

National Electrical Code (NEC) NFPA 70 and Electrical Safety in the Workplace NFPA 70E Update



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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

- IEEE – NESC
- NFPA – NEC & NFPA 70E

- 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

Purposes/Scopes

Inside 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

August 11, 2016 = Release of 2017 Code

Awaiting adoption into law by PUCs, legislatures and regulations

NFPA 70E

New edition – still in progress of working

Consensus standard

Workplace safety for protection against electrical hazards

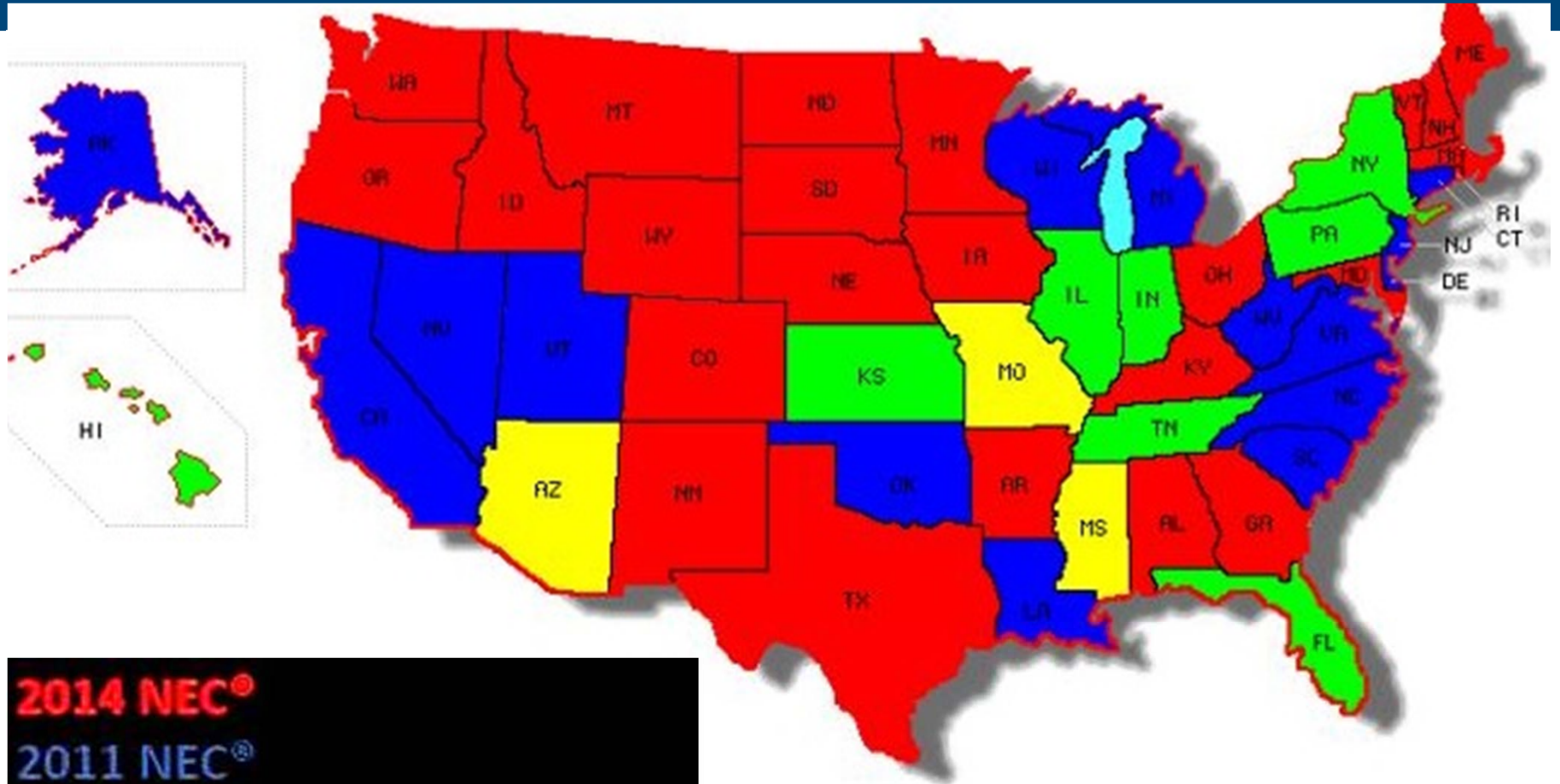
- Electrical shocks
- Arc flash

Other Codes -- GO 95, GO128, OSHA 1910.269/1910.268,general work rules

- **NEC** - Adopted by municipalities, legislative bodies, utility commissions and other Authorities Having Jurisdiction (AHJ)
 - Unlike voluntary standards, NEC[®] carries the force of law
 - Used by inspectors to approve electrical and communications installations
 - Impacts daily activities of communications utilities in providing services as well as manufacturers providing communications products.

