



PROTECTION
ENGINEERS
GROUP

HUNTSVILLE, AL - MARCH 13-15, 2018

NEC Review of Public Inputs (PIs) Impacting the Communications Industry and EMC Updates

Presented by:

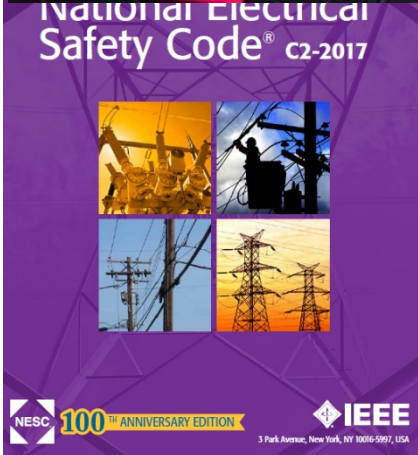
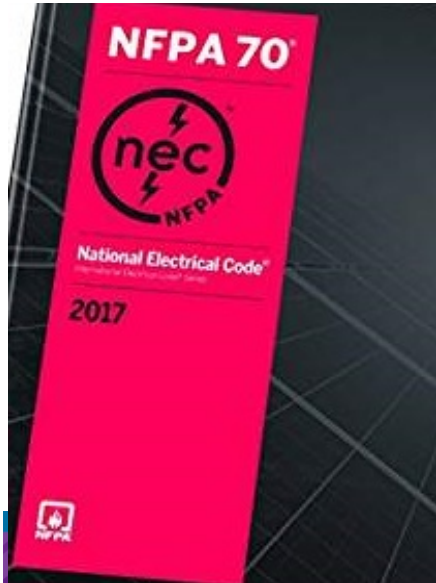
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Ericsson

- NEC
 - Overview
 - Preliminary Results of First Draft Meeting
 - Actions on ATIS-related PIs
 - Independence of Chapter 8
 - Relevant NEC & NESC Rules for Powering Circuits serving Communications Equipment
 - NFPA 70E
- Related Issues for GR-1089 and EMC





National Fire Protection Association
The authority on fire, electrical, and building safety



California Public Utilities Commission

Overhead Electric Line Construction



Prescribed by the
PUBLIC UTILITIES COMMISSION

- **NFPA – NEC & NFPA 70E**

- **IEEE – NESC**

- GO-95....GO128....GO165

- OSHA 1910.268/269

- Internal M&Ps

- **GRs and UL Listings**

- Joint Use Agreements (JUA)

- UL

- GRs/SRs

- ATI

- **Industry Safety Codes and Standards**

- **Regulatory Rules..... Legal Mandates**

- **Internal Practices.....Engineering Design**

Inside and On Buildings → NEC

Purpose = The practical safeguarding of persons and property from hazards arising from the use of electricity

- NFPA = Fire Protection

Scope – covers installation of electrical and communications (electrical and fiber optic) conductors, equipment and raceways, for

- Public & private premises (homes, residences, buildings, similar properties) ... inside
- Load side of the demarcation point
- Out of Scope (Exemption) = Exclusive control of Utility (Communications, Power....)

Not a Design Manual

OSP → NESC

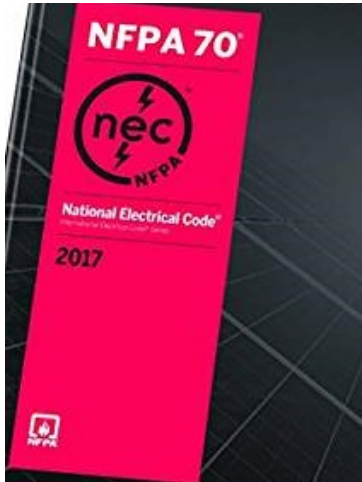
Purpose = The practical safeguarding of persons, utility facilities, and affected property during the installation, operation, and maintenance of electric supply and communication facilities.

- IEEE = Electrical Safety of Public and Workers

Scope - covers supply and communication facilities and associated work practices employed by a electric supply, communications, or railway in the exercise of its functions as a utility.

- Facilities = lines, equipment, and specified infrastructure (e.g., poles, distribution plant sub-stations, vaults...)
- The NESC covers similar systems under the exclusive control of the utility and being worked by qualified persons, such as those associated with an industrial complex or utility interactive system.

Not a Design Guide or Instruction Manual (*)

