National Electrical Code NEC (NFPA 70)

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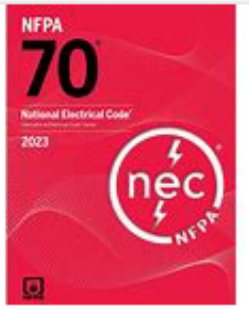
National Electrical Code (NEC)



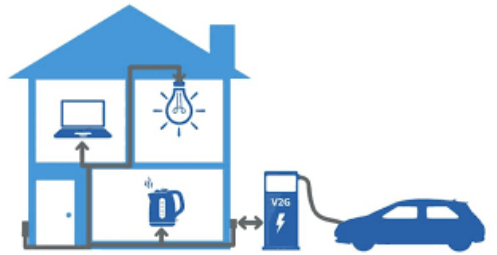
- Adopted in all 50 states, NFPA 70, the **National Electrical Code (NEC)** is the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards.
- The **National Electrical Code (NEC)** is enforced by **local and state authorities** responsible for electrical safety regulations. These authorities include building inspectors, fire marshals, and electrical inspectors. They ensure that electrical installations comply with the NEC standards to prevent hazards and protect public safety.
- The **National Electrical Code (NEC)** is updated on a **three-year cycle**. The **National Fire Protection Association (NFPA)**, which publishes the NEC, reviews and revises it periodically to address emerging technologies, safety concerns, and industry advancements. The most recent version of the NEC is the **2023 edition**.
- Currently developing the 2026 NEC – next step is to publish Draft of 2026 edition in March

What is Coming Down the Pike?

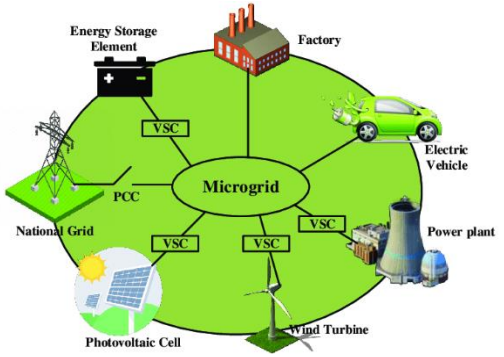
Sources are evolving quickly.

Traditional Power Generation Facilities are being augmented by more “alternative” sources, many not owned by the utility, and many more bi-directional

Vehicle to Grid



Microgrids



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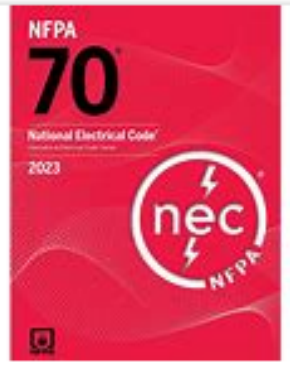
What are NFPA/NEC objectives?

- Remain relevant with the quickly evolving electrical industry
- Improve usability
  - Eliminate redundancy
  - Place content where it makes sense
  - Logical/parallel structure
  - Improve Limited Energy Content
  - Improve Medium Voltage Content
  - Eliminate “Special Equipment” – Equipment is Equipment
  - Leverage the past to make the future even better
- For communications arena – catch up the NEC content and structure with the rapidly evolving communications networks and technologies
- Look to the future = Modernize the code

National Electrical Code (NEC)



- **Where are we now**
- **Second Draft Meetings for 2026 code completed**
- **CC's long-term reorganization plan and vision** suggested by their Structure Task group has passed the initial ballot steps of the technical CMPs for 2026 Draft.
- **90.2 and 90.3 -** necessary preliminary changes made to the NEC format to facilitate the implementation of the future proposed structure.
- **2026 NEC** – Little steps toward the 2029 NEC long-term vision.