NEC Adoption

- June 2015



2014 NEC®

2011 NEC®

2008 NEC®

No Statewide NEC® Adoption



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Representation



NEC = NFPA 70

Correlating Committee (CC)

3 NEC Panels (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 actions
- Monitor other Panel/Actions – Panel 12 (Article 645)
- Related work on other NFPA Standards 70E, 72, 75 and 76



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NEC - areas of Interest



- 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
 - Electrical installations, wiring and protection, grounding
 - Article 100 – *Definitions*,
 - Article 110 – General Installations (**Arc Flash Warning– 110.16**)
 - 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)**





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NEC - areas of Interest



- Code Arrangement (cont'd.)
 - **Chapter 8, Communications Systems**
 - Article 800, *Communications Circuits (General)*
 - 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 for 2017 code release)*
 - 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



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Reprise of NEC Action Plans



Support



IBT – revised definition and 250.94



Align Chapter 8 references with new 250.94



Revised definition of communications equipment

Article 645 changes – support proposed changes

Oppose



The expansion of the Mechanical execution of work from just 300.4(D) to include all of 300.4

OK in 800-840

770 ?



Consolidation of Chapter 8 sections – POTS, CATV, FTTH are different

deferred for moment



No impact for telecom

Neutral = Monitor Progress

- New Test and inspection section 110.41
- Revised definition of communications equipment
- New revised Article 840 – do we need higher power limits ?
- Monitor for mismatch between NEC and NESC rules



OK at moment
More to come

Continue to monitor



NEC (NFPA 70) Highlights

NEC = NFPA 70 - 3-yr revision schedule --- 2017 Code issued **August 11, 2016**

- Exemption & scope (Article 90) - Independency of Chapter 8 (Communications) – retained/no challenge
- Arc Flash labeling (Article 110.16) → necessary PPE is elsewhere (70E, OSHA, NESC 410A3, IEEE...)
- Grounding (CMP 5) – IBT harmonized with Chapter 8
 - EGC for parallel circuits (250.122F) ,
- Communications Systems (CMP16) - Articles 770, 800, 810, 820, 830 and 840
 - Mechanical Execution of installation work (770.24?)
 - Customer Powering of Networks/circuits (new 840.160 problematic) –
 - **Revised and expanded Article 840** to include not only FTTH but also PoE and 725.144,
 - 60 watts limit for 840 → goes to 725.144 otherwise (is 60 watts too low ?)
- Distributed Energy Generation (DEG)
 - Solar farms (new Article 692) -→ relationship with NESC)
 - Roof top solar panel systems remain under Article 691
- Article 645 (panel 12) – **Emergency power Off (EPO)** – positive 645.10 rule change affirmed.
- Related work on other NFPA Standards 70E, 72, 75 and 76



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Definition of Communications Equipment



Communications Equipment clarified.....

- **NEC Definition of Communications Equipment**

The electronic equipment that performs the telecommunications operations for the transmission of audio, video, and data, and includes power equipment (e.g., dc converters, inverters, and batteries), technical support equipment (e.g., computers), and conductors **dedicated solely to the operation of the equipment.**

*Informational Note: As the telecommunications network transitions to a **more data-centric network, computers, routers, servers** are becoming essential to the transmission of audio, video, and data and are finding increasing applications in communications equipment installations*

Possible Future Issues –

- **Different Powering schemes ...**
 - PoE, G-fast, customer powered services?
 - Distributed power generation – battery backup of individual frames
- **Devices with integrated Power and communications capacity**
 - Which is primary function?
 - What are acceptable power levels?



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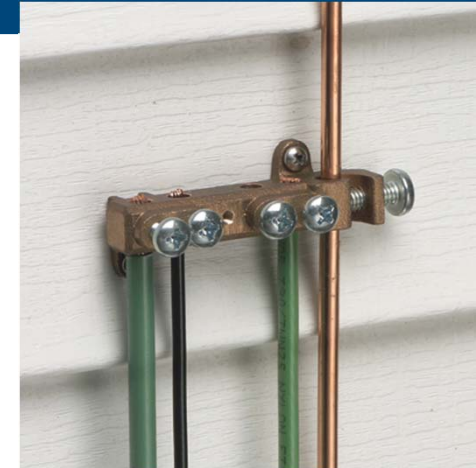
CMP 5 - Article 250.94

Intersystem Bonding Termination

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- CMP5 affirms that **primary purpose** for the IBT is to provide accessible bonding point for telecom ground with the power ground and ground electrode system.
- CMP 16 modified Chapter 8 grounding references and harmonized with new 250.94 - 770.100(B), 800.100(B), 810.21(F), 820.100(B), & 830.100(B)
- › Improved 250.94 - benefits for communications providers
 - **250.94 Bonding for Communication Systems** = change title to highlight and strengthen the rationale that the IBT is intended to provide a reliable common bonding point primarily for communications circuits to the power service grounding conductor and the grounding electrode system.
 - **Add a new 250.94(B) that provides an option to use a copper busbar as a bonding connection point if an IBT is not readily available.**
As communications facilities are extended and expanded to include many other buildings and structures, the ability to use such a busbar as a surrogate IBT will be useful for both communications companies and customers.