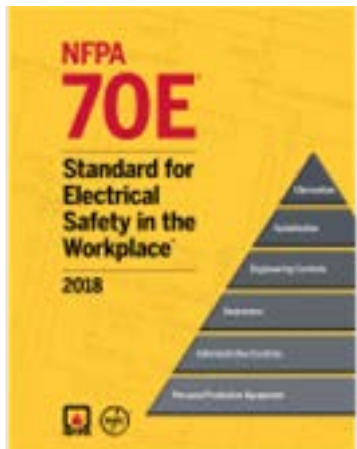


NEC = NFPA 70 - 3-year revision schedule

2017 NEC is in process of adoption by PUCs, legislatives and regulatory bodies

January 8-20, 2018 = First Draft Meeting

Oct. 28 –Nov. 9, 2018 = Second Draft Meeting



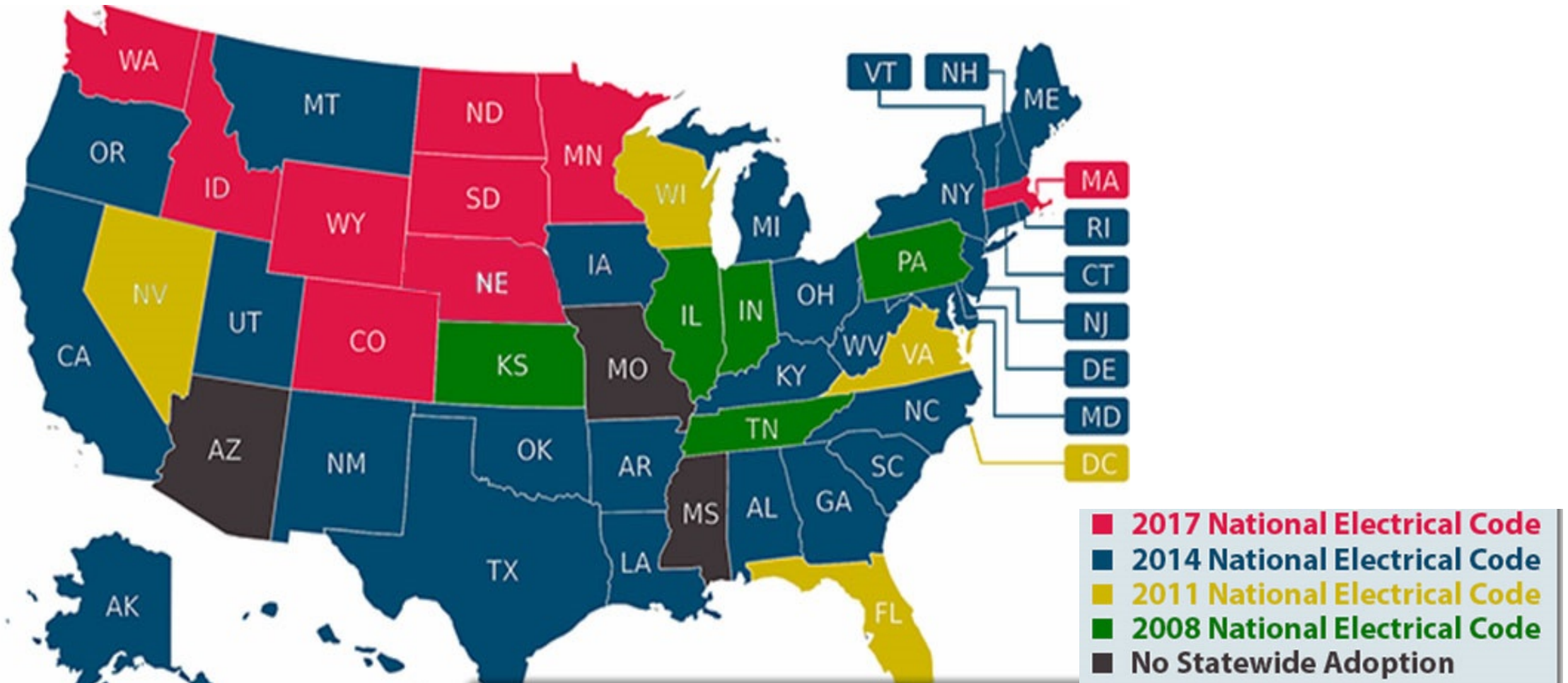
NFPA 70E

2018 - Consensus standard for *Workplace safety for protection against Electrical Hazards*

- Electrical Shocks
- Arc Flash
- Harmonize with OSHA 1910 Part-S & OSHA 1926 Part-K
- August 13-17, 2018 = First Draft Meeting

NEC Adoption – August 2017

IMPROVING NETWORK INFRASTRUCTURE RELIABILITY AND SUSTAINABILITY



Correlating Committee (CC) and 3 NEC Technical Committees (CMPs)

- **CMP 1** – Purpose and Scope (Arts. 90, 100 and 110),
- **CMP 5** – Grounding (Arts. 200, 250, 280 and 285),
- **CMP 16** – Communications Systems (Arts. 770, 800, 810, 820, 830 and 840),
- **NEC CC** - Oversight responsibility for the entire Code-making process, i.e., ensuring due process and correlating the technical committee actions
- Monitor other Panels and Actions – e.g., CMP3 (Article 300 – wiring methods, Chapter 9 - Table 11), CMP4 (Article 690, 692 - PV and fuel cell systems) and CMP12 (Article 645 IT equipment)...
- Related work on other NFPA Standards 70E, 72, 75 and 76.
- Includes participation in NEC Technical Committee and CC task groups
 - Membership Task Group for possible realigning of members and panel workloads
 - PoE Task group is looking at Article 840.160 and 725 looking at possible revisions
 - Implementation Task Group addressing the “simplification and consolidation of Chapter 8”.

- **Introduction and Nine Chapters**

- Article 90, *Introduction* - Purpose, Scope and Code Arrangement
 - **Section 90.2(B)(4)** and 90.2(B)5), 'Exemption'
 - **Section 90.3**, 'Independence' of Chapter 8
- Chapters 1 through 4 apply generally to Electrical installations, wiring and protection, grounding
 - Article 100 – *Definitions*,
 - Article 110 – General Installations
 - Article 250, *Grounding and Bonding* (**250.94 Intersystem Bonding**)
- Chapters 5 through 7 apply to special occupancies, equipment
 - Elevators, IT equipment, fire alarm systems, data centers
 - Article **645** - Information Technology Equipment (**645.10(B) – EPO**)
 - Article 690 & **691** - PV systems... 692 Fuel cells ... 694 - Wind..
 - Article 725 - Class 1-3, Remote, Signaling and Power-limited Circuits
 - **Article 770 (Fiber Optic)**



- Code Arrangement (cont'd.)
 - **Chapter 8, Communications Systems**
 - Article 800, *Communications Circuits*
 - Article 810, *Radio and Television Equipment*
 - Article 820, *CATV and Radio Distribution Systems*
 - Article 830, *Network-Powered Broadband Communications Systems*
 - **Article 840**, *Premises-Powered Broadband Communications Systems (Broadened in 2017)*
 - Chapter 8 is independent of Chapters 1 -7, except where specifically referenced in Chapter 8 - **Art. 770 → referenced in Section 800.3**
 - Parallelism and cross references between Sections/Articles





NEC Process Dates

IMPROVING NETWORK INFRASTRUCTURE RELIABILITY AND SUSTAINABILITY

Process Step	Date
Public Input (PI) closing date	Sept 7, 2017
First Draft (FD) meeting	Jan 8-20, 2018
Posting of FD for Panel ballot → FD panel ballots → Receipt of recirculation panel ballot	March 9 → March 23 → March 30 2018
Posting of FD for Correlating Committee (CC) → Correlating Committee Meeting	April 6 → May 8-11, 2018
Posting of FD for CC ballot → FD ballots of CC → Receipt of recirculation FD ballot of CC	June 15 → June 22 → June 29, 2018
Post final First Draft report	July 6, 2018
Public comment closing date	August 30, 2018
Second Draft (SD) meeting	Oct 22 – Nov 3, 2018
Posting of SD and panel ballot → SD panel ballots → Receipt of recirculation SD panel ballot	Dec 21 → Jan 11 → Jan 18, 2018
Posting of Second Draft for Correlating Committee (CC) → Correlating Committee meeting	Feb 1 → Feb 19-22, 2019
Posting of SD and CC ballot → SD ballots of CC → Receipt of recirculation SD ballot of CC	March 15 → March 22 → March 29, 2019
Post final draft for NITMAM review → NITMAM closing date	April 5 → April 26, 2019
Posting of certified amending motions	May 17, 2019
Association meeting to approve 2020 NEC	June 17-20, 2019



Caveat to all the following Highlights from First Draft Meetings

These are Preliminary Views.

