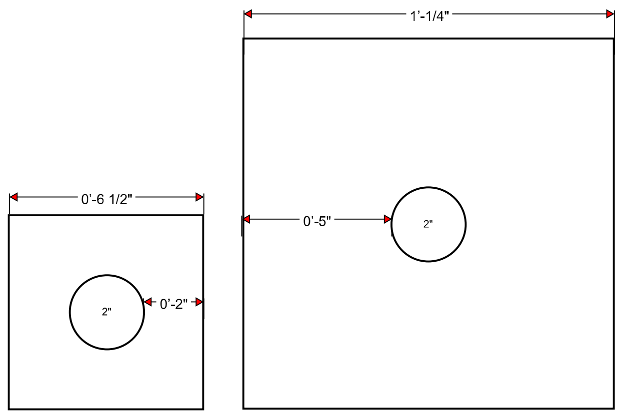
Submittal Date: Tue Aug 13 12:05:02 EDT 2024
Committee: NEC-P13



2" encasement around 2" conduit

42 sq in total area
conduit is 5 sq inches
volume of concrete = 37 sq in

5" encasement around 2" conduit

154 sq in total area
conduit is 5 sq inches
volume of concrete = 149 sq in

the 5" requirement is 149sqin of concrete over 37sqin - that corresponds to a 4X increase in concrete volume necessary to meet the requirements

Public Comment No. 1602-NFPA 70-2024 [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 No. 1: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system, by establishing a rating when tested. 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 a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 3: 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 concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

~~Informational Note No. 4: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

Statement of Problem and Substantiation for Public Comment

Although difficult to see in Terraview, this comment seeks to remove the added Informational Note and reverse the requirement for concrete encasement from 5" back to 2".
The substantiation is based on a report that was obviously not peer reviewed, nor did it contain any test data. In fact, the last line of the reprt states "More research in the form of modeling or experimental testing may be necessary, if further substantiation is required." This "research" report is not research at all, it is a literature review of various online sources.

The very first paragraph of this report should cause the reader to raise an eybrow and question its veracity. It reads: "Different codes and standards have been developed in order to ensure the safety of
buildings and their occupants. The National Electric [sic] Code (NEC) provides the requirements and parameters for electrical equipment. Within the NEC, fire safety and protection is referenced in many sections. In terms of fire protection equipment, such as fire pumps and emergency systems, the electrical feeder associated with these systems needs to be protected from the thermal effects of fire. The 2017 edition of the National Electric [sic] Code (NEC) allows conductors to be installed under 2-inches of concrete to provide this thermal protection. This is stated in several places including sections in Articles 230, 695, 700, and 708. This is intended to provide a 2 hour fire rating equivalent to locating the conductor outside of the building.

Not only does the author (shockingly) not know the name of the National Electrical Code, the author is incorrect in their assumptions. The concrete encasement contemplated in Article 230 was never to protect the conductors from a fire within the building , they are to protect the building from a FIRE CREATED FROM the conductors! This is why the requirement for a disconnect at the point of entrance has been in the NEC since its creation in 1897. In fact, that concept predates the NEC itself and goes back to at least October 19th, 1881 in a meeting of the New York Board of Fire Underwriters. We want service conductors (the target of Article 230) outside of the building because their ground-fault and short-circuit protection far exceeds that allowed by the NEC, and there is no way to manually disconnect them. The requirement in Article 230 has nothing to do with this issue.
The author of the "research" paper is somewhat correct, however, when they refer to Articles 695, 700, and 708. Those articles do indeed provide protection requirements to protect the conductors, however, they were never intended to provide a particular fire-resistance rating (be it one hour, two hours, or any other number). This can be verified by a quick review of those sections prior to the 2017 NEC. Those editions indicated that 2" of concrete was sufficient. That was changed in 2017, however, although no testing was performed and no data was submitted. As indicated in the negative votes, the practice of having 2" concrete encasement is decades old (my books only go back to the 1950s, and it was in the NEC at that time) and has an impeccable track record. There are still no documented problems from having these conductors encased in 2" of concrete, as, once gain, expressed in the negative voting to the 2026 public input.
There was a time when a change like this would have been laughed out of the room if it was not accompanied by testing data. Did the submitted ever test the temperature of conductors inside of a raceway subjected to the ASTM E119 test? If so, where are the results? This is reminiscant of the rooftop temperature adder that was added to Article 310 back in 2011. It was added as a result of bad science and it took good science to undo it. Why is this committee willing to make the same mistake? A change like this should be driven by good science, not a poorly written literature review like the one that this change is based on (and that is being considered for inclusion as an Informational Note).

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1578-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1600-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1601-NFPA 70-2024 [Section No. 700.10(D)(2)]	

Related Item

- FR 8080

Submitter Information Verification

Submitter Full Name: Ryan Jackson
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Affiliation: Steel Tube Institute
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City:
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Zip:

Submittal Date:	Sat Aug 24 13:47:00 EDT 2024
Committee:	NEC-P13

Public Comment No. 1835-NFPA 70-2024 [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 No. 1: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system, by establishing a rating when tested. 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 a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 3: 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 ~~concrete with~~ a minimum ~~thickness~~ of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) ~~measured from each point on the surface~~ of ~~the cable or raceway.~~

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~Exception No. 2: Alternative thicknesses of~~

(1) concrete

~~shall be permitted to be selected by a licensed professional engineer qualified in such design~~

(1) .

~~The selection shall be documented and stamped by the professional engineer.~~

(1)

~~Informational Note No. 4: See Fire Protection Research Foundation Report FPRF-2018-16, "Fire Resistance of Concrete for Electrical Conductors," for information about concrete fire resistance.~~

Additional Proposed Changes

File Name	Description	Approved
Public_Comment_Attachment_for_NEC_695.7_A_2_1_FR-8063_695.14_F_1_FR-8065_700.10_D_2_5_FR-8078_and_708.10_C_2_4_FR-8080_.pdf		

Statement of Problem and Substantiation for Public Comment

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 Fire Resistance of Concrete for Electrical Conductors (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used "because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours" and by "making the requirement 5 inches you remove the need to specify the type of concrete to use". The author's conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author's conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment). In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.

The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the "heat transmission" end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.

The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, “Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture,” and PCA Publication T-140, Fire Resistance of Reinforced Concrete Floors.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the “fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)”. Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.

The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between “a 2-hour fire resistance rating of a structural member, such as a wall” and “a 2-hour fire rating of an electrical circuit, such as a conduit with wires”. Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1818-NFPA 70-2024 [Section No. 695.7(A)(2)]	Identical comment
Public Comment No. 1829-NFPA 70-2024 [Section No. 695.14(F)]	Identical comment
Public Comment No. 1832-NFPA 70-2024 [Section No. 700.10(D)(2)]	Identical comment

Related Item

• FR-8063 • FR-8065 • FR-8078 • FR-8080

Submitter Information Verification

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Committee: NEC-P13

Public Comment Attachment for NEC 695.7(A)(2)(1) [FR-8063], 695.14(F)(1) [FR-8065], 700.10(D)(2)(5) [FR-8078], and 708.10(C)(2)(4) [FR-8080]:

Summary:

This comment does not intend to justify or support the current prescriptive minimum covering depth requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of the IBC fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Context:

The proposed changes to NEC 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. cites Fire Protection Research Foundation (FPRF) FPRF-2018-16 *Fire Resistance of Concrete for Electrical Conductors* (report) as a basis for the code change. However, the referenced report does not accurately apply the intentions of fire-resistance ratings of construction elements in the IBC as described or depicted in the literature review published by FPRF.

The report references IBC Table 722.2.1.1 – *Minimum Thickness of Cast-in-Place or Precast Concrete Walls, Load-Bearing or Non-Load-Bearing* as a basis for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. The minimum slab thickness for siliceous concrete to achieve a 2-hour fire-resistance rating is tabulated as 5.0 inches, which is the highest value of any listed concrete type to achieve a 2-hour fire-resistance rating in the table. The FPRF report claims that the 5-in. value should be used “because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours” and by “making the requirement 5 inches you remove the need to specify the type of concrete to use”. The author’s conclusion is that increasing the minimum thickness of encasement to 5 in. would achieve the 2 hours of fire-resistance rating for every concrete type at the 5-in. minimum thickness. However, the basis for which this conclusion was made is founded on the incorrect application of the calculated fire resistance rating tables from the International Building Code. Table 722.2.1.1 is not intended to apply in the context of encasement of power and control wiring. Therefore, the foundation of the author’s conclusion is fundamentally flawed.

First, the ICC Commentary for IBC Table 722.2.1.1 states the following:

> Although there have been few fire tests of concrete walls (other than concrete masonry), there have been many fire tests of concrete slabs tested as floors or roofs. <u>Fire tests of floors or roofs are considered to be more severe than those of walls because of the loading</u>

conditions (tension cracks associated with bending moment). In addition, most ASTM E119 or UL 263 fire tests of floor assemblies have been conducted while the assembly was supported within restraining frames. As concrete assemblies are heated and expanded, the expansion is resisted by the restraining frame. These restraining forces are usually much greater than the superimposed loads supported by load-bearing walls. Thus, floor or roof assemblies are subjected to both vertical superimposed loads and horizontal restraining loads during fire tests. By contrast, load-bearing walls are subjected only to superimposed loads.

> The fire endurance of masonry or concrete walls is nearly always governed by the ASTM E119 or UL 263 criteria for temperature rise of the unexposed surface (i.e., the "heat transmission" end point). For flat concrete slabs or panels, the heat transmission fire endurance depends primarily on the aggregate type and thickness and is essentially the same for floors as it is for walls.
>
> The data in Table 722.2.1.1 were derived from Portland Cement Association (PCA) Bulletin 223, "Fire Endurances of Concrete Slabs as Influenced by Thickness, Aggregate Type, and Moisture," and PCA Publication T-140, *Fire Resistance of Reinforced Concrete Floors*.

In summary, the values in IBC Table 722.2.1.1, for walls, are identical to those in IBC Table 722.2.2.1, which gives the minimum thickness for reinforced and prestressed concrete floors/roofs. The commentary language above notes that the same values are used for walls as for floors/roofs as it is acknowledged that the "fire tests of floors or roofs are considered to be more severe than those of walls because of the loading conditions (tension cracks associated with bending moment)". Thus, the values presented in the referenced IBC Table 722.2.1.1 are inherently conservative for walls and may not be appropriately applied in the context of minimum thickness of power and control wiring encasement in concrete, which is often installed within concrete walls.

Second, the NEC Handbook commentary for Section 695.6(A)(2) states the following:

> Feeder conductors are those that are installed from the load side of the supervised disconnecting means permitted by 695.4(B)(1)(a), (b), or (c). In addition, conductors directly connected to the output of an on-site standby generator are also covered by 695.6(A)(2). Unlike service conductors, feeder conductors are not required to be installed on the outside of a building or structure. However, if the feeder conductors are run through a building, they are required to be protected from damage by fire to ensure that power to the fire pump is not interrupted.
>
> The difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall, is that at the end of a 2-hour fire test on an electrical conduit with wires, the circuit must function electrically (no short circuits, grounds, or opens are permitted) and its insulation must be intact. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, without regard to damage to the wall. All fire ratings and fire

resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the effects of the fire.

From this commentary, it is evident that the NEC acknowledges that there is a distinct difference between “a 2-hour fire resistance rating of a structural member, such as a wall” and “a 2-hour fire rating of an electrical circuit, such as a conduit with wires”. Thus, the application of IBC Table 722.2.1.1 for purposes of determining the requirements for minimum thickness of power and control wiring encasement in concrete, as desired by the proposed change, is applied out of context.

In conclusion, the proposed changes to 695.7(A)(2)(1), 695.14(F)(1), 700.10(D)(2)(5), 708.10(C)(2)(4), and any other similar instances for increasing the minimum thickness of concrete encasement for power/control wiring of fire protection systems or critical operations power systems (COPS) from 2 in. to 5 in. is not substantiated by a solid technical basis, applicable research data, or real-world examples of failures utilizing the current requirements.

This comment does not intend to justify or support the current requirements, however, it solely seeks to question the technical basis presented by the proposed code revision and argue that the basis for which the proposed code change is presented is fundamentally flawed and incorrectly applied to this application. The FPRF report states a conclusion, cited as the primary justification for the proposed change, that is rooted in misapplication of fire resistance tables and without any research or testing data to further demonstrate the inadequacy of the current 2-inch requirement or the adequacy of the proposed 5-inch requirement.

Typical FPRF reports are set up with a document review, gap analysis, and work plan; this specific report provides a document review, gap analysis, and a conclusion based on conservative utilization of tables that have, in themselves, not been previously justified based on a technical basis. Our recommendation is to perform further technical research regarding this matter rather than increase the minimum thickness of concrete encasement to 2.5 times the current value, which can have a significant impact to projects in multiple ways, without technical cause.

Public Comment No. 1838-NFPA 70-2024 [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 No. 1: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system, by establishing a rating when tested. 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 a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 3: 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 concrete with a minimum thickness of 127 mm (5 in.) measured from each point on the surface of the cable or raceway.

Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.

Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.

Informational Note No. 4: See Fire Protection Research Foundation Report FPRF-2018-16, “Fire Resistance of Concrete for Electrical Conductors,” for information about concrete fire resistance.

Statement of Problem and Substantiation for Public Comment

There wasn't any technical substantiation or results of subsequent testing provided by the submitter of the public input to justify the increase of the concrete encasement from 2 (two) inches to 5 (five) inches. ASTM E119 deals with testing of structural building components such as the following information: Giving a structure a fire rating is quite simple: in the case that a material maintains structural integrity for 30 minutes, it will have a fire rating of 30 minutes; or, if the structure lasts for 1 hour, it will have a rating of 1 hour.

The time-temperature curve simply allows engineers to understand the heat capacity for materials over some time, but the specific temperatures are not included as part of the fire rating. In general, structures and materials that last over 1 hour are viewed as being quite reliable.
We are not trying to give the cables or raceways a fire rating. Before we add such a radical change to fire pump emergency circuit, and critical operation power system circuits in raceways and cables, testing data must be provided for accurate protection. The submitter of the public input even stated that he felt even five inches of concrete may not be enough encapsulation. This change can radically change installation in under-slab installations and in-slab installations in many commercial and industrial installations. Again, without proper technical substantiation. The NEC Panel should not be required to guess at whether this change will provide proper protection but should have the test data provided for this change. We dealt with similar proposed changes a few cycles ago when I was on Panel 3 and Panel 13, again, without proper technical substantiation. A similar proposed change was dealt with at the NFPA Annual Meeting and ultimately was rejected based on the lack of technical substantiation.

Related Item

• FR-8080

Submitter Information Verification

Submitter Full Name: Mark Ode
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Submittal Date: Tue Aug 27 16:30:26 EDT 2024
Committee: NEC-P13

Public Comment No. 1848-NFPA 70-2024 [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 No. 1: See UL 1724, *Fire Tests for Electrical Circuit Protective Systems*, for one method of defining an electrical circuit protective system, by establishing a rating when tested. 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 a listed fire-resistive cable system with a minimum 2-hour fire rating.

Informational Note No. 2: See UL 2196-2017, *Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables*, for testing requirements for fire-resistive cables.

Informational Note No. 3: 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~~ covered in concrete with a minimum thickness of ~~127 mm~~ 50 mm (~~5 in~~ 2 in .) measured from each point on the surface of the cable or raceway.

~~*Exception No. 1: Cables and raceways installed underground shall not be considered to be inside the building.*~~

~~*Exception No. 2: Alternative thicknesses of concrete shall be permitted to be selected by a licensed professional engineer qualified in such design. The selection shall be documented and stamped by the professional engineer.*~~

~~Informational Note No. 4: See Fire Protection Research Foundation Report FPRF-2018-16, “Fire Resistance of Concrete for Electrical Conductors,” for information about concrete fire resistance.~~

Additional Proposed Changes

File Name	Description	Approved
Review_of_FPRF_Report_August_20_2024.pdf	Technical Review of NFPA Research Report - "Fire Resistance of Concrete for Electrical Conductors" - review by Dr. Jeff Packer	

Statement of Problem and Substantiation for Public Comment

These changes that have been proposed would increase the requirement from 2” to 5”, which an increase of 150%. To make a change this drastic to the code, technical substantiation should be provided that is not only robust and conclusive, but also shows actual testing of the use case that is in question. Unfortunately, the public input did not provide this, but instead provides a document that has been inaccurately titled a “research report.”

The NFPA Research Foundation report, “Fire Resistance of Concrete for Electrical Conductors,” does not constitute empirical research and does not provide any actual test results or original research. It would be more accurately titled as a literature review. It lays out goals to provide a literature review, a gap analysis, and a final report. It only accomplishes the first of these goals in any significant way.

The stated purpose of the report was to identify gaps and recommend additional work that needs to be done to fill those gaps. In the end, the authors didn’t identify the gaps in knowledge. Usually, a report like this recommends additional specific research that needs to be done. It does not draw conclusions about code changes. This report takes this leap and draws conclusions without recommending any specific research.

The “Final Report” consists of 1 paragraph where bold statements are provided that are drastic leaps as conclusions related to electrical conductors, given that none of the data in literature review provided any testing of electrical conductors, raceways, or systems. The literature review discusses the fire resistance of requirements of different codes that are for structural members. Structural members are tested for fire resistance with the load it is intended to carry, because this affects the fire resistance rating. The electrical raceways carrying the electrical conductors would not be stressed with a structural load, which means that they would be able to achieve a longer fire resistance rating with a thinner amount of concrete.
The fact that the literature review focuses on structural members under load, should make any conclusions inadmissible to this issue. The one accurate statement that the report does make is found in the final sentence, when it says that “more research in the form of modeling or experimental testing may be necessary, if further substantiation is required.”

To provide an additional opinion on this report and the proposed code changes, I contacted Dr. Jeffrey Packer, PhD, DSC, PEng, of the University of Toronto. Dr. Packer is a widely published professor of engineering and a prolific researcher on structural loading and fire resistance. Dr. Packer provided the attached response to the question of whether the NFPA report “Fire Resistance of Concrete for Electrical Conductors” provided technical support for these code changes. Please carefully consider his response and expert analysis.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1563-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1565-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1847-NFPA 70-2024 [Section No. 695.14(F)]	
Public Comment No. 1563-NFPA 70-2024 [Section No. 695.7(A)(2)]	
Public Comment No. 1565-NFPA 70-2024 [Section No. 700.10(D)(2)]	
Public Comment No. 1847-NFPA 70-2024 [Section No. 695.14(F)]	

Related Item

- FR 8080

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REVIEW of "Fire Resistance of Concrete for Electrical Conductors"

by Caitlyn Peterson, Fire Protection Research Foundation, December 2018

The author does not appear to be an expert on the design of concrete structures for fire resistance, and the investigation is based on articles procured from a web search (likely by keywords). Apart from technical misunderstandings (described below), there are a disconcerting number of English errors indicating that the report was not checked.

It is well-known that the resistance of a concrete member or element, under a standard (e.g. ISO) fire, is a function of a number of parameters: the concrete cover (i.e. insulation); the type of concrete; type of concrete element (i.e. slab, versus column, beam or wall); and reinforcement within (plain, rebar or fiber). The author, however, "discovers" such truisms regarding fire resistance by browsing many documents.

The report is presented as a hodge-podge of "information" all together. For example, considering a 2-hour fire rating, Tables 6 and 7 present the required overall dimensions of a member (3.6 to 5 inches for slabs, 9 to 10 inches for columns), whereas Tables 8 and 9 then present the required minimum cover of a member (0.75 to 1 inch for slabs, 0.75 to 1.25 inches for beams). This confusion between the overall dimension(s) and the concrete cover is inherent throughout this report.

In the "Information Gap Analysis", page 20, the third bullet concludes that … "A 2-inch thickness does not always equate to a 2-hour fire rating". Of course it does not; 2 inches of concrete cover is what is intended. This naivety is reiterated on pages 21 and 23. The relevant clauses from the NEC 2017 Edition Requirements for Feeder Protection are reproduced in Figure 5 (page 21) and the highlighted parts are quite acceptable – except the wording should be improved to be more explicit. Part (d)(1) should state … "The cable or raceway is encased on any side by a minimum of 50 mm (2 in.) of concrete cover."

Changes to the proposed code clauses, reflecting the above, are provided separately. Key is that the word "cover" be explicitly stated, and "encasement" be avoided. With 2 inches of concrete cover, the minimum member (e.g. slab) thickness would be 4 inches + the diameter of the electrical conductor/conduit.