90.3 (2023 NEC)

Introduction

Definitions & General Requirements
Chapter 1

Wiring and Protection
Chapter 2

Wiring Methods and Materials
Chapter 3

Equipment for General Wiring
Chapter 4

Special Occupancies
Chapter 5

Special Equipment
Chapter 6

Special Conditions
Chapter 7

Communication Systems
Chapter 8

Tables
Chapter 9

Informative Annex A through Informative Annex K

Applies generally to electrical installations

Supplemental or Amendatory requirements

Applicable as referenced

Informative Only

Initially Proposed 90.3 (2029 NEC)

Introduction

Definitions & General Requirements
Chapter 1

Wiring and Protection
Chapter 2 - 4

Wiring Methods and Materials
Chapters 5 - 10

Equipment
Chapter 11 - 14

Specific Locations and Occupancies
Chapters 15 – 17

Energy Sources
Chapters 18

Life Safety and Emergency Systems
Chapter 19

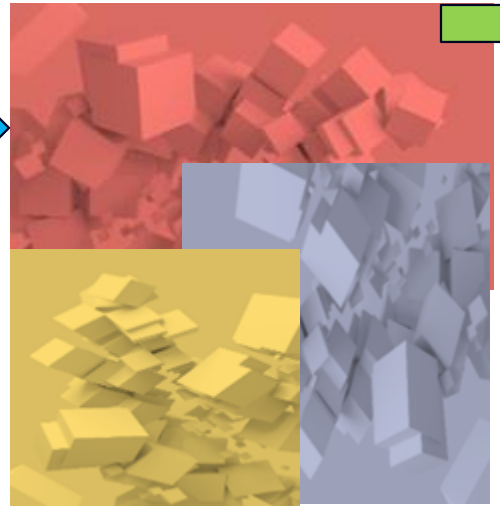
Tables
Chapter 20

Informative Annex A through Informative Annex K

2023

2023 - 9 Chapters with some common features, some independent, some special articles

2023-2026



2026 – deconstruct and re-arrange medium voltage, load calculations, Class 1, 2, 3, 4 and optical fiber and communications related articles to find common requirements and add parallel parts to each article in the chapters.

2029 (TBD?)

?

ORDER

?

?

Some Order

Similar but different type of order to 2023 in 20 chapters

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What this means for Communications?

Past

- Perceived as Confusing
- No more Ma Bell
- Everything communicates
- Independent Chapter 8 vs.
  Modifiable Chapters 1-7
- Cat 5/6 Cable Article 725 and 805
- How does NEC maintain relevance?