**Formal ballot where 2/3 vote is required
shall not be finalized until March 30, 2018.**



NFPA Received – 3070 PIs over 19 CMPs → **CMP 1** addressed **233 PIs** → resulting in the development of **34 FRs** (First Revisions)

The portion of the NEC falling under the purview of CMP 1 is mainly power-oriented, except for Article 90, *Introduction*, Article 100, *Definitions*, and some portions of Article 110, *Requirements for Electrical Installations*. Article 90 applies to Chapter 8, as do the applicable definitions of Article 100.

Under the present NEC arrangement, the requirements of Article 110 apply only if specifically referenced in Chapter 8.

- **Independency of Chapter 8** (Communications) is under coordinated unprecedented attack in CMP 1, CMP 3 and CMP 16 as well as within the Correlating committee (CC)
 - Exemption & Scope (Article 90) – revision to 90.3 to remove independence was proposed and passed informal ballot 6-5. Our efforts to defeat during formal ballot continue through our membership on this committee to preserve the independence of Chapter 8.
 - Action to relocate “mechanical execution of work” requirements from 725.24, 760.24, 800.24, 820.24, 830.24 and 840.24 to a more general 110.12(C) was accepted by CMP1 with unsubstantiated technical changes, potentially resulting in increased requirements.
 - Chapter 8 & Article 770 - Telcordia, on behalf of ATIS, has succeeded in maintaining the status quo in CMP 16. CMP 16 accepted our preemptive PIs to place independence statements in 800.3, 820.3, 830.3 and 840.3 (as well as new proposed 890.3) to maintain independence of Chapter 8 no matter what happens in 90.3. These additions explicitly state that the requirements of Chapters 1 through 7 shall apply only where referenced in this article. Thus, that adverse effects of the proposed revision of 90.3 and 110.12(C) have been mitigated.
 - Feedback received on CMP 3 actions indicate that status-quo (independence) is maintained in Articles 300, 725, and 760.

1. Installed in a **neat and workmanlike manner**.
2. Installed in a manner that the cable will **not be damaged by normal building use**
3. **To Conform to 300.4(D)** - alerts the installer about when cables, conduits or raceways are attached to framing members and provides guidance on where to place cables so as not to be likely to be damaged by nails or screws. These are reasonable precautions which will apply more often in an open basement or in a Greenfield constructions where the building envelope or walls have not closed (i.e., sheetrock not placed). 300.4(D) is sufficient and adequate.
4. **To Conform to 300.11** -
 - 300.11 (A) – *Secured in place* = help ensure cables are securely fastened
 - 300.11 (B) defines limits for using raceways as *means of support*
 - 300.11 (C) – clarifies that cables shall not used as *means of support*

800.24...820.24...830.44...840.24 are coordinated and presently conform to the above objectives. 830.24 for

Network Powered systems includes “300.4(A), (D), (E), (F) and 300. 11...” based on possible power levels in conductors.

770.24 is misaligned with Chapter 8 Articles - The requirements of all of 300.4 are appropriate for power wiring, not optical fiber cables, traditional wire-line telephone service, and traditional CATV service.



Various PIs were submitted to add language to explicitly either:

- State that NEC covers PV solar farms interconnected to the power grid in 90.2(A), or
- Exclude Independent Power Producers (IPPs) as beyond the scope of NEC under 90.2(B)(5).

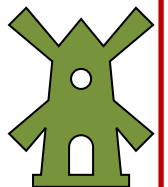


These PIs were resolved (rejected) with the following Panel statements

- “...Section 90.2(B)(5) adequately addresses installations not covered because they are under the exclusively control of the electric utility.....”
- “.....The special permission of 90.2(C) already addresses the concerns of the submitter.....”
→ This is a reference to the ability of the AHJ to grant exceptions for specific installations.

The recommended approach for code compliance for PV solar Farms, wind farms and other distributed generation facilities that are inter-connected to the power grid should be to:

- 1) Look towards the NESC as the baseline national safety code for the larger facilities and treat these facilities like electric utility substations (Part 1 of the NESC)
- 2) Use the NESC for obtaining acceptance and concurrence from AHJ for the facility.



CMP 5 addressed **268 PIs** → resulting in the development of **58 FRs** (First Revisions)

The purview of CMP 5 is grounding and bonding requirements.

Of all the articles under the jurisdiction of Panel 5, **Section 250.94 (Bonding to Other Systems)** covering the Intersystem Bonding Termination (IBT) is the one that pertains most directly to communications plant and contains explicit cross references to the optical fiber and communications Articles 770, 800, 810, 820 and 830.

All the PIs and CMP 5 actions were addressed in a manner acceptable to Telcordia's prepared positions and in accord with current best practices used in communications industry.

The Intersystem Bonding Termination (IBT) Section 250.94 remains unchanged.

- PIs to require an IBT for every customer in a multi-dwelling building were rejected unnecessary and overly restrictive.
- PI to mandate or encourage bonding of natural gas piping and other systems to the communications IBT were correctly rejected. The definition of IBT in Article 100 remains the same despite proposals to add gas piping to the definition. Gas piping rules belong in 250.104
- **The IBT shall and should exclusively remain for communications bonding and grounding purposes.**



CMP5 has control over grounding/bonding rules related to the IBT as well as for generators that communications companies use for backup powering systems and on aerial bucket trucks.

Supply-Side Bonding and Grounding Connectors (Section 250.24, 250.30)

- Revisions to 250.24 (*Grounding Service Supplied AC systems*) and 250.30 (*Separately Derived Systems*) to clarify language and rules to help cover systems on the load-side of the service point.
- One driver is for solar panel (photovoltaic) and other systems inter-connected with grid power services to premises with utility-interactive inverters.
- There is no direct impact on communications service providers
 - Details may become relevant when communications service providers are required to provide control, monitoring and alarm circuits to these distributed power generation facilities of wind/solar farm stations.
 - Better addressed in NESC since these facilities will usually be under exclusive control of service provider.

Portable and Vehicle-Mounted Generators (Section 250.34)

- Modifications to 250.34 rules applicable to portable and vehicular-mounted generators were added to clarify distinctions for trailer-mounted generators. None of these changes are of concern with communications industry practices for their bucket truck generators remain in harmony with the NEC and OSHA rules.
- Baseline functional requirements for generators are found in NFPA 110.