In my opinion, this Peterson/FPRA report does not constitute technical research and does not provide sufficient technical justification to make substantive code changes.

Professor Jeffrey A. Packer, PhD, DSc, PEng
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Public Comment No. 1405-NFPA 70-2024 [Section No. 708.20(E)(5)]

(5) Outdoor Generator Sets.

(a) *Permanently Installed Generators and Portable Generators Greater Than 15 kW.* ~~Where an~~ An outdoor housed generator set ~~is~~ shall be equipped with ~~a readily accessible disconnecting~~ a disconnecting means in accordance with 445.18~~, and~~ . If the disconnecting means is not readily accessible or is not located within sight of the building or structure supplied, an additional disconnecting means ~~shall not be~~ shall 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~~ The disconnecting means shall meet the requirements of 225.36 for voltages not over 1000 V ac, 1500 V dc or 267 . 31(C) for voltages over 1000 V ac, 1500 V dc nominal .

(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 Comment

This public comment is submitted to correlate the requirements in Article 708 with requirements in Articles 700, 701 and 702. This is not a new concept, since similar First Revisions regarding outdoor housed generators and disconnects were processed for Sections 700.12(D)(4) (FR 8176), 701.12(D)(3) (FR 8194) and 702.12(A) (FR 8212).

As written, 708.20(E)(5)(a), the type of disconnecting means shall meet the requirements of 225.36 in all cases. Section 225.36 specifically addresses the type of disconnecting means for voltage not over 1000 V ac, 1500 V dc, but these requirements are not appropriate when the system voltage is over 1000 V ac. This public comment adds a reference to 267.31(C) to properly select the type of disconnecting means for voltages over 1000 V ac, 1500 V dc nominal.

Related Item

- FR8176, FR8194 and FR8212

Submitter Information Verification

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Submittal Date: Thu Aug 22 13:49:39 EDT 2024
Committee: NEC-P13

Public Comment No. 2065-NFPA 70-2024 [Section No. 708.22(A)]

(A) Capacity and Rating.

A COPS shall have capacity and rating for all loads to be operated simultaneously for continuous operation with variable load for an unlimited number of hours, except for required ~~maintenance~~ servicing of the power source. A portable, temporary, or redundant alternate power source shall be available for use whenever the COPS power source is out of service for servicing ~~or maintenance~~ .

Statement of Problem and Substantiation for Public Comment

The term "maintenance" has been replaced with "servicing" and "or maintenance" has been deleted to correlate with the definition of servicing.

Related Item

- FR-77921

Submitter Information Verification

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Submittal Date: Wed Aug 28 17:45:32 EDT 2024
Committee: NEC-P13

Public Comment No. 1207-NFPA 70-2024 [Section No. 708.24(C)]

(C) ~~Redundant Transfer Equipment.~~

~~If COPS loads are supplied by a single feeder, the COPS shall include redundant transfer equipment or a bypass isolation transfer switch~~

Bypass and Isolation .

Means shall be provided to bypass and isolate the transfer equipment to facilitate maintenance as required in 708.6(C) without jeopardizing continuity of power. ~~If the redundant transfer equipment or bypass isolation switch is manual (or nonautomatic~~ Inadvertent parallel operation shall be prevented.

Informational Note: Bypass isolation switches and bypass isolation transfer switches are examples of such means.

If the bypass means is manual (non-automatic), then it shall be actively supervised by a qualified person when the primary (automatic) transfer equipment is disabled for servicing and maintenance. ~~When redundant transfer equipment is used, a means shall be provided to disconnect the transfer switch from all supply side sources. Inadvertent parallel operation shall be prevented.~~

Exception: The requirement for bypass and isolation of the transfer equipment shall not apply where any of the following conditions exist:

1. All processes that rely on the COPS source are capable of being disabled during servicing and maintenance activities without jeopardizing the safety to human life.

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 shall be permitted to be substituted for the COPS.

A written emergency plan that includes mitigation actions and responsibilities for qualified persons to address the recognized site hazards for the duration of the servicing and maintenance or repair activities shall be developed and implemented. The emergency plan shall be made available to the authority having jurisdiction.

Statement of Problem and Substantiation for Public Comment

As written, FR 8215 creates confusion and possibly eliminates the use of bypass isolation switches. The proposed revisions clarify the basic requirement for bypass and isolation and clearly identify the specific requirements for this equipment.

Related Item

- FR8215

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Submittal Date: Sat Aug 17 01:24:15 EDT 2024
Committee: NEC-P13

Public Comment No. 2067-NFPA 70-2024 [Section No. 708.24(C)]

(C) Redundant Transfer Equipment.

If COPS loads are supplied by a single feeder, the COPS shall include redundant transfer equipment or a bypass isolation transfer switch to facilitate maintenance as required in 708.6(C) without jeopardizing continuity of power. If the redundant transfer equipment or bypass isolation switch is manual (or nonautomatic), then it shall be actively supervised by a qualified person when the primary (automatic) transfer equipment is disabled for servicing ~~and maintenance~~ . When redundant transfer equipment is used, a means shall be provided to disconnect the transfer switch from all supply side sources. Inadvertent parallel operation shall be prevented.

Statement of Problem and Substantiation for Public Comment

The term "and maintenance" has been deleted to correlate with the definition of servicing.

Related Item

- FR-8215

Submitter Information Verification

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Public Comment No. 1722-NFPA 70-2024 [Section No. 708.52(A)]

(A) Applicability.

The requirements of 708.52 shall apply to critical operations (including multiple occupancy buildings) with critical operation areas. **Requirements for Ground Fault Protection of Equipment, as specified in 230.95 and 215.10, shall not apply to critical operations (including multiple occupancy buildings) with critical operation areas for either of the following:**

(1) For fused disconnects, where the available fault current, at the fused disconnect, is 10,000 amperes or greater, if the fuses have a clearing time of 0.07 seconds or less at the lower of the calculated minimum available arcing current or 38% of the available fault current, or if the disconnect switch complies with Section 240.67(B)(1), 240.67(B)(3), or 240.67(B)(4), and is set to operate at the lower of the calculated minimum arcing current or 38% of the available fault current, or

(2) For circuit breakers, where the available fault current, at the circuit breaker, is 10,000 amperes or greater, if the circuit breaker complies with Section 240.87(B)(2), 240.87(B)(4),240.87(B)(5), or 240.87(B)(6), and is set to operate at the lower of the calculated minimum arcing current or 38% of the available fault current.

Additional Proposed Changes

File Name	Description	Approved
Figure_1_for_Public_Comment_on_708.52.docx	Figure 1 for Public Comment on 708.52	

Statement of Problem and Substantiation for Public Comment

BACKGROUND:

We can now accurately calculate the minimum three-phase arcing current, and the minimum sustainable line-to-ground arcing current, for a high impedance arcing fault. Knowing these currents, we can determine whether or not the arc energy reduction methods in List Items 1 and 2 will operate at, or below, those calculated values. If they do operate at or below those levels, the equipment damage will be just a small percentage of that allowed by the GFPE requirements of 230.95. This applies to all available fault currents of 10,000 amperes or greater. A requirement (230.95) for ground fault protection of equipment (GFPE) was added to the 1971 NEC® because 480/277 volt, solidly grounded wye services, protected by 1000 ampere and larger overcurrent protective devices, were burning down due to arcing ground faults. 208/120 volt services and those services protected by smaller overcurrent protective devices were not burning down, so they weren't included in the new GFPE requirement. Over many Code cycles, GFPE requirements were also added for branch circuits (210.13), feeders (215.10), and equipment (240.13). In all cases, the intent was to limit, not eliminate, damage to the switchboard, switchgear, panelboard or equipment being supplied by the 1000 ampere and larger overcurrent protective device.

PRESENT DAY:

The electrical industry has evolved considerably since those early GFPE requirements were introduced. In those years, J. R. Dunki-Jacobs, Harris I. Stanback, and R. H. Kaufman authored numerous ground-breaking papers on arcing ground faults and the need for ground fault protection. They accomplished a great deal that has prevented multitudes of equipment burndowns. Their determination that the minimum sustainable line-to-ground arcing fault on a 480/277 volt system was 38% of the available bolted fault current is very close to the values predicted today by IEEE1584-2018.

In recent editions of the NEC®, Sections were added to require the protection of an employee that is exposed to dangerous levels of incident energy while working on energized equipment. To avoid serious injuries, employees, working on or near energized equipment, can only withstand a small fraction of the incident energy to which equipment may be subjected by the allowances of 230.95(A). This substantiation compares the levels of equipment damage allowed by existing 230.95(A) with the levels allowed by the employee arc-flash protection requirements of 240.67 and 240.87. It shows that the equipment damage allowed by the employee arc-flash protection requirements of 240.67 and 240.87 is just a small fraction of that allowed by 230.95(A).

EXAMPLES:

The following example utilizes IEEE 1584-2018 for a 480 volt arcing fault with 32mm equipment spacing, in a 20"x20"x20" box and an HCB configuration (horizontal conductors in a metal enclosure). Equipment damage is described in terms of kW-cycles which is a product of arcing current (kA) X number of arcing cycles (cycles) X arc voltage (100 volts on a 480 system).

Worst Case Equipment Damage with 10 kA Available Fault Current As Allowed by 230.95(A)

The IEEE 1584-2018 minimum arcing current is 6.09kA. Using the maximum 230.95(A) opening time of 60 cycles, the equipment damage is (6.09 kA X 60 cycles X 100 arcing volts) = 36,540 kW-cycles. See Figure 1.

Worst Case Equipment Damage with 10 kA Available Fault Current As Allowed by List Item 1.

The IEEE 1584-2018 minimum arcing current is 6.09kA. Assuming the maximum opening time of 4.2 cycles (0.07 seconds) for 240.67(B), the equipment damage is 6.09 kA X 4.2 cycles X 100 arcing volts) = 2,558 kW-cycles. Assuming an opening time of 7 cycles for 240.67(B)(1) and (B)(3), the equipment damage is (6.09 kA X 7 cycles X 100 arcing volts = 4,263 kW-cycles. Assuming an opening time of 1/2 cycle for 240.67(B)(4), the equipment damage is (6.09 kA X 0.5 cycles X 100 arcing volts) = 305 kW-cycles. Worst-case damage for the minimum arcing current with this exception for fusible switches (4,263 kW-cycles) is less than 12% of the worst-case damage allowed by 230.95(A) (36,540 kW-cycles). See Figure 1.

Worst Case Equipment Damage with 10 kA Available Fault Current As Allowed by List Item 2.

The IEEE 1584-2018 minimum arcing current is 6.09kA. Assuming an opening time of 4 cycles for 240.87(B)(1), (B)(2), or (B)(4), the equipment damage is (6.09 kA X 4.0 cycles X 100 arcing volts) = 2,436 kW-cycles. Assuming an opening time of 3 cycles for 240.87(B)(5) or (B)(6), the equipment damage is (6.09 kA X 3 cycles X 100 arcing volts) = 1,827 kW-cycles. Worst-case damage for the minimum arcing current with this exception for circuit breakers (2,426 KW-Cycles) is less than 7% of the worst-case damage allowed by 230.95(A) (36,540 kW-cycles). See Figure 1.

(Open attached file "Figure 1 for Public Comment on 708.52")

Figure 1

Figure 1 shows that equipment damage allowed by this Public Comment is always, from 10,000 amperes available through 100,000 amperes available, just a small fraction of the equipment damage allowed by 230.95(A).

One might ask whether it is possible that the alternate protective systems in this Public Comment could be set such that they might provide arc energy reduction, but not operate during a lower level arcing ground fault where traditional GFPE will provide protection. That question is answered by the very last lines of the new language for both fusible switches and circuit breakers, as both the fusible switches and circuit breakers must be “set to operate at the lower of the calculated minimum arcing current or 38% of the available fault current.” Since we know the minimum three phase arcing current from IEEE 1584-2018 and the minimum sustainable phase to ground arcing current of 38% of the available fault current, we know whether or not the fusible switch or circuit breaker is set to operate at those values. SO, THERE IS NO MINIMUM VALUE OF ACTUAL ARCING CURRENT THAT COULD BE SO SMALL AS TO BE PICKED UP BY 230.95(A) REQUIREMENTS THAT WOULD NOT ALSO BE SENSED BY THE REQUIREMENTS OF LIST ITEMS 1AND 2.

Let’s look at an example with 10,000 available short-circuit amperes (lowest available fault current for which List Items 1 and 2 could apply). In this case the minimum 1584-2018 three-phase arcing current is 6.09 kA and the minimum sustainable phase-to-ground arcing current is 38% of 10,000 amps = 3.8 kA. Per the requirements of the list items the fusible switch or circuit breaker must be set to operate at the lower of either 6.09 kA or 3.8 kA, so the fusible switch or circuit breaker must operate for arcing currents of 3.8 kA or greater. If a three phase arcing fault occurs it is calculated to be 6.09 kA with the possibility that a single phase to ground arcing fault could be as low as 3.8 kA. In either case, the requirements of List Items 1 and 2 assure that the arcing fault is taken off-line in no more than 7 cycles for List Item 1 and no more than 4 cycles for List Item 2, while 230.95(A) would allow a full 60 cycles.

What happens if the available fault current is less than or even significantly less than 10,000 amperes? Then the List Items 1 and 2 do not apply and GFPE would be required.

Energy reducing maintenance switches (240.67(B)(2) and 240.87(B)(3)) are not included in the exceptions because energy-reducing maintenance switches are typically turned off when a worker is not working on energized equipment, whereas ground fault protection is constantly protecting the equipment, whether or not a worker is working on the energized equipment.

The Approved Equivalent Means, (240.67(B)(5) and 240.87(B)(7)), are excluded because the opening times for these methods are unclear.

KEY BENEFIT:

While GFPE can often be set as low as 200 amperes, because of numerous nuisance GFPE openings, in some cases even for ground faults in 277-volt lighting circuits, it has become common for plant electricians, plant engineers, consulting engineers, and electrical contractors to set GFPE at the maximum allowable 230.95 and 708.52(B) settings. That has solved a portion of the nuisance tripping problem, but even set at the maximum, it is often difficult to selectively coordinate a feeder GFPE with sub-feeder phase overcurrent protective devices of 400 amperes or greater. So, for example, even with a service GFPE set at the 230.95 maximum and a feeder GFPE set at the 708.52(D) maximum, a ground fault on a 400 ampere (or larger) sub-feeder circuit can easily also open the GFPE on the feeder blacking out the entire feeder. With List Items 1 and 2, the GFPE is no longer required on the service, and therefor on the 708.52(B)-required feeders. Or if the service were at medium voltage and a feeder needed GFPE perexisting 215.10, List Items 1 and 2 would no longer require GFPE on the feeder and therefor not on the 708.52(B)-required subfeeders either. The equipment is still protected (even better protected) and the entire feeder is not subjected to a nuisance blackout because of a ground fault on a sub-feeder. The key benefit of this Public Comment is that when these alternate methods are utilized, it provides the consulting engineer or design-build contractor with the ability to provide even better arcing fault protection for the equipment and the ability to much more easily meet the selective coordination requirements of 708.54.

Note that the requirements of 708.52(B) would still require a second level of GFPE on the feeders if GFPE were installed on the service and would still require GFPE on the sub-feeders if GFPE were installed on a feeder per 215.10.

CONCLUSION:

This Public Comment takes advantage of the arc-energy reduction technologies found in 240.67 and 240.87. It provides an alternative to GFPE requirements whenever specific 240.67 and 240.87 methods to reduce arcing fault clearing time are utilized. Arc energy reduction technologies, as detailed in List Items 1and 2, must open in a much faster time than allowed by 230.95(A). Reviewing Figure 1, it becomes obvious that List Items 1 and 2 will limit the equipment’s arcing fault damage to a level that is considerably less than that currently allowed by the requirements found in 230.95(A). Ground fault protection is not needed for faults that are not high impedance arcing faults. If the fault is not arcing, it is a bolted fault, which is safely interrupted by the phase overcurrent device (fuse or circuit breaker). If it is arcing, the limitations in List Items 1 & 2 assure that the arc energy reduction technologies allow less damage than allowed by existing 230.95. Opening “at the lower of the calculated minimum arcing current or 38% of the available fault current” assures that the arc energy reduction technologies open when a potentially damaging arc is initiated. There’s no need for the arc energy reduction technologies to operate unless the fault begins arcing. It should be remembered that this Public Comment does not prohibit Ground-Fault Protection. It simply provides an alternative method of protecting equipment from burndown. If ground fault protection is desired for burndown protection of downstream equipment it can be included with the phase overcurrent device that is protecting that equipment. A key point to remember is that if the downstream equipment is protected with a phase overcurrent protective device (fuse or circuit breaker) at less than 1000 amperes, extensive testing, and field experience, over decades, has shown that the downstream equipment is adequately protected from arcing ground faults by that fuse or circuit breaker. In closing, arc energy reduction technology, in order to protect human flesh (as opposed to copper, aluminum, and steel), must operate much quicker than is allowed in existing 230.95. Doesn’t it just make common sense that arc energy reduction technologies which protect an employee’s skin from third degree burns will also prevent copper, aluminum, and steel from melting?

Related Item

• FR 7565 • PI 1645 • PC 1616 • PI 1641 • PC 1615 • PI 1655 • PC 1617 • PC 1766

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Figure 1

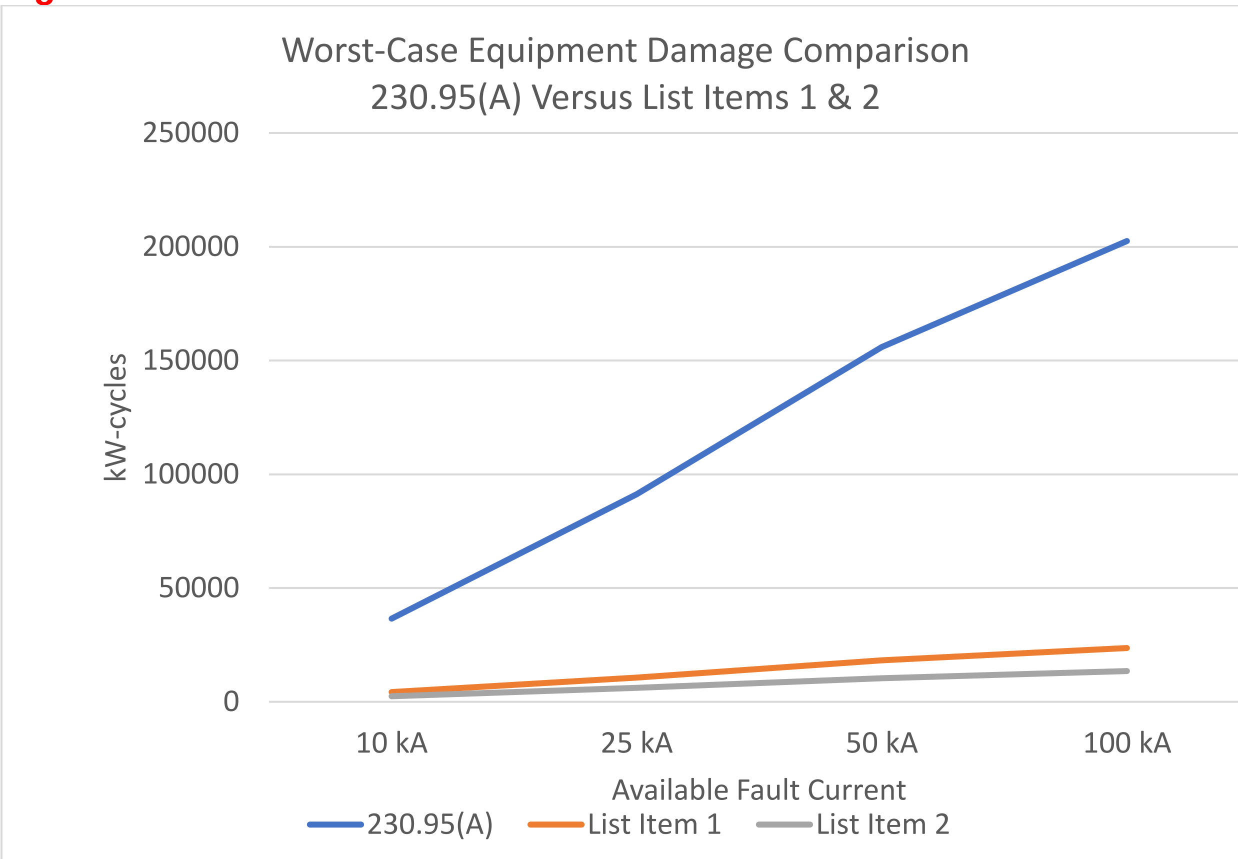

Figure 1 shows that equipment damage allowed by this Public Comment is always, from 10,000 amperes available through 100,000 amperes available, just a small fraction of the equipment damage allowed by 230.95(A).

