Updates on Safety Codes
- NEC and NESC -

April 6th 2016

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Monroe LA

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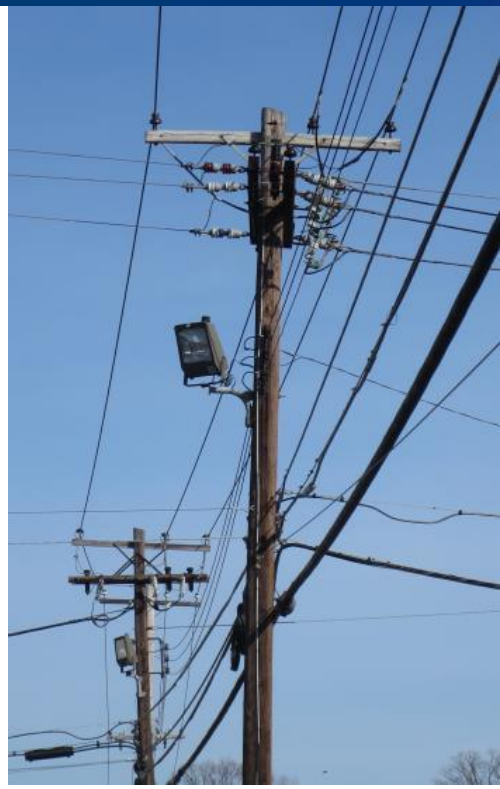
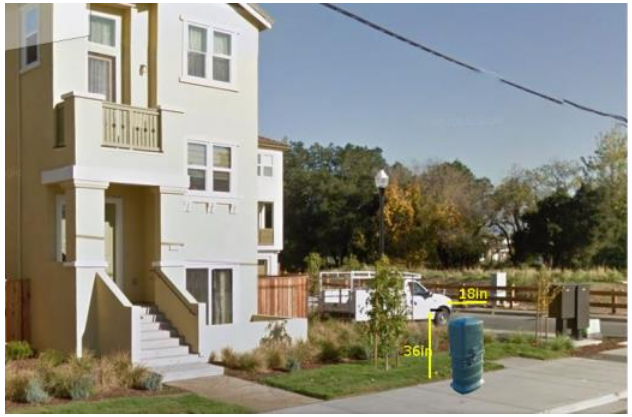
Overview

- NEC and NESC Code
- Revision Process
- Changes from Telecom Perspective
- Codes in Context
- 2015 PEG Reprise
- Topics and Concerns – Issues by Rule #
- Plans and Paths Forward – 2016……





Codes in Context

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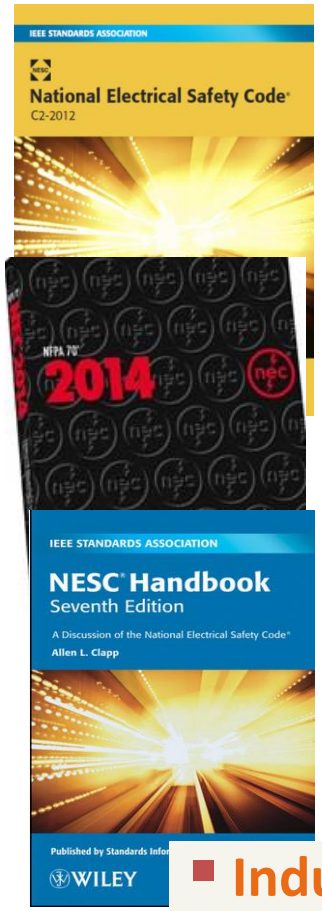


IEEE
Advancing Technology for Humanity

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

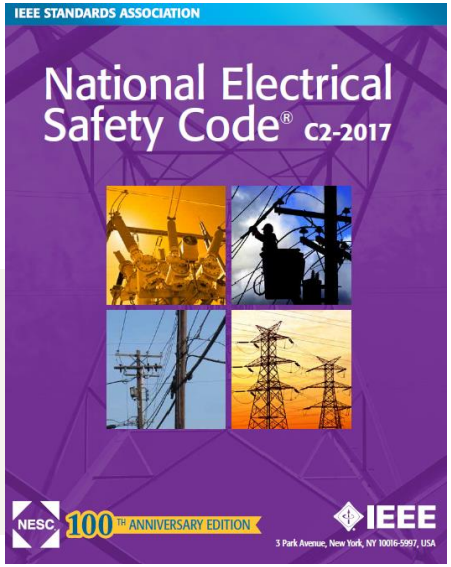
California Public Utilities Commission

Overhead Electric Line Construction

Prescribed by the
PUBLIC UTILITIES COMMISSION

- **IEEE – NESC**
- **NFPA -- NEC**

- GO-95….GO128….GO165
- OSHA 1910.268/269
- Internal M&Ps
  - GRs and UL Listings
- Joint Use Agreements (JUA)
- UL
- GRs/SRs
- ATIS
- etc……



- **Industry Safety Codes and Standards**
- **Regulatory Rules…… Legal Mandates**
- **Internal Practices……Engineering Design**

Purposes/Scopes

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 (*)

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 (*)

(*) The codes are often considered defacto minimum criteria used as starting baseline points for design/engineering calculations adding in various safety factors and clearances to provide high reliable, resilient and functioning networks.

Revision Process

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NEC = NFPA 70

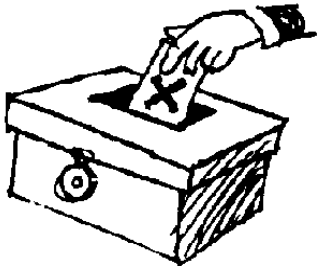
- 3-year revision schedule
- National Fire Protection Association
- Code-Making Panels (CMPs)
- Correlating Committee (CC), NFPA Standards Council
- Public Inputs (PIs) = change proposals
- Public Comments (PCs) on CMP actions
- 2014 Edition (released Sept 2013)
- Public Inputs by Oct/Nov 2014
- CMP action/ballots in Jan/Feb 2015
- NEC 2017 1st Revision report → July 2015
- Public Comments by Aug/Sept 2015
- CMP actions/ballots – 2nd Rev, Nov/Dec 2015
- CC actions – Jan-March 2016
- Final 2017 Draft - April 2016 (…NITMAN)
- Release of 2017 Code = **August 11, 2016**
- Applies on adoption by PUC, State legislative or local AHJ bodies – varies

NESC = IEEE C2

- 5-year revision schedule
- IEEE - Institute Electrical & Electronics Engineers
- Technical Subcommittee (SCs)
- Correlation and Coordination – SC1, Main & Exec Committees and Standards Committee
- Public change proposals (CPs)
- Public comments (CMs) on SC actions on CPs
- 2012 Edition (released Sept 2011)
- Change proposals by July 2013
- SC action on proposals, Sept 2013-May 2014
- 2017 Preprint issued for review in Sept. 2014
- Public Comment deadline = May 1st 2015
- SC action on comments during Aug. – Oct 2015
- Review by Main & Exec. Committees Jan/May 2016
- Final Draft of 2017 NESC released May 2016
- ANSI Approval
- Release of 2017 Code = **August 2016**
- Applies on adoption by PUC, State legislative or local AHJ bodies - varies

Process

- **NEC -** 4,500-to-5,000 Public Inputs (PIs) → First Revision (FR)
  - Comments → 2nd Revision
  - New process … More Electronic … More Pre-Meeting Work
- **NESC -** ~800 Change Proposals (CP) → Preprint
  - ~650-700 Public comment (CM) → 2017 Draft
- **Multi-Step Processes -**
  - Open processes with **several Public and Internal review steps**
  - PIs/CPs set tone and likely direction of code development
  - Each code has an Appeals process
  - Adoption Variations – State by State, PUC and AHJ inputs



- **Next Major Steps**
  - NEC 2017 Edition - **August 11, 2016** = Release date
    - June – NFPA Association Meeting (NITMAN…)
  - NESC 2017 Edition - **August 1, 2016** = Release date
    - May 15 – sent for ANSI approval
    - Oct 18-19 2016 – Summit (Future of NESC – process, format, scope)
  - Start developing Change Proposals for next cycle

Relevance

- 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.
- NESC - Adopted by most States and municipalities through legislative and/or regulatory (PUC) process after a review
  - Automatic use of latest edition or adoption of specific date
  - Some do piecemeal adoption – Part 4 (Work Rules)
  - Some States have separate independent codes – e.g., GO95 (California).
  - Contractual basis of Joint-Use and Pole Agreements & Inter-Company Contracts.