Sizing of Equipment Grounding Conductors (Section 250.122)

- Instead of sizing the EGC from the overcurrent device, the new method for sizing equipment grounding conductors will now be based on the size of the ungrounded circuit conductors – derived from UL 1569 (*Metal-Clad Cables*) and UL-1277 (*Tray Cables*).
- This approach provides sizing flexibility for industrial applications and commercial applications where multiple feeders, raceways and branch circuits are being used in a facility; while ensuring that adequate sized EGC conductors are available as a fault path. The changes to 250.122 should improve and clarify the code.

Copper Clad Aluminum and Copper-Clad Stainless Steel (CCSS) Grounding Conductors (250.28, 250.64, 250.120B)

- **Copper Clad aluminum in contact with soils** - Refinements on permitted use of aluminum and copper-clad aluminum grounding conductors were introduced into 250.28, 250.64 and 250.120(B) with associated sizing tables. Concerns about the susceptibility of aluminum materials to corrosion associated with moisture and soil contamination resulted in changes to particularly clarify that terminations in a listed sealed wire-connector system are also acceptable within 18 inches of the earth to avoid the corrosion problems often associated with aluminum in contact with soils.
- **Copper clad stainless-steel conductors** - Suggestions about adding details for copper clad stainless-steel conductors were rejected because
 - Local inspectors (AHJs) were concerned about not being able to clearly determine the applicable percent conductivity of the conductor.
 - Rigid CCSS product is not compatible with premises wiring applications and system bonding jumpers where flexibility and installation criteria (e.g., pulling through ducts) needs to be met consistently.

The use of copper-clad stainless-steel (CCSS) conductors is permitted under the current NEC and NESC language through the terminology such as “... or other corrosion-resistant material...” provided the necessary ampacity, resistance and impedance properties of the conductor are met. The use of copper clad stainless-steel conductors as grounding conductors at dedicated telecommunications facilities is permitted under the NESC rules.

Replacement of a copper conductor with a CCSS conductor is expected to require new connection and attachment hardware (new sizes and types). Using the same hardware for the larger size conductor can result in a less effective connection. Although appropriate splice and connector hardware are commercially available for utility facilities, such hardware is not normally NRTL listed since the utility companies who own and operate these facilities are outside of the scope of the NEC and those utilities provide their own functional performance and safety requirements for such hardware.

Possible applications of these conductors may be found on poles, cell towers and so forth where higher strength is desirable and theft a more likely possibility. Such applications are generally outside of the scope of the NEC.

The positive changes made to the 2017 NEC were re-affirmed in this First Draft meeting with no changes proposed in the Public Inputs (PIs) and no panel action to revise this section occurred.

(B) **Critical Operations Data Systems.** Remote disconnecting controls shall not be required for critical operations data systems when all of the following conditions are met:

- (1) An approved procedure has been established and maintained for removing power and air movement within the room or zone.
- (2) Qualified personnel are continuously available to ~~meet~~ **advise** emergency responders and to ~~advise~~ **instruct** them of disconnecting methods.
- (3) A smoke-sensing fire detection system is in place.

Informational Note: For further information, see **NFPA 72**, *National Fire Alarm and Signaling Code*.

CMP 16 addressed **250 PIs** → resulting in the development of **90 FRs** (First Revisions)

- Unprecedented attack upon the independence and stand-alone status of Chapter 8, Communications Systems, → discussed above under CMP1 items. Specific items relative to the simplification and consolidation of Chapter 8 addressed by CMP 16 included the following:
 - PI 2840 to combine Articles 800, 820, 830 and 840 into a single article that included a number of adverse, unsubstantiated revisions to requirements was resolved (rejected).
 - FR 7512 to create new Article 890, General Requirements for Communications Systems, without technical changes to requirements was accepted (11-6)Acceptance of new Article 890 [FR 7512] may be the better long term strategy (defense) to resist and mitigate attacks on the independence of Chapter 8. FR 7512 is preferable to the PI 2840 proposal.
- Related PIs to delete Sections 800.21, 800.24, 800.25 and 800.26 and relocate the requirements to either Article 300 or Article 110, and similar PIs for Articles 820, 830 and 840, were resolved (rejected).
- PIs submitted by Telcordia were accepted to counter possible revision of Section 90.3 to remove the stand-alone status of Chapter 8.

- There is relocation and deletion (in some places) of bonding and grounding Informational Notes and figures illustrating communications bonding with and without an intersystem bonding termination.
 - No fundamental problem with these actions – terminology issue has been currently addressed in manufacturer’s literature and industry guidance documents (e.g., Construction Blue Book).
 - Although these figures may have out-lived their usefulness within the NEC, confusion remains about use of precise grounding and bonding terminology within the code as opposed to general industry use of “grounding conductor” or “bonding conductor” for communications applications
- PI to eliminate the five-foot communications ground rod in 800.100(B)(3) was resolved (rejected). The 5 foot rod was based on research of Edison Electric Institute and Bell Labs in 1935 and has been successfully and safely used for 75+ years.

- New terms, “Communications Service Provider” or “Service Provider” has been introduced into 800, 820, 830 and 840, and is defined in 840.2, with the definition likely to be relocated to Article 100.

[840.2] Communications Service Provider. An organization, business, or individual that offers communications service to others.

The term was added to recognize the increasing number of situations where telecom services are provided by non-regulated parts of telecommunications utilities or other entities and to ensure that the NEC user understands that the Code applies also to these providers.

- The definition “Communications Circuit” in 800.2 was revised for clarity, deleting the “list” of service types that apparently caused confusion, and adding the term “service provider”.

“Communications Circuit: The circuit that electrically extends service from the communications utility or service provider up to and including the customer's communications equipment.”

- The proposed new definition has some problems, for example, communications service over optical fiber is not electric and cannot “electrically extend service”, that will likely be need to be addressed during the Second Draft phase of the NEC development process if this is accepted in the formal ballot.

- New definitions for “Broadband” and “Premises-Powered” were added to 840.2 as these terms are used in Article 840 but were previously undefined [FR 7856, 7859]. The new definitions are as follows:

Broadband. Wide bandwidth data transmission which transports multiple signals, protocols, and traffic types over various media types.

Premises-Powered. Using power provided locally from the premises.



- The term “premises” can cause confusion regarding the distinction between equipment located inside or outside of buildings. “Premises” can include both, often referred to as “contiguous premises”, depending on the provider’s point of service or demarcation point.