Public Comment No. 255-NFPA 70-2024 [Section No. A.1]

A.1

Table A.1(a) Product Safety Standards for Conductors and Equipment That Have an Associated Listing Requirement

Article	Standard Number	Standard Title		
110	UL 10C-2016	Positive Pressure Fire Tests of Door Assemblies		
	-	UL 305-2012	Panic Hardware	
	-	UL 486D-2015	Sealed Wire Connector Systems	
	-	UL 2043-2013	Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces	
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations	
130	UL ~~60730-1~~	~~Automatic Electrical Controls~~	916	Energy Management Equipment
	UL 3141	Power Control Systems		
210	UL 498-2017	Attachment Plugs and Receptacles		
	-	UL 935-2001	Fluorescent-Lamp Ballasts	
	-	UL 943-2016	Ground Fault Circuit Interrupters	
	-	UL 1029-1994	High-Intensity-Discharge Lamp Ballasts	
	-	UL 1699-2017	Arc-Fault Circuit-Interrupters	
	-	UL 1699A-2010	Outlet Branch Circuit Outlet Branch Circuit Arc-Fault Circuit-Interrupters	
225	UL 6-2022	Electrical Rigid Metal Conduit — Steel		
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel	
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit	
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings	
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel	
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit	
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings	
230	UL 6-2022	Electrical Rigid Metal Conduit — Steel		
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel	
	-	UL 67-2018	Panelboards	
	-	UL 98-2016	Enclosed and Dead-Front Switches	
	-	UL 218-2015	Fire Pump Controllers	
	-	UL 231-2016	Power Outlets	
-	-	-		
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit	
	-	UL 414-2016	Meter Sockets	
	-	UL 486A-486B-2016	Wire Connectors	
	-	UL 486C-2018	Splicing Wire Connectors	
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures	
	-	UL 508-2018	Industrial Control Equipment	
	-	UL 508A-2018	Industrial Control Panels	
	-	UL 514B-2012	Conduit, Tubing and Cable Fittings	
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings	
	-	UL 845-2021	Motor Control Centers	
	-	UL 857-2009	Busways	
	-	UL 869A-2006	Reference Standard for Service Equipment	
	-	UL 891-2019	Switchboards	
	-	UL 977-2012	Fused Power-Circuit Devices	
	-	UL 1008-2014	Transfer Switch Equipment	
-	-	-		
	-	UL 1008M-2022	Meter-Mounted Transfer Switches	
	-	UL 1008S-2012	Solid-State Transfer Switches	
	-	UL 1053-2015	Ground-Fault Sensing and Relaying Equipment	
	-	UL 1062-1997	Unit Substations	
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures	
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel	
	-	UL 1429-2000	Pullout Switches	
	-	UL 1449-2021	Surge Protective Devices	
	-	UL 1558-2016	Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear	
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit	
	-	UL 1740-2018	Robots and Robotic Equipment	

Article	Standard Number	Standard Title	
	-	UL 1953-2020	Power Distribution Blocks
	-	UL 2011-2022	Machinery
	-	UL 2200-2012	Stationary Engine Generator Assemblies
	-	UL 2416-2015	Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems
	-	UL 2446-2004	Unitary Boiler Room Systems
	-	UL 2565-2013	Industrial Metalworking and Woodworking Machine Tools
	-	UL 2735-2011	Electric Utility Meters
	-	UL 2745-2014	Meter Socket Adapters for Communications Equipment
	-	UL 2876-2022	Remote Racking Devices for Switchgear and Controlgear
	-	UL 4248-1-2022	Fuseholders — Part 1: General Requirements
	-	UL 60947-1-2012	Low-Voltage Switchgear and Controlgear — Part 1: General Rules
	-	UL 61800-5-1-2022	Adjustable Speed Electrical Power Drive Systems — Part 5-1: Safety Requirements — Electrical, Thermal and Energy
240	UL 248-1-2000	Low-Voltage Fuses — Part 1: General Requirements	
	-	UL 248-2-2000	Low-Voltage Fuses — Part 2: Class C Fuses
	-	UL 248-3-2000	Low-Voltage Fuses — Part 2: Class CA and CB Fuses
	-	UL 248-4-2000	Low-Voltage Fuses — Part 4: Class CC Fuses
	-	UL 248-5-2000	Low-Voltage Fuses — Part 5: Class G Fuses
	-	UL 248-6-2000	Low-Voltage Fuses — Part 6: Class H Non-Renewable Fuses
	-	UL 248-8-2011	Low-Voltage Fuses — Part 8: Class J Fuses
	-	UL 248-9-2000	Low-Voltage Fuses — Part 9: Class K Fuses
	-	UL 248-10-2011	Low-Voltage Fuses — Part 10: Class L Fuses
	-	UL 248-11-2011	Low-Voltage Fuses — Part 11: Plug Fuses
	-	UL 248-12-2011	Low-Voltage Fuses — Part 12: Class R Fuses
	-	UL 248-15-2018	Low-Voltage Fuses — Part 15: Class T Fuses
	-	UL 248-17-2018	Low-Voltage Fuses — Part 17: Class CF Fuses
	-	UL 248-18-2022	Low-Voltage Fuses — Part 18: Class CD Fuses
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
	-	UL 489I-2022	Solid State Molded-Case Circuit Breakers
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 1053-2015	Ground-Fault Sensing and Relaying Equipment
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
	-	UL 4248-1-2022	Fuseholders — Part 1: General Requirements
242	UL 1449-2021	Surge Protective Devices	
250	UL 1-2005	Flexible Metal Conduit	
	-	UL 4-2004	Armored Cable
	-	UL 5-2016	Surface Metal Raceways and Fittings
	-	UL 6-2022	Electrical Rigid Metal Conduit — Steel
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 153-2014	Portable Electric Luminaires
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 486A-486B-2018	Wire Connectors
	-	UL 486C-2018	Splicing Wire Connectors
	-	UL 486D-2015	Sealed Wire Connector Systems
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 504-2022	Mineral-Insulated, Metal-Sheathed Cable
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 797-2007	Electrical Metallic Tubing — Steel
	-	UL 797A-2014	Electrical Metallic Tubing — Aluminum
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
	-	UL 1569-2018	Metal-Clad Cables
	-	UL 1652-2006	Flexible Metallic Tubing
300	UL 4-2004	Armored Cable	
	-	UL 44-2018	Thermoset-Insulated Wires and Cables
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 83A-2016	Fluoropolymer Insulated Wire
	-	UL 263-2011	Fire Tests of Building Construction and Materials
	-	UL 504-2022	Mineral-Insulated, Metal-Sheathed Cable
	-	UL 746C-2018	Polymeric Materials — Use in Electrical Equipment Evaluations
	-	UL 1569-2018	Metal-Clad Cable

Article	Standard Number	Standard Title	
	-	UL 1581-2001	Reference Standard for Electrical Wires, Cables, and Flexible Cords
	-	UL 2239-2015	Hardware for Support of Conduit, Tubing and Cable
	-	UL 2556-2021	Wire and Cable Test Methods
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
310	UL 44-2018	Thermoset-Insulated Wires and Cables	
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 83A-2016	Fluoropolymer Insulated Wire
	-	UL 83B	Switchboard and Switchgear Wires and Cables
	-	UL 224-2021	Extruded Insulating Tubing
	-	UL 493-2018	Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables
	-	UL 854-2020	Service-Entrance Cables
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 1441-2021	Coated Electrical Sleeving
	-	UL 1581-2021	Reference Standard for Electrical Wires, Cables, and Flexible Cords
312	UL 50-2015	Enclosures for Electrical Equipment	
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
-	-	-	
	-	UL 2808-2020	Energy Monitoring Equipment
	-	UL 61010-1-2012	Electrical Equipment for Measurement, Control, and Laboratory Use — Part 1: General Requirements
	-	UL 61010-2-030-2018	Electrical Equipment for Measurement, Control, and Laboratory Use — Part 2-030: Particular Requirements for Testing and Measuring Circuits
314	UL 50-2015	Enclosures for Electrical Equipment	
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations
	-	UL 486D-2015	Sealed Wire Connector Systems
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498B-2022	Receptacles with Integral Switching Means
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 514D-2013	Cover Plates for Flush-Mounted Wiring Devices
	-	UL 1953-2020	Power Distribution Blocks
315	ANSI C119.4	Electric Connectors — Connectors for Use between Aluminum-to-Aluminum and Aluminum-to-Copper Conductors Designed for Normal Operation at or Below 93ºC and Copper-to-Copper Conductors Designed for Normal Operation at or Below 100ºC	
	-	IEEE 48	IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
	-	IEEE 386	IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
	-	IEEE 404	IEEE Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV
	-	UL 4-2004	Armored Cable
	-	UL 504-2022	Mineral-Insulated, Metal-Sheathed Cable
	-	UL 1072-2006	Medium Voltage Power Cables
	-	UL 1569-2018	Metal-Clad Cable
320	UL 4-2004	Armored Cable	
	-	UL 44-2018	Thermoset-Insulated Wires and Cables
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 83A-2016	Fluoropolymer Insulated Wire
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 1565-2022	Positioning Devices
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing, and Cable

Article	Standard Number	Standard Title	
322	UL 486A-486B-2018	Wire Connectors	
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 514A-2013	Metallic Outlet Boxes
324	UL 486A-486B-2018	Wire Connectors	
	-	UL 498-2017	Attachment Plugs and Receptacles
330	UL 44-2018	Thermoset-Insulated Wires and Cables	
	-	UL 66-2023	Fixture Wire
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 83A-2016	Fluoropolymer Insulated Wire
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 1565-2022	Positioning Devices
	-	UL 1569-2018	Metal-Clad Cables
	-	UL 2225-2013	Cables and Cable-Fittings For Use In Hazardous (Classified) Locations
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing, and Cable
332	UL 504-2022	Mineral-Insulated, Metal-Sheathed Cable	
	-	UL 514B-2012	Conduit, Tubing and Cable Fittings
334	UL 719-2015	Nonmetallic-Sheathed Cables	
	-	UL 2256-2001	Nonmetallic Sheathed Cable Interconnects
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
335	UL 2250-2017	Instrumentation Tray Cable	
336	UL 514B-2012	Conduit, Tubing, and Cable Fittings	
	-	UL 1277-2018	Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
	-	UL 2225-2013	Cables and Cable-Fittings For Use In Hazardous (Classified) Locations
337	UL 1309A-2020	Cable for Use in Mobile Installations	
338	UL 514B-2012	Conduit, Tubing, and Cable Fittings	
	-	UL 854-2020	Service-Entrance Cables
340	UL 514B-2012	Conduit, Tubing, and Cable Fittings	
	-	UL 493-2018	Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables
342	UL 514B-2012	Conduit, Tubing, and Cable Fittings	
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
344	UL 6-2022	Electrical Rigid Metal Conduit — Steel	
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
348	UL 1-2005	Flexible Metal Conduit	
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
350	UL 360-2013	Liquid-Tight Flexible Steel Conduit	
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
352	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings	
353	UL 651A-2011	Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit	
354	UL 1990-2013	Nonmetallic Underground HDPE Conduit with Conductors	
355	UL 2420-2009	Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings	
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
	-	UL 2515A-2011	Supplemental Requirements for Extra-Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
356	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit	
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
358	UL 514B-2012	Conduit, Tubing, and Cable Fittings	
	-	UL 797-2007	Electrical Metallic Tubing — Steel
	-	UL 797A-2014	Electrical Metallic Tubing — Aluminum and Stainless Steel
360	UL 514B-2012	Conduit, Tubing, and Cable Fittings	
	-	UL 1652-2006	Flexible Metallic Tubing
362	UL 1653-2019	Electrical Nonmetallic Tubing	

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	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
366	UL 870-2016	Wireways, Auxiliary Gutters, and Associated Fittings	
368	UL 509-2015	Bus Drop Cable	
370	ANSI/CSA C22.2 No. 273	Cablebus	
371	UL 1386-2022	Flexible Bus Systems	
	-	UL 1387-2022	Flexible Insulated Bus
374	UL 209-2011	Cellular Metal Floor Raceways and Fittings	
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit
376	UL 870-2016	Wireways, Auxiliary Gutters, and Associated Fittings	
	-	UL 1953-2020	Power Distribution Blocks
378	UL 870-2016	Wireways, Auxiliary Gutters, and Associated Fittings	
382	UL 5A-2015	Nonmetallic Surface Raceways and Fittings	
	-	UL183-2009	Manufactured Wiring Systems
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 498M-2020	Marine Shore Power Inlets
	-	UL 514D-2013	Cover Plates for Flush-Mounted Wiring Devices
	-	UL 746C-2018	Polymeric Materials — Use in Electrical Equipment Evaluations
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 991-2004	Tests for Safety-Related Controls Employing Solid-State Devices
	-	UL 1077-2015	Supplementary Protectors for Use in Electrical Equipment
	-	UL 1699-2017	Arc-Fault Circuit-Interrupters
	-	UL 1998-2013	Software in Programmable Components
384	UL 5B-2004	Strut-Type Channel Raceways and Fittings	
386	UL 5-2016	Surface Metal Raceways and Fittings	
388	UL 5A-2015	Nonmetallic Surface Raceways and Fittings	
392	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations	
393	UL 13-2015	Power-Limited Circuit Cables	
	-	UL 50-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 1310-2018	Class 2 Power Units
	-	UL 2043-2013	Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
	-	UL 2577-2013	Suspended Ceiling Power Grid Systems and Equipment
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
396	UL 1072-2006	Medium-Voltage Power Cables	
404	ANSI/NEMA WD 6–2016	Wiring Devices — Dimensional Specifications	
	-	UL 20-2018	General-Use Snap Switches
	-	UL 98-2016	Enclosed and Dead-Front Switches
	-	UL 98A-2014	Open-Type Switches
	-	UL 363-2011	Knife Switches
	-	UL 489-2016	Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches
	-	UL 773-2016	Plug-In Locking Type Photocontrols for Use with Area Lighting
	-	UL 773A-2016	Nonindustrial Photoelectric Switches for Lighting Control
	-	UL 917-2006	Clock-Operated Switches
	-	UL 977-2012	Fused Power-Circuit Devices
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

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	-	UL 1472-2015	Solid-State Dimming Controls	
	-	UL 1429-2000	Pullout Switches	
	-	UL 60730-1-2016	Automatic Electrical Controls — Part 1: General Requirements	
	-	UL 60730-2-2020	Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches	
	-	UL 60730-2-7-2014	Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches	
406	UL 498-2017	Attachment Plugs and Receptacles		
	-	UL 498B-2022	Receptacles with Integral Switching Means	
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts	
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection	
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts	
	-	UL 498M-2020	Marine Shore Power Inlets	
	-	UL 514A-2013	Metallic Outlet Boxes	
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers	
	-	UL 514D-2013	Cover Plates for Flush-Mounted Wiring Devices	
	-	UL 943-2016	Ground-Fault Circuit-Interrupters	
	-	UL 943B-2017	Appliance Leakage-Current Interrupters	
	-	UL 943C-2012	Special Purpose Ground-Fault Circuit-Interrupters	
	-	UL 970-2020	Retail Fixtures and Merchandising Displays	
	-	UL 1053-2015	Ground-Fault Sensing and Relaying Equipment	
		-	-	See 406.4(D)(8)
	-	UL 1286-2022	Office Furnishings Systems	
	-	UL 1310-2018	Class 2 Power Units	
	-	UL 1682-2017	Plugs, Receptacles, and Cable Connectors, of the Pin and Sleeve Type	
	-	UL 1691-2021	Single Pole Locking-Type Separable Connectors	
	-	UL 1699-2017	Arc-Fault Circuit-Interrupters	
	-	UL 1699A-2010	Outlet Branch Circuit AFCIs	
		-	-	See 406.4(D)(4)(1)
	-	UL 2999-2020	Individual Commercial Office Furnishings	
408	UL 44-2018	Thermoset-Insulated Wires and Cables		
	-	UL 67-2018	Panelboards	
	-	UL 891-2019	Switchboards	
	-	UL 1558-2016	Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear	
409	UL 508-2018	Industrial Control Equipment		
	-	UL 508A-2018	Industrial Control Panels	
410	ANSI/CSA-C22.2 No. 184.2	Solid-State Controls for Lighting Systems (SSCLS)		
	-	UL 153-2014	Portable Electric Luminaires	
	-	UL 496-2017	Lampholders	
	-	UL 498-2017	Attachment Plugs and Receptacles	
	-	UL 498B-2022	Receptacles with Integral Switching Means	
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts	
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection	
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts	
	-	UL 542-2005	Fluorescent Lamp Starters	
	-	UL 588-2015	Seasonal and Holiday Decorative Products	
	-	UL 935-2001	Fluorescent-Lamp Ballasts	
	-	UL 943-2016	Ground-Fault Circuit-Interrupters	
	-	UL 970-2020	Retail Fixtures and Merchandising Displays	
	-	UL 1029-1994	High-Intensity-Discharge Lamp Ballasts	
	-	UL 1029A-2006	Ignitors and Related Auxiliaries for HID Lamp Ballasts	
	-	UL 1574-2004	Track Lighting Systems	
	-	UL 1598-2008	Luminaires	
	-	UL 1598B-2000	Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires, Supplemental Requirements	
	-	UL 1598C-2014	Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits	
	-	UL 1993-2017	Self-Ballasted Lamps and Lamp Adapters	
	-	UL 2388-2017	Flexible Lighting Products	
	-	UL 8750-2015	Light Emitting Diode (LED) Equipment for Use in Lighting Products	

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	-	UL 8752-2012	Organic Light Emitting Diode (OLED) Panels
	-	UL 8753-2013	Field-Replaceable Light Emitting Diode (LED) Light Engines
	-	UL 8754-2013	Holders, Bases and Connectors for Solid-State (LED) Light Engines and Arrays
	-	UL 8800-2019	Horticultural Lighting Equipment and Systems
411	UL 1310-2018	Class 2 Power Units	
	-	UL 1838-2003	Low-Voltage Landscape Lighting Systems
	-	UL 2108-2015	Low-Voltage Lighting Systems
	-	UL 5085-3-2006	Low Voltage Transformers — Part 3: Class 2 and Class 3 Transformers
422	ANSI/CSA-C22.2 No. 339	Hand-held motor-operated electric tools — Safety — Particular requirements for chain beam saws	
	-	UL 22-2008	Amusement and Gaming Machines
	-	UL 73-2011	Motor-Operated Appliances
	-	UL 82-2017	Electric Gardening Appliances
	-	UL 122-2007	Photographic Equipment
	-	UL 141-2011	Garment Finishing Appliances
	-	UL 174-2004	Household Electric Storage Tank Water Heaters
	-	UL 197-2010	Commercial Electric Cooking Appliances
	-	UL 283-2015	Air Fresheners and Deodorizers
	-	UL 399-2017	Drinking Water Coolers
	-	UL 430-2015	Waste Disposers
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 499-2014	Electric Heating Appliances
	-	UL 507-2017	Electric Fans
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 515-2015	Electrical Resistance Trace Heating for Commercial Applications
	-	UL 561-2011	Floor Finishing Machines
	-	UL 574-2003	Electric Oil Heaters
	-	UL 621-2010	Ice Cream Makers
	-	UL 705-2017	Power Ventilators
	-	UL 710B-2011	Recirculating Systems
	-	UL 749-2017	Household Dishwashers
	-	UL 751-2016	Vending Machines
	-	UL 763-2018	Motor-Operated Commercial Food Preparing Machines
	-	UL 778-2016	Motor-Operated Water Pumps
	-	UL 834-2004	Heating, Water Supply, and Power Boilers — Electric
	-	UL 858-2014	Household Electric Ranges
	-	UL 859	Household Electric Personal Grooming Appliances
	-	UL 875-2009	Electric Dry-Bath Heaters
	-	UL 921-2020	Commercial Dishwashers
	-	UL 923-2013	Microwave Cooking Appliances
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 962-2014	Household and Commercial Furnishings
	-	UL 962A-2018	Furniture Power Distribution Units
	-	UL 979-2016	Water Treatment Appliances
	-	UL 982-2019	Motor-Operated Household Food Preparing Machines
	-	UL 987-2011	Stationary and Fixed Electric Tools
	-	UL 1017-2017	Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines
	-	UL 1026-2012	Household Electric Cooking and Food Serving Appliances
	-	UL 1086-2016	Household Trash Compactors
	-	UL 1090-2016	Electric Snow Movers
	-	UL 1206-2003	Electric Commercial Clothes-Washing Equipment
	-	UL 1240-2005	Electric Commercial Clothes-Drying Equipment
	-	UL 1278-2014	Movable and Wall- or Ceiling-Hung Electric Room Heaters
	-	UL 1447-2017	Electric Lawn Mowers
	-	UL 1450-2010	Motor-Operated Air Compressors, Vacuum Pumps, and Painting Equipment
	-	UL 1453-2016	Electric Booster and Commercial Storage Tank Water Heaters
	-	UL 1576-2022	Flashlights and Lanterns