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NEC Adoption

- June 2015

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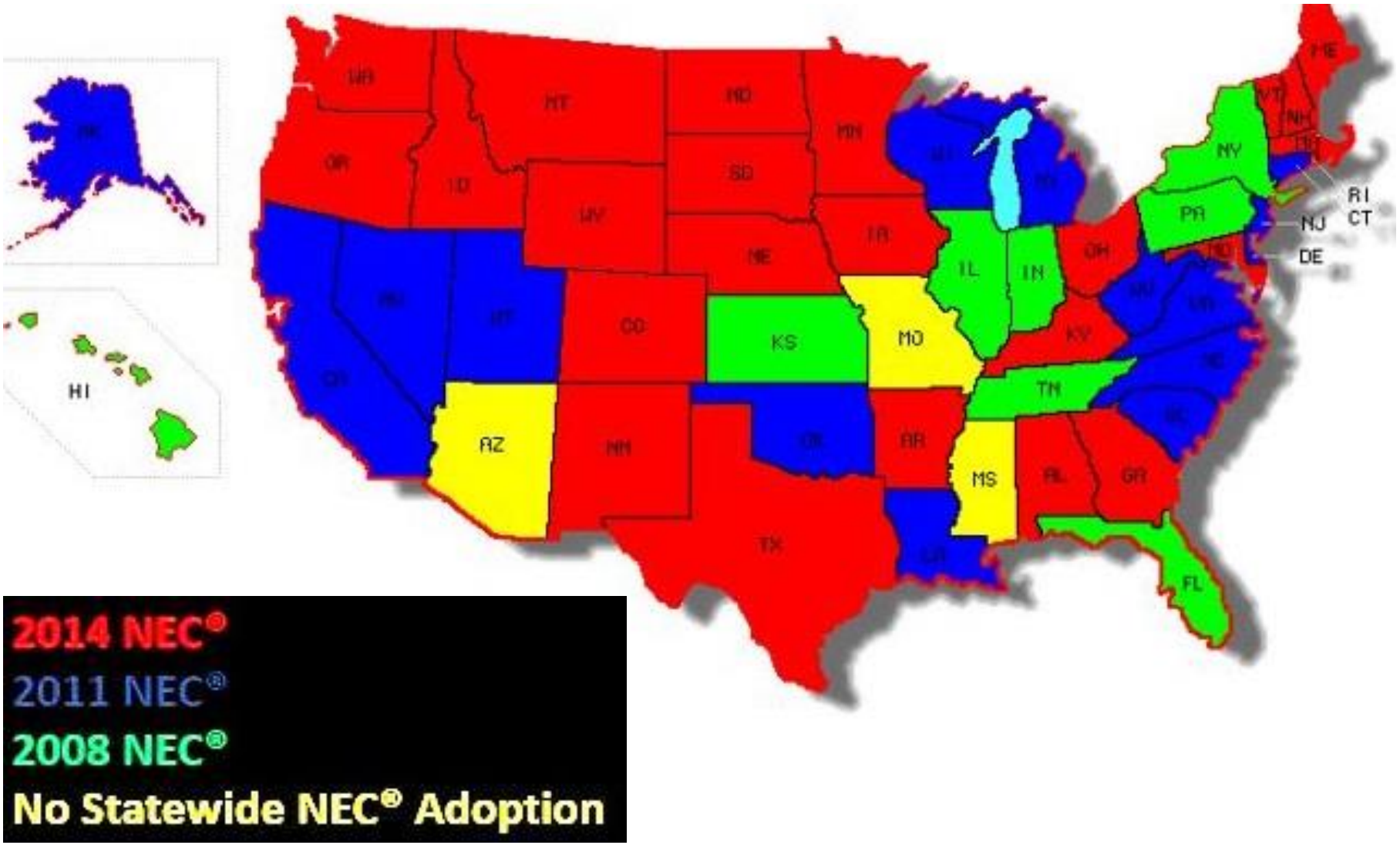

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NESC Adoption

Based on 2007 survey data

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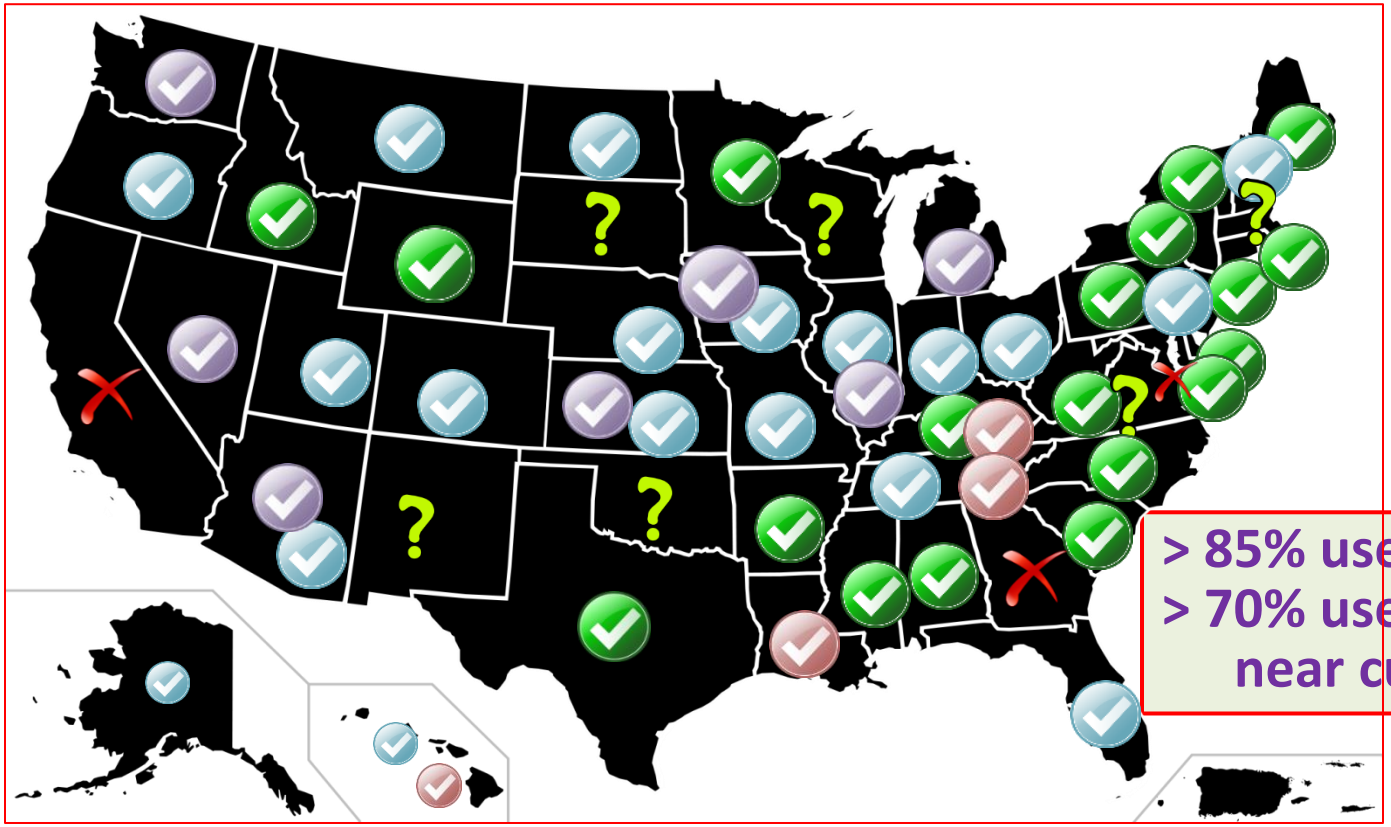


> 85% use in some form
> 70% use current or near current version

Automatically adopts latest NESC	Adopts current NESC after review	Currently use old Edition or part of NESC	Uses NESC to develop internal code	Does not use NESC	Status Unclear
✓	✓	✓	✓	✗	?

NESC -- 100 Year Anniversary Issue

- Keep the NESC active, real, practical, useful and used for next 100 years **(standards.ieee.org/about/nesc & www.standardsuniversity.org/videos)**
- Review of the scope, purpose and operating procedures to help position the code for the new networks and technologies to come

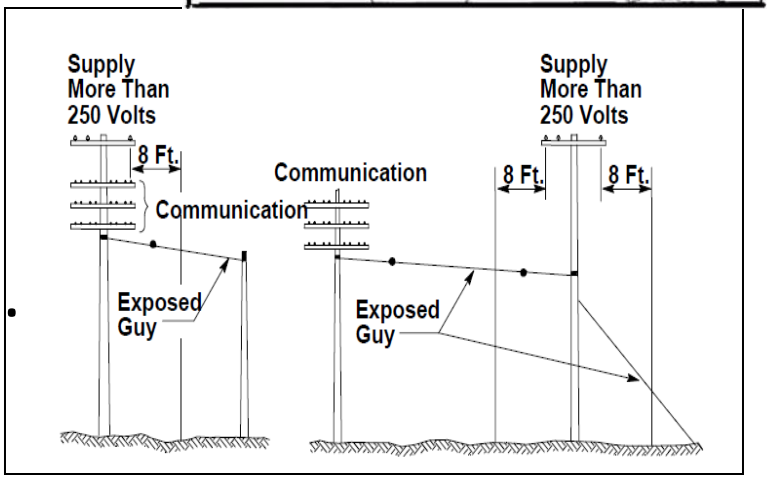
Summits – "Past, Present, and Future" April 2015 - Alexandria, VA

Workshop: Changes for the Future Oct 18-19, 2016, San Antonio, TX

- Raise awareness and importance of NESC to stakeholders such as utilities, government, industry (non-utility), trade associations, and the public;
- Seek input on the future direction of the NESC – to increase use, scope and relevance of the NESC code
  - Scope & purpose issues - connection with design/engineering choices and role in attaining a reliable and resilient network
  - Procedural matters - 5-year Vs. 3-year cycle, code segmentation, Fast track

Safety Versus Reliability versus "Resiliency"

- Safety codes – Defacto Minimum Criteria
- Plus Business and Design/Engineering factors & choices for the desired
  - Functional Performance Objectives
  - Quality & Reliable level of Networks
  - Resiliency Level for Services
  - Criticality of Services
    - – E911, hospitals, smart grid, military, police…..



ATIS 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

NESC = IEEE C2

C2 Standards Committee

6 of the 7 NESC Subcommittees

(not on substations SC 3)

- **SC1** – Purpose, Scope definitions
- **SC 2** – Grounding (Rules 09….)
- **SC 4** – Aerial Clearances (Rules 20-23)
- **SC 5** – Strength/Loading (Rules 24-26)
- **SC 7** – Underground/Buried (Rules 30-34)
- **SC 8** – Work Rules (Part 4 - Rules 40-44)
- **Main and Executive** Committees
- C2 Standards Committee - Oversight responsibility for the entire Code-making process, i.e., ensuring due process and correlating the actions
  - ANSI review
  - Interpretation Requests

Reprise of NEC Action Plans - 2015 PEG -

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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

Neutral = Monitor Progress

- New Test and inspection section 110.41 — No impact for telecom
- Revised definition of communications equipment — See above
- New revised Article 840 – do we need higher power limits ? — OK at moment More to come
- Monitor for mismatch between NEC and NESC rules — Continue to monitor

Reprise of NESC Action Plans - 2015 PEG -

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Support

- New definitions of supply and communications equipment
- Support revision to Rule 97G to help clarify intersystem bonding
- Support new revision to Battery rule 420 G
- Revise 224B to match modified 334
- Changes to 235H – clearances between communications lines
- Retention of Grade N
- Support change to Rule 344
- Support revision to Rule 354D

Oppose

- Proposals to develop definitions of supply and communications space — Changes OK at moment
- Changes to preferred level Rules 220 — Changes OK at moment – monitor rule application
- Deletion of exemption for 60 ft pole
- Any proposal to prohibit metallic buckets