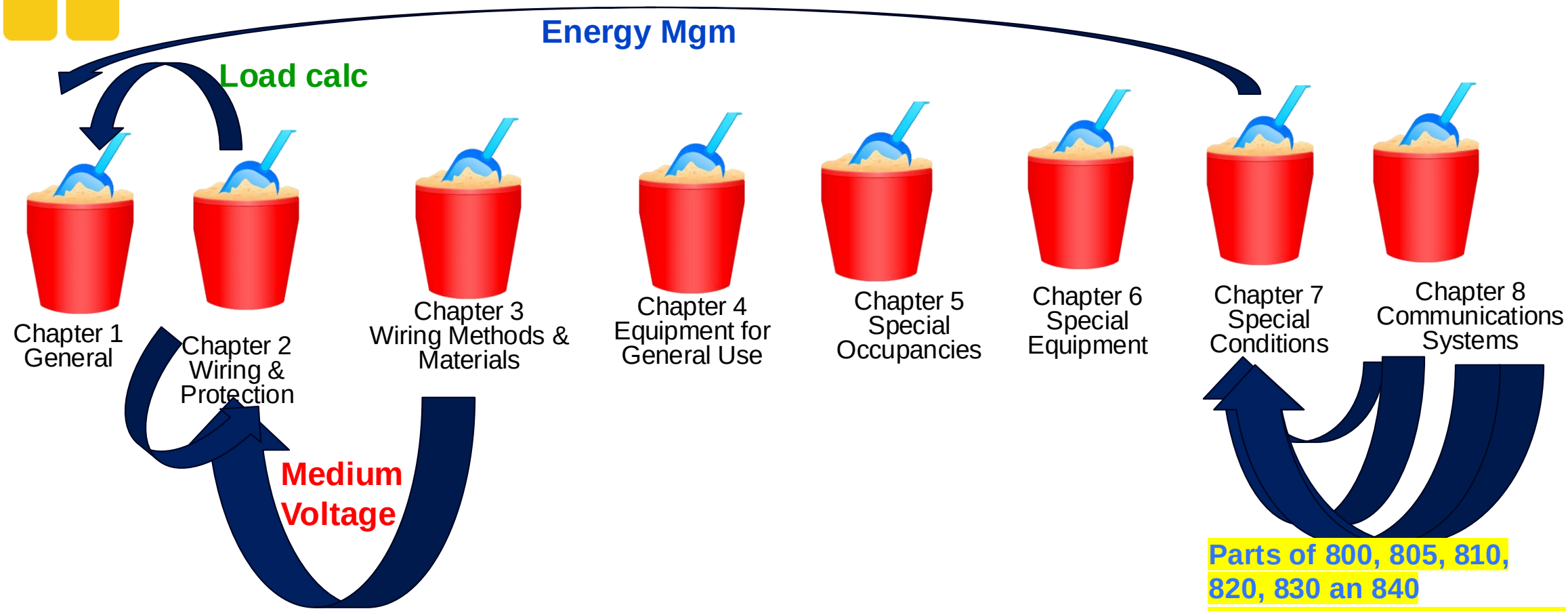
Future

- Improve usability.
- Create structure that is technology agnostic.
- Eliminate redundancy.
- Parallel Structure across code
- Encompass communications systems under the broader umbrella of “limited energy”

New Limited Energy Articles in Chapter 7

- Revisions most significant in the communications articles of Chapters 7-8
- New category of “Limited Energy” circuits and systems was defined to include
  - Class 2, 3 and 4 systems - Includes new FMPS (Class 4) powering systems
  - All the communications circuits that were located in Chapter 8
    - Traditional twisted pair, CATV, antenna systems, premises power and network powered broadband systems
    - Some sections were left orphaned in Chapter 8 – they did not fit under the limited energy general rules
  - Optical fiber systems that were in Article 770
- The over-riding direction and intent was to move requirements into a more logical arrangement BUT NOT TO MAKE TECHNICAL CHANGES.

NEC Structure – 2023 to 2026



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Limited Energy Definitions

Limited-Energy System *-- The equipment and cables of an end-to-end system that are either power-restricted, or capable of limiting or shutting down the power source to prevent deviations above normal operating limits to mitigate hazards related to electric shock and fire.*

Cable, Limited-Energy (Limited-Energy Cable) *-- A factory assembly of one or more conductors or optical fibers used for any of the following:*

(1) Class 2 circuits
(2) Class 3 circuits
(3) Class 4 circuits
(4) Optical fiber systems
(5) Communications circuits
(6) Community antenna television circuits (CATV)
(7) Network-powered broadband low-power communications circuits
(8) Premises communications circuits
(9) Power-limited fire alarm circuits

NEW Limited Energy Articles	Articles with Major REVISIONS	DELETED Articles
720 – General LE Wiring and Cables	724 – Class 1 systems	770 – Optical Fiber
721 – LE Power Sources	725 – Requirements for Class 1 systems and signaling circuits	790 – interim draft article that became 720
722 – LE Installation of LE cables	726 – Class 4 systems	794 - interim draft article that became 722
723 – Raceways, Cable Routing Assemblies and Cable Trays for LE Installations	800 – General communications systems for outside plant and entrance cabling	728 – article was revised and now became 772
742 – LE – Electrical Protection	805 – Listing of distributing frame wire, jumper wires and service drops for communications applications	
750 – LE Grounding and Bonding	810 – Antenna Systems	
760 – Fire Alarm	820 – CATV systems	
772 – Fire Resistive Cables	830 – Network Powered broadband systems	
	840 – Premises powered communications systems	