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-	UL 1594-2008	Sewing and Cutting Machines
-	UL 1647-2015	Motor-Operated Massage and Exercise Machines
-	UL 1727-2012	Commercial Electric Personal Grooming Appliances
-	UL 1776-2002	High-Pressure Cleaning Machines
-	UL 2157-2015	Electric Clothes Washing Machines and Extractors
-	UL 2158-2018	Electric Clothes Dryers
-	UL 2565-2013	Industrial Metalworking and Woodworking Machine Tools
-	UL 60335-2-3-2004	Household and Similar Electrical Appliances, Part 2: Particular Requirements for Electric Irons
-	UL 60335-2-8-2018	Household and Similar Electrical Appliances, Part 2: Particular Requirements for Shavers, Hair Clippers, and Similar Appliances
-	UL 60335-2-24-2017	Household and Similar Electrical Appliances, Part 2: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances, and Ice-Makers
-	UL 60335-2-40-2019	Household and Similar Electrical Appliances, Part 2: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers
-	UL 60335-2-67-2017	Household and Similar Electrical Appliances — Safety — Part 2-67: Particular Requirements for Floor Treatment Machines, For Commercial Use
-	UL 60335-2-68-2020	Household and Similar Electrical Appliances — Safety — Part 2-68: Particular Requirements for Spray Extraction Machines, for Commercial Use
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-	UL 60335-2-79-2016	Household and Similar Electrical Appliances — Safety — Part 2-79: Particular Requirements for High Pressure Cleaners and Steam Cleaners
-	UL 60730-2-9-2010	Automatic Electrical Controls; Part 2: Particular Requirements for Temperature Sensing Controls
-	UL 60745-1-2007	Hand-Held Motor-Operated Electric Tools — Safety — Part 1: General Requirements
-	UL 60745-2-1-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-1: Particular Requirements for Drills and Impact Drills
-	UL 60745-2-2-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-2: Particular Requirements for Screwdrivers and Impact Wrenches
-	UL 60745-2-3-2007	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-3: Particular Requirements for Grinders, Polishers, and Disk-Type Sanders
-	UL 60745-2-4-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-4: Particular Requirements for Sanders and Polishers Other Than Disk Type
-	UL 60745-2-5-2012	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-5: Particular Requirements for Circular Saws
-	UL 60745-2-6-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-6: Particular Requirements for Hammers
-	UL 60745-2-8-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-8: Particular Requirements for Shears and Nibblers
-	UL 60745-2-9-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-9: Particular Requirements for Tappers
-	UL 60745-2-11-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-11: Particular Requirements for Reciprocating Saws
-	UL 60745-2-12-2005	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-12: Particular Requirements For Concrete Vibrators
-	UL 60745-2-13-2011	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-13: Particular Requirements For Chain Saws
-	UL 60745-2-14-2004	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-14: Particular Requirements for Planers
-	UL 60745-2-15-2010	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-15: Particular Requirements for Hedge Trimmers
-	UL 60745-2-16-2009	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-16: Particular Requirements for Tackers
-	UL 60745-2-17-2011	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-17: Particular Requirements for Routers and Trimmers
-	UL 60745-2-18-2005	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-18: Particular Requirements For Strapping Tools
-	UL 60745-2-19-2005	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-19: Particular Requirements for Jointers
-	UL 60745-2-20-2005	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-20: Particular Requirements for Band Saws
-	UL 60745-2-21-2005	Hand-Held Motor-Operated Electric Tools — Safety — Part 2-21: Particular Requirements For Drain Cleaners
-	UL 60745-2-22-2012	Hand-Held Motor-Operated electric Tools — Safety — Part 2-22: Particular Requirements for Cut-Off Machines
-	UL 60745-2-23-2013	Hand-Held Motor-Operated electric Tools — Safety — Part 2-23: Particular Requirements for Die Grinders and Small Rotary

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		Tools
-	UL 62841-1-2015	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 1: General Requirements
-	UL 62841-2-1-2018	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-1: Particular Requirements For Hand-Held Drills and Impact Drills
-	UL 62841-2-2-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-2: Particular Requirements For Screwdrivers And Impact Wrenches
-	UL 62841-2-3-2021	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-3: Particular Requirements For Hand-Held Grinders, Polishers, and Disk-Type Sanders
-	UL 62841-2-4-2015	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-4: Particular Requirements For Hand-Held Sanders And Polishers Other Than Disc Type
-	UL 62841-2-5-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-5: Particular Requirements For Hand-Held Circular Saws
-	UL 62841-2-8-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-8: Particular Requirements For Hand-Held Shears and Nibblers
-	UL 62841-2-9-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-9: Particular Requirements For Hand-Held Tappers And Threaders
-	UL 62841-2-10-2017	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-10: Particular Requirements For Hand-Held Mixers
-	UL 62841-2-11-2017	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-11: Particular Requirements for Hand-Held Reciprocating Saws
-	UL 62841-2-14-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-14: Particular Requirements For Hand-Held Planers
-	UL 62841-2-17-2018	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-17: Particular Requirements For Hand-Held Routers
-	UL 62841-2-21-2018	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-21: Particular Requirements For Hand-Held Drain Cleaners
-	UL 62841-3-1-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-1: Particular Requirements For Transportable Table Saws
-	UL 62841-3-4-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-4: Particular Requirements for Transportable Bench Grinders
-	UL 62841-3-6-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-6: Particular Requirements For Transportable Diamond Drills with Liquid System
-	UL 62841-3-9-2021	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-9: Particular Requirements For Transportable Mitre Saws
-	UL 62841-3-10-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-10: Particular Requirements for Transportable Cut-Off Machines
-	UL 62841-3-12-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-12: Particular Requirements for Transportable Threading Machines
-	UL 62841-3-13-2018	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-13: Particular Requirements For Transportable Drills
-	UL 62841-3-14-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-14: Particular Requirements for Transportable Drain Cleaners
-	UL 62841-3-1000-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-1000: Particular Requirements for Transportable Laser Engravers
-	UL 62841-4-1-2020	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 4-1: Particular Requirements for Chain Saws
-	UL 62841-4-2-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 4-2: Particular Requirements for Hedge Trimmers

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	-	UL 62841-4-1000-2020	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 4-1000: Particular Requirements For Utility Machines
424	UL 499-2014	Electric Heating Appliances	
	-	UL 1042-2009	Electric Baseboard Heating Equipment
	-	UL 1673-2010	Electric Space Heating Cables
	-	UL 1693-2010	Electric Radiant Heating Panels and Heating Panel Sets
	-	UL 1995-2015	Heating and Cooling Equipment
	-	UL 1996-2009	Electric Duct Heaters
	-	UL 2021-2015	Fixed and Location-Dedicated Electric Room Heaters
	-	UL 2683-2020	Electric Heating Products for Floor and Ceiling Installation
425	UL 508-2018	Industrial Control Equipment	
	-	UL 2021-2015	Fixed and Location-Dedicated Electric Room Heaters
426	IEEE 515	Testing, Design, Installation and Maintenance of Electrical Resistance Trace Heating for Industrial Applications	
	-	UL 1588-2002	Roof and Gutter De-Icing Cable Units
	-	UL 2049-2006	Residential Pipe Heating Cable
427	IEEE 515	Testing, Design, Installation and Maintenance of Electrical Resistance Trace Heating for Industrial Applications	
	-	UL 515-2015	Electrical Resistance Heat Tracing for Commercial Applications
	-	UL 2049-2006	Residential Pipe Heating Cable
430	UL 4-2004	Armored Cable	
	-	UL 98-2016	Enclosed and Dead-Front Switches
-	-	-	
-	-	-	
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 508-2018	Industrial Control Equipment
	-	UL 705-2017	Power Ventilators
	-	UL 745-1-2007	Portable Electric Tools
	-	UL 845-2021	Motor Control Centers
	-	UL 987-2011	Stationary and Fixed Electric Tools
	-	UL 1004-1-2012	Rotating Electrical Machines — General Requirements
	-	UL 1004-2-2014	Impedance Protected Motors
	-	UL 1004-3-2015	Thermally Protected Motors
	-	UL 1004-6-2012	Servo and Stepper Motors
	-	UL 1004-7-2018	Electronically Protected Motors
	-	UL 1004-8-2013	Inverter Duty Motors
	-	UL 1004-9-2016	Form Wound and Medium Voltage Rotating Electrical Machines
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
	-	UL 1569-2018	Metal Clad Cables
	-	UL 1812-2013	Ducted Heat Recovery Ventilators
	-	UL 1815-2012	Nonducted Heat Recovery Ventilators
	-	UL 2565-2013	Industrial Metalworking and Woodworking Machine Tools
	-	UL 60034-1-2018	Rotating Electrical Machines — Part 1: Rating and Performance
	-	UL 60335-2-40-2019	Household and Similar Electrical Appliances — Part 2: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers
	-	UL 60730-2-22-2017	Automatic Electrical Controls — Part 2: Particular Requirements for Thermal Motor Protectors
	-	UL 60745-1-2007	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 1: General Requirements
	-	UL 60745-2-1-2004	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-1: Particular Requirements For Hand-Held Drills and Impact Drills
	-	UL 60745-2-2-2004	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-2: Particular Requirements For Screwdrivers And Impact Wrenches
	-	UL 60745-2-3-2007	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-3: Particular Requirements For Hand-Held Grinders, Polishers, and Disk-Type Sanders
	-	UL 60745-2-4-2004	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-4:

Article	Standard Number	Standard Title
		Particular Requirements For Hand-Held Sanders And Polishers Other Than Disc Type
-	UL 60745-2-5-2012	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-5: Particular Requirements For Hand-Held Circular Saws
-	UL 60745-2-8-2004	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-8: Particular Requirements For Hand-Held Shears and Nibblers
-	UL 60947-1-2022	Low-Voltage Switchgear and Controlgear — Part 1: General Rules
-	UL 60947-4-1-2022	Low-Voltage Switchgear and Controlgear — Part 4-1: Contactors and Motor-Starters — Electromechanical Contactors and Motor-Starters
-	UL 60947-4-2-2022	Low-Voltage Switchgear and Controlgear — Part 4-2: Contactors and Motor-Starters — AC Semiconductor Motor Controllers and Starters
-	UL 60947-5-1-2022	Low-Voltage Switchgear and Controlgear — Part 5-1: Control Circuit Devices and Switching Elements — Electromechanical Control Circuit Devices
-	UL 60947-5-2-2022	Low-Voltage Switchgear and Controlgear — Part 5-2: Control Circuit Devices and Switching Elements — Proximity Switches
-	UL 61800-5-1-2012	Adjustable Speed Electrical Power Drive Systems — Part 5-1: Safety Requirements — Electrical, Thermal and Energy
-	UL 62841-2-9-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-9: Particular Requirements For Hand-Held Tappers And Threaders
-	UL 62841-2-10-2017	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-10: Particular Requirements For Hand-Held Mixers
-	UL 62841-2-11-2017	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-11: Particular Requirements for Hand-Held Reciprocating Saws
-	UL 62841-2-14-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-14: Particular Requirements For Hand-Held Planers
-	UL 62841-2-17-2018	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-17: Particular Requirements For Hand-Held Routers
-	UL 62841-2-21-2018	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 2-21: Particular Requirements For Hand-Held Drain Cleaners
-	UL 62841-3-1-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-1: Particular Requirements For Transportable Table Saws
-	UL 62841-3-4-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-4: Particular Requirements for Transportable Bench Grinders
-	UL 62841-3-6-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-6: Particular Requirements For Transportable Diamond Drills with Liquid System
-	UL 62841-3-9-2021	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-9: Particular Requirements For Transportable Mitre Saws
-	UL 62841-3-10-2016	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-10: Particular requirements for Transportable Cut-Off Machines
-	UL 62841-3-12-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-12: Particular requirements for Transportable Threading Machines
-	UL 62841-3-13-2018	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-13: Particular Requirements For Transportable Drills
-	UL 62841-3-14-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-14: Particular requirements for Transportable Drain Cleaners
-	UL 62841-3-1000-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 3-1000: Particular Requirements for Transportable Laser Engravers
-	UL 62841-4-1-2020	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 4-1: Particular Requirements for Chain Saws
-	UL 62841-4-2-2019	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 4-2: Particular Requirements for Hedge Trimmers
-	UL 62841-4-1000-2020	Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery — Safety — Part 4-1000: Particular Requirements For Utility Machines
440	UL 98-2016	Enclosed and Dead-Front Switches

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	-	UL 416-1993	Refrigerated Medical Equipment
	-	UL 484-2014	Room Air Conditioners
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 508-2018	Industrial Control Equipment
	-	UL 541-2016	Refrigerated Vending Machines
	-	UL 563-2009	Ice Makers
	-	UL 1429-2000	Pullout Switches
	-	UL 1995-2015	Heating and Cooling Equipment
	-	UL 60335-2-24-2017	Household and Similar Electrical Appliances, Part 2: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers
	-	UL 60335-2-40-2019	Household and Similar Electrical Appliances, Part 2: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers
	-	UL 60335-2-89-2017	Household and Similar Electrical Appliances — Safety — Part 2-89: Particular Requirements for Commercial Refrigerating Appliances with an Incorporated or Remote Refrigerant Unit or Compressor
	-	UL 60947-4-1-2022	Low-Voltage Switchgear and Controlgear — Part 4-1: Contactors and Motor-Starters — Electromechanical Contactors and Motor-Starters
	-	UL 60947-4-2-2022	Low-Voltage Switchgear and Controlgear — Part 4-2: Contactors and Motor-Starters — AC Semiconductor Motor Controllers and Starters
	-	UL 61800-5-1-2012	Adjustable Speed Electrical Power Drive Systems — Part 5-2: Safety Requirements — Functional
445	UL 508-2018	Industrial Control Equipment	
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 943C-2012	Special Purpose Ground-Fault Circuit-Interrupters
	-	UL 1004-4-2018	Electric Generators
	-	UL 1741-2021	Inverters, Converters, Controllers, and Interconnection System Equipment for Use With Distributed Energy Resources
	-	UL 2200-2012	Stationary Engine Generator Assemblies
450	UL 10C-2016	Positive Pressure Fire Tests of Door Assemblies	
	-	UL 305-2012	Panic Hardware
	-	UL 340-2017	Tests for Comparative Flammability of Liquids
	-	UL 60730-2-14-2013	Automatic Electrical Controls; Part 2: Particular Requirements for Electric Actuators
480	UL 10C-2016	Positive Pressure Fire Tests of Door Assemblies	
	-	UL 305-2012	Panic Hardware
	-	UL 1642-2020	Lithium Batteries
	-	UL 1973-2022	Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
	-	UL 1989-2013	Standby Batteries
	-	UL 2054-2021	Household and Commercial Batteries
	-	UL 4127-2014	Low Voltage Battery Cable
	-	UL 4128-2020	Intercell and Intertier Connectors for use in Electrochemical Battery System Applications
490	UL 347-2020	Medium-Voltage AC Contactors, Controllers, and Control Centers	
	-	UL 347A-2021	Medium Voltage Power Conversion Equipment
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	-	UL 347C-2014	Medium Voltage Solid State Resistive Load Controllers, Up to 15kV
	-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
500	FM 121303	Guide for Use of Detectors for Flammable Gases	
	-	IEEE 844.1	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements
	-	IEEE 1349	Guide for the Application of Electric Machines in Zone 2 and Class I, Division 2 Hazardous (Classified) Locations
	-	NFPA 33-2024	Standard for Spray Application Using Flammable or Combustible Materials
	-	NFPA 34-2024	Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids
	-	NFPA 496-2024	Standard for Purged and Pressurized Enclosures for Electrical Equipment
	-	UL 674-2022	Electric Motors and Generators for Use in Hazardous (Classified) Locations

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	-	UL 698A-2018	Industrial Control Panels Relating to Hazardous (Classified) Locations
	-	UL 783-2003	Electric Flashlights and Lanterns for Use in Hazardous (Classified) Locations
	-	UL 823-2006	Electric Heaters For Use in Hazardous (Classified) Locations
	-	UL 844-2012	Electric Heaters For Use in Hazardous (Classified) Locations
	-	UL 913-1997	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations
	-	UL 1203-2013	Explosionproof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
	-	UL 1389-2019	Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations
	-	UL 1836-2022	Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations
	-	UL 2225-2013	Cable and Cable Fittings for Use in Hazardous (Classified) Locations
	-	UL 60079-28-2017	Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation.
	-	UL 60079-29-1-2019	Explosive Atmospheres — Part 29-1: Gas Detectors — Performance Requirements of Detectors for Flammable Gases
	-	UL 60079-29-4-2018	Explosive Atmospheres — Part 29-4: Gas Detectors — Performance Requirements of Open Path Detectors for Flammable Gases
	-	UL 60079-30-1-2017	Explosive Atmospheres — Electrical Resistance Trace Heating — General and Testing Requirements
	-	UL 60079-33-2021	Explosive Atmospheres — Part 33: Equipment Protection by Special Protection “s”
	-	UL 121201-2017	Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
	-	UL 121303-2020	Guide for Use of Detectors for Flammable Gases
	-	UL 122001-2014	General Requirements for Electrical Ignition Systems for Internal Combustion Engines in Class I, Division 2 or Zone 2, Hazardous (Classified) Locations
	-	UL 122701-2022	Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids
501	IEEE 844.1	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements	
	-	IEEE 1349	Guide for the Application of Electric Machines in Zone 2 and Class I, Division 2 Hazardous (Classified) Locations
	-	NFPA 496-2024	Standard for Purged and Pressurized Enclosures for Electrical Equipment
	-	UL 674-2022	Electric Motors and Generators for Use in Hazardous (Classified) Locations
	-	UL 783-2003	Electric Flashlights and Lanterns for Use in Hazardous (Classified) Locations
	-	UL 823-2006	Electric Heaters For Use in Hazardous (Classified) Locations
	-	UL 844-2012	Luminaires for Use in Hazardous (Classified) Locations
	-	UL 1072-2006	Medium-Voltage Power Cables
	-	UL 1203-2013	Explosionproof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
	-	UL 1277-2018	Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
	-	UL 1309A-2020	Cable for Use in Mobile Applications
	-	UL 1836-2022	Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations
	-	UL 2225-2013	Cable and Cable-Fittings for Use in Hazardous (Classified) Locations
	-	UL 60079-28-2017	Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation
	-	UL 60079-29-1-2019	Explosive Atmospheres — Part 29-1: Gas Detectors — Performance Requirements of Detectors for Flammable Gases
	-	UL 60079-29-4-2018	Explosive Atmospheres — Part 29-4: Gas Detectors — Performance Requirements of Open Path Detectors for Flammable Gases
	-	UL 60079-30-1-2017	Explosive Atmospheres — Part 30-1: Electrical Resistance Trace Heating — General and Testing Requirements
	-	UL 60079-33-2021	Explosive Atmospheres — Part 33: Equipment Protection by Special Protection “s”