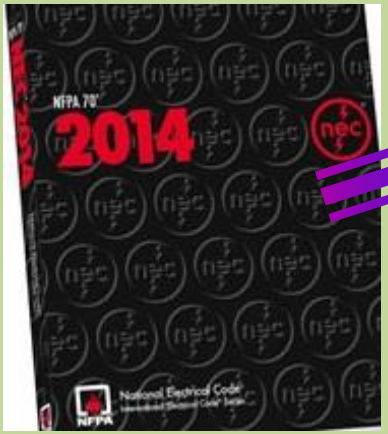
Neutral = Monitor Progress

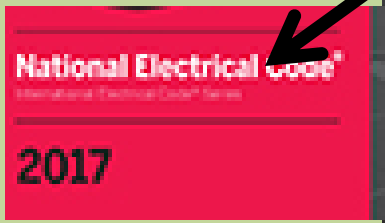
- Monitor GO 95 activities for new ideas to avoid or those to emulate — Continue to monitor
- Attend NESC Summit – better ways to use NESC to support telco industry
- Review Guy/Insulator (215), marker (217) & Vegetation Mgm (218) — Continue to monitor rule application
- Monitor "K additive Constant" debate to help ensure consistency — OK at moment - more to come
- Support OSHA harmonization efforts for arc flash, fall protection, MAD –Part 4
- Monitor "Structure Conflict" debate — OK at moment – more to come

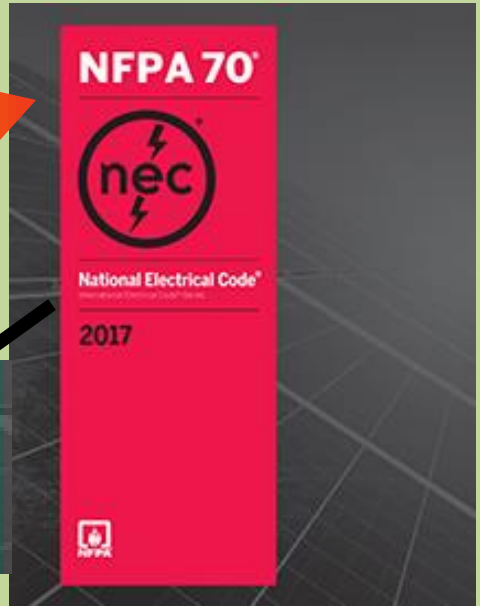
NEC

NEC Highlights

by CMP & Topic







NEC Code Arrangement - 1

- 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)**

NEC Code Arrangement - 2

- 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 requirements are specifically referenced within Chapter 8 ……. **Article 770** → reference as a whole in Section 800.3
    - Parallelism and cross references between Sections/Articles
  - Chapter 9 consists of tables that are applicable as referenced
    - Conduit fill, conductor properties, power source limitations

CMP 1 Activities

No challenges or changes to the important provisions for communications industry systems

- **Section 90.2(B)(4) -** facilities under exclusive communications utility control are not covered (i.e., **out of scope of NEC**)

  The 'exemption' precludes electrical inspection being required for central office, telephone closets, and similar facilities; the safety & reliability of which has been fully covered by industry best practices and internal specifications (e.g., GRs) for many decades.

- **Section 90.3** - Chapter 8, *Communications Systems*, is not subject to the requirements of Chapters 1–7 unless explicitly referenced (e.g., 800.3 points to 770) precludes application of inappropriate electrical power requirements to the low voltages communications facilities.

CMP 1 Changes

ARC Flash (110.16) Arc Flash – Risk assessment and Warning Labels

- OSHA…. NFPA 70 (NEC) and 70E … NESC Rule 410A …….IEEE 516……..IEE 1584
- Risk assessment for Telecom workers finds low-minimal risk in normal work activities

Working Spaces around equipment and safe exit/egress (lighting, space…)

Voltage Limits … 600 to 1000 Volts vs ~~2000 volts~~ (Solar Farms..)

Actual versus Nominal Volts - "Nominal" is particularly apt, more flexible and useful for telecom applications – Note clarifies definition

Listed versus Labelled

- NRTL Listed vs labeled vs marked vs approved vs Certification marks
- Product specifications and testing (GRs)
- CC considers that "and labeling" is unnecessary

Qualified - Public vs unqualified vs authorized persons vs licensed electrician

  - Qualified is equated with training → Qualified = " one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved"

CMP 5 - Article 250.94 Intersystem Bonding Termination

- CMP 5 rejected PIs that would have expanded items mandated or allowed to bond to IBT [e.g., corrugated gas piping (CSST)]
- 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 to use such a busbar as a surrogate IBT will be both communications companies and custo

New 250.94

250.94 Bonding for Communication Systems. Communications system bonding terminations shall be connected in accordance with (A) or (B).

(A) Intersystem Bonding Device. An intersystem bonding termination (IBT) for connecting intersystem bonding conductors shall be provided external to enclosures at the service equipment or metering equipment enclosure and at the disconnecting means for any additional buildings or structures. If an intersystem bonding termination device is used it shall comply with the following:

(1) Be accessible for connection and inspection.

(2) Consist of a set of terminals with the capacity for connection of not less than three intersystem bonding conductors.

(3) Not interfere with opening the enclosure for a service, building or structure disconnecting means, or metering equipment.

(4) At the service equipment, be securely mounted and electrically connected to an enclosure for the service equipment, to the meter enclosure, or to an exposed nonflexible metallic service raceway, or be mounted at one of these enclosures and be connected to the enclosure or to the grounding electrode conductor with a minimum 6 AWG copper conductor

(5) At the disconnecting means for a building or structure, be securely mounted and electrically connected to the metallic enclosure for the building or structure disconnecting means, or be mounted at the disconnecting means and be connected to the metallic enclosure or to the grounding electrode conductor with a minimum 6 AWG copper conductor.

(6) The terminals shall be listed as grounding and bonding equipment.

……continued…..

New 250.94 continued…

Exception: In existing buildings or structures where any of the intersystem bonding and grounding electrode conductors required by 770.100(B)(2), 800.100(B)(2), 810.21(F)(2), 820.100(B)(2), and 830.100(B)(2) exist, installation of the intersystem bonding termination is not required. An accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be permitted at the service equipment and at the disconnecting means for any additional buildings or structures by at least one of the following means:

(1) Exposed nonflexible metallic raceways

(2) An exposed grounding electrode conductor

(3) Approved means for the external connection of a copper or other corrosion-resistant bonding or grounding electrode conductor to the grounded raceway or equipment

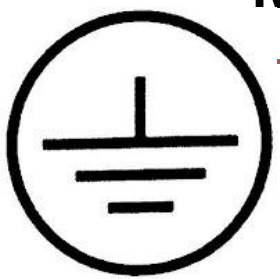
(B) **Other Means**. Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (1⁄4 in. thick × 2 in. wide) and of sufficient length to accommodate at least three terminations for communication systems in addition to other connections. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector. If aluminum busbars are used, the installation shall comply with 250.64(A)

Exception to (A) and (B) Methods for bonding intersystem bonding conductors are not required where communications systems are not likely to be used.

Informational note: The use of an IBT can reduce electrical noise on communication systems.

Grounding & Bonding Conductor Choices

- **Equipment Grounding Conductor Vs. Equipment Bonding Conductor**
  - Recognized EGC also performs bonding (Article 100 definition)
  - Most telecom grounding conductors are really bonding conductors
- **NESC (Rule 099C) → 6 AWG for IBT to ground electrode**
- **NEC →** IBT requirements across NEC are in general harmonized
  - 250.94 and 800.100/770.100/820.100/830.100/840.100
  - 820.100 → permits use of down to a **14 AWG**
- **Grounding & Bonding conductors** inside equipment boxes and within telecom circuits (NIDs, NIUs, ONUs, ONTs, BETs, cabinets…) are sized (ampacity) for functional use/purpose and for expected possible events → 14 AWG to 6 AWG depending on load and circuit
- **Multi-Ground Neutral (MGN) System** –
  - CMP5 affirmed MGN systems provide additional safety for electrical workers, lightning protection and have a proven track record



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*

- **NESC Definition of Communications Equipment.**

Communication Equipment. Equipment that produces, modifies, regulates, or controls communication signals. This equipment may also produce, modify or safeguard a supply of electric energy for the exclusive use of communication devices as long as the equipment and communications devices being served are owned and operated by the same party . See electric supply equipment.

Note to NESC Definition of Electric Supply Equipment.

*…..NOTE: Electric supply equipment does not include equipment whose purpose is to **provide power to support locally mounted communication systems**. For example, power supplies supporting CATV or communication amplifiers or repeaters are not considered to be supply equipment.*

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*

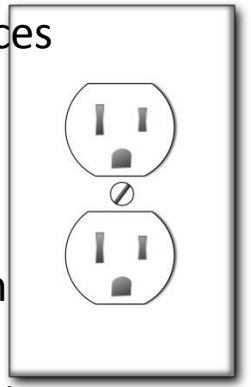
800.24…820.24…830.44…840.24 are coordinated and generally confirm to the above objectives.

830.24 for Network Powered systems includes “300.4(A), (D), (E), (F) and 300. 11…” based on possible power levels in conductors. Article 840 cross references to other articles.

770.24 is now 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**. Neither a fire nor electrical safety hazard has been identified to justify expanding the requirements.

New Article 840



- 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 …

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.**

New Article 840

.... cont....

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

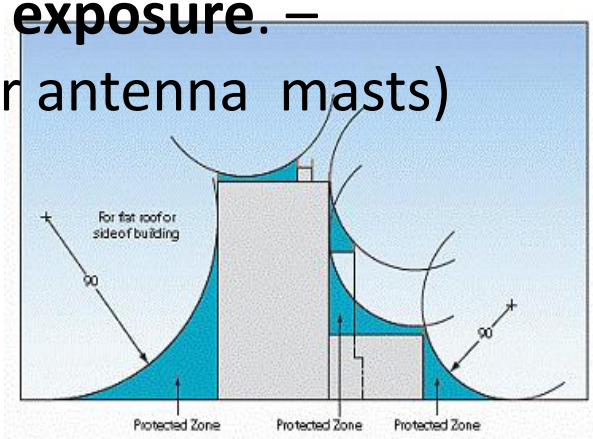
" 840.160 Powering Circuits. Communications cables, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment. Where the power supplied over a communications cable to communications equipment is greater than 60 watts, communications 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

CMP 16
Other Activities

- **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



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 datacenter 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 in 2nd Revision**

Revised Article 645.10

(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.