- PIs to remove the definition of abandoned cable from 800.2, 820.2 and 830.2 and relocate as a single, revised definition (with technical changes) in Article 100 were resolved (rejected).
 - The definitions are different for different network media and need to be separate.
 - Important distinctions exist in terms of labeling and termination for twisted pairs, coaxial and other cable types for circuits that are being reserved for future use.
- The PI to delete Article 830 was resolved (rejected) since the panel considered that 830 was useful to include for network powered communications circuits. With a variety of powering systems being proposed and designed for communications networks, the panel retained the Article 830 to cover one possible powering scheme.
- New Sections 840.94 and 840.102 were added to address lightning protection of circuits leaving the building to power equipment remote to the building.

Section 840.160 was revised to clarify listing requirements and to provide improved distinction between powering applications associated with lower level communications applications and those powering applications appropriately covered in Article 725. The proposed revised 840.160 is shown below.

840.160 Powering Circuits. Communications cables listed in accordance with 800.179, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment listed in accordance with 800.170. The power source shall be listed in accordance with 840.170(G). Installation of the listed communications cables shall comply with 725.144 where communications cables are substituted for Class 2 and Class 3 cables in accordance with 725.154(A).

Exception: Installing communications cables in compliance with 725.144 shall not be required for listed 4-pair communications cables where the rated current does not exceed 0.3 amperes in any conductor 24 AWG or larger.

Informational Note: A typical communications cable for this application is a 4-pair cable sometimes referred to as Category 5e (or higher) LAN cable or balanced twisted pair cable. These types of cables are often used to provide Ethernet and Power over Ethernet (PoE) type services. A large number of such powering cables bundled together can cause overheating of the wiring if not controlled as described in Table 725.144.





Applicable and Relevant NESC and NEC Rules for Communications Cables that Contain Powering Circuits For Communications Equipment

(slides 26 to 40 were updated based on the discussions during the ATIS-PEG meeting)



- If the power circuits are exclusively for providing power to communications equipment, then
 - They are defined as “communications lines” for purposes of NESC
 - Defined as “communications equipment” for purposes of NEC and therefore fall primarily under Chapter 8 unless other chapters/sections are specially and explicitly referenced from Chapter 8.
- Outside Plant Cables = located on supply side of service point and/or on network side of demarcation point are covered under NESC.
 - Such OSP cables are typically under the exclusive control of communications utility, therefore they are outside of scope of NEC as per NEC 90.2(B)(4).
- Premises Cables = located on load side or on the premises side of the demarcation point are covered under NEC Chapter 8.
- Service Drop Cables = may be covered by both NESC and NEC depending on the approach and knowledge of AHJ inspectors – the ground clearances, separations and other key parts of the two codes are basically in harmony at present.



The cables are treated as “communications lines” for general purposes of meeting applicable NESC clearance/separation, grounding, protection, and other relevant NESC rules.

NESC Section 2 – Definition of “**Communication Lines**” – provides considerable flexibility

- a. located in the communication space. The conductors and their supporting or containing structures, equipment, and apparatus that are used for public or private signal or communications service, and which operate at potentials not exceeding 400 V to ground or 750 V between any two points of the circuit, and the transmitted power of which does not exceed 150 W. When operating at not more than 90 V ac or 150 V dc, no limit is placed on the transmitted power of the system. Under specified conditions, communication cables may include communication circuits exceeding the preceding limitation where such circuits are also used to supply power solely to communications equipment. Fiber-optic cables are considered as communication lines, regardless of whether they are installed in the communication space or supply space in accordance with applicable rules,
- b. located in the supply space. Communication lines located in the supply space and meeting Rule 224A may (a) operate at any voltage, (b) include supply circuits of any voltage, or (c) be included within a supply conductor or cable operating at any voltage.

The specific NESC rules that apply to these cables carrying power circuits exclusively used for communications equipment are **Rule 224B** for aerial cables and **Rule 344** for buried/underground cables

B. Supply circuits used exclusively in the operation of communication circuits

Circuits used for supplying power solely to apparatus forming part of a communications system shall be installed as follows:

1. Open-wire circuits shall have the grades of construction, clearances, insulation, etc., prescribed elsewhere in these rules for supply or communication circuits of the voltage concerned.
2. Special circuits operating at voltages in excess of 90 V ac or 150 V dc and used for supplying power solely to communications equipment may be included in communication cables under the following conditions:
 - a. Such cables shall have a conductive sheath or shield that is effectively grounded.
 - b. All circuits in such cables shall be owned or operated by one party and shall be maintained only by qualified personnel.
 - c. Supply circuits included in such cables shall be terminated at points accessible only to qualified personnel.
 - d. Communication circuits brought out of such cables, if they do not terminate in a repeater station or terminal office, shall be protected or arranged so that in the event of failure within the cable, the voltage on the communication circuit will not exceed 400 V to ground.
 - e. Terminal apparatus for the power supply shall be so arranged that the live parts are inaccessible when such supply circuits are energized.

EXCEPTION: The requirements of Rule 224B2 do not apply to communication circuits where the transmitted power does not exceed **150 W**.



- The cables are treated as “communications equipment”, as per the Article 100 definition, for purposes of the NEC which takes one to the applicable and relevant parts of Chapter 8 -
 - 8XX.48 - 800.48, 820.48, 840.48 – this is the **50 foot rule** that permits the penetration of unlisted outside plant cables into the building (premises) before termination into a communications equipment. This point-of-entrance for the building can be extended further into the building by use of fire-rated conduits.
 - Therefore → Keep the network terminal and any sort of reverse powering or power distribution equipment as close as practical to the point of entrance.
 - 800.173 requires the service drop cable (the unlisted OSP cable) to have the adequate current carrying capacity which includes adequate conductor ampacity for powering currents without overheating the cables.
 - 8XX.179 – 800.179, 820.179, 830.179 – the cable shall have a voltage rating > 300 volts, and with a minimum temperature rating of greater than 60C. Although some cable types are identified in these sections, the **NEC does not prohibit other cable designs from being used providing they meet these minimum voltage and temperature ratings.**
 - Power limits for Coaxial cables are defined in Rule 820.15 (for CATV systems) and for network powered circuits in Rule 830.15 that point to Table 11 in Chapter 9.
 - **For premises powered systems, Section 840 would be the most relevant NEC section** to be used for these cables and installations including Rules 840.160 and 840.170 (cross reference 800.179) and 840.179 – see next slides