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Positives from 2026 NEC

- The creation of these "***Limited Energy***" articles should eliminate perceived confusion about the appropriate treatment in the NEC for data cables, machine-to-machine communications circuits, broadband systems and the other types of communication cables that are used in various applications.
- The affirmation and inclusion of Class 4 – **Fault Managed Power Systems** – used for providing power to communications facilities into the NEC.
  - Concomitant revisions were made to the 2023 of the NESC (National Electrical Safety Code) that covers the safe use of Fault-Managed Power Systems in the outside plant facilities of communications. Further guidance on use of these FMPS systems has also found in ATIS, UL and the Construction Blue Book (SR-1421).
- Improved clarity in grounding and bonding guidance in Section 800.48 on the appropriate interface between outside plant cables and the inside cables of the premises cables

Open Issues from 2026 NEC

- Fate of orphaned Chapter 8 articles uncertain
  - 800, 805, 810, 820, 830 & 840 → ??? Rules do not fit in LE articles
- Reorganization process, path and final form are uncertain
  - 720-through-750 → Chapter 3? 4? 6? (all were suggested earlier)
- Are all necessary exemptions added to the limited energy (LE) articles given the loss of independence of Chapter 8?
  - Despite due care and attention, omissions may have slipped through
  - Needs real world user review and feedback

Recommendations for Communications Users

Need to be practical, look to future likely actions, and keep their options open

1) Users should **not** revise their training manuals to reference the new 2026 code. The interim article and rule numbers are expected to change again in the next cycle.

2) If users build their installations to **meet the 2023 edition**, then they should also meet the intent of the 2026 and 2029 code editions.

3) Selected sections in the 2026 edition would benefit by user review and included in any training materials because (1) of the improvements in clarity from revisions and (2) for finding mistakes or code inconsistencies in new LE articles compared to 2023 communications articles (see next slide).

Candidate Sections in 2026 edition for review

- Listing & Marking guidance – 722.2 and 722.100, 722.131,
- Cable substitution Tables – 722.122, 722.132,
- Installation – 720.22, 722.15, 722.120, 722-131 and Article 723 – for most current guidance about what cables with limited energy circuits when installed can be mixed together or need to be separated in ducts, cable trays, and routing assemblies.
- FMPS Class 4 guidance – 721.50, 722.150, and Article 726
- Raceways, Cable trays, and Listed Cable Routing Assemblies – 722-130 & 723
- Class 2 and 3 specific rules – Article 725
- Protection requirements for communications circuits – Article 742
- Section 800.48 along with 750.48 and 250.94 to better understand the grounding and bonding requirements where network outside plant cables meet premises wiring.

Next Steps

- Correlating Committee Review and Action items
  - Includes likely reorganization Task Groups
- July 2025 = Review 2026 Draft
- NFPA Annual Mtg -- NITMANs & Standards Council
- 2026-2027 - Prepare Public Inputs for next code cycle (2029)

Thank You & Questions

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National Electrical Safety Code NESC (IEEE C2)

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National Electric Safety Code

Purpose - The practical safeguarding of **persons**, during the installation, operation, and maintenance of electric supply and communications facilities.

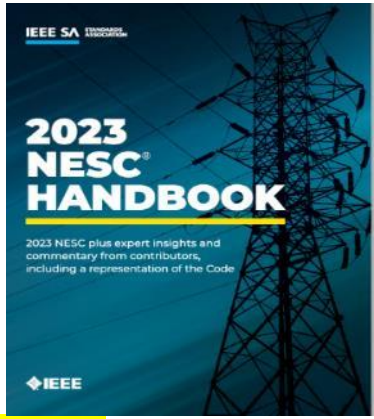
Scope - covers **supply and communication facilities** and associated work practices employed by an electric supply, communications, or railway in the exercise of its functions as a utility.