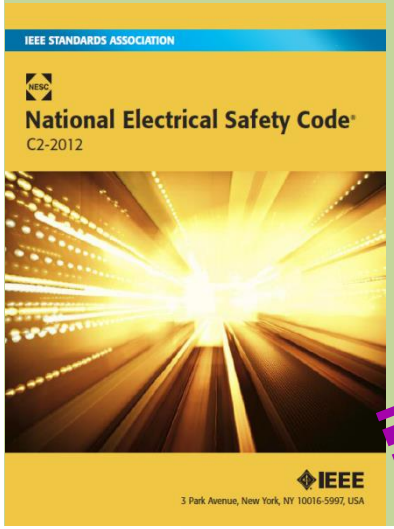
(3) A smoke-sensing fire detection system is in place.

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

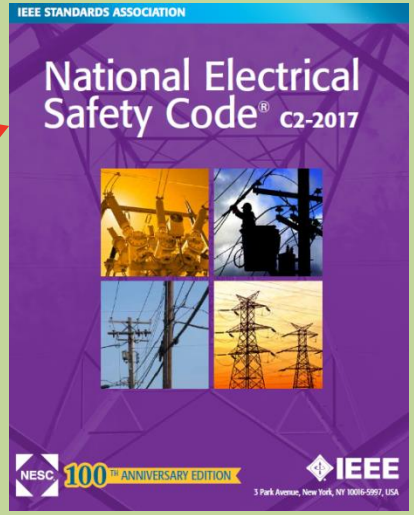
NESC Highlights

http://standards.ieee.org/about/nesc

http://www.standardsuniversity.org/videos



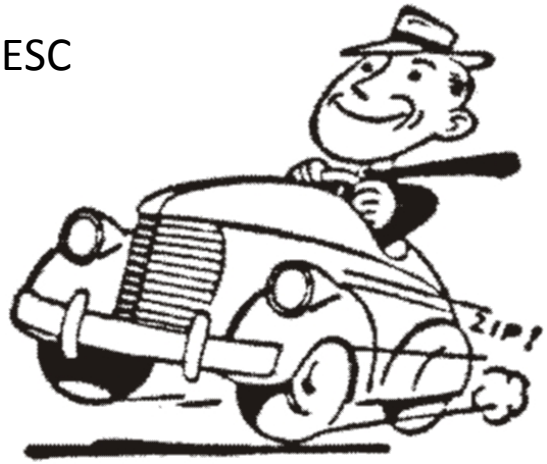
NESC Highlights By SC & Topic



Drivers for NESC Changes

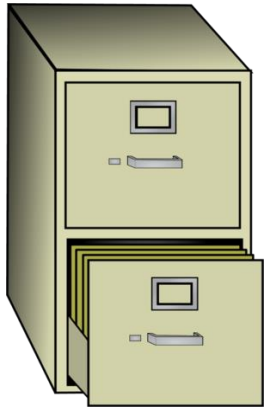
PRIMARY = REACTIVE

- Problems, issues and conflicts revealed during active use of NESC
  - Problems during Engineering/Design/Planning activities
  - Joint-Use Agreement Conflicts – Wireless, Light Rail….
  - Regulatory Inspections - OSHA and AHJ Compliance
  - Regulatory Harmonization and Feedback
    - FCC, Public utilities – Boards and Commissions
  - Tests & Inspections – part of routine work, planned, documented (Rule 214/313)
  - Field incidents, accidents, and legal cases



SECONDARY = PROACTIVE (5 year code cycle can limit reaction time)

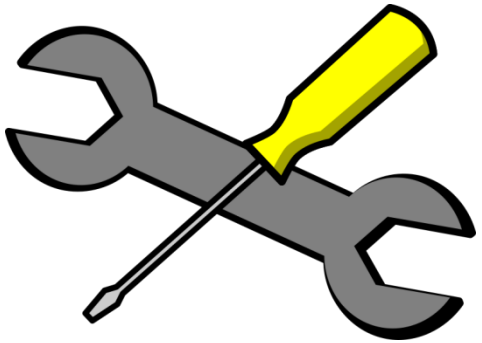
- Mismatch of new technologies to practices based on traditional code
  - Intersystem Grounding & Bonding
  - Wireless Antennas – Growth into Femtocells and DAS systems
  - Smart Grid Devices – joint power and communications functions
  - Alternate and hybrid sources of energy – wind, solar, etc….



New Directions, Challenges and Drivers

Internal Code Issues

- Internal review to consider Next 100 years (NESC Summits/Workshops)
  - On line tools and internet delivery of codes and services - MOOC (Massively Open Online Courses)
  - Outreach to old and new stakeholders
  - **http://www.standardsuniversity.org/videos**



External Issues

- Code needs to keep up with rapid technological change
- **Congestion** on structures and underground
  - Traditional stakeholders are the Power and Incumbent Communications (ILEC) Utilities plus usual suspects of railroads, Light Rail, suburban subway transit, and (DoT) traffic control/monitor devices …… plus the new players and …..
  - Competitive LECs (CLECs) and Wireless Companies
    - Subsidiaries of ILECs and CLECs……Newcomers (Google Fiber)
  - Distributed/Alternate sources of energy – wind, solar, microgrids, etc….
    - Smart Grid Devices – joint power and communications functions
    - Interconnection hardware

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CONGESTION

PEG CONFERENCE

Underlying Concerns

- **Congestion on Poles and in Buried locations (Parts 2 and 3)**
- **Bonding and Grounding (Rule 096, 097, 099, 354, 384)**
- **Scope Boundaries of NESC/NEC - Codes Inter-Relationship**
  - **NESC…NEC…GO95… local PUC variations…**
- **Risk Management - Work Rules**
  - **Worker & Public Safety (Part 4 - Work Rules)**
- **Clearance and Separation (SC4 and Sections 20-23)**
- **Pole Loading and Strength (SC5 and Sections 24-26)**
  - How Conservative should one be?
  - For safety, for reliability, for resiliency or for practical reality?
  - Guidance from Historical Data and Experience Vs. Latest LRFD Engineering Approach ?

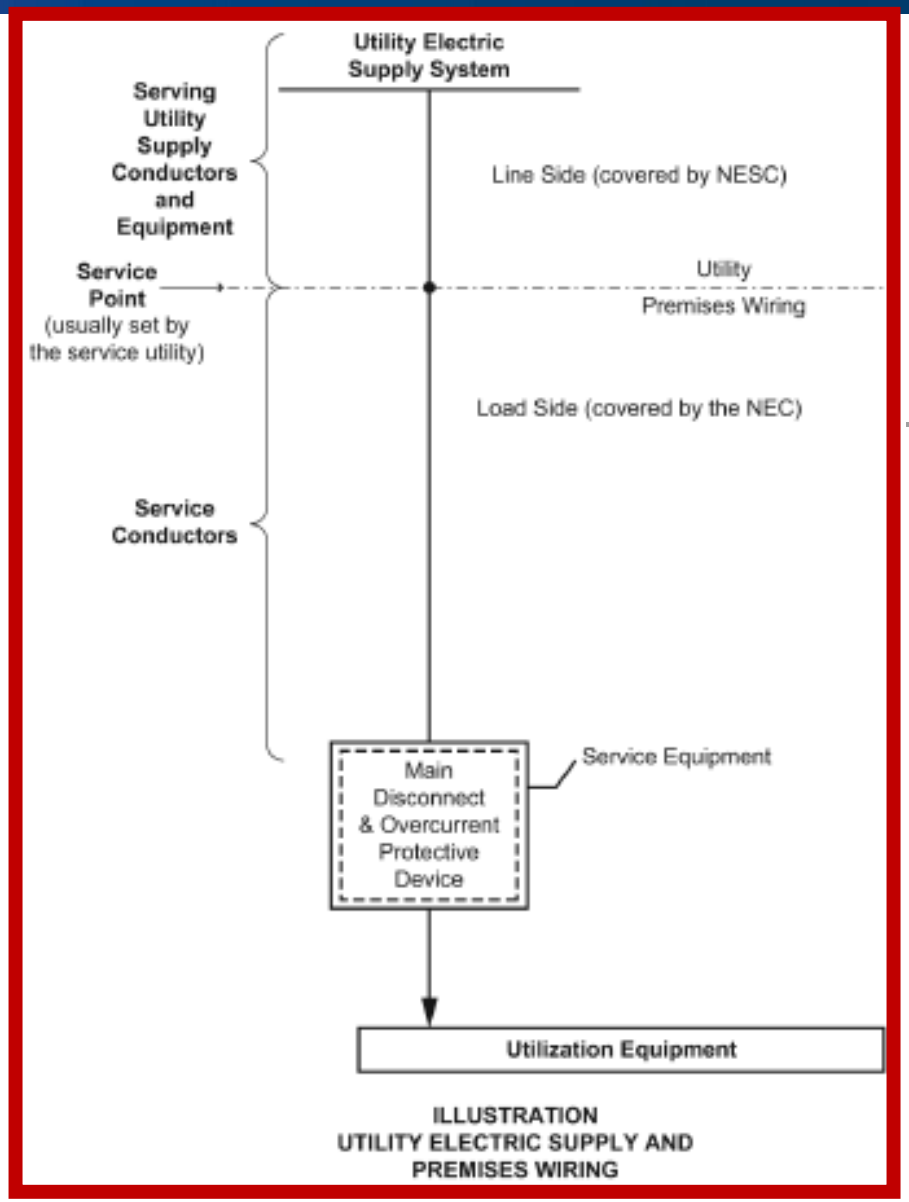
Competing Views from Engineers (Design/Plan) -- Statisticians
Risk Management – Meteorologists – Regulators -- AHJs