- **2017 Edition**
 - General permission provided for “...communications cables, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment...”
 - Permits substitution of listed communications cables to be used in place of Class 2/Class 3 cables providing 725.144 is met.
 - For circuits carrying > 60 watts, the installation needs to follow limitations of 725.144 to help prevent overheating of cables.
- **2017 Edition with revisions of TIA 70-17-12 – Dec 2017**
 - General permission remains for “...communications cables, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment...”
 - Continues the permitted substitution of listed communications cables in place of Class 2/Class 3 cables providing the cables meet 725.144 with revised text - “.....Installations of listed communications cables shall comply with 725.144 where listed communications cables are used in place of Class 2 and Class 3 cables...”
 - The cross reference to 725.144 in 840.160 is explicitly to the “installations” aspects of 725.144 which is where the allowable cable bundles and applicable current limits are defined. The reference from 840.160 is not meant to require meeting other parts of Section 725 or other chapters.
 - The reference to an upper limit of 60 watts was replaced with a clearer criterion of “.....nominal current does not exceed 0.3 amperes in any conductor...” that is more directly attuned to the immediate concern with power levels and over-heating of the conductor. The TIA also introduced a definition of “nominal current” into 840.2.
- **First Revision Draft (FR-7892) of 2017 Edition – January 2018** - The objectives were to consolidate the changes from the TIA, make the “installation” and “listing” references to 725.144 and 725.154(A) more explicit, and clarify the 840.160 text



840.160 Powering Circuits

Communications cables listed in accordance with 800.179, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment listed in accordance with 800.170. The power source shall be listed in accordance with 840.170(G). Installation of the listed communications cables shall comply with 725.144 where communications cables substituted for Class 2 and Class 3 cables in accordance with 725.154(A).

Exception: Installing communications cables in compliance with 725.144 shall not be required for listed 4-pair communications cables where the rated current does not exceed 0.3 amperes in any conductor 24 AWG or larger.

Informational Note: A typical communications cable for this application is a 4-pair cable sometimes referred to as Category 5e (or higher) LAN cable or balanced twisted pair cable. These types of cables are often used to provide Ethernet and Power over Ethernet (PoE) type services. A large number of such powering cables bundled together can cause overheating of the wiring if not controlled as described in Table 725.144.



840.160 Powering Circuits

Communications cables listed in accordance with 800.179, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment listed in accordance with 800.170. The power source shall be listed

the listed communications cables shall comply with 725.144 for Class 2 and Class 3 cables in accordance with 725.154(A)

Provides the permission for communications cables to carry both communications and power circuits.

Exception: Installing communications cables in accordance with 725.144 shall be permitted for listed 4-pair communications cables where the conductor is 24 AWG or larger.

Reference to 800.179 requires listed cables inside the building commensurate with location – CM, CMR, CMP....

The Section is entitled “Powering Circuits” showing that the concern as about power (watts) → that can be defined by voltage, current or a combination of both.

Reference to 800.170 requires listed equipment. Equipment (power source or communications device) and its electrical protectors that are designed for deployment inside premises should be listed and through that listing will meet the requirements of 800.170 and 725.121.

controlled as described in Table 725.144.



840.160 Powering Circuits

Communications cables listed in accordance with 800.179, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment listed in accordance with 800.170. The power source shall be listed in accordance with 840.170(G). Installation of the listed communications cables shall comply with 725.144 where communications cables substituted for Class 2 and Class 3 cables in accordance with 725.154(A).

Exception: Installing communications cables listed 4-pair communications cables with conductor 24 AWG or larger.

Informational Note: A typical communications cable referred to as Category 5e (or similar) cables are often used to provide power. A large number of such powering cables are controlled as described in Table 725.121.

The reference to 800.170 (for electrical protection) and 840.179G (which references Table 11B of Chapter 9) is specific to the receiving equipment and power source equipment respectively (not the cables) for their application environments inside the premises.

These power and electrical protection requirements are not new requirements for communications equipment.

Typical equipment (power source or communications device) and its electrical protectors that are designed for deployment inside premises should be listed and through that listing will meet the requirements of 800.170 and 725.121.



840.160 Powering Circuits

Communications cables listed in accordance with 800.179, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment listed in accordance with 800.170. The power source shall be listed in accordance with 840.170(G). Installation of the listed communications cables shall comply with 725.144 where communications cables substituted for Class 2 and Class 3 cables in accordance with 725.154(A).

Exception: Installation of communications cables shall be permitted to be larger.

Informational Note: Communications cables shall be permitted to be installed as Category 5 or higher cables to provide Ethernet networks bundled together.

- Permits the substitution of listed communications cables in place of Class 2/Class 3 cables providing the cables meet 725.144 . The cross reference to 725.144 is explicitly about “installations” aspects in 725.144.
 - The reference to “725.144” would be cleaner if it was to “Table 725.144” where one finds the focus on allowed current levels (power) in a conductor for given number of cables in an installed bundle.
 - The reference to “725.154(A)” would be cleaner if it was to “Table 725.154(A)” where the permitted substitutions of cables are defined.
- If the power levels used are in excess of the levels specified in Table 11 (Chapter 9) and/or Table 725.144 then a user should be providing adequate electrical protection and meeting the applicable parts of Class 2/Class 3 circuits in Section 725.
- The reference from 840.160 is not meant to require meeting all other parts of Sections 725 or other chapters.



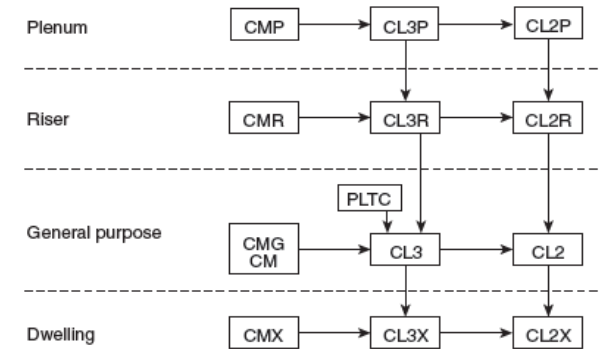
840.160 Powering Circuits

.....Installation of the listed communications cables shall comply with 725.144 where communications cables substituted for Class 2 and Class 3 cables **in accordance with 725.154(A).**

- This reference to 725.154(A) is a reference the **Table 725.154(A)** where the permitted substitutions of cables are defined.
- If the reference is taken to include the sentence in 725.154(A) “.....Where substitute cables are installed, the **wiring requirements** of Article 725, Parts I and III, shall apply....” in 725.154(A) then it is complicating and confusing because
 - The use of multiple terms of circuits, conductors, cables and wiring to describe the facilities are confusing about what specific rules of Part I and III apply. For example, which are the “the wiring requirements” as opposed to Class 2 or Class 3 circuit, cable or conductor requirements?
 - If the circuits meet Table 11, then they are exempted from requirements of Class 2 or Class 3 circuits for listed equipment under 725.121 Exception No. 2 to (3): Limited power circuits of listed equipment where these circuits have energy levels rated at or below the limits established in Chapter 9, Table 11(A) and Table 11(B).
 - It will be difficult to determine which other cross referenced sections and rules apply