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	-	UL 121201-2017	Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
	-	UL 122001-2014	General Requirements for Electrical Ignition Systems for Internal Combustion Engines in Class I, Division 2 or Zone 2, Hazardous (Classified) Locations
	-	UL 122701-2022	Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids
502	IEEE 844.1	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements	
	-	NFPA 496-2024	Standard for Purged and Pressurized Enclosures for Electrical Equipment
	-	UL 674-2022	Electric Motors and Generators for Use in Hazardous (Classified) Locations
	-	UL 783-2003	Electric Flashlights and Lanterns for Use in Hazardous (Classified) Locations
	-	UL 823-2006	Electric Heaters For Use in Hazardous (Classified) Locations
	-	UL 844-2012	Luminaires for Use in Hazardous (Classified) Locations
	-	UL 1203-2013	Explosionproof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
	-	UL 1309A-2020	Cable for Mobile Installations
	-	UL 1836-2022	Outline of Investigation for Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations
	-	UL 2225-2013	Cable and Cable-Fittings for Use in Hazardous (Classified) Locations
	-	UL 60079-28-2017	Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation
	-	UL 60079-30-1-2017	Explosive Atmospheres — Electrical Resistance Trace Heating — General and Testing Requirements
	-	UL 60079-33-2021	Explosive Atmospheres — Part 33: Equipment Protection by Special Protection “s”
	-	UL 121201-2017	Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
503	IEEE 844.1	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements	
	-	UL 823-2006	Electric Heaters For Use in Hazardous (Classified) Locations
	-	UL 844-2012	Luminaires for Use in Hazardous (Classified) Locations
	-	UL 1836-2022	Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations
	-	UL 60079-30-1-2017	Explosive Atmospheres — Electrical Resistance Trace Heating — General and Testing Requirements
	-	UL 121201-2017	Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
504	UL 698A-2018	Industrial Control Panels Relating to Hazardous (Classified) Locations	
	-	UL 913-1997	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations
	-	UL 120202-2014	Recommendations for the Preparation, Content, and Organization of Intrinsic Safety Control Drawings
505	FM 121303	Guide for Use of Detectors for Flammable Gases	
	-	IEEE 844.1	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements
	-	IEEE 1349	Guide for the Application of Electric Machines in Zone 2 and Class I, Division 2 Hazardous (Classified) Locations
	-	UL 1309A-2020	Cable for Mobile Installations
	-	UL 2225-2013	Cable and Cable-Fittings for Use in Hazardous (Classified) Locations
	-	UL 60079-0-2013	Explosive Atmospheres — Part 0: Equipment — General Requirements
	-	UL 60079-1-2015	Explosive Atmospheres — Part 1: Equipment Protection by Flameproof Enclosures “d”
	-	UL 60079-2-2017	Explosive Atmospheres — Part 2: Equipment protection by pressurized enclosure “p”
	-	UL 60079-5-2016	Explosive Gas Atmospheres — Part 5: Type of Protection — Powder Filling “q”
	-	UL 60079-6-2016	Explosive Atmospheres — Part 6: Equipment Protection by Liquid Immersion “o”

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	-	UL 60079-7-2008	Explosive Atmospheres — Part 7: Equipment Protection by Increased Safety “e”
	-	UL 60079-10-1	Explosive Atmospheres — Part 10-1: Classification of Areas — Explosive Gas Atmospheres
	-	UL 60079-11-2013	Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety “i”
	-	UL 60079-13-2022	Explosive Atmospheres — Part 13: Equipment Protection by Pressurized Room “p” and Artificially Ventilated Room “v”
	-	UL 60079-15-2013	Explosive Atmospheres — Part 15: Equipment Protection by Type of Protection “n”
	-	UL 60079-18-2015	Explosive Atmospheres — Part 18: Equipment Protection by Encapsulation “m”
	-	UL 60079-25-2011	Explosive Atmospheres — Part 25: Intrinsically Safe Electrical Systems
	-	UL 60079-26-2017	Explosive Atmospheres — Part 26: Equipment with Equipment Protection Level (EPL) Ga
	-	UL 60079-28-2017	Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation
	-	UL 60079-29-1-2019	Explosive Atmospheres — Part 29-1: Gas Detectors — Performance Requirements of Detectors for Flammable Gases
	-	UL 60079-29-4-2018	Explosive Atmospheres — Part 29-4: Gas Detectors — Performance Requirements of Open Path Detectors for Flammable Gases
	-	UL 60079-30-1-2017	Explosive Atmospheres — Part 30-1: Electrical Resistance Trace Heating — General and Testing Requirements
	-	UL 60079-33-2021	Explosive Atmospheres — Part 33: Equipment Protection by Special Protection “s”
	-	UL 80079-36-2021	Explosive Atmospheres — Part 36: Non-Electrical Equipment for Explosive Atmospheres — Basic Method and Requirements
	-	UL 80079-37-2021	Explosive Atmospheres — Part 37: Non-Electrical Equipment for Explosive Atmospheres — Non Electrical Type of Protection Constructional Safety “c”, Control of Ignition Source “b”, Liquid Immersion “k”
	-	UL 121303-2020	Guide for Use of Detectors for Flammable Gases
	-	UL 122701-2022	Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids
506	IEEE 844.1	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements	
	-	UL 698A-2018	Industrial Control Panels Relating to Hazardous (Classified) Locations
	-	UL 2225-2013	Cable and Cable-Fittings for Use in Hazardous (Classified) Locations
	-	UL 60079-0-2013	Explosive Atmospheres — Part 0: Equipment — General Requirements
	-	UL 60079-2-2017	Explosive atmospheres — Part 2: Equipment protection by pressurized enclosure “p”
	-	UL 60079-11-2013	Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i"
	-	UL 60079-18-2015	Explosive Atmospheres — Part 18: Equipment Protection by Encapsulation “m”
	-	UL 60079-25-2011	Explosive Atmospheres — Part 25: Intrinsically Safe Electrical Systems
	-	UL 60079-28-2017	Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation
	-	UL 60079-30-1-2017	Explosive Atmospheres — Electrical Resistance Trace Heating — General and Testing Requirements
	-	UL 60079-31-2015	Explosive Atmospheres — Part 31: Equipment Dust Ignition Protection by Enclosure “t”
	-	UL 60079-33-2021	Explosive Atmospheres — Part 33: Equipment Protection by Special Protection “s”
	-	UL 62784	Vacuum Cleaners and Dust Extractors Providing Equipment Protection Level Dc for the Collection of Combustible Dusts — Particular Requirements
	-	UL 80079-36-2021	Explosive Atmospheres — Part 36: Non-Electrical Equipment for Explosive Atmospheres — Basic Method and Requirements
	-	UL 80079-37-2021	Explosive Atmospheres — Part 37: Non-Electrical Equipment for Explosive Atmospheres — Non Electrical Type of Protection Constructional Safety “c”, Control of Ignition Source “b“, Liquid Immersion “k”
512	UL 1389-2019	Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations	

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516	NFPA 33-2024	Standard for Spray Application Using Flammable or Combustible Materials	
	-	NFPA 34-2024	Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids
	-	UL 844-2012	Luminaires for Use in Hazardous (Classified) Locations
517	AAMI ES 60601-1	Medical electrical equipment — Part 1: General requirements for basic safety and essential performance	
	-	UL 5-2016	Surface Metal Raceways and Fittings
	-	UL 5A-2015	Nonmetallic Surface Raceways and Fittings
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
	-	UL 1022-2012	Line Isolation Monitors
	-	UL 1047-2015	Isolated Power Systems Equipment
	-	UL 1286-2022	Office Furnishing Systems
	-	UL 2930-2020	Cord-and-Plug-connected Health Care Facility Outlet Assemblies
	-	UL 60601-1-2003	Medical Electrical Equipment — Part 1: General Requirements for Safety
	-	UL 122701-2022	Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids
518	UL 498-2017	Attachment Plugs and Receptacles	
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 943C-2012	Special Purpose Ground-Fault Circuit-Interrupters
	-	UL 2305-2001	Exhibition Display Units, Fabrication and Installation
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520	UL 62-2018	Flexible Cords and Cables	
	-	UL 334-2022	Theater Lighting Distribution and Control Equipment
	-	UL 489-2016	Attachment Plugs and Receptacles
	-	UL 1573-2003	Stage and Studio Luminaires and Connector Strips
	-	UL 1640-2016	Portable Power-Distribution Equipment
	-	UL 1691-2021	Single Pole Locking-Type Separable Connectors
522	UL 13-2015	Power Limited Circuit Cables	
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 2250-2017	Instrumentation Tray Cable
525	UL 62-2018	Flexible Cords and Cables	
	-	UL 817-2015	Cord Sets and Power-Supply Cords
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 943C-2012	Special Purpose Ground-Fault Circuit-Interrupters
	-	UL 1691-2021	Single Pole Locking-Type Separable Connectors
530	UL 62-2-18	Flexible Cords and Cables	
	-	UL 1479-2-15	Fire Tests of Penetration Firestops
	-	UL 1573-2003	Stage and Studio Luminaires and Connector Strips
	-	UL 1680-2003	Stage and Lighting Cables
	-	UL 1691-2021	Single Pole Locking-Type Separable Connectors
	-	UL 1836-2022	Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
540	UL 67-2018	Panelboards	
	-	UL 943-2016	Ground-Fault Circuit Interrupters
	-	UL 1640-2016	Portable Power-Distribution Equipment
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
545	UL 5-2016	Surface Metal Raceways and Fittings	
	-	UL 5A-2015	Nonmetallic Surface Raceways and Fittings

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	-	UL 5B-2004	Strut-Type Channel Raceways and Fittings
	-	UL 5C-2016	Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits
	-	UL 20-2018	General Use Snap Switches
	-	UL 209-2011	Cellular Metal Floor Raceways and Fittings
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 2024-2014	Cable Routing Assemblies and Communications Raceways
547	UL 50-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations	
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 1598-2008	Luminaires
	-	UL 2225-2013	Cable and Cable-Fittings for Use in Hazardous (Classified) Locations
550	UL 6-2022	Electrical Rigid Metal Conduit — Steel	
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 307A-2018	Liquid Fuel-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles
	-	UL 307B-2006	Gas-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
	-	UL 817-2015	Cord Sets and Power-Supply Cords
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
	-	UL 1462-2006	Mobile Home Pipe Heating Cable
	-	UL 1598-2008	Luminaires
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit
	-	UL 2108-2015	Low-Voltage Lighting Systems
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
551	UL 6-2022	Electrical Rigid Metal Conduit — Steel	
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 231-2016	Power Outlets
	-	UL 234-2005	Low Voltage Lighting Fixtures for use in Recreational Vehicles
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 486C-2018	Splicing Wire Connectors
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 514D-2013	Cover Plates for Flush-Mounted Wiring Devices

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	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
	-	UL 817-2015	Cord Sets and Power-Supply Cords
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 1004-4-2018	Electric Generators
	-	UL 1008-2014	Transfer Switch Equipment
	-	UL 1008M-2022	Transfer Switch Equipment, Meter Mounted
	-	UL 1008S-2012	Solid-State Transfer Switches
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
	-	UL 1449-2021	Surge Protective Devices
	-	UL 1598-2008	Luminaires
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit
	-	UL 2200-2012	Stationary Engine Generator Assemblies
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
	-	UL 60730-1-2009	Automatic Electrical Controls; Part 1: General Requirements
	-	UL 60730-2-9-2010	Automatic Electrical Controls; Part 2: Particular Requirements for Temperature Sensing Controls
552	SAE J1128-2015	Low Voltage Primary Cable, for Types GXL, HDT, and SXL	
	-	SAE J1127-2015	Low Voltage Battery Cable, for Types SGT and SGR
	-	UL 6-2022	Electrical Rigid Metal Conduit — Steel
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 50-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 67-2018	Panelboards
	-	UL 231-2016	Power Outlets
	-	UL 234-2005	Low Voltage Lighting Fixtures for Use in Recreational Vehicles
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 430-2015	Waste Disposers
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
	-	UL 817-2015	Cord Sets and Power-Supply Cords
	-	UL 916-2015	Energy Management Equipment
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 1004-4-2018	Electric Generators
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
	-	UL 1563-2009	Electric Spas, Equipment Assemblies, and Associated Equipment
	-	UL 1598-2008	Luminaires
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit
	-	UL 2108-2015	Low Voltage Lighting Systems
	-	UL 2200-2012	Stationary Engine Generator Assemblies
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
555	UL 6-2022	Electrical Rigid Metal Conduit — Steel	
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 231-2016	Power Outlets
	-	UL 486D-2015	Sealed Wire Connector Systems
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
	-	UL 676-2015	Underwater Luminaires and Submersible Junction Boxes
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 1053-2015	Ground-Fault Sensing and Relaying Equipment
	-	UL 1399	Leakage Current Measurement Devices for Use in Marina Applications
	-	UL 1650-2015	Portable Power Cable
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
590	UL 496-2017	Lampholders	
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings

Article	Standard Number	Standard Title	
	-	UL 588-2015	Seasonal and Holiday Decorative Products
	-	UL 817-2015	Cord Sets
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 1088-2015	Temporary Lighting Strings
	-	UL 1377-2019	Wire used in Low Voltage Seasonal Lighting Products In Circuits With a Maximum Available Power of 15W
	-	UL 1640-2016	Portable Power-Distribution Equipment
600	UL 1-2005	Flexible Metal Conduit	
	-	UL 5-2016	Surface Metal Raceways and Fittings
	-	UL 5A-2015	Nonmetallic Surface Raceways and Fittings
	-	UL 13-2015	Power-Limited Circuit Cables
	-	UL 48-2011	Electric Signs
	-	UL 50-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations
	-	UL 98B-2015	Enclosed and Dead-Front Switches for Use in Photovoltaic Systems
	-	UL 248-19-2015	Low-Voltage Fuses — Part 19: Photovoltaic Fuses
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 489B-2016	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures For Use With Photovoltaic (PV) Systems
	-	UL 508I-2015	Disconnect Switches Intended for Use in Photovoltaic Systems
	-	UL 814-2011	Gas-Tube-Sign Cable
	-	UL 879-2009	Electric Sign Components
	-	UL 879A-2012	LED Sign and Sign Retrofit Kits
	-	UL 879B-2002	Polymeric Enclosure Systems for the Splice Between Neon Tubing Electrode Leads and GTO Cable, and the GTO Cable Leading to the Splice
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 1310-2018	Class 2 Power Units
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit
	-	UL 1699B-2018	Photovoltaic (PV) DC Arc-Fault Circuit Protection
	-	UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
	-	UL 2161-2016	Neon Transformers and Power Supplies
	-	UL 2703-2015	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels
	-	UL 3001-2023	Distributed Energy Generation and Storage Systems
	-	UL 3003-2015	Distributed Generation Cables
	-	UL 3703-2015	Solar Trackers
	-	UL 4703-2014	Photovoltaic Wire
	-	UL 6703-2014	Connectors for Use in Photovoltaic Systems
	-	UL 7103-2019	Investigation for Building-Integrated Photovoltaic Roof Coverings
	-	UL 8703-2011	Concentrator Photovoltaic Modules and Assemblies
	-	UL 9703-2018	Distributed Generation Wiring Harnesses
	-	UL 61730-1-2022	Photovoltaic (PV) Module Safety Qualification — Part 1: Requirements For Construction
	-	UL 61730-2-2022	Photovoltaic (PV) Module Safety Qualification — Part 2: Requirements For Testing
	-	UL 62109-2014	Power Converters for Use in Photovoltaic Power Systems — Part 1: General Requirements
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
604	UL 1-2005	Flexible Metal Conduit	
	-	UL 4-2004	Armored Cable
	-	UL 5-2016	Surface Metal Raceways and Fittings
	-	UL 5A-2015	Nonmetallic Surface Raceways and Fittings
	-	UL 5B-2004	Strut-Type Channel Raceways and Fittings
	-	UL 5C-2016	Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 183-2009	Manufactured Wiring Systems
	-	UL 209-2011	Cellular Metal Floor Raceways and Fittings
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 797-2007	Electrical Metallic Tubing — Steel
	-	UL 797A-2014	Electrical Metallic Tubing — Aluminum and Stainless Steel

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	-	UL 857-2009	Busways
	-	UL 1569-2018	Metal-Clad Cables
	-	UL 2024-2014	Cable Routing Assemblies and Communications Raceways
605	UL 962-2014	Household and Commercial Furnishings	
	-	UL 1286-2022	Office Furnishings Systems
	-	UL 1310-2018	Class 2 Power Units
	-	UL 2999-2020	Individual Commercial Office Furnishings
	-	UL 5085-3-2006	Low Voltage Transformers — Part 3: Class 2 and Class 3 Transformers
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
610	UL 62-2018	Flexible Cords and Cables	
	-	UL 2273-2019	Festoon Cable
620	UL 62-2018	Flexible Cords and Cables	
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 98-2016	Enclosed and Dead-Front Switches
	-	UL 104-2016	Elevator Door Locking Devices and Contacts
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 508-2018	Industrial Control Equipment
	-	UL 508A-2018	Industrial Control Panels
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
	-	UL 1310-2018	Class 2 Power Units
	-	UL 1449-2021	Surge Protective Devices
	-	UL 1685-2015	Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
	-	UL 2556-2021	Wire and Cable Test Methods
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
625	UL 62-2018	Flexible Cords and Cables	
	-	UL 1650-2015	Portable Power Cable
	-	UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
	-	UL 2202-2022	DC Charging Equipment for Electric Vehicles
	-	UL 2231-1-2012	Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits — Part 1: General Requirements
	-	UL 2231-2-2012	Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits — Part 2: Particular Requirements for Protection Devices for Use in Charging Systems
	-	UL 2251-2017	Plugs, Receptacles and Couplers for Electrical Vehicles
	-	UL 2580-2020	Batteries for Use in Electric Vehicles
	-	UL 2594-2022	Electric Vehicle Supply Equipment
	-	UL 9741-2021	Electric Vehicle Power Export Equipment (EVPE)
	-	UL 60730-1	Automatic Electrical Controls
626	UL 62-2018	Flexible Cords and Cables	
	-	UL 231-2016	Power Outlets
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 498F-2020	Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
	-	UL 817-2015	Cord Sets and Power-Supply Cords
	-	UL 1651-2015	Optical Fiber Cable
	-	UL 1686-2012	Pin and Sleeve Configurations
630	UL 551-2009	Transformer-Type Arc-Welding Machines	
640	UL 13-2015	Power Limited Circuit Cables	
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 813-1996	Commercial Audio Equipment
	-	UL 1310-2018	Class 2 Power Units
	-	UL 1419-2016	Professional Video and Audio Equipment
	-	UL 1492-1996	Audio-Video Products and Accessories
	-	UL 1711-2006	Amplifiers for Fire Protective Signaling Systems
	-	UL 2269-2021	Optical Fiber/Communications/Signaling/Coaxial Cable Outlet Boxes
	-	UL 6500-1999	Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use
	-	UL 60065-2015	Audio, Video and Similar Electronic Apparatus — Safety Requirements

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	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
645	UL 38-2008	Manual Signaling Boxes for Fire Alarm Systems	
	-	UL 268-2023	Smoke Detectors for Fire Alarm Systems
	-	UL 444-2017	Communications Cables
	-	UL 464-2016	Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
	-	UL 497B-2004	Protectors for Data Communications and Fire Alarm Circuits
	-	UL 833-2021	Control Units and Accessories for Fire Alarm Systems
	-	UL 864-2014	Control Units and Accessories for Fire Alarm Systems
	-	UL 1424-2015	Cables for Power-Limited Fire-Alarm Circuits
	-	UL 1425-2015	Cables for Non-Power-Limited Fire-Alarm Circuits
	-	UL 1449-2021	Surge Protective Devices
	-	UL 1480-2016	Speakers for Fire Alarm and Signaling Systems, Including Accessories
	-	UL 1638-2016	Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
	-	UL 1651-2015	Optical Fiber Cable
	-	UL 1685-2015	Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
	-	UL 1690-2015	Data-Processing Cable
	-	UL 1778-2014	Uninterruptible Power Systems
	-	UL 2024-2014	Cable Routing Assemblies and Communications Raceways
	-	UL 60950-1-2007	Information Technology Equipment Safety — Part 1: General Requirements
	-	UL 60950-21-2003	Information Technology Equipment Safety — Part 21: Remote Power Feeding
	-	UL 60950-22-2017	Information Technology Equipment Safety — Part 22: Equipment to be Installed Outdoors
	-	UL 60950-23-2007	Information Technology Equipment Safety — Part 23: Large Data Storage Equipment
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
646	UL 10C-2016	Positive Pressure Fire Tests of Door Assemblies	
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 67-2018	Panelboards
	-	UL 98-2016	Enclosed and Dead-Front Switches
	-	UL 305-2012	Panic Hardware
	-	UL 347-2020	Medium-Voltage AC Contactors, Controllers, and Control Centers
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 508-2018	Industrial Control Equipment
	-	UL 508A-2018	Industrial Control Panels
	-	UL 845-2021	Motor Control Centers
	-	UL 869A-2006	Reference Standard for Service Equipment
	-	UL 891-2019	Switchboards
	-	UL 924-2016	Emergency Lighting and Power Equipment
	-	UL 977-2012	Fused Power-Circuit Devices
	-	UL 1008-2014	Transfer Switch Equipment
	-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
	-	UL 1008M-2022	Meter-Mounted Transfer Switches
	-	UL 1008S-2012	Solid-State Transfer Switches
	-	UL 1062-1997	Unit Substations
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
	-	UL 1429-2000	Pullout Switches
	-	UL 1449-2021	Surge Protective Devices
	-	UL 1655-2009	Community-Antenna Television Cables
	-	UL 1989-2013	Standby Batteries
	-	UL 2755-2018	Modular Data Centers
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
647	UL 1598-2008	Luminaires	
650	UL 1310-2018	Class 2 Power Units	
	-	UL 1581-2001	Reference Standard for Electrical Wires, Cables, and Flexible Cords
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements