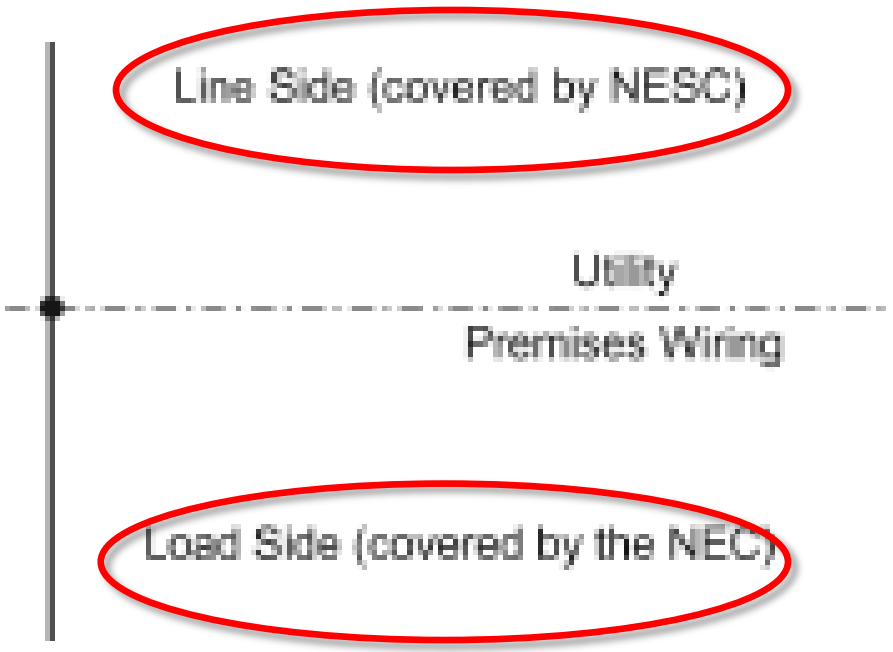
SC1 Activities

SC1 - Purpose & Scope

- Better delineate NESC scope (Rules 010, 011, 012, 013)
- Better define Communications and Supply Space (+ Figure)
  - Communications Worker Safety Zone (CWSZ) is defined by Rules 235-239, not by a formal Section 2 Definition
- Communications Equipment global definition (tweaked)
- Supply Equipment global definition (tweaked)
- Qualified vs Trained vs Authorized (Harmonized across code)
- Structure Conflicts - Rule 013 (remains under active debate)
- **Safety code as opposed to a design manual or engineering tool for making a reliable resilient network**.

Demarcation





Demarcation Between Codes

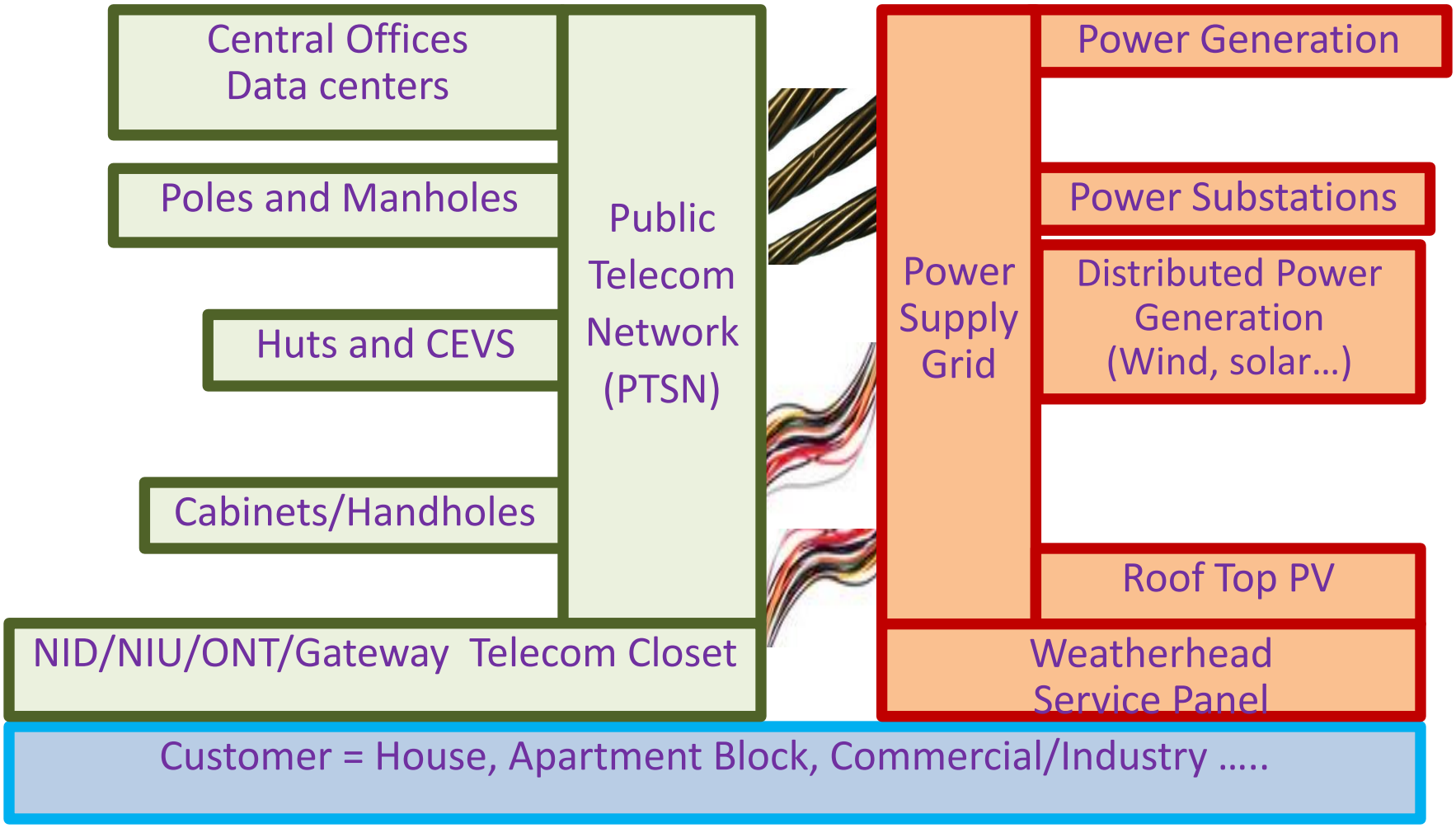
Electrical Supply …….. Telecommunications

Service Points ……..Network Interface

****Utility Defined Demarcation Point****

- @ Residence – Network Interface Device or Unit (NID or NIU)/Optical Network Unit (ONU)
  - Outside of house…. AC Panel inside house
- Commercial Building
  - Building Entrance Terminal (BET – inside or outside) …. Telecom Closet or Room
  - AC Panel or power Room inside building
- Communications Nodes - Electronic Hut or Cabinet or Active Fiber Hub
  - Closure Inside Hut
  - Distinct AC compartment in cabinet or separate adjacent box
- Lighting for Parking Area
- Long Rural line serving Remote Farm or Residence
  - At Main Road…….At Property Boundary…….At Buildings
- Distributed/Alternate Power– Solar/Wind farms, Microgrids….
  - Interconnection to power Grid ….. Smart Grid Devices
- Line and span powering ……..G.fast

Demarcation Points



Space Definitions

communication space. The space on joint-use structures where communication facilities are separated from the supply space by the communication worker safety zone. See Figure D-1.

Safety for workers (both)

Ground clearance Safety for Public

Safety through separation

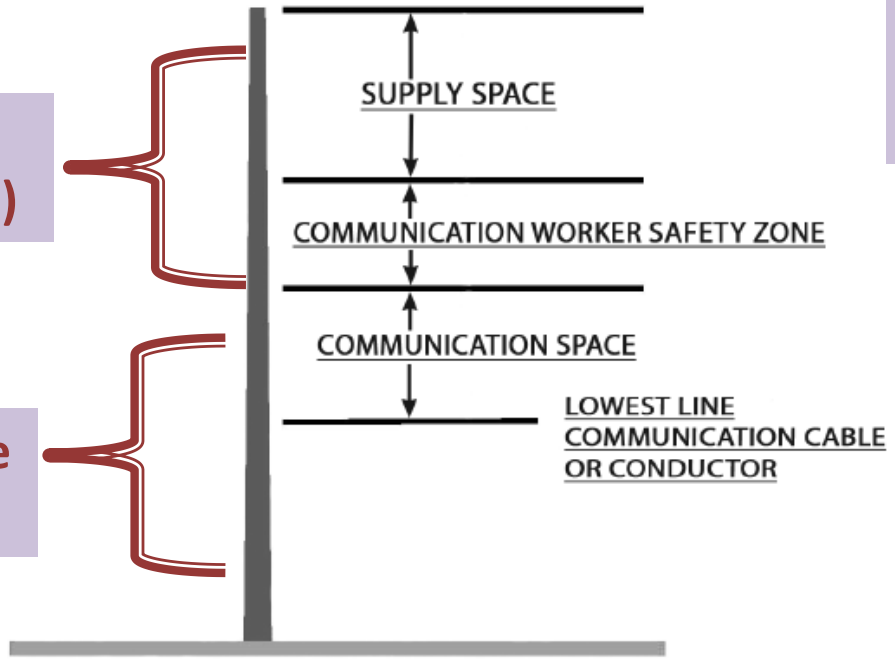


Figure D-1

supply space. The space on joint-use structures where supply facilities are separated from the communication space by the communication worker safety zone. See Figure D-5.

NOTE: Communication facilities may be located in the supply space (see Rule 224A).

NESC Equipment Definitions

- **Electric Supply Equipment. -** Equipment that produces, modifies, regulates, controls, or safeguards a supply of electric energy for the electric power supply grid that is (1) transferred to supply lines, or (2) used to provide power and/or control for other electric supply equipment, or (3) used to provide power to the devices of another utility.

  *NOTE: Electric supply equipment does not include equipment **whose purpose is to provide power to support locally mounted communication systems**. For example, power supplies supporting CATV or communication amplifiers or repeaters are not considered to be supply equipment.*

- **Communications Equipment. -** Equipment that produces, modifies, regulates, or controls communication signals. This equipment may also *produce, modify or safeguard a supply of **electric energy for the exclusive use of communication devices*** as long as the equipment and communications devices being served are owned and operated by the same party .

These definitions are in harmony and consistent with those in the NEC and both codes recognize that communications equipment includes servers and routers and their powering supplies.

NESC Rule 012

012. General Rules

A. All electric supply and communication lines and equipment shall be designed, constructed, operated, and maintained to meet the requirements of these rules.

B. The utilities, authorized contractors, or other entities, as applicable, performing design, construction, operation, or maintenance tasks for electric supply or communication lines or equipment covered by this Code shall be responsible for meeting applicable requirements.