IEEE
Advancing Technology for Humanity

The 2028 Code development process has passed the Change Proposals meetings stage -- Preprint preparation is next step

Preprint release scheduled for July 2025 for Public comments

NESC Scope and Uses



NESC Is Not a Design Guide or Instruction Manual; however

- The NESC is used as reference for Joint-Use Agreements (How to we work best together!), design choices, and construction guidelines across the supply power and communications industries as well as in legal compensation cases (i.e., Who's to blame! Who's at fault!).
- Part 4 Work Rules Harmonizes with OSHA (1910), IEEE 1584, …..
- Industry best practices such as Telcordia GRs & SRs, ATIS standards, IEEE Guides, and many industry practices align with the objectives of NESC rules
- The current NESC competes with but does not directly conflict with NFPA 70 (NEC) or 70E requirements in areas where their scopes meet and may overlap (peaceful handshakes!)
- The NESC is used by 90+% of the States in USA with 80-85% following the current version for regulatory purposes and rulings (California GO 95 is major exception)

The NESC provides a critical safety-focused baseline and design guideline to help manage the logistics, business and technical (design/engineering) complications that may arise

NESC Schedule -- 2023 to 2028

- **5-year Revision Schedule –**
- Administered by IEEE … ANSI Approved
- 2023 NESC issued August 2022 with Effective Date of Feb 2023 applies on adoption by PUC, State legislative or local AHJ bodies
- 2023 – TIAs and Fast Track changes to the 2023 code were made for FMPS issues
- Feb 1st - May 15th 2024 = Submission of Change Proposals (CPs)
- August–October 2024 Subcommittee Review and action on all 500-600 CPs

- **1 July 2025 Preprint** of 2028 Edition Issued
- **21-23 October 2025 -- NESC WORKSHOP** - Review Preprint and look forward to 2028
- 24 March 2026 = Final date for Public Comments (PCs) on Draft for Aug/Oct 2026 review
- 1 August 2027 Publication of the 2028 Edition of the NESC

Major Changes accepted to 2023 NESC

- Added **new generation facilities** **Part 5** and sections to better cover grid-connected distributed energy facilities (solar & wind farms, energy storage..) – separated from, but based heavily on, the rules for **substations in Part 1**
  - Further adjustments expected on format and harmonizing for these 2 related parts
- Clarification of clearances associated with communications and wireless
  - Rule 235 and 238F – practical interpretation and application of these rules for wireless and other facilities in vertical space on poles **remains a challenge in congested communication space**, and in the negotiation of fair and consistent pole attachment agreements
- **Strength and loading for poles** – new updated ASCE wind and ice map references with refinements to Appendices of calculation examples
- The usual editorials, clarifications and format revisions

“Resolved” Issues - 1

- **Ground Elecrodes** (Rule 094C2) – Replace “equivalent” with “acceptable” to recognize that the different electrodes are effective grounding means, but not strictly equal in all ways
- **Powering of Communications Equipment** (wireline/wireless) using **FMPS (Fault Managed Power Systems)** - Rules 224/344 & revised Definitions –
  - Interim modifications to accommodate FMPS were reaffirmed for 2023 and 2028 code to permitting no shield under specified conditions
  - Definitions included for FMPS in communication applications
- **Construction Grades** – clarifications to Table 242-1 provide a clear concise guidance table for applicable construction grades (B, C or N) for joint use situations
- **Underground and Buried Plant (Part 3) - Terminology changes** for more consistent application of rules
  - Duct and conduit (single) ---Duct bank (one or more ducts or conduits) – Conduit Systems