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670	ANSI/CSA-C22.2 No. 19085-1	Woodworking machines — Safety — Part 1: Common requirements	
	-	UL 508-2018	Industrial Control Equipment
	-	UL 61800-5-1-2012	Adjustable Speed Electrical Power Drive Systems — Part 5-1: Safety Requirements — Electrical, Thermal and Energy
675	UL 493-2018	Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables	
	-	UL 1581-2001	Reference Standard for Electrical Wires, Cables, and Flexible Cords
680	UL 6-2022	Electrical Rigid Metal Conduit — Steel	
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 20-2018	General Use Snap-Switches
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 379-2013	Power Units for Fountain, Swimming Pool, and Spa Luminaires
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 486D-2015	Sealed Wire Connector Systems
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
	-	UL 676-2015	Underwater Luminaires and Submersible Junction Boxes
	-	UL 676A-2003	Potting Compounds for Swimming Pool, Fountain, and Spa Equipment
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 943C-2012	Special Purpose Ground-Fault Circuit-Interrupters
	-	UL 1004-10-2020	Pool Pump Motors
	-	UL 1081-2016	Swimming Pool Pumps, Filters, and Chlorinators
	-	UL 1241-2003	Junction Boxes for Swimming Pool Luminaires
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
	-	UL 1261-2016	Electric Water Heaters for Pools and Tubs
	-	UL 1563-2009	Electric Spas, Equipment Assemblies, and Associated Equipment
	-	UL 1569-2018	Metal-Clad Cables
	-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit
	-	UL 1795-2016	Hydromassage Bathtubs
	-	UL 2420-2009	Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
	-	UL 2452-2006	Electric Swimming Pool and Spa Cover Operators
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
	-	UL 2515A-2011	Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
	-	UL 2995-2016	Lifts for Swimming Pools and Spas
	-	UL 60335-2-1000-2017	Household and Similar Electrical Appliances: Particular Requirements for Electrically Powered Pool Lifts
682	UL 486D-2015	Sealed Wire Connector Systems	
	-	UL 943-2016	Ground-Fault Circuit-Interrupters
	-	UL 1053-2015	Ground-Fault Sensing and Relaying Equipment
	-	UL 1650-2015	Portable Power Cable
	-	UL 1838-2003	Low Voltage Landscape Lighting Systems
690	UL 98B-2015	Enclosed and Dead-Front Switches for Use in Photovoltaic Systems	
	-	UL 248-19-2015	Low-Voltage Fuses — Part 19: Photovoltaic Fuses
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 489B-2016	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures For Use With Photovoltaic (PV) Systems
	-	UL 508I-2015	Disconnect Switches Intended for Use in Photovoltaic Systems
	-	UL 1569-2018	Metal-Clad Cables
	-	UL 1699B-2018	Photovoltaic (PV) DC Arc-Fault Circuit Protection
	-	UL 1703-2002	Flat-Plate Photovoltaic Modules and Panels
	-	UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
	-	UL 2703-2015	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels
	-	UL 3001-2023	Distributed Energy Generation and Storage Systems
	-	UL 3003-2015	Distributed Generation Cables

Article	Standard Number	Standard Title	
-	-	-	
	-	UL 3703-2015	Solar Trackers
	-	UL 3730-2014	Photovoltaic Junction Boxes
	-	UL 3741-2020	Photovoltaic Hazard Control
	-	UL 4703-2014	Photovoltaic Wire
	-	UL 6703-2014	Connectors for Use in Photovoltaic Systems
	-	UL 7103-2019	Investigation for Building-Integrated Photovoltaic Roof Coverings
	-	UL 8703-2011	Concentrator Photovoltaic Modules and Assemblies
	-	UL 8801-2022	Photovoltaic Luminaire Systems
	-	UL 9703-2018	Distributed Generation Wiring Harnesses
	-	UL 9741-2021	Electric Vehicle Power Export Equipment (EVPE)
	-	UL 61730-1-2022	Photovoltaic (PV) Module Safety Qualification — Part 1: Requirements for Construction
	-	UL 61730-2-2022	Photovoltaic (PV) Module Safety Qualification — Part 2: Requirements for Testing
	-	UL 62109-1-2014	Power Converters for Use in Photovoltaic Power Systems — Part 1: General Requirements
	-	UL 62109-2	Power Converters for Use in Photovoltaic Power Systems — Part 2: Particular Requirements for Inverters
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
692	UL 2262-2012	Fuel Cell Modules for Use in Portable and Stationary Equipment	
	-	UL 2262A-2011	Borohydride Fuel Cartridges with Integral Fuel Processing for Use with Portable Fuel Cell Power Systems or Similar Equipment
	-	UL 2265-2012	Fuel Cell Power Units and Fuel Storage Containers for Portable Devices
	-	UL 2265A-2018	Hand-held or Hand-Transportable Fuel Cell Power Units with Disposable Methanol Fuel Cartridges for use in Original Equipment Manufacturer's Information Technology Equipment
	-	UL 2265C-2006	Hand-Held or Hand-Transportable Alkaline (Direct Borohydride) Fuel Cell Power Units and Borohydride Fuel Cartridges For Use With Consumer Electronics or Information Technology Equipment
	-	UL 2266-2007	Electromagnetic Compatibility, Electrical Safety, and Physical Protection of Stationary and Portable Fuel Cell Power Systems for Use with Commercial Network Telecommunications Equipment
	-	UL 2267-2020	Fuel Cell Power Systems for Installation in Industrial Electric Trucks
694	UL 467-2022	Grounding and Bonding Equipment	
	-	UL 489C-2012	Molded-Case Circuit Breakers and Molded-Case Switches for Use with Wind Turbines
	-	UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
	-	UL 2227-2007	Flexible Motor Supply Cable and Wind Turbine Tray Cable
	-	UL 2736-2010	Single Pole Separable Interconnecting Cable Connectors for Use with Wind Turbine Generating Systems
	-	UL 4143-2018	Wind Turbine Generator — Life Time Extension (LTE)
	-	UL 6141-2016	Wind Turbines Permitting Entry of Personnel
	-	UL 6142-2012	Small Wind Turbine Generating Systems
695	UL 6-2022	Electrical Rigid Metal Conduit — Steel	
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 218-2015	Fire Pump Controllers
	-	UL 448-2020	Centrifugal Stationary Pumps for Fire-Protection Service
	-	UL 448B-2023	Residential Fire Pumps Intended for One- and Two-Family Dwellings and Manufactured Homes
	-	UL 448C-2023	Stationary, Rotary-Type, Positive-Displacement Pumps for Fire Protection Service
	-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
	-	UL 1004-5-2014	Fire Pump Motors
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
	-	UL 1569-2018	Metal-Clad Cables
	-	UL 1724-2006	Fire Tests for Electrical Circuit Protective Systems
	-	UL 2196-2017	Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
700	UL 924-2016	Emergency Lighting and Power Equipment	
	-	UL 1008-2014	Transfer Switch Equipment

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	-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
	-	UL 1449-2021	Surge Protective Devices
	-	UL 1724-2006	Fire Tests for Electrical Circuit Protective Systems
	-	UL 2196-2017	Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables
	-	UL 2200-2012	Stationary Engine Generator Assemblies
701	UL 924-2016	Emergency Lighting and Power Equipment	
	-	UL 1008-2014	Transfer Switch Equipment
	-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
702	UL 98-2016	Enclosed and Dead-Front Switches	
	-	UL 1008-2014	Transfer Switch Equipment
	-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
	-	UL 1008M-2022	Meter-Mounted Transfer Switches
	-	UL 1008S-2012	Solid-State Transfer Switches
705	UL 62-2018	Flexible Cords and Cables	
	-	UL 98-2016	Enclosed and Dead-Front Switches
	-	UL 486D-2015	Sealed Wire Connector Systems
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
	-	UL 1429-2000	Pullout Switches
	-	UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
	-	UL 2200-2012	Stationary Engine Generator Assemblies
	-	UL 3001	Distributed Energy Resource Systems
	-	UL 3003-2015	Distributed Generation Cables
	-	UL 3010	Single Site Energy Systems
	-	UL 6141-2016	Wind Turbines Permitting Entry of Personnel
	-	UL 6142-2012	Small Wind Turbine Systems
	-	UL 9540-2020	Energy Storage Systems and Equipment
	-	UL 9741-2021	Electric Vehicle Power Export Equipment (EVPE)
	-	UL 62109-1	Power Converters for Use in Photovoltaic Power Systems — Part 1: General Requirements
	-	UL 62109-2	Power Converters for Use in Photovoltaic Power Systems — Part 2: Particular Requirements for Inverters
706	UL 248-2-2000	Low-Voltage Fuses — Part 2: Class C Fuses	
	-	UL 248-3-2000	Low-Voltage Fuses — Part 3: Class CA and CB Fuses
	-	UL 248-4-2000	Low-Voltage Fuses — Part 4: Class CC Fuses
	-	UL 248-5-2000	Low-Voltage Fuses — Part 5: Class G Fuses
	-	UL 248-6-2000	Low-Voltage Fuses — Part 6: Class H Non-Renewable Fuses
	-	UL 248-8-2011	Low-Voltage Fuses — Part 8: Class J Fuses
	-	UL 248-9-2000	Low-Voltage Fuses — Part 9: Class K Fuses
	-	UL 248-10-2011	Low-Voltage Fuses — Part 10: Class L Fuses
	-	UL 248-12-2011	Low-Voltage Fuses — Part 12: Class R Fuses
	-	UL 248-15-2018	Low-Voltage Fuses — Part 15: Class T Fuses
	-	UL 248-17-2018	Low-Voltage Fuses — Part 17: Class CF Fuses
	-	UL 248-18-2022	Low-Voltage Fuses — Part 18: Class CD Fuses
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 489H-2017	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures, for Use with Direct Current (DC) Microgrids
	-	UL 1066-2022	Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
	-	UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
	-	UL 9540-2020	Energy Storage Systems and Equipment
708	UL 1-2005	Flexible Metal Conduit	
	-	UL 4-2004	Armored Cable
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 360-2013	Liquid-Tight Flexible Metal Conduit
	-	UL 493-2018	Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables
	-	UL 497A-2001	Secondary Protectors for Communications Circuits
	-	UL 1008-2014	Transfer Switch Equipment
	-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
	-	UL 1008M-2022	Meter-Mounted Transfer Switches
	-	UL 1008S-2012	Solid-State Transfer Switches

Article	Standard Number	Standard Title	
	-	UL 1569-2018	Metal-Clad Cables
	-	UL 2196-2017	Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables
710	UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources	
	-	UL 2200-2012	Stationary Engine Generator Assemblies
	-	UL 8801-2022	Photovoltaic Luminaire Systems
	-	UL 9540-2020	Energy Storage Systems and Equipment
	-	UL 9741-2021	Electric Vehicle Power Export Equipment (EVPE)
	-	UL 62109-1-2014	Power Converters for use in Photovoltaic Power Systems — Part 1: General Requirements
	-	UL 62109-2	Power Converters for Use in Photovoltaic Power Systems — Part 2: Particular Requirements for Inverters
722	UL 13-2015	Power-Limited Circuit Cables	
	-	UL 444-2017	Communications Cables
	-	UL 1424-2015	Cables for Power-Limited Fire-Alarm Circuits
	-	UL 1651-2015	Optical Fiber Cable
	-	UL 1666-2007	Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
	-	UL 1685-2015	Vertical-Tray Fire-Propagation and Smoke- Release Test for Electrical and Optical-Fiber Cables
	-	UL 1724-2006	Fire Tests for Electrical Circuit Protective Systems
	-	UL 2024-2019	Commercial Closed-Circuit Television Equipment
	-	UL 2196-2017	Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables
	-	UL 2556-2021	Wire and Cable Test Methods
725	UL 1310-2018	Class 2 Power Units	
	-	UL 5085-3-2006	Low Voltage Transformers — Part 3: Class 2 and Class 3 Transformers
	-	UL 9990-2021	Information and Communication Technology (ICT) Power Cables
	-	UL 60730-1	Automatic Electrical Controls
	-	UL 61010-2-201-2018	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use — Part 2-201: Particular Requirements for Control Equipment
	-	UL 61800-5-1-2012	Adjustable Speed Electrical Power Drive Systems — Part 5-1: Safety Requirements — Electrical, Thermal and Energy
	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
726	UL 1400-1-2022	Fault-Managed Power Systems — Part 1 General Requirements	
	-	UL 1400-2-2022	Fault-Managed Power Systems — Part 2 Requirements for Cables
	-	UL 1666-2007	Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
	-	UL 1685-2015	Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
	-	UL 2556-2021	Wire and Cable Test Methods
728	UL 5-2016	Surface Metal Raceways and Fittings	
	-	UL 5A-2015	Nonmetallic Surface Raceways and Fittings
	-	UL 5B-2004	Strut-Type Channel Raceways and Fittings
	-	UL 5C-2016	Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits
	-	UL 209-2011	Cellular Metal Floor Raceways and Fittings
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 514A-2013	Metallic Outlet Boxes
	-	UL 514C-2014	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
	-	UL 568-2002	Nonmetallic Cable Tray Systems
	-	UL 884-2016	Underfloor Raceways and Fittings
	-	UL 1724-2006	Fire Tests for Electrical Circuit Protective Systems
	-	UL 2024-2014	Cable Routing Assemblies and Communications Raceways
	-	UL 2196-2017	Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables
760	UL 268-2023	Smoke Detectors for Fire Alarm Systems	
	-	UL 268A-2008	Smoke Detectors for Duct Application
	-	UL 486C-2018	Splicing Wire Connectors
	-	UL 497B-2004	Protectors for Data Communication and Fire Alarm Circuits
	-	UL 1424-2015	Cables for Power-Limited Fire-Alarm Circuits
	-	UL 1425-2015	Cables for Non–Power-Limited Fire-Alarm Circuits
	-	UL 1480-2016	Speakers for Fire Alarm and Signaling Systems, Including Accessories

Article	Standard Number	Standard Title	
	-	UL 1666-2007	Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
	-	UL 1685-2015	Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
	-	UL 2196-2017	Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables
	-	UL 60730-2-14-2013	Automatic Electrical Controls; Part 2: Particular Requirements for Electric Actuators
770	UL 467-2022	Grounding and Bonding Equipment	
	-	UL 568-2002	Nonmetallic Cable Tray Systems
	-	UL 1651-2015	Optical Fiber Cable
	-	UL 2024-2014	Optical Fiber and Communication Cable Raceway
	-	UL 2196-2017	Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control and Data Cables
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
800	UL 444-2017	Communications Cables	
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 489A-2008	Circuit Breakers for Use in Communication Equipment
	-	UL 497-2001	Protectors for Paired-Conductor Communications Circuits
	-	UL 497A-2001	Secondary Protectors for Communications Circuits
	-	UL 497C-2001	Protectors for Coaxial Communications Circuits
	-	UL 497E-2011	Protectors for Antenna Lead-In Conductors
	-	UL 523-2006	Telephone Service Drop Wire
	-	UL 568-2002	Nonmetallic Cable Tray Systems
	-	UL 723-2018	Test for Surface Burning Characteristics of Building Materials
	-	UL 1581-2001	Reference Standard for Electrical Wires, Cables, and Flexible Cords
	-	UL 1666-2007	Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
	-	UL 1685-2015	Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
	-	UL 1724-2006	Outline for Fire Tests for Electrical Circuit Protective Systems
	-	UL 1863-2004	Communication Circuit Accessories
	-	UL 2024-2014	Cable Routing Assemblies and Communications Raceways
	-	UL 2043-2013	Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
	-	UL 2196-2017	Tests for Fire Resistive Cables
	-	UL 2556-2021	Wire and Cable Test Methods
	-	UL 62275-2021	Cable Management Systems — Cable Ties for Electrical Installations
	-	UL 62368-1	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
805	-	-	
	-	UL 497-2001	Protectors for Paired-Conductor Communications Circuits
	-	UL 497A-2001	Secondary Protectors for Communications Circuits
	-	UL 497C-2001	Protectors for Coaxial Communications Circuits
	-	UL 497E-2011	Protectors for Antenna Lead-In Conductors
	-	UL 523-2015	Telephone Service Drop Wire
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	-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
810	UL 150-2004	Antenna Rotators	
	-	UL 452-2006	Antenna-Discharge Units
	-	UL 467-2022	Grounding and Bonding Equipment
	-	UL 497E-2011	Protectors for Antenna Lead-In Conductors
820	UL 444-2017	Communications Cables	
	-	UL 497E-2011	Protectors for Antenna Lead-In Conductors
	-	UL 1655-2009	Community-Antenna Television Cables
830	UL 444-2017	Communications Cables	
	-	UL 497A-2001	Secondary Protectors for Communications Circuits

Article	Standard Number	Standard Title
-	UL 497C-2001	Protectors for Coaxial Communications Circuits
-	UL 497E-2011	Protectors for Antenna Lead-In Conductors
-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
840	UL 444-2017	Communications Cables
-	UL 467-2022	Grounding and Bonding Equipment
-	UL 498A-2008	Current Taps and Adapters
-	UL 1310-2018	Class 2 Power Units
-	UL 1651-2015	Optical Fiber Cable
-	UL 1863-2004	Communication Circuit Accessories
-	UL 2024-2014	Cable Routing Assemblies and Communications Raceways
-	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
Tables 11(A) and 11(B)	UL 1310-2018	Class 2 Power Units
	UL 1434-1998	Thermistor-Type Devices
	UL 5085-3-2006	Low Voltage Transformers — Part 3: Class 2 and Class 3 Transformers
	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements
Tables 12(A) and 12(B)	UL 1310-2018	Class 2 Power Units
	UL 1434-1998	Thermistor-Type Devices
	UL 5085-3-2006	Low Voltage Transformers — Part 3: Class 2 and Class 3 Transformers
	UL 62368-1-2012	Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements

Table A.1(b) Product Safety Standards for Conductors and Equipment That Do Not Have an Associated Listing Requirement

Article	Standard Number	Standard Title
110	NEMA CY 10000-2023	Cybersecurity Implementation Guidance for Connected Electrical Infrastructure
-	UL 969-2017	Marking and Labeling Systems
-	UL 9691-2021	Recommended Practice for Nameplates for Use in Electrical Installations
210	UL 1053-2015	Ground-Fault Sensing and Relaying Equipment
215	UL 1053-2015	Ground-Fault Sensing and Relaying Equipment
235	UL 6-2022	Electrical Rigid Metal Conduit — Steel
-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
-	UL 347	Medium-Voltage AC Contactors, Controllers, and Control Centers
-	UL 360	Liquid-Tight Flexible Metal Conduit
-	UL 486C-2018	Splicing Wire Connectors
-	UL 514B-2012	Conduit, Tubing and Cable Fittings
-	UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
-	UL 1660-2019	Liquid-Tight Flexible Nonmetallic Conduit
-	UL 2200-2012	Stationary Engine Generator Assemblies
-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
-	UL 2876-2022	Remote Racking Devices for Switchgear and Controlgear
240	NEMA CY 10000-2023	Cybersecurity Implementation Guidance for Connected Electrical Infrastructure
245	IEEE C37.09	IEEE Standard Test Procedures for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V
-	IEEE C37.41	IEEE Standard Design Tests for High-Voltage (>1000 V) Fuses and Accessories
-	IEEE C37.42	IEEE Standard Specifications for High-Voltage (>1000 V) Fuses and Accessories
-	NEMA C37.54	NEMA Standard Indoor AC High Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear — Conformance Test Procedures
300	UL 635-2012	Insulating Bushings
314	UL 514B-2012	Conduit, Tubing, and Cable Fittings
-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
-	UL 3004	Outline of Investigation for Medium Voltage Junction Boxes