C. For all particulars not specified, but within the scope of these rules, as stated in Rule 011A, construction and maintenance should be **done in accordance with accepted good practice** for the given local conditions known at the time by those responsible for the construction or maintenance of the communication or supply lines and equipment.

SC2 and SC3

SC2 - Grounding

- Grounding Intervals (096C)
  - Exception added for long spans (water and valley crossings)
  - Do not need to open sheath solely to meet 4 ground per mile
- Effectively Grounded versus grounded
  - Grounded through hardware and guys (Rule 215)
- Copper Clad Stainless Steel Conductors (% conductivity)
- Rule 094B – Ground rod sizes (trade and actual) and materials
- **Rule 097** – Bonding between power and communications (097G)
- Rule 099 – Intersystem Bonding at House (Demarcation Point)

SC3 – Power Sub-Stations

- Fences and Access Control
- Storage Batteries (Section 14… Rule 420G)
- Possible place for future sections on distributed and alternate power facilities (e.g., solar/wind farms, microgrids, fuel cells…) that are interconnected into the electric power grid.

Rule 097 – Grounding & Intersystem Bonding

Rule 097 has 7 interlocking subsections with implicit/explicit links to other Rules (e.g., **096, 224, 344, 354, 384**) applicable to intersystem bonds

- Rule 097A requires separate grounding conductors except as permitted by 097B providing 097C (4 grounds/mile) is met.
- Rule 097B – permits a bond to the power ground where a MGN system is being used and providing Rule 097C (i.e., 4 grounds/mile) is met.
  - The combination of Rule 097B with 097C is the basis for the practice of bonding communications to the vertical pole supply ground in MGN systems with a 6AWG conductor and approved connector. It is highly desirable to maintain and encourage this practice with an bond between power and communications as the first choice.
- Rule 097C - 4 grounds/mile criteria helps define an effective ground
- **Rule 097G** requires a single grounding conductor on structures except as required by Rule 097A
  - One objective of Rule 097G is to distinguish between intersystem bonding necessary in cases of MGN power systems as opposed to ungrounded or single grounded systems.

Rule 097G

2017 NESC shall read as follows -

G. Bonding of communication systems to electric supply systems

Where both electric supply systems and communication systems are grounded on a joint use structure and a single grounding conductor is present, the grounding conductor shall be connected to both systems. Where separate supply and communications grounding conductors are used, they shall be bonded together.

Exception 1: Where separation is required by Rule 097A

Exception 2: Where the electric supply utility is maintaining isolation between primary and secondary neutrals, the communication system ground shall be connected only to the primary grounding conductor if it complies with the requirements of Rule 097C.

Telcordia supported this revision as an improvement and clarification

- **Sets expectation that bond to vertical ground should be made unless explicit technical reason exists not to bond**
- **Clarifies the relationship between 097G and other subsections of Rule 097 by placing the criteria in explicit Exceptions.**

Telcordia agrees that further editorial improvements may be necessary.

Rule 384C

A. Cases and enclosures made of conductive material shall be effectively grounded or guarded.

B. Guards constructed of conductive material shall be effectively grounded.

C. Bonding should be provided between all aboveground metallic supply and communications enclosures that are separated by a distance of 1.8 m (6 ft) or less. For the purpose of this rule, pole grounds are not required to be bonded to the communication enclosure.

NOTE: This rule does not prohibit bonding communication metallic enclosures to supply pole grounds, provided all affected parties are in agreement.

Note: This rule does not prohibit bonding communication metallic enclosures to supply pole grounds provided all affected parties are in agreement.

Rule 384C

This note added to 384C was recognition that NESC in rules like 097 has the expectation that a bond to an existing MGN such as a vertical pole ground is a good safety measure unless there are explicit technical reasons not to bond such as when the vertical pole ground is from

- Lightning arrestors or rods
- Single point grounded systems
- Power systems that require isolation

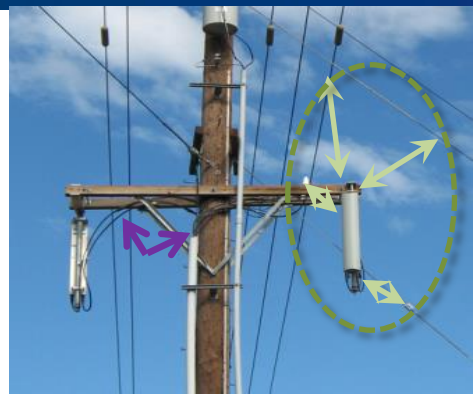
Do not want the cable shields or conductors of the communications circuits to become the best ground path or main pathway to earth.

Lesson - Some code changes take time - 2007-2017 – patience and persistence

Intersystem Bonding (097 & 099)

- **Rule 097 – Bonding Power and Communications Grounds**
  - Bond to power ground or MGN, if possible
  - Single ground rods or Ground beds – e.g., 3 rods → may be needed in OSP facilities
  - Bond grounding systems together in some cases (not all)
  - More separate telecom grounds
- **Rule 099 – Intersystem Bonding at House**
  - Choices – NEC versus NESC
  - Intersystem bond near meter box or point of entrance following Chapter 8 (e.g., 800.100 or 250.94 on the IBT)
  - 6 AWG copper preferred (smaller gauges 6 AWG to 14 AWG are possible inside the equipment)
  - Single ground rod at house → If earth connection is not adequate or effective, then add one extra rod (bonded).

SC4 Activities



- **Space Definitions (see previous SC1 discussions)**
- **Clearances between communications lines Rule 235H**
  - 12 inch minimum separation at support
  - 4 inch minimum anywhere in span (spacers?)
  - Under all ambient conditions (all expected conditions)
  - Wording of final rule may need revision during next cycle period
- **Wireless (Antenna) Attachment – Rule 235I clarified**
  - All other clearances need to be met as facilities are attached to congested poles with multiple communications and power facilities
  - Challenge to work out engineering designs to meet the local conditions and still allow for the necessary and multiple adjustments and customizations that will be needed during installation
- **Clearance between communications and supply facilities – Rule 238**
  - Encourages grounding of supply equipment by having larger (40 inch) separation for ungrounded supply equipment

Clearance & Separation

Aerial Clearances

- **Water Crossings and Bridges – Rule 232/235**
  - Defined by area, and the boat/yacht traffic…
- **Driveways (**Minimum values) – **Rule 232**
  - Residential versus Business
  - Rural vs urban
  - Changing behavior under line
  - Ground clearances are always minimums → design with objective to attain as much clearance and spacing as practical and possible.
- **Service Masts and Service Drops – Rules 232/235**
  - Distances from openings (e.g., windows, doors) and accessible areas (over roofs, porches, swimming pools….)
- **Road/Field clearance for large farm vehicles**
  - Increase reference ground clearances to accommodate larger and larger farm vehicles (cotton strippers and grain tanks). → rejected
  - The NESC cannot prevent manufacturers from building machines of any heights – it provides adjustments where practical and desirable (e.g., Footnote 25 to Table 232-1, Footnote 3 to Table 232-2, and Footnote 16 to Table 234-1.

Powering Circuits for Communications

Modern communications cables can include power supply circuits for Power-over-Ethernet (PoE), span/line powering applications and to provide for other communications devices (e.g., antenna). Requiring each conductor of a supply circuit used exclusively to power communications devices to be *"individually enclosed with an effective shield"* is not necessary. Having additional shields around each individual conductor does not add significantly to the safety of the circuit or cable configuration.

- **SC4 → Rule 224B2(a) – Aerial cables**

  a. Such cables shall have a conductive sheath or shield that is effectively grounded~~, and each such circuit shall be carried on conductors that are individually enclosed with an effectively grounded shield~~.

- **SC7 → Rule 344A1– Underground/Buried Cables**

  1. Such cables shall have a conductive sheath or shield that shall be effectively grounded~~, and each such circuit shall be carried on conductors that are individually enclosed with an effectively grounded shield~~.

  EXCEPTION: The requirements of Rule 344A do not apply to communication circuits where the transmitted power does not exceed 150 W.

Other SC4 Activities

Rule 220 revised – simplified and exemptions added with references to other sections (232, 235 and 238)

- **Preferred levels -** *Supply conductors/cables or equipment should be carried at the higher level, where practical.*
  - Allowance for service drops, railroads, light rail , trolley wires, communications lines, antennas, grounded switches/boxes,…

Changes may confuse but are technically correct → wait for feedback next cycle

- **Rule 215 - Guys and Guy insulators**
  - Effectively grounded……..Connections through hardware
  - Objective is that if guys are slack or broken, the guys do not create hazard to public…….Reference height is 8+ ft

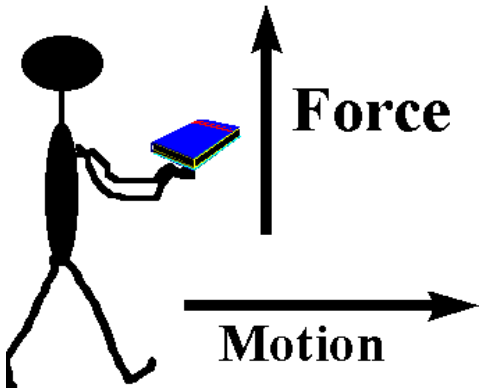
- **Guy Markers** (Rule 217)
- **Vegetation Management** (Rule 218)

SC4/SC5 Activities

- **Emergency Installation**
  - Grade of construction (SC5) – Grade N
  - Permits laying cables on grade providing they are guarded.
  - Emergency versus temporary… how long is temporary?