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CMP 12 Activities

Article 645 – IT Equipment



Revisions to 645.10 – Emergency Power Off -

- Single emergency disconnect potentially provides a single point of mechanical failure that increases the risk of false shutdown and can, through human error or criminal intent (sabotage, terroristic threat), shut down the entire data center resulting in disruption of normal business activity.



- Move to delete entire Article 645.10 → **Rejected**
- Change “qualified” to “knowledgeable” personnel → **Rejected**
- New language that does not require person to be on-site 24/7 and provides more flexibility for work schedule and personnel management .
→ **ACCEPTED → reaffirmed for 2017 code**

(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.



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CMP 16 - Mechanical Execution of Work



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*



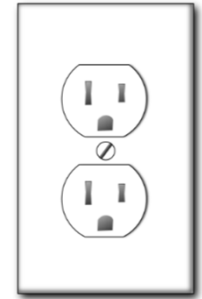
800.24...820.24...830.44...840.24 are coordinated and confirm to the above objectives. 830.24 for Network Powered systems includes “300.4(A), (D), (E), (F) and 300. 11...” based on possible power levels in conductors.

770.24 is misaligned with Chapter 8 Articles - Revisions for 2017 code were rejected resulting in a return to 2014 code text where it incorrectly expands the reference to all of 300.4 The requirements of all of 300.4 **are appropriate for power wiring, not optical fiber cables.**

- Expansion of Article 840 to cover Power over Ethernet (PoE) and other services that use twisted-pair and coaxial cables as well as optical fiber cable,

Scope: This article covers **premises-powered** broadband communications systems.

Informational Note No. 1: A typical basic system configuration consists of an **optical fiber, twisted pair or coaxial cable** to the premises supplying a broadband signal to a network terminal that converts the broadband signal into component electrical signals, such as traditional telephone, video, high-speed internet, and interactive services. Powering for the **network terminal** and network devices is typically accomplished through a premises power supply that might be built into the network terminal or provided as a separate unit. In order to provide communications in the event of a power interruption, a battery backup unit or an uninterruptible power supply (UPS) is typically part of the powering system.



- Concerns associated with safely powering premises equipment (PoE) over cables traditionally viewed as carrying only low-voltage, low-current signals were addressed by revisions.

— “LP” cable category - Types CMP-LP, CMR-LP or CM-LP ...





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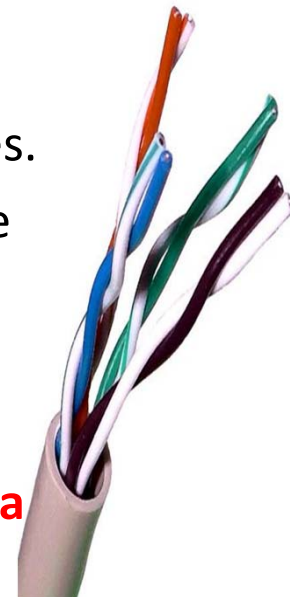
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New Article 840

.... cont....



- **Article 840 - 2017 code will reference**
 - **Article 770** for optical fiber cables
 - **Article 800** for communications circuits
 - **Article 820** for community antenna & radio circuits,
 - **Article 725** for Class 2, Class 3, and limited power circuits
 - **Article 760** for power-limited fire alarm circuits.
 - Numerous revisions are made throughout the Article to accommodate the introduction of twisted-pair and coaxial cables.
 - New Sections to provide listing requirements for equipment, the power source, and cables, and grounding devices.
 - Mainly through parallel sections and cross references to other Chapter 8 Articles and Sections
 - **Limited Power (new Section 840.160) -- Systems are limited to a maximum of 60 Watts for Article 840 to apply.**



- **Limited Power (new Section 840.160) -- Systems are limited to a maximum of 60 Watts for Article 840 to apply.**

“ 840.160 Powering Circuits. Communications cables, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment. Where the power supplied over a communications cable to communications equipment is greater than 60 watts, communications cables and the power circuit shall comply with 725.144 where the communications cables are used in place of Class 2 and class 3 cables. “