Table 725.154(A) Cable Substitutions

Cable Type	Permitted Substitutions
CL3P	CMP
CL2P	CMP, CL3P
CL3R	CMP, CL3P, CMR
CL2R	CMP, CL3P, CL2P, CMR, CL3R
PLTC	
CL3	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC
CL2	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG, CM, PLTC, CL3
CL3X	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC, CL3, CMX
CL2X	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG, CM, PLTC, CL3, CL2, CMX, CL3X



Type CM—Communications wires and cables
 Type CL2 and CL3—Class 2 and Class 3 remote-control, signaling, and power-limited cables
 Type PLTC—Power-limited tray cable
 [A]→[B] Cable A shall be permitted to be used in place of cable B.

FIGURE 725.154(A) Cable Substitution Hierarchy.



840.160 Powering Circuits.

Exception: Installing communications cables in compliance with 725.144 shall not be required for listed 4-pair communications cables where the rated current does not exceed 0.3 amperes in any conductor 24 AWG or larger.....

- The exception is designed for circuits with low power levels where there is less than 0.3 amps per 24 AWG gauge (or larger) conductor. The limitation to 24 AWG and larger conductors was based on the available data in the Fact finding UL study provided to the panel.
- Communications cables typically use 22, 24 and 26 nominal gauges with the smaller 26 AWG conductors used in larger pair count OSP cables where cable size and weight are important for running in conduits or across longer aerial spans. Premises wiring typically use 22 or 24 AWG wire conductors and will fall under the exception. Smaller 26 AWG gauge conductors in OSP cables fall under the NESC.
- If power levels are more than 0.3 amps per conductor then installation of bundled cables will need to follow the limitations of Table 725.144 as to cable temperature rating and number of cables in a bundle. If power levels are sufficient high then considerations are required of conductor ampacity and related factors that could lead to overheating of conductor, cables, connectors or equipment.
- The 0.3 ampere level is a very conservative
- The exception should be broader – e.g., permit up to 1 amp in a 26 AWG or larger conductor in a 4-pair or 6-pair communications cable that is not part of a bundle (as per the .



Informational Note No. 5: See ANSI/NEMA C137.3-2017, *American National Standard for Lighting Systems — Minimum Requirements for Installation of Energy Efficient Power over Ethernet (PoE) Lighting Systems*, for information on installation of cables for PoE lighting systems.

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 Data Balanced Twisted-Pair Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86°F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables

AWG	Number of 4-Pair Cables in a Bundle																																				
	1			2-7			8-19			20-37			38-61			62-91			92-192																		
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating																					
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C																
26	4	4	4	1.00	1.23	1.42	0.7	0.71	0.8	0.87	1.02	0.5	0.55	0.6	0.68	0.7	0.78	0.4	0.46	0.5	0.57	0.6	0.67	0.4	0.45	0.5	0.55	0.6	0.64	NA	NA	NA					
24	2	2	2	1.19	1.46	1.69	0.8	0.81	1.01	1.17	0.6	0.63	0.7	0.78	0.9	0.91	0.5	0.55	0.6	0.67	0.7	0.78	0.4	0.46	0.5	0.56	0.6	0.65	0.3	0.40	0.4	0.48	0.5	0.55			
23	2.5	2.5	2.5	1.24	1.53	1.78	0.8	0.89	1.1	1.28	0.6	0.67	0.8	0.83	0.9	0.97	0.5	0.58	0.7	0.72	0.8	0.83	0.5	0.59	0.7	0.72	0.8	0.82	0.4	0.45	0.5	0.55	0.6	0.63			
22	3	3	3	1.41	1.60	1.86	2.1	2.16	1.04	1.2	1.28	1.4	1.49	0.7	0.77	0.9	0.95	1.1	1.11	0.6	0.66	0.8	0.82	0.9	0.96	0.6	0.62	0.8	0.77	0.9	0.89	0.5	0.53	0.6	0.63	0.7	0.72

Alternative conservative current value for 840.160 exception where unbundled cables or small bundles are used.

Source of the conservative current value used in 840.160 exception



840.160 Powering Circuits.

Informational Note: A typical communications cable for this application is a 4-pair cable sometimes referred to as Category 5e (or higher) LAN cable or balanced twisted pair cable. These types of cables are often used to provide Ethernet and Power over Ethernet (PoE) type services. A large number of such powering cables bundled together can cause overheating of the wiring if not controlled as described in Table 725.144.

- The informational note is not mandatory and provides the rationale and background for the power limitations and bundle size criteria found in 840.160 and Table 725.144.
- The last sentence in the informational note describes the safety concern that is driving the 840.160 requirement and this concern should drive the interpretation of the 840.160 rule, and its cross references to Table 725.144 in particular.



840.160 Powering Circuits

Communications cables listed in accordance with 800.179, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment listed in accordance with 800.170. The power source shall be listed in accordance with 840.170(G). Installation of the listed communications cables shall comply with Table 725.144 where communications cables substituted for Class 2 and Class 3 cables in accordance with Table 725.154(A).

Add
"Table"
for clarity

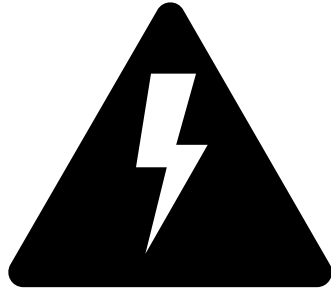
Exception 1: Installing communications cables in compliance with 725.144 shall not be required for listed 4-pair communications cables where the rated current does not exceed ~~0.3~~ 0.4 amperes in any conductor 24 AWG or larger.

Harmonize
with new
values
proposed in
FR-8941 for
725.144.

Exception 2: Installing communications cables in compliance with 725.144 shall not be required for listed 4-pair communications cables in bundles of less than 7 cables where the rated currents do not exceed 1.0 amperes in any conductor 26 AWG or larger.

Informational Note: A typical communications cable for this application is a 4-pair cable sometimes referred to as Category 5e (or higher) LAN cable or balanced twisted pair cable. These types of cables are often used to provide Ethernet and Power over Ethernet (PoE) type services. A large number of such powering cables bundled together can cause overheating of the wiring if not controlled as described in Table 725.144.