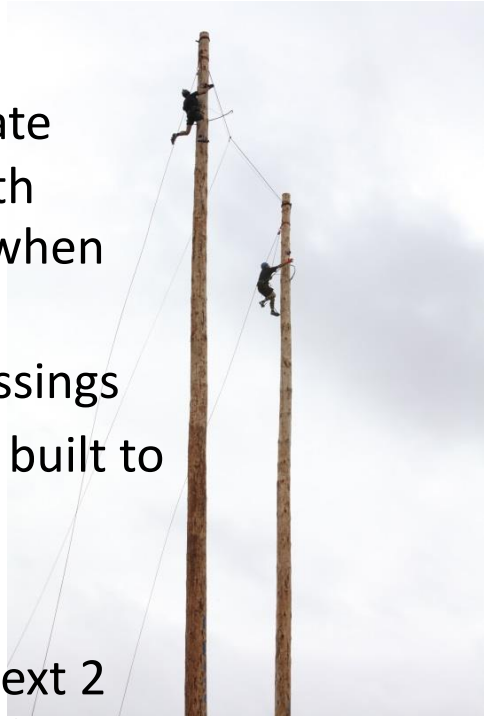
- **Metric versus Customary Units** (meters vs feet)

- **SC4 Clearance Sect. 20-23 vs SC5 Strength Sect. 24-26**
  - Clearance & Spacing → sags plus conductor loadings
  - Pole strength → tensions and safety factors



SC5 – Pole Strength and Loading

- **60 foot exemption** – Retained
- **Construction Grade N** used for temporary work, private rights of way and service drops → Grade N is retained with clarifications and changes to more clearly define where, when and how it shall be used (Table 242-1 revised).
  - Grade B = highest grades – for joint use & railroad crossings
  - Grade C = traditionally most of communications poles built to this grade
- **"K additive constant"** -
  - Retained – for present but expect in long term (over next 2 code cycles) to replace k factor with new ice/wind loading factors and addition of Non-Linear Design methods.



Overall Caveat - Given the long successful field record and performance of pole lines, there is no need to, or SC5 intent to require a significant increase in the required pole strength for a given application, geography and environment.

SC7 Activity Underground/Buried

- **Water crossings** – coordinate with grounding interval in Rule 096C
- **Railroad crossings** – outside of trackbed (includes shoulders)
- **Conduit vs duct** – definitions moved from notes to Section 302
- **Backfill** – "….Backfill material should be adequately compacted to limit settling under the expected surface usage…" (Rules 321, 322 and 352)
  - specific materials guidance was removed. SC7 decided this detail not necessary in the Code and should be left up to the utility to make this determination through internal practices (M&Ps) and product specifications (e.g., Construction Blue Book, product GRs,..).
- **Rule 344** - Communications cables containing special supply circuits
  - ATIS Change proposals was accepted and parallel changes made in 224B (some concerns raised based on old SNET hybrid cable design.




Powering Circuits for Communications

Modern communications cables can include power supply circuits for Power-over-Ethernet (PoE), span/line powering applications and to provide for other communications devices (e.g., antenna). Requiring each conductor of a supply circuit used exclusively to power communications devices to be "*individually enclosed with an effective shield*" is not necessary. Having additional shields around each individual conductor does not add significantly to the safety of the circuit or cable configuration.

- **SC4 → Rule 224B2(a) – Aerial cables**

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  EXCEPTION: The requirements of Rule 344A do not apply to communication circuits where the transmitted power does not exceed 150 W.

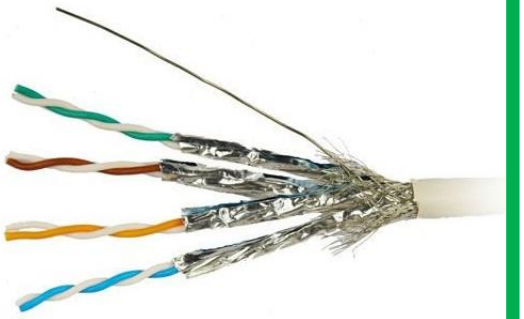
Powering Circuits for Communications

This is an older hybrid cable design that is a power cable which had 480 V power on the 1/0 AWG conductors as well as some communications conductors in the center portion.

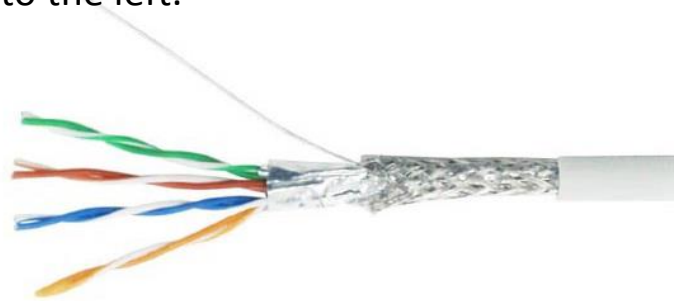
The attempted use of this type of hybrid power cable was the reason that this 224B and 344 rule was first created.

This hybrid construction does require the individual shield/ground for each 1/0 AWG conductor for safety reasons.

The configuration to the right has individual shields and complies with 2012 NESC.



The objective for the NESC change was to permit the safe shielding variation shown below for span powering or line powering applications over small gauge twisted-pair (19-24 AWG) conductors. These are much lower voltage and power level circuits then the 480 V power cable shown to the left.



Rule 354 - Changes Random Separation

Rule 354 – Joint Buried – Random Separation **…**(correlate with 096C)

- Where long un-interrupted spans of cables exist, the requirement to ground 4 or 8 times per mile should be relaxed. The basic principle being that one should not open a cable sheath for the sole purpose of grounding a shield or conductor.
- "However, at all locations where the cable is accessible to personnel, the neutral shall be effectively grounded" which helps to clearly state the importance of grounding plant as soon as practical outside of the long uninterrupted span.– e.g., in a hut, padmount cabinet, pedestal, etc… provides -

  (i) adequate safety to drain away any foreign voltage/current from communications circuits

  (ii) help ensure under power fault conditions that the supply circuit is de-energized and protection devices operate efficiently as power Rule 354A3.

- Modernize Rule 354D3 to accommodate standard cable designs but retain adequate safety margin

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354D3

354 Random Separation

.....

D. Supply and Communications Cables and conductors

.....

3. Insulating jacketed effectively grounded neutral supply cables

Each phase conductor of a multi-grounded supply system operating above 300 V to ground and having an overall insulating jacket shall have an effectively grounded copper concentric conductor meeting all of the following requirements:

a. Adequate for the expected magnitude and duration of fault current that may be imposed

b. Effectively grounded as required by Rule 314 except that the number of grounding electrodes shall be not less than eight in each 1.6 km (1 mile) of the random buried section, not including grounds at individual services

EXCEPTION: The grounding interval of Rule 354D3b may be increased for grounded neutral supply cables with insulating jackets where adherence would require opening a non-metallic duct and/or removing the protective jacket of the buried cable only for the purpose to install a ground connection. For such cases, the supply circuit shall be effectively grounded where the cable does become accessible. Where practical, the ground of the supply circuit shall be bonded together with the communications shield ground.

Rule 354D3 Changes

Modernize Rule 354D3 to accommodate standard cable designs but retain adequate safety margin

- General Rules 354A3 and 354D1f provide adequate protector devices and a grounding system to promptly de-energize a supply circuit if necessary.
- The Rule 354D1e requires a metallic shield on the communications cable that should help minimize or reduce any foreign voltages and currents on the twisted pairs.
- **Therefore deletion of the 354D3a requirement that the conductance of the grounded conductor shall be "not less than one half that of the phase conductor" is not a safety concern for communications plant sharing the joint trench.**
  - It is an issue of power cable design and for power utility operations and their safety. The safety of the adjacent communication plant and their workers is well covered by the remaining parts of the Rule 354D3b and 354D3c. The inclusion of the exception harmonizes with the changes to Rule 096 (see Section 2.2of this report for details of those Rule 096 changes).

Rule 384C

A. Cases and enclosures made of conductive material shall be effectively grounded or guarded.

B. Guards constructed of conductive material shall be effectively grounded.

C. Bonding should be provided between all aboveground metallic communications enclosures that are separated by a distance of 1.8 m (6 ft) or less, pole grounds are not required to be bonded to the communications

NOTE: This rule does not prohibit bonding communications metallic enclosures to supply pole grounds, provided all affected parties are in agreement.

Already covered in Slides 47 and 48

Note: This rule does not prohibit bonding communications metallic enclosures to supply pole grounds provided all affected parties are in agreement.

SC8 Activities
Work Rules (Part 4)

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SC8 – Work Rules (Part 4 : Sections 40-to-44)

- NESC changes in response to **2014 OSHA release** of new electrical worker rules under 29 CFR 1910.269, “Electric Power Generation, Transmission, and Distribution”
- **Arc Flash PPE & Risk Assessment - Rule 410A3**
  - OSHA…. IEEE 516 … NFPA 70E
- **Minimum Approach Distances (MAD) - Rules 431 and 441**
  - OSHA…. IEEE 516
  - Reach and Extended reach – with/without tools
- **Fall Protection - Rules 411F and 420K**
  - OSHA 1910.268/269
  - 420J – Ladders and supports

Arc-Flash & MAD

Arc Flash PPE & Risk Assessment – Rule 410A3

- Rule strongly encourages that a **Hazard Risk Assessment** be completed → otherwise default PPE is required
  - NESC 410 A3…. OSHA…. IEEE 516 … NFPA 70E
  - Harmonized mostly with equivalent safety results
- Default DC limits –
  - 50 V to 250 V and up to 8000 amps → use 5 cal/cm^2 PPE
- **Engineering Controls = Best Practices (M&s)**
  - *"NOTE 5 : Engineering controls can be utilized to reduce arc energy levels and work practices can be utilized to reduce exposure levels."*

Minimum Approach Distances (MAD) - Rules 431 & 441

- Reach and Extended reach – with/without tools

Fall Protection

- **Fall Protection …. NESC 411F & 420K & 420J**
  - Fall Prevention versus Fall Arrest
  - Activates at working heights above 4 ft instead of 10 ft
  - “Climbing to” or Transferring versus “at Working” position
  - Prohibitions-
    - 100% leather positioning straps
    - Non-locking snaphooks.

420J – Ladders and supports

- Support needs to be “adequately strong, in good condition, and properly secured in place”

  420J1 - Employees shall not support themselves, or any material or equipment, on any portion of a tree, pole structure, scaffold, ladder, walkway, or other elevated structure or aerial device, etc., without it first being determined, to the extent practical, that such support is adequately strong, in good condition, and properly secured in place.

TABLE 431-1 MAD

SC8 – Work Rules – Rule 431 Minimum Approach Distances (MAD)

- Communications Employees

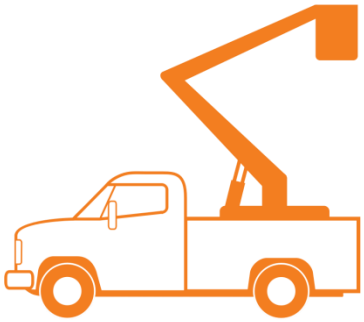
Table 431-1—Communication work minimum approach distances [3, 4]
(See Rule 431 in its entirety.)