Article	Standard Number	Standard Title	
320	UL 514A-2013	Metallic Outlet Boxes	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
322	UL 5-2016	Surface Metal Raceways and Fittings	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
324	UL 5-2016	Surface Metal Raceways and Fittings	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
330	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable	
332	UL 1565-2022	Positioning Devices	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
334	UL 6-2022	Electrical Rigid Metal Conduit — Steel	
	-	UL 6A-2008	Electrical Rigid Metal Conduit — Aluminum, Red Brass and Stainless Steel
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 651-2011	Schedule 40 and 80 Rigid PVC Conduit
	-	UL 797-2007	Electrical Metallic Tubing — Steel
	-	UL 797A-2014	Electrical Metallic Tubing — Aluminum and Stainless Steel
	-	UL 1242-2006	Electrical Intermediate Metal Conduit — Steel
	-	UL 1565-2022	Positioning Devices
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
	-	UL 2420-2009	Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
	-	UL 2515-2019	Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
	-	UL 2515A-2011	Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
335	UL 2250-2017	Instrumentation Tray Cable	
337	UL 1565-2022	Positioning Devices	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
340	UL 493-2018	Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables	
342	UL 635-2012	Insulating Bushings	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
344	UL 635-2012	Insulating Bushings	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
348	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable	
350	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable	
352	UL 635-2012	Insulating Bushings	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
353	UL 635-2012	Insulating Bushings	
355	UL 635-2012	Insulating Bushings	
	-	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable
356	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable	
358	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable	
362	UL 2239-2015	Hardware for the Support of Conduit, Tubing and Cable	
368	UL 857-2009	Busways	
392	UL 568-2002	Nonmetallic Cable Tray Systems	
400	UL 62-2018	Flexible Cords and Cables	
	-	UL 498-2017	Attachment Plugs and Receptacles
	-	UL 498B-2022	Receptacles with Integral Switching Means
	-	UL 498D-2020	Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts
	-	UL 498E-2020	Attachment Plugs, Cord Connectors and Receptacles — Enclosure Types for Environmental Protection
	-	UL 514B-2012	Conduit, Tubing, and Cable Fittings
	-	UL 817-2015	Cord Sets and Power-Supply Cords
	-	UL 1650-2015	Portable Power Cable
	-	UL 1680-2003	Stage and Lighting Cables
402	UL 66-2023	Fixture Wire	
408	UL 50-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations	
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations

Article	Standard Number	Standard Title	
409	UL 1436	Outlet Circuit Testers and Other Similar Indicating Devices	
	-	UL 61010-1	Electrical Equipment for Measurement, Control, and Laboratory Use — Part 1: General Requirements
	-	UL 61010-2-030	Electrical Equipment for Measurement, Control, and Laboratory Use — Part 2-30: Particular Requirements for Testing and Measuring Circuits
424	UL 834-2004	Heating, Water Supply, and Power Boilers — Electric	
	-	UL 1693-2010	Electric Radiant Heating Panels and Heating Panel Sets
	-	UL 1995-2015	Heating and Cooling Equipment
	-	UL 1996-2009	Electric Duct Heaters
	-	UL 60335-1-2204	Safety of Household and Similar Electrical Appliances, Part 1: General Requirements
	-	UL 60335-2-40-2019	Household and Similar Electrical Appliances — Safety — Part 2–40: Part 2–40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers
425	UL 834-2004	Heating, Water Supply, and Power Boilers — Electric	
426	UL 1588-2002	Roof and Gutter De-Icing Cable Units	
427	UL 515-2015	Electrical Resistance Trace Heating for Commercial Applications	
	-	UL 1462-2006	Mobile Home Pipe Heating Cable
	-	UL 2049-2006	Residential Pipe Heating Cable
430	UL 248-13-2022	Low Voltage Fuses — Part 13: Semiconductor Fuses	
	-	UL 347	Medium-Voltage AC Contactors, Controllers, and Control Centers
	-	UL 347A	Medium Voltage Power Conversion Equipment
445	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3010	Single Site Energy Systems
450	IEEE C57.12.00	IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers	
	-	IEEE C57.12.28	IEEE Standard for Pad-Mounted Equipment — Enclosure Integrity
	-	IEEE C57.12.29	IEEE C57.12.29 IEEE Standard for Pad-Mounted Equipment — Enclosure Integrity for Coastal Environments
	-	IEEE C57.16	IEEE Standard for Requirements, Terminology, and Test Code for Dry-Type Air-Core Series-Connected Reactors
	-	UL 50-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations
	-	UL 50E-2020	Enclosures for Electrical Equipment, Environmental Considerations
	-	UL 248-1-2022	Low-Voltage Fuses — Part 1: General Requirements
	-	UL 248-2-2000	Low-Voltage Fuses — Part 2: Class C Fuses
	-	UL 248-3-2000	Low-Voltage Fuses — Part 3: Class CA and CB Fuses
	-	UL 248-4-2000	Low-Voltage Fuses — Part 4: Class CC Fuses
	-	UL 248-5-2000	Low-Voltage Fuses — Part 5: Class G Fuses
	-	UL 248-8-2011	Low-Voltage Fuses — Part 8: Class J Fuses
	-	UL 248-9-2000	Low-Voltage Fuses — Part 9: Class K Fuses
	-	UL 489-2016	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
	-	UL 1561-2011	Dry-Type General Purpose and Power Transformers
	-	UL 1562	Standard for Transformers, Distribution, Dry-Type Over 600 Volts
	-	UL 5085-2-2021	Low Voltage Transformers — Part 2: General Purpose Transformers
460	UL 810-2019	Capacitors	
	-	UL 1283-2017	Electromagnetic Interference Filters
	-	UL 60384-14-2014	Fixed Capacitors for Use in Electronic Equipment — Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains
470	UL 508-2018	Industrial Control Equipment	
	-	UL 1283-2017	Electromagnetic Interference Filters
495	IEEE C37.09	IEEE Standard Test Procedures for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V	
	-	IEEE C37.20.2	IEEE Standard for Metal-Clad Switchgear
	-	IEEE C37.20.3	IEEE Standard for Metal-Enclosed Interrupter Switchgear (1 kV–38 kV)
	-	IEEE C37.20.4	IEEE Standard for Indoor AC Switches (1 kV to 38 kV) for Use in Metal-Enclosed Switchgear
	-	IEEE C37.20.6	IEEE Standard for 4.76 kV to 38 kV Rated Ground and Test Devices Used in Enclosures
	-	IEEE C37.20.9	IEEE Standard for Metal-Enclosed Switchgear Rated 1 kV to 52 kV Incorporating Gas Insulating Systems
	-	IEEE C37.23	IEEE Standard for Metal-Enclosed Bus
	-	IEEE C37.41	IEEE Standard Design Tests for High-Voltage (>1000 V) Fuses and Accessories

Article	Standard Number	Standard Title
-	IEEE C37.42	IEEE Standard Specifications for High-Voltage (>1000 V) Fuses and Accessories
-	IEEE C37.59	IEEE Standard for Requirements for Conversion of Power Switchgear Equipment
-	IEEE C37.60	IEEE International Standard — High-voltage switchgear and controlgear — Part 111: Automatic circuit reclosers for alternating current systems up to and including 38 kV
-	IEEE C37.74	IEEE Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV
-	NEMA C37.54	American National Standard for Indoor AC High Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear — Conformance Test Procedures
-	NEMA C37.55	American National Standard for Switchgear — Medium Voltage Metal-Clad Assemblies — Conformance Test Procedures
-	NEMA C37.57	American National Standard for Switchgear — Metal-Enclosed Interrupter Switchgear Assemblies — Conformance Testing
-	NEMA C37.58	American National Standard for Switchgear — Indoor AC Medium Voltage Switches for Use in Metal-Enclosed Switchgear — Conformance Test Procedures
-	UL 347	Medium-Voltage AC Contactors, Controllers, and Control Centers
-	UL 347A	Medium Voltage Power Conversion Equipment
-	UL 347C	Outline of Investigation for Medium Voltage Solid State Resistive Load Controllers, Up to 15KV
-	UL 1008A-2017	Transfer Switch Equipment, Over 1000 Volts
-	UL 2748	Arcing Fault Quenching Equipment
-	UL 2877	Power Supplies, Medium Voltage
-	UL 3004	Outline of Investigation for Medium Voltage Junction Boxes
500	ANSI/IEEE C2	National Electrical Safety Code, Section 127A, Coal Handling Areas
-	ANSI/UL 121203	Recommended Practice for Portable/Personal Electronic Products Suitable for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2, Class III, Division 1, Class III, Division 2, Zone 21 and Zone 22 Hazardous (Classified) Locations
-	API RP 14F	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Division 1 and Division 2 Locations
-	API RP 500	Recommended Practice for Classification of Locations of Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
-	API RP 2003	Protection Against Ignitions Arising Out of Static Lightning and Stray Currents.
-	ASHRAE 15	Safety Standard for Refrigeration Systems.
-	ASME B1.20.1	Pipe Threads, General Purpose (Inch)
-	IEEE 844.2	Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance
-	IEEE 60079-30-2	IEEE/IEC International Standard for Explosive atmospheres — Part 30-2: Electrical resistance trace heating — Application guide for design, installation, and maintenance
-	IIAR 2	Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems
-	ISA-12.10	Area Classification in Hazardous (Classified) Dust Locations
-	ISO 965-1	ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data
-	ISO 965-3	ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads
-	NFPA 30-2024	Flammable and Combustible Liquids Code
-	NFPA 32-2021	Standard for Drycleaning Facilities
-	NFPA 33-2024	Standard for Spray Application Using Flammable or Combustible Materials
-	NFPA 34-2024	Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids
-	NFPA 35-2021	Standard for the Manufacture of Organic Coatings
-	NFPA 36-2025	Standard for Solvent Extraction Plants
-	NFPA 45-2024	Standard on Fire Protection for Laboratories Using Chemicals
-	NFPA 55-2026	Compressed Gases and Cryogenic Fluids Code
-	NFPA 58-2024	Liquefied Petroleum Gas Code
-	NFPA 59-2024	Utility LP-Gas Plant Code
-	NFPA 77-2024	Recommended Practice on Static Electricity
-	NFPA 497-2024	Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
-	NFPA 499-2024	Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installation in Chemical Process Areas

Article	Standard Number	Standard Title	
	-	NFPA 780-2026	Standard for the Installation of Lightning Protection Systems
	-	NFPA 820-2024	Standard for Fire Protection in Wastewater Treatment and Collection Facilities
	-	UL 60079-29-2-2018	Explosive Atmospheres — Part 29-2: Gas detectors — Selection, installation, use and maintenance of detectors for flammable gases and oxygen
	-	UL 120002-2022	Certificate Standard for AEx Equipment for Hazardous (Classified) Locations
	-	UL 120101-2019	Definitions and Information Pertaining to Electrical Equipment in Hazardous (Classified) Locations
	-	UL 121303-2020	Guide for Combustible Gas Detection as a Method of Protection
-	-	-	
501	UL 62-2018	Flexible Cord and Cable	
	-	UL 504-2022	Mineral-Insulated, Metal-Sheathed Cable
-	-	-	
503	NFPA 505-2024	Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations	
-	-	-	
504	ISA-RP 12.06.01	Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety	
505	ANSI/API RP 14FZ	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations	
	-	API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2
	-	API RP 2003	Protection Against Ignitions Arising Out of Static Lightning and Stray Currents.
	-	ASME B1.20.1	Pipe Threads, General Purpose (Inch)
	-	EI 15	Model Code of Safe Practice, Part 15: Area Classification Code for Installations Handling Flammable Fluids
	-	IEEE 844.2	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance
	-	IEEE 60079-30-2	Explosive Atmospheres — Part 30-2: Electrical resistance trace heating — Application guide for design, installation and maintenance
	-	IIAR 2	Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems
	-	ISA-60079-10-1 (12.24.01)	Explosive Atmospheres — Part 10-1: Classification of Areas — Explosive gas atmospheres
	-	ISA-60079-29-2	Explosive Atmospheres — Part 29-2: Gas detectors — Selection, installation, use and maintenance of detectors for flammable gases and oxygen
	-	ISO 965-1	ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data
	-	ISO 965-3	ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads
	-	NFPA 30-2024	Flammable and Combustible Liquids Code
	-	NFPA 77-2024	Recommended Practice on Static Electricity
	-	NFPA 497-2024	Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
	-	NFPA 780-2026	Standard for the Installation of Lightning Protection Systems
	-	UL 80079-20-1-2020	Explosive Atmospheres — Part 20-1: Material Characteristics for Gas and Vapour Classification — Test Methods and Data
	-	UL 120101-2019	Definitions and Information Pertaining to Electrical Equipment in Hazardous (Classified) Locations
	-	UL 121303-2020	Guide for Use of Detectors for Flammable Gases
-	-	-	
506	ASME B1.20.1	Pipe Threads, General Purpose (Inch)	
	-	IEEE 844.2	Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance
	-	IEEE 60079-30-2	Explosive Atmospheres — Part 30-2: Electrical resistance trace heating — Application guide for design, installation and maintenance
	-	ISA-60079-10-2 (12.10.05)	Explosive Atmospheres — Part 10-2: Classification of Areas — Combustible Dust Atmospheres
	-	NFPA 499-2024	Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
-	-	-	

Article	Standard Number	Standard Title	
511	NFPA 30A-2024	Code for Motor Fuel Dispensing Facilities and Repair Garages	
	-	NFPA 88A-2023	Standard for Parking Structures
512	ICC IFC	International Fire Code	
	-	NFPA 1-2023	Fire Code
	-	NFPA 30-2024	Flammable and Combustible Liquids Code
	-	NFPA 33-2024	Standard for Spray Application Using Flammable or Combustible Materials
	-	NFPA 36-2025	Standard for Solvent Extraction Plants
	-	NFPA 58-2024	Liquefied Petroleum Gas Code
	-	NFPA 70B-2023	Standard for Electrical Equipment Maintenance
	-	NFPA 497-2024	Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
513	NFPA 30-2024	Flammable and Combustible Liquids Code	
	-	NFPA 33-2024	Standard for Spray Application Using Flammable or Combustible Materials
	-	NFPA 409-2022	Standard on Aircraft Hangars
514	NFPA 2-2023	Hydrogen Technologies Code	
	-	NFPA 30A-2024	Code for Motor Fuel Dispensing Facilities and Repair Garages
	-	NFPA 52-2023	Vehicular Natural Gas Fuel Systems Code
	-	NFPA 58-2024	Liquefied Petroleum Gas Code
	-	NFPA 59-2024	Utility LP-Gas Plant Code
	-	NFPA 303-2026	Fire Protection Standard for Marinas and Boatyards
515	NFPA 30-2024	Flammable and Combustible Liquids Code	
516	NFPA 13-2025	Standard for the Installation of Sprinkler Systems	
	-	NFPA 33-2024	Standard for Spray Application Using Flammable or Combustible Materials
	-	NFPA 34-2024	Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids
	-	NFPA 77-2024	Recommended Practice on Static Electricity
	-	NFPA 91-2026	Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids
	-	NFPA 701-2023	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
620	UL 4-2004	Armored Cable	
	-	UL 44-2018	Thermoset-Insulated Wires and Cables
	-	UL 66-2023	Fixture Wire
	-	UL 504-2022	Mineral Insulated Wire
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 1569-2018	Metal-Clad Cable
625	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3010	Single Site Energy Systems
630	UL 1276-2015	Welding Cable	
650	UL 1651-2015	Optical Fiber Cable	
660	UL 62-2018	Flexible Cords and Cables	
	-	UL 817-2015	Cord Sets and Power Supply Cords
668	UL 4-2004	Armored Cable	
	-	UL 62-2018	Flexible Cords and Cables
670	UL 1740-2018	Standard for Robots and Robotic Equipment	
	-	UL 2011-2022	Machinery
	-	UL 3100	Standard for Automated Mobile Platforms (AMPs)
675	UL 44-2018	Thermoset-Insulated Wires and Cables	
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 83A-2016	Fluoropolymer Insulated Wire
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 1263-2020	Irrigation Cable
690	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3010	Single Site Energy Systems
691	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3010	Single Site Energy Systems
692	UL 44-2018	Thermoset-Insulated Wires and Cables	

Article	Standard Number	Standard Title	
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 83A-2016	Fluoropolymer Insulated Wire
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 3001-2023	Distributed Energy Generation and Storage Systems
	-	UL 3010	Single Site Energy Systems
694	UL 44-2018	Thermoset-Insulated Wires and Cables	
	-	UL 62-2018	Flexible Cords and Cables
	-	UL 83-2017	Thermoplastic-Insulated Wires and Cables
	-	UL 83A-2016	Fluoropolymer Insulated Wire
	-	UL 1063-2017	Machine-Tool Wires and Cables
	-	UL 3001-2023	Distributed Energy Generation and Storage Systems
	-	UL 3010	Single Site Energy Systems
700	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3008	Automatic Interconnection Switches for Emergency Systems
701	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3008	Automatic Interconnection Switches for Emergency Systems
702	UL 3001-2023	Distributed Energy Generation and Storage Systems	
705	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3010	Single Site Energy Systems
708	NEMA CY 10000-2023	Cybersecurity Implementation Guidance for Connected Electrical Infrastructure	
710	UL 3001-2023	Distributed Energy Generation and Storage Systems	
	-	UL 3010	Single Site Energy Systems

Statement of Problem and Substantiation for Public Comment

It appears as if the incorrect standard has been referenced for Article 130. Per the informational note in 130.2: See UL 916, Energy Management Equipment, for information on listed energy management equipment, and UL 3141, Power Control Systems, for information on listed PCS equipment.

Related Item

- FR-8095

Submitter Information Verification

Submitter Full Name: Jeff Nicholson
Organization: Lumin
Street Address:
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Submittal Date: Thu Jul 25 17:19:21 EDT 2024
Committee: NEC-P13

Public Comment No. 824-NFPA 70-2024 [New Part after I.]

706.5 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* .

Statement of Problem and Substantiation for Public Comment

While this was previously in 706.3, that section is now occupied by reconditioned equipment. Accordingly, this requirement and associated informational note is being recommended to be restored and relocated as 706.5 as this section is open. This requirement and associated informational note should not have been removed. The committee statement is incorrect in its contention that equipment installation by qualified persons is a code requirement. There is no such requirement.

Related Item

- FR-7899

Submitter Information Verification

Submitter Full Name: Palmer Hickman

Organization: Electrical Training Alliance

Street Address:

City:

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Zip:

Submittal Date: Mon Aug 05 17:58:54 EDT 2024

Committee: NEC-P13

Public Comment No. 1096-NFPA 70-2024 [Sections Part II., 130.50, 130.60, 130.70, 130.80]

Sections Part II., 130.50, 130.60, 130.70, 130.80

Part II. ~~EMS for Overload Control~~ Power Control Systems (PCS)

130.50 General.

Part II contains additional requirements for ~~EMS~~ PCS, which are EMS that provide controls required to prevent the overloading of conductors and equipment ~~through the use of a PCS~~ .

130.60 Conductors and Equipment

(A) Monitoring and Controls.

~~The EMS with PCS~~ The PCS shall include monitoring and automatic ~~control devices to~~ controls to prevent overload of conductors and power distribution equipment associated with ~~the EMS with PCS~~ the PCS .

(B) Malfunction.

~~The EMS with PCS~~ The PCS shall transition to a controlled state that prevents overload in response to a failure or malfunction affecting the ability to monitor and control currents within the PCS.

Informational Note: Examples of failure or malfunction ~~are operating conditions where~~ due to single fault conditions when the control system is not able to achieve or maintain the desired ~~setpoint value~~ control setting . Equipment failure, delayed response, or the loss of control or feedback elements are common causes of system malfunction.

130.70 Settings.

(A) ~~Current Setpoint~~ PCS Control Settings .

The ~~EMS with~~ PCS shall ~~be~~ include control settings capable of being ~~set to a current setpoint in~~ set in amperes for each controlled conductor, controlled source, or controlled load. - In the case of a controlled load, the PCS control setting shall be considered as a continuous load.

Informational Note: ~~Current setpoints~~ Control settings may be used for calculating the connected load(s) and or source(s). See 120.7 for application of ~~an EMS with PCS setpoint~~ a PCS control setting used in load calculations. 120.7 requires the PCS control setting to be set to no greater than 80 percent of the rating of the overcurrent protective device for the circuit for which the PCS is providing overload control.