NFPA 70E





The National Fire Protection Association Code (NFPA) Standard 70E, titled *Standard for Electrical Safety in the Workplace*, is the consensus standard recognized by OSHA. This standard is a compilation of technical provisions designed to protect employees from exposure to electrical hazards, such as arc flash and shock hazards. Telecommunication facilities are considered a workplace.

2018 Edition Issued

Next cycle starts again - August 13-17, 2018 = First Draft Meeting

NFPA 70E *Standard for Electrical Safety in the Workplace* is related to the *National Electrical Code* (NFPA 70) as follows:

The National Electrical Code (NEC) describes how to design and install electrical systems but not how to actually perform the work.

- Section 110.16 in the NEC is intended to warn qualified persons of the hazard of arc flash and is a major step toward increasing the awareness of this potential for injury and death. Additionally, the Informational note (IN) to Section 110.16 references NFPA 70E and is a crucial link between the NEC and NFPA 70E.
- NFPA 70E describes safe work practices for electrical construction and maintenance but not how to design or install electrical systems.

The two documents (NEC and NFPA 70E) have identical scopes and many of the same definition. They both cover “inside” wiring in buildings and similar structures. Neither of them covers utility (line) construction which would be covered by the National Electric Safety Code (NESC).

NFPA 70E Covers Electrical Hazards Only - NFPA 70E describes how to protect workers from three kinds of electrical hazards:

- Electric shock and electrocution
- Arc-flash (electrical fireball)
- Arc-blast (electrical explosion at high energy levels)

The NFPA 70E standard covers electrical hazards and doesn't cover other construction hazards such as fall protection, safe use of ladders and scaffolds, hazardous substances, and respirators. These other subjects are covered by OSHA construction safety regulations and the NESC.



NFPA 70E Significance

It is important to note that NFPA 70E, is a series of guidelines rather than laws.

The Occupational Health and Safety Administration (OSHA), on the other hand, is a regulatory body. OSHA's regulations for worker health and safety are written in Title 29 of the Code of Federal Regulations (29 CFR). OSHA does not enforce NFPA 70E, and NFPA 70E is not incorporated in 29 CFR, yet employers can be cited for not following the standard.

It is **important to note** that as with the NEC, NFPA 70E would also come under the NEC Exception of Article 90 that it would not apply in areas under the exclusive control of the utility. However, OSHA would have enforcement authority under general work rule area.

The more pertinent areas of 70E for communication service providers, are focused on the information in 70E about the effects of arc flash, arc blast, and direct current (dc) hazards, along with recent protection trends and developments in electrical design and Personal Protective Equipment (PPE).

70E requires that, when working on or near exposed energized circuits, **safety-related work practices** shall be used to safeguard employees from injury while they are working on or near exposed electric conductors or circuit parts that are or can become energized.

The specific safety-related work practice shall be **consistent with the nature and extent** of the associated electric **hazards**. These work practices shall include wearing protective clothing and other personal protective equipment (PPE) when working with the flash protection boundary.

An **arc-flash hazard analysis** shall be done in order to protect personnel from the possibility of being injured by an arc flash. The flash hazard analysis shall determine the Flash Protection Boundary and the personal protective equipment that people within the Flash Protection Boundary shall use.

[In the NESC, the equivalent rule is the hazard risk assessment of NESC Rule 410A3]

70E also provides some descriptions associated with working distances, or boundaries, with respect to being a qualified versus unqualified person. These boundaries are as follows:

- **Flash Protection Boundary** - The distance at which the incident energy from the live part is equal to 1.2 cal/cm², the limit for a second-degree burn on bare skin. Persons must not cross this boundary unless they are wearing appropriate personal protective clothing and are under close the supervision of a qualified person.
- **Limited Approach** - The distance at which barriers should be placed to protect unqualified personnel from an electrical hazard. Only qualified persons and escorted unqualified persons are allowed to enter a limited space.
- **Restricted Approach** - The distance at which only qualified personnel are allowed with appropriate protective clothing and personal protective equipment for the associated hazard. No unauthorized conductive material and no unqualified persons are permitted to cross a restricted boundary. Further, a documented and management approved plan is required to enter a restricted space.
- **Prohibited Approach** - The distance at which qualified personnel should not introduce grounded equipment or material not insulated for the voltage rating due to the possibility of flashover. A documented and management-approved risk analysis and plan are required to enter a prohibited space.

- The major concern at the last meeting relative to the use of 70E by telecommunication service providers was proposed changes to TABLE 130.4 (C) (b) around the 50 Vdc vs 100 Vdc baseline criteria debate
 - Actual versus nominal voltages
 - Operational versus charging voltages
 - 100 Vdc vs 50 Vdc.....60 Vdc vs 50 Vdc
- The current edition uses 50 Vdc or ac as the safe limit with reference to nominal voltage, so the concern about float voltage to as high as 56 Vdc that is often found in the communications facility is covered on the nominal 48 or 50 V systems.
- Additional guards and unnecessary safety rules will not apply. .
- Electrical Worker safety - Arc Flash – it becomes a Risk/Hazard Assessment concern for Communications job activities
 - In general, risk assessments of communications worker jobs finds low-minimal risk in normal work activities following usual best practices and procedures
 - Also covered in NESC Work Rules (Part 4 – Rule 410A3)

- Section 2, "System-Level Electrostatic Discharge (ESD) and Electrical Fast Transient (EFT),"
 - Test methods have been updated for clarity.
- Section 3, "Electromagnetic Interference (EMI),"
 - The test methods have been updated for clarity.
 - Radiated emissions limits have been extended up to 40 GHz.
- Section 4, "Lightning and Power Fault,"
 - The test methods have been updated for clarity.
- Section 7, "Electrical and Optical Safety Criteria,"
 - The safety criteria have been updated.
- Appendix D, "Radiated Immunity in the Millimeter Wave Frequency Ranges"
 - An Informative Annex," is a new appendix that provides, for informational purposes, a test procedure for radiated immunity testing.
- Appendix E, "Section 4 First-Level Lightning Criteria Discussion,"
 - A new appendix that discusses the rationale for the requirements in Section 4.

- Continued efforts to refine and harmonize 840.160 and 725.144
- Continue maintain independence of Chapter 8
- Develop code changes (where necessary) to safely accommodate new technologies including pulsed (or interrupted) DC systems and other powering schemes that enter customer premises and building.



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***Thanks for
Your Attention***



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