Voltage range Phase-to-Phase (rms)	Distance to employee at altitudes from sea level to 12 000 ft
0 to 50 V[2]	Not specified
51 to 300 V[2]	Avoid contact
301 to 750 V [2]	1 ft-1 in
751 V to 15 kV	2 ft-3 ~~2 ft 2 in~~
15.1 kV to 36 kV	3 ft-0 in
36.1 kV to 46 kV	3 ft-6 in
46.1 kV to 72.5 kV	4 ft-0 in

- Calculations based on standard atmosphere conditions (above freezing, no wind/rain, normal pressure) with dry/clean insulators
- IEEE 516 using phase-to-ground exposure (maximum T values) plus 1.1 x C2 tool factor + 1 foot for inadvertent movement + 1 foot allowance for communications worker.
- Correlated with Rule 441 (MAD) for Electrical Worker = larger clearances

SC8 Activities

- **Metallic Aerial Devices**
  - Accidents are independent of whether it's a metallic or fiberglass/dielectric covered bucket -> It's the contact between the person, hand, or tool with live energized line/equipment that is the main danger.
  - Contact occurs because the worker has not followed industry rules and best practices for safe operations.



- **Antenna – RF Exposure – Rules 410A6 and 420Q**
- **Storage/Backup Batteries (Rule 420 G) -** (actions in IFC 608?)

G. Liquid-cell batteries

1. Employees shall ascertain that battery areas are adequately ventilated before performing work.
2. Employees should avoid smoking, using open flames, or using tools that may produce sparks in the vicinity of liquid-cell batteries.
3. Employees shall use eye and skin protection when handling an electrolyte.
4. Employees shall not handle energized parts of batteries unless necessary precautions are taken to avoid short circuits and electrical shocks.

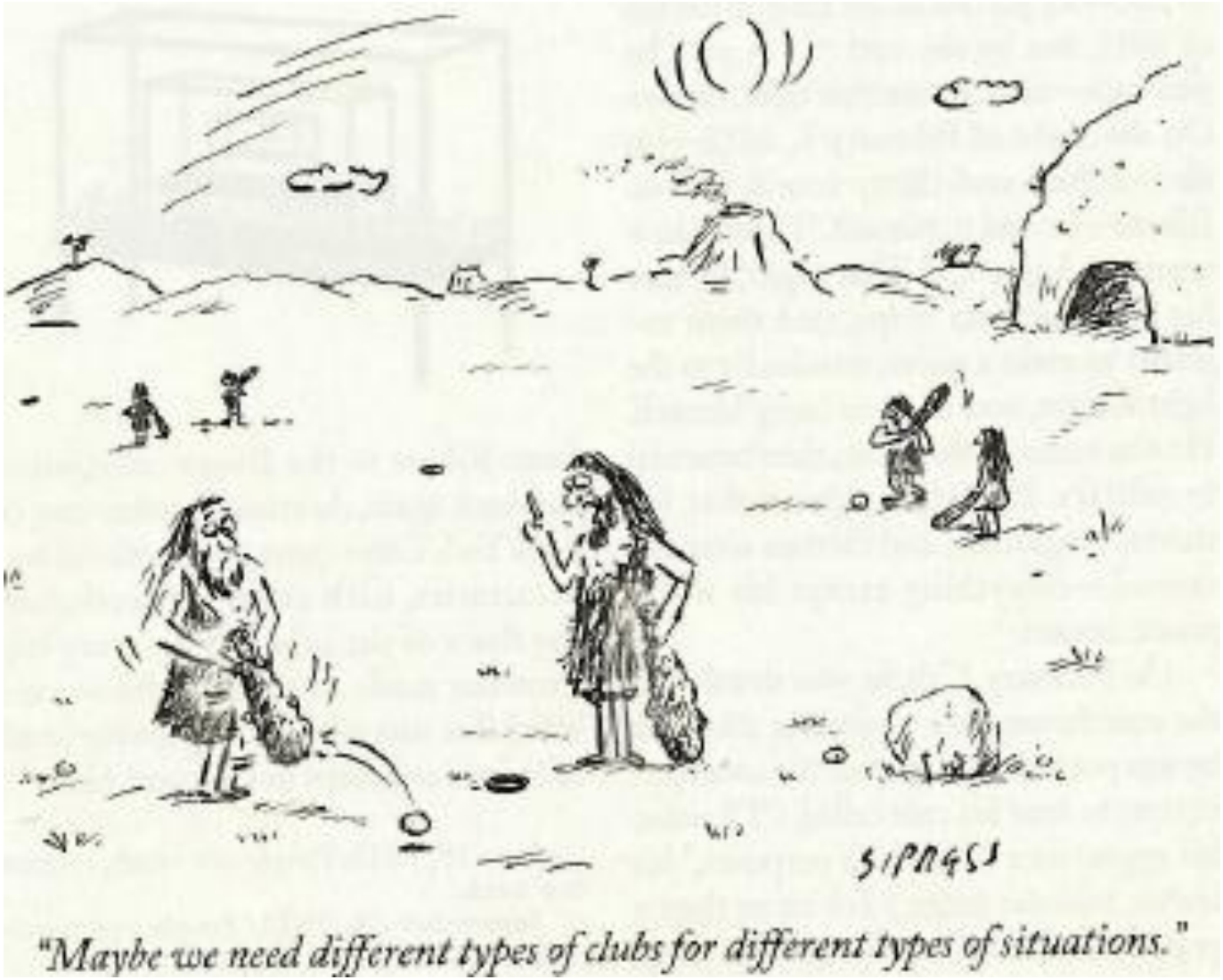
Storage Batteries

- **Rule 420G – Liquid cell Batteries** – (Section 14)
  - Keeping up with new battery technologies → Liquid ?
  - Lead-Acid, Lead-Calcium VRLA type systems Lead-Selenium
  - Ni-Cd (Nickel-Cadmium) … Ni-MH = Nickel Metal Hydride
  - Na-Ni-Cl = Sodium Metal Hydride, sodium-sulfur
  - Zn-Br… Li-ion – lithium ion technologies – large variety of chemistries

Growing varieties

- Related Issues for Part 1 (Substations)
  - Distributed power and alternate energy sources
  - Solar and Wind Farms, Microgrids, fuel cells, etc…

Larger Sizes



"Maybe we need different types of clubs for different types of situations."

Safety Codes Are Not Enough

atis Protection Engineers Group

PEG Conference

- **Safety Codes…….Regulatory and Legal Mandates**
  - NESC…NEC..OSHA…GO 95…. Local and Regional Building and Fire Codes
- **Internal Practices – Best Industry Practices**
  - Telcordia Construction Blue Book – Issue 5 (2011).., new issue in 2106
  - Service Providers - ATT..Verizon… Centurylink … RUS..
  - Manufacturer/Supplier provided instructions and guidance documents
  - CSRIC Best Practices - Communications, Security, Reliability, and Interoperability Council (old NRIC Best practices) - links to FCC
- **Product Specifications and Functional Performance Criteria**
  - Wireless Facilities – Family of GRs GR-3171,GR-3031, 3032, 3033, 3178
  - Poles & Hardware - GR-60 Wood, GR-3159 Non-Wood, GR-3174 Hardware
  - Equipment - Physical Protection -- GR-3108… GR-1089 EMC…..GR-63
  - Enclosures and Closures - GR-43 (Huts), GR-487 (Electronic Equipment Cabinets), GR-950 (ONUs), GR-902 (Handholes), GR-3121/3123/3125 (FDHs)
  - Cables - GR-421, GR-3163, GR-3164, GR-137, GR-492, GR-20, etc……
- **Design Engineering for Network**
  - Reliability and Long Lifetimes --- 20…..40 years
  - Quality and Availability of Services (99.999+%)
  - Resilient Designs – Backup Services, Duplicate Routes, Sharing Agreements

Paths Forward - A PEG CONFERENCE

NEC

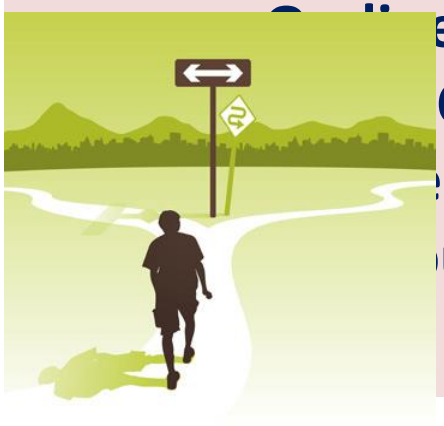
- Review Application of 2017 NEC Code for Problems
  - Article 840 implementation – Gap analysis
  - Span/line Powering… G fast Applications
  - Fiber Build-out issues inside Buildings

- Begin Change Proposal development for next cycle (2020)
  - Mechanical Execution of Work

Paths Forward - B

NESC

- Review Application of 2017 NESC Code
  - Wireless Deployments and Fiber Builds
  - Greenfields and Brownfields.
  - Span/line Powering Applications
- Begin Change Proposal development for next cycle
  - Grounding & Bonding – Rule 097G
  - Storage Batteries – Rule 420G and Section 14
- Monitor and Participate in Summits/Workshops
  - e Resources, Fast Track processes,
  - Clarification Debates – for role in Safety,
  - ering, Design, Resiliency of Networks and workers
  - uted Energy, Smart Grid, … facilities



Paths Forward - C

Develop Guidance and Position Documents

1. SR 1421 – Issue 6 of Construction Blue Book – 2016
2. Arc Flash Risk Assessment for Telecom Workers – 2016
3. Product Specification developments - GRs – GR-487… GR-3108… GR-513..

- Grounding and Bonding – effective grounding for safety and service quality, Intersystem bonding and separate ground beds, Ground rod materials and sizing
- Wireless Facility Designs for Joint Use Structures and DAS Systems -- Pole Attachment concerns
- Service Wire/Drop Issues – Fiber Plant
- Pole Placement/Reflectors
- Engineering and Design aspects of Resilient Networks
- etc…

THE END

Thanks for Your Attention

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