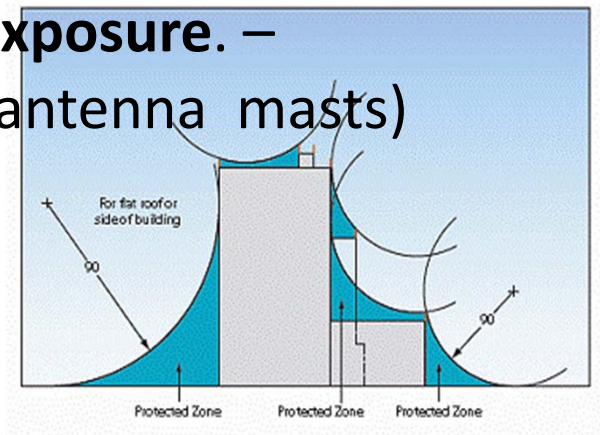
- For higher power then Article 725.144 applies .
- Concerns were around overheating of insulations and conductors in cable bundles where multiple powering circuits are present such as could be found in larger Server facilities or Data Centers.



Note: there are still applicable Power Limitations requirements found in Table 11 of Chapter 9 including the traditional 100 VA limit



- **Intersystem Bonding Termination and 250.94** - Harmonization
- Retention of permission to use **5-ft communications ground rod** in Articles 770, 800 and 830
- **Point of Entrance** Clarifications – Coordinated changes between Article 100 Definitions and subsections 48 in 770 and Chapter 8 (e.g., 770.48/800.48....840.48)
 - **50 foot Rule** – Allowances for the penetration of OSP cable (Unlisted) into a building.
- Added “**rolling sphere**” theory of lightning exposure. – correlates with **NFPA 780** (in Article 810 for antenna masts)
- **Consolidate** parallel Sections of Chapter 8 and 770 into a single Section 800
→ rejected

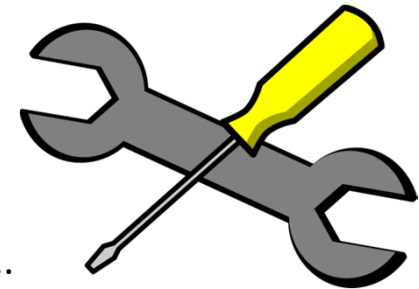


For the 2017 Code, all batteries will be covered in Article 480 regardless of chemistry.

Article 706 will reference Article 480 for batteries or require them to be listed. This may change going forward to the 2020 Code.

- Work Rules in and around
 - New battery/energy storage systems
 - Distributed energy generation/storage
 - NEC....NFPA 70E.... NESC
- Corodination with other NFPA documents

Future Code Issues



- **Future codes** – faster response to emerging technologies to enable codes keep up with rapid technological change
 - Possible Wider use of TIAs
 - On line tools and internet delivery of codes and services
- **Distributed/Alternate sources of energy** – wind, solar, microgrids, etc....
 - Smart Grid Devices – joint power and communications functions
 - Interconnection hardware
 - Power – primary supply and backup reserves
 - Batteries and other energy storage devices – reliability, safety , work rule around
- **Code demarcation**... delineate responsibility
 - OSHA vs NESC vs NEC 70E....Mm
 - NEC vs NESC vs customer premises/proprietary
 - Line side vs load side Span powering
- **Risk management – work rules** – Arc flash, PPE
- Congestion on structures and in underground and on Customer Premises
- Network Resiliency – design vs safety - Competing Views from Engineers (Design/Plan) -- Statisticians Risk Management – Meteorologists – Regulators – AHJs
 - Safety code as opposed to a design manual or engineering tool for making a reliable resilient network



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Future Code Issues



There are two important NEC task groups underway:

1. The Membership Task Group is reviewing possible realigning of members and panel workloads. Telcordia NIS (E.Gallo) is a member of this task group
2. The PoE Task group is looking at Article 840.160 and 725 looking at possible revisions through either a TIA or more likely to submit changes to the 2020 NEC. Telcordia NIS (E.Gallo) is the Chair of this task group and (J.Brunssen) is task group member.

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.

Schedule - Revision Cycle:

- Report Posting Date: 1/16/2017
- Motions Committee Report (NITMAM)
- Motions Committee Report (NITMAM)
- NITMAM Closing Date: 2/20/2017
- NITMAM Posting Date: 4/17/2017



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70 E - What's Covered



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 fine print note (FPN) 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.



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NFPA 70E Significance

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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 Coverage

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.

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 published version lists dc systems under 50 Vdc as safe and includes requirements for systems above 50 Vdc. This section does not note nominal 50V dc, so while a typical telecommunication facility is 48 Vdc, an AHJ can claim that the float voltage can be as high as 56 Vdc so the communications facility is considered higher than 50 Vdc.
- That could lead to requirements of guards, use of personal protective equipment when working on a typical 48 V dc system. This would not result in additional safety and could result in undue burdens.
- 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

*Thanks for
Your Attention*



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