(B) Adjustable Settings.

Adjustable settings for overload control functions shall be permitted ~~if access~~ , and if provided, shall be implemented through the PCS user interface. A PCS shall not utilize communication networks for adjustable settings. Access to the settings ~~is~~ shall be limited by at least one of the following:

(1) Located behind locked doors accessible only to qualified personnel

(2) Software that has password protected access to the adjusting means accessible to qualified personnel only

(3) Hardware such as dip switches located behind locked doors or areas requiring a tool for access

Exception: - ~~Adjustable trip circuit breakers with restricted access, as allowed in 240.6(C) or 240.6(D) , shall be permitted.~~ Adjustable settings for overload control functions shall be permitted using local, nonnetworked, communication networks for systems with multiple devices.

-

Informational Note: PCS control function(s) sometimes include communication interfaces to off-site devices for features not related to PCS control settings such as data monitoring, reporting, and status information.

-

130.80 Marking and Documentation.

(A) Marking.

The equipment that supplies the branch circuit, feeder, or service shall be marked with the following information:

(1) - ~~Current setpoint~~ PCS control setting (s)

(2) In other than one- and two-family dwellings, the date of calculation and identification of qualified personnel determining the settings

(3) Identification of loads and sources managed by ~~the EMS with PCS~~ the PCS

(4) The following or equivalent wording: "Circuits within this equipment are controlled by a power control system. The ~~current setpoints~~ control settings shall only be changed by a qualified person."

(5) Identification as eiher a multisource or single source PCS, as applicable.

Informational Note: A multisource PCS is rated for source control,, or source and load control. A single source PCS is rated for load control only.

The markings shall meet the requirements in 110.21(B) and shall be located such that they are clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

(B) Documentation.

A list of the monitoring

~~and control~~

, control function(s), and control equipment and associated settings that perform the overload control functions shall be documented and readily available.

Informational Note: ~~Listed EMS with PCS~~ Listed PCS may include specific hardware and software components that are detailed in the documentation included with the listing.

(C) Directory.

Where ~~the EMS with PCS~~ the PCS control equipment is not located within sight of the overcurrent device(s) for the controlled circuit(s), a directory identifying the controlled device(s) and associated circuit(s) shall be posted on the enclosure of the control device(s), disconnect, or branch-circuit overcurrent device.

Additional Proposed Changes

File Name	Description	Approved
NEC_130_part_II_edits_and_justification_Per_Scott_Picco_of_UL_Solutions.docx	Word format of changes proposed in Terraview. This is meant as a 2nd view of the proposed changes and does not have any differences relative of the changes submitted in Terraview.	

Statement of Problem and Substantiation for Public Comment

The use of the term EMS for PCS is unnecessary within the context of part II of 130. 130.2 already establishes that part II applies to a PCS. Simplifying the terminology within part II of 130 to "PCS" improves readability and clearly establishes PCS as the correct term for equipment providing overload control. Included edits revise all occurrences of "EMS with PCS" to "PCS".

130.60(A) has been revised to indicate that the controls of the PCS shall include monitoring and be capable of automatic control functionality. The term "control devices" was confusing when speaking about the need for automatic functionality to be present within a PCS.

130.60(B) added the word "controlled" preceding the word "state" to further clarify the type of state that the PCS shall transition to. Note the functional safety requirements of UL 3141 use the term "controlled state" when defining the type of action a PCS shall take upon presence of a single fault condition resulting in a PCS malfunction. The informational note also was revised to reference the single fault condition required by functional safety standards as well as within UL 3141. The note was also updated to use the term "control setting" rather than "setpoint value" to align terminology with UL 3141.

130.70(A) was revised to use UL 3141 terminology for PCS of "control settings" rather than "current setpoint". A new sentence was added to clarify that PCS controlled load(s) shall be considered as continuous loads per PCS requirements in 120.7. The informational note also expanded on the alignment of a PCS controlled load with continuous loads per 120.7 requirements.

The exception to 130.70(B) was revised to allow for local, nonnetworked interfaces only. The revised exception aligns with UL 3141 requirements that require PCS control functions and PCS control settings to be located locally (onsite) and adjustments of the settings only able to be implemented via local nonnetworked communication interfaces.

130.80(A)(1) was renamed "PCS control setting(s)" to align with UL 3141 terminology for PCS. Further, (A)(4) was revised to use the term "control settings" rather than "current setpoints" to align with UL 3141 terminology.

130.80(A)(5) was added to require a PCS be marked as either a multisource PCS or single source PCS. The suitability of the PCS for the overload application depends on the PCS type selected. A multisource PCS implements a PCS function that includes control of sources only, or PCS function that includes control of both source and load Single Source PCS address only load control (management) applications. These additions align with critical ratings and markings that are required in UL 3141. It is necessary to have the appropriate rating / marking present with a PCS to ensure it can be utilized to address multisource applications or single source applications. For example, a single source PCS would not be suitable or evaluated per UL 3141 for multisource operation.

130.80(B) was revised to include "control function(s)," and “control equipment” within the list of required documentation for a PCS. This was added to ensure the controlled function(s) are required to be provided within the documentation list to ensure a PCS is suitable for the installation application. Under the previous language, a list of the monitoring and control equipment was required. Revising the list to also require the control function(s) aligns with UL 3141 ratings and marking requirements and ensures compatibility with the PCS with the installation application.

Related Item

- FR 8095

Submitter Information Verification

Submitter Full Name: Scott Picco
Organization: UL Solutions
Street Address:
City:
State:
Zip:

Submittal Date: Wed Aug 14 14:19:26 EDT 2024
Committee: NEC-P13

Sections Part II., 130.50, 130.60, 130.70, 130.80

Part II. ~~EMS for Overload Control~~ Power Control Systems (PCS)

130.50 General.

Part II contains additional requirements for ~~EMS~~ PCS, which are EMS that provide controls required to prevent the overloading of conductors and equipment ~~through the use of a PCS~~.

130.60 Conductors and Equipment

(A) Monitoring and Controls.

~~The EMS with PCS~~ The PCS shall include monitoring and automatic ~~control devices to~~ controls to prevent overload of conductors and power distribution equipment associated with ~~the EMS with PCS~~the PCS.

(B) Malfunction.

~~The EMS with PCS~~ The PCS shall transition to a controlled state that prevents overload in response to a failure or malfunction affecting the ability to monitor and control currents within the PCS.

Informational Note: Examples of failure or malfunction ~~are operating conditions where~~ due to single fault conditions when the control system is not able to achieve or maintain the desired ~~setpoint value~~control setting. Equipment failure, delayed response, or the loss of control or feedback elements are common causes of system malfunction.

130.70 Settings.

(A) ~~Current Setpoint~~PCS Control Settings.

The ~~EMS with~~ PCS shall ~~be~~ include control settings capable of being ~~set to a current setpoint in~~ set in amperes for each controlled conductor, controlled source, or controlled load. In the case of a controlled load, the PCS control setting shall be considered as a continuous load.

Informational Note: ~~Current setpoints~~ Control settings may be used for calculating the connected load(s) and or source(s). See 120.7 for application of ~~an EMS with PCS setpoint~~ a PCS control setting used in load calculations. 120.7 requires the PCS control setting to be set to no greater than 80 percent of the rating of the overcurrent protective device for the circuit for which the PCS is providing overload control.

(B) ~~Local Restricted Access~~ Adjustable Settings.

Adjustable settings for overload control functions shall be permitted, and if provided, shall be on the PCS user interface. A PCS shall not utilize communication networks for the adjustable settings. ~~if~~ A~~a~~ccess to the settings shall be~~is~~ limited by at least one of the following:

1. Located behind locked doors accessible only to qualified personnel
2. Software that has password protected access to the adjusting means accessible to qualified personnel only
3. Hardware such as dip switches located behind locked doors or areas requiring a tool for access

~~3.~~ *Exception: Adjustable settings for overload control functions shall be permitted using ~~L~~local, nonnetworked, communication networks ~~for PCS control settings are permitted~~ for systems with multiple devices.*

Informational Note: PCS control function(s) ~~are permitted to~~can include communication interfaces to off-site devices for features not related to PCS control settings such as data monitoring, reporting, and status information

130.80 Marking and Documentation.

(A) Marking.

The equipment that supplies the branch circuit, feeder, or service shall be marked with the following information:

1. ~~Current setpoint~~PCS control setting(s)
2. In other than one- and two-family dwellings, the date of calculation and identification of qualified personnel determining the settings

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3. Identification of loads and sources managed by ~~the EMS with PCS~~ the PCS
4. The following or equivalent wording: "Circuits within this equipment are controlled by a power control system. The ~~current setpoints~~ control settings shall only be changed by a qualified person."
5. Identification as either a multisource or single source PCS, as applicable.

Informational Note: A multisource PCS is rated for source control, or source and load control. A single source PCS is rated for load control only.

The markings shall meet the requirements in 110.21(B) and shall be located such that they are clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

(B) Documentation.

A list of the monitoring ~~and control~~ , control function(s), and control equipment and associated settings that perform the overload control functions shall be documented and readily available.

Informational Note: ~~Listed EMS with PCS~~ Listed PCS may include specific hardware and software components that are detailed in the documentation included with the listing.

(C) Directory.

Where ~~the EMS with PCS~~ the PCS control equipment is not located within sight of the overcurrent device(s) for the controlled circuit(s), a directory identifying the controlled device(s) and associated circuit(s) shall be posted on the enclosure of the control device(s), disconnect, or branch-circuit overcurrent device.

Substantiation per Scott Picco:

The use of the term EMS for PCS is unnecessary within the context of part II of 130. 130.2 already establishes that part II applies to a PCS. Simplifying the terminology within part II of 130 to "PCS" improves readability and clearly establishes PCS as the correct term for equipment providing overload control. Included edits revise all occurrences of "EMS with PCS" to "PCS".

130.60(A) has been revised to indicate that the controls of the PCS shall include monitoring and be capable of automatic control functionality. The term "control devices" was confusing when speaking about the need for automatic functionality to be present within a PCS.

130.60(B) added the word "controlled" preceding the word "state" to further clarify the type of state that the PCS shall transition to. Note the functional safety requirements of UL 3141 use the term "controlled state" when defining the type of action a PCS shall take upon presence of a single fault condition resulting in a PCS malfunction. The informational note also was revised to reference the single fault condition required by functional safety standards as well as within UL 3141. The note was also updated to use the term "control setting" rather than "setpoint value" to align terminology with UL 3141.

130.70(A) was revised to use UL 3141 terminology for PCS of "control settings" rather than "current setpoint". A new sentence was added to clarify that PCS controlled load(s) shall be considered as continuous loads per PCS requirements in 120.7. The informational note also expanded on the alignment of a PCS controlled load with continuous loads per 120.7 requirements.

. The exception to 130.70(B) was revised to allow for <u>local, nonnetworked interfaces only. The revised exception aligns with UL 3141 requirements that require PCS control functions and PCS control settings to be located locally (onsite) and adjustments of the settings only able to be implemented via local nonnetworked communication interfaces.</u>

130.80(A)(1) was renamed "PCS control setting(s)" to align with UL 3141 terminology for PCS. Further, (A)(4) was revised to use the term "control settings" rather than "current setpoints" to align with UL 3141 terminology.

130.80(A)(5)was added to require a PCS be marked as either a multisource PCS or single source PCS. The suitability of the PCS for the overload application depends on the PCS type selected. A multisource PCS implements a PCS function that includes control of sources only, or PCS function that includes control of both source and load Single Source PCS address only load control (management) applications. These additions align with critical ratings and markings that are required in UL 3141. It is necessary to have the appropriate rating / marking present with a PCS to ensure it can be utilized to address multisource applications or single source applications. For example, a single source PCS would not be suitable or evaluated per UL 3141 for multisource operation.

130.80(B) was revised to include "control function(s)," and "control equipment" within the list of required documentation for a PCS. This was added to ensure the controlled function(s) are required to be provided within the documentation list to ensure a PCS is suitable for the installation application. Under the previous language, a list of the monitoring and control equipment was required. Revising the list to also require the control function(s) aligns with UL 3141 ratings and marking requirements and ensures compatibility with the PCS with the installation application.

Public Comment No. 327-NFPA 70-2024 [Global Input]

CMP 1 has deleted the definition for "In Sight From", and the requirements that were part of that definition are now located in 110.29. This global Correlating Committee Note directs all CMP's to review occurrences of the phrase "in sight from", "within sight from", and "within sight" and consider whether references to 110.29 or 110.39 should be included.

Additional Proposed Changes

File Name	Description	Approved
CN_26.pdf	NEC_CN26	✓

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 26 appeared in the First Draft Report on First Revision No. 9187.

CMP 1 has deleted the definition for "In Sight From", and the requirements that were part of that definition are now located in 110.29. This global Correlating Committee Note directs all CMP's to review occurrences of the phrase "in sight from", "within sight from", and "within sight" and consider whether references to 110.29 or 110.39 should be included.

Related Item

- First Revision No. 9187

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 29 17:05:29 EDT 2024
Committee: NEC-P01

Correlating Committee Note No. 26-NFPA 70-2024 [Global Input]

Submitter Information Verification

Committee: NEC-AAC

Submittal Date: Tue May 07 14:23:07 EDT 2024

Committee Statement and Meeting Notes

Committee Statement: CMP 1 has deleted the definition for “In Sight From”, and the requirements that were part of that definition are now located in 110.29. This global Correlating Committee Note directs all CMP’s to review occurrences of the phrase “in sight from”, “within sight from”, and “within sight” and consider whether references to 110.29 or 110.39 should be included.

First Revision No. 9187-NFPA 70-2024 [Section No. 225.41]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.

Bowmer, Trevor N.

Hickman, Palmer L.

Holub, Richard A.

Jackson, Peter D.

Kendall, David H.

Manche, Alan

Osborne, Robert D.

Porter, Christine T.

Schultheis, Timothy James

Williams, David A.

Public Comment No. 443
Assigned to CMP-5, Referred to CMPs 1 - 18

Public Comment No. 443-NFPA 70-2024 [Global Input]

The Correlating Committee directs all Code-Making Panels to verify cross-references to Article 200 are accurate due to the renumbering of the article.

Additional Proposed Changes

File Name	Description	Approved
CN_84.pdf		✓

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 84 appeared in the First Draft Report.

The Correlating Committee directs all Code-Making Panels to verify cross-references to Article 200 are accurate due to the renumbering of the article.

Related Item

- Correlating Committee Note No. 84

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
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Submittal Date: Tue Jul 30 17:35:49 EDT 2024
Committee: NEC-P05

Correlating Committee Note No. 84-NFPA 70-2024 [Global Input]

Submitter Information Verification

Committee: NEC-AAC

Submittal Date: Wed May 08 08:49:53 EDT 2024

Committee Statement

Committee Statement: The Correlating Committee directs all Code-Making Panels to verify cross-references to Article 200 are accurate due to the renumbering of the article.

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 504
Assigned to CMP-18, Referred to CMPs 1 - 17

Public Comment No. 504-NFPA 70-2024 [Global Input]

The Correlating Committee directs the CMPs to review the revision of the title of Article406 (Wiring Devices) and the new definition for the term "wiring device" in Article 100 forcorrelation of existing terminology using the newly define term in their articles.

Additional Proposed Changes

File Name	Description	Approved
CN_157.pdf		✓

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 157 appeared in the First Draft Report on First Revision No. 7965.

The Correlating Committee directs the CMPs to review the revision of the title of Article 406 (Wiring Devices) and the new definition for the term "wiring device" in Article 100 for correlation of existing terminology using the newly define term in their articles.

Related Item

- First Revision No. 7965

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:

Submittal Date: Tue Jul 30 22:29:14 EDT 2024
Committee: NEC-P18

Correlating Committee Note No. 157-NFPA 70-2024 [Global Input]

Submitter Information Verification

Committee: NEC-AAC

Submittal Date: Thu May 09 08:59:03 EDT 2024

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs the CMPs to review the revision of the title of Article 406 (Wiring Devices) and the new definition for the term "wiring device" in Article 100 for correlation of existing terminology using the newly define term in their articles.

First Revision No. 7965-NFPA 70-2024 [New Definition after Definition: Wireways, Nonmetallic. (No...]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 527
Assigned to CMP- 2, Referred to CMPs 1 - 18

Public Comment No. 527-NFPA 70-2024 [Global Input]

The CMPs are directed to review references to Article 220 in the articles under their purview and make necessary revisions based on Article 220 being relocated to Article120.

Additional Proposed Changes

File Name	Description	Approved
CN_212.pdf		✓

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 212 appeared in the First Draft Report.

The CMPs are directed to review references to Article 220 in the articles under their purview and make necessary revisions based on Article 220 being relocated to Article 120.

Related Item

• Correlating Committee Note No. 212

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jul 30 23:08:41 EDT 2024
Committee: NEC-P02

Correlating Committee Note No. 212-NFPA 70-2024 [Global Input]

Submitter Information Verification

Committee: NEC-AAC

Submittal Date: Thu May 09 11:53:08 EDT 2024

Committee Statement and Meeting Notes

Committee Statement: The CMPs are directed to review references to Article 220 in the articles under their purview and make necessary revisions based on Article 220 being relocated to Article 120.

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.
Bowmer, Trevor N.
Hickman, Palmer L.
Holub, Richard A.
Jackson, Peter D.
Kendall, David H.
Manche, Alan
Osborne, Robert D.
Porter, Christine T.
Schultheis, Timothy James
Williams, David A.

Public Comment No. 542
Assigned to CMP-3, Referred to CMPs 1 - 18

Public Comment No. 542-NFPA 70-2024 [Global Input]

The Correlating Committee directs the CMPs to review all references to requirements in Chapters 7 & 8 for accuracy in light of the relocation of requirements occurring in the First Draft.

Additional Proposed Changes

File Name	Description	Approved
CN_401.pdf		✓

Statement of Problem and Substantiation for Public Comment

NOTE: The following CC Note No. 401 appeared in the First Draft Report.

The Correlating Committee directs the CMPs to review all references to requirements in Chapters 7 & 8 for accuracy in light of the relocation of requirements occurring in the First Draft.

Related Item

- Correlating Committee Note No. 401

Submitter Information Verification

Submitter Full Name: CC Notes
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jul 30 23:39:04 EDT 2024
Committee: NEC-P03

Correlating Committee Note No. 401-NFPA 70-2024 [Global Input]

Submitter Information Verification

Committee: NEC-AAC
Submittal Date: Fri May 10 12:35:51 EDT 2024

Committee Statement

Committee Statement: The Correlating Committee directs the CMPs to review all references to requirements in Chapters 7 & 8 for accuracy in light of the relocation of requirements occurring in the First Draft.

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
1 Not Returned
11 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Not Returned

McDaniel, Roger D.

Affirmative All

Ayer, Lawrence S.

Bowmer, Trevor N.

Hickman, Palmer L.

Holub, Richard A.

Jackson, Peter D.

Kendall, David H.

Manche, Alan

Osborne, Robert D.

Porter, Christine T.

Schultheis, Timothy James

Williams, David A.

Public Comment No. 649
Assigned to CMP-1, Referred to CMPs 2 - 18

Public Comment No. 649-NFPA 70-2024 [Global Input]

Delete the words, "to be installed" everywhere they appear in the First Draft.

Statement of Problem and Substantiation for Public Comment

The term "to be installed" is always redundant. 90.2(C) says, "This code covers the installation and removal of electrical conductors, equipment, and raceways...". Every requirement of the NEC is about installation or removal (and requirements about removal are a very small minority). "Shall be permitted" and "shall not be permitted," as applied to equipment, mean that the subject equipment either is or is not allowed to be installed.
The new First Draft restrictions on reconditioned equipment seem to have overlooked the scope and purpose of the NEC. Adding the superfluous term "to be installed" also does not conform to 3.1.1, 3.1.2, and 3.5.1.1 of the NEC Style Manual.

Related Item

• FR-9197 • FR-9236 • FR-7868 • PI-3713 • FR-8938 • FR-7970 • FR-8831 • FR-8941 • FR-8944 • FR-8947 • FR-7925 • FR-7585 • FR-8136 • FR-8148 • FR-8984 • FR-8293 • FR-8362 • FR-8348 • FR-8360 • FR-7614 • FR-7658 • FR-7734 • FR-7746 • FR-8150 • FR-7717

Submitter Information Verification

Submitter Full Name: William Fiske
Organization: Intertek Testing Services
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City:
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Submittal Date: Fri Aug 02 09:19:44 EDT 2024
Committee: NEC-P01