“Resolved” Issues - 2

- **Section 25-27 -** Further refinements expected to **Pole Strength and Loading**
  - **Wind and Ice Loading maps** – load factors and calculation methods – the ASCE (American Society of Civil Engineers) guidelines ASCE-7 and ASCE-74 will be carefully considered and customized for possible alignment to utility pole applications and uses.
- **Sections 23 and 25** - traditional use of the
  - **Additive Constant** (“K factor”) retained for calculations of clearances (sags) and loads
  - **60 foot exemption for extreme wind loading** retained
- **Part 4 – Work Rules** - Refinements and Adjustments on
  - **Arc Flash clothing** default table (Rule 410A3) – updated with latest Laboratory test data
  - **Communications worker rules** (Section 43) remain the same.
  - Work rules around batteries and energy storage systems needs review for consist application between related rules in Parts 4, 5 and 1.

Open Issues – Ground Clearances

- **Ground Clearances** for insulators on guys (215), cables over driveways (232), on climbable structures (239).
- Reference height for safety based on person reaching up at full extension is currently 8 ft which is practical to the bottom of guy insulators, and minimum gap to hand holds to make a structure not readily climbable.
  - Proposals to increase to 10 ft or more were withdrawn by submitter or rejected because of lack of technical rationale. One reduction made to allow 9.5 ft in footnote 7 (Table 232-1) where cars less than 8 ft are driven.
  - More Public Comments (PCs) expected during this and next code cycle
    - Taller RVs and delivery vans are common and require higher, more practical clearances over driveways
    - Higher clearances would be safer
    - Pole congestion in communications space could lead to
      - Taller poles being required = higher make-ready costs
      - Conflicts with other communications lines of CLEC and ILEC,

        streel lighting, and traffic signals
      - Compromising the Communications Worker Safety Zone (CWSZ) between communications space and power lines on joint-use structures.

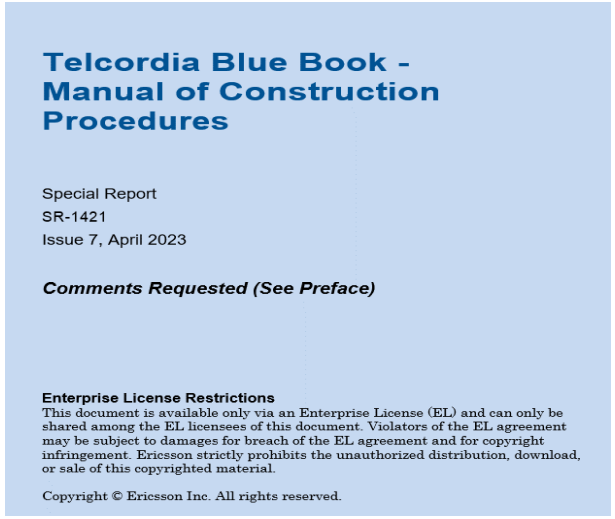
Open Issues – Congestion on Pole

- **<u>Congestion/competition on Poles</u>** – (Clearances - Section 23) –
  - Partly resolved by modifications and clarifications to Rules 235C (General Application), 235H (Within communications space) and 238F (Wireless).
  - The competition for vertical space between communications wireline, wireless carriers, ILECs and other players will escalate and continue.
  - The solution is not to be found in the NESC rules where great flexibility is found in rules for the communications space.
  - An economic viable solution is not to be found in bringing disputes to the regulatory arena with new public utility commissions rules and actions
  - Disputes between competing communications providers in communications space need to be resolved through mutual agreements and other industry guidelines and practices; for example - IEEE Guide on Joint Use P2939 "*IEEE Guide for Joint Use of Utility Poles with Wireline and/or Wireless Facilities*"
  -

Open Issues – Grounding, Bonding and NEC

- **<u>Grounding at Customer Premises</u>** – (Rule 099) –
  - Customer Premises buildings is where the handshake between the two codes (NEC and NESC) occurs.
  - Specific cross references to NEC are in flux because of the major reorganization of the NEC planned for the 2026 and 2029 editions of the code
  - Currently Section 250.94 in the NEC on the IBT is the most likely best reference to cite for direction to other rules in NEC for communications facilities
    - NEC 250.94 is the least likely rule to move during the reorganization
    - NEC 250.94 is likely to have references to other Grounding & Bonding rules for communications circuits and systems that are updated during the reorganizations and article changes.
    - NEC Reorganization will need to be tracked (and monitored) through 2029

NESC Related Activities



- **SR-1421** - ***Telcordia Construction Blue Book*** – issued 2023
  - Revisions are under considerations in 2025 and 2026 TBD
- **IEEE Guide - P2939** – Issued Nov 2023 - IEEE *Guide for the Joint Use of Utility Poles with Wireless Facilities* – needs to be tested through use to see if revisions, corrections and additions are needed
- Active work on **ATIS and UL Standards** on span powering and FMPS continues in for example
  - ATIS 0600040 (FMS), ATIS-0600333(Grounding and Bonding of Telecom Equipment), ATIS-0600315 (Voltage Levels for DC-Powered Equipment Used in the Telecom Environment), etc….
  - UL 1400-1 and 1400-2 covering FMPS – refinements continue
- **NEC new proposed "Limited Energy"** Articles 720, 721, 722, 723, 724, 725, 726, 728, 742, 750, 800, 805, 820, 820, 830 and 840 need review for practical use and viability relevant to best practices in the communications industry.

Thank You and Questions

Further questions may be emailed to tnbowmer@gmail.com or egallo@nebscore.com

Fast Track Changes to 2023 Code for FMPS - 1

New FMPS Definition in NESC Section 2

Fault-Managed Power System (FMPS). A powering system for communications equipment that monitors for electrical faults and controls the current delivered to limit fault energy.

NOTE 1: Fault- managed power systems consist of a power transmitter and a power receiver connected by a cabling system. These systems are characterized by monitoring the circuit for faults and controlling the power transmitted to ensure the energy and power delivered into any fault is limited with respect to electric shock between transmitter and receiver. ATIS Technical Report 0600040, - Fault Managed Power Distribution Technologies –- Human Contact Fault Analysis, provides a description of FMPS and testing protocols. FMPS circuits are also referred to as Class 4 circuits.

NOTE 2: The monitoring and control systems differentiate fault-managed power from electric light and supply power circuits with different requirements regarding minimum wire sizes, overcurrent and surge protection, insulation requirements, and wiring methods.

This description defines FMPS in the NESC as a method specifically for powering communications equipment and explicitly points to ATIS 0600040.

Fast Track Changes to 2023 Code for FMPS - 2

Revisions to "communications lines" under "lines" definition in NESC Section 2

1. communication lines.

The conductors and their supporting or containing structures, equipment, and apparatus that are used for public or private signal or communications service. A communication line may include fault-managed power system (FMPS) circuits used exclusively for communications equipment that monitors for electrical faults and controls the current delivered to limit fault energy meeting Rule 224B. See: fiber-optic cable—supply and fiber-optic cable—communication.

a. located in the communication space. Communication lines located in the communication space and which operate at potentials not exceeding 400 V to ground or 750 V between any two points of the circuit, and the transmitted power of which does not exceed 150 W. When operating at not more than 90 V ac or 150 V dc or as an FMPS circuit, no limit is placed on the transmitted power of the system.

.....

This revision links the FMPS application for powering communications equipment with rule 224B and the new definition of FMPS .

Fast Track Changes to 2023 Code for FMPS - 3

Revised 224B2(a) in NESC Part 2

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

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

1. Open-wire circuits shall have the grades of construction, clearances, insulation, etc., prescribed elsewhere in these rules for supply or communication circuits of the voltage concerned.

2. Special circuits operating at voltages in excess of 90 V ac or 150 V dc and used for supplying power solely to communications equipment may be included in communication cables under the following conditions:

a. Such cables shall have a conductive sheath or shield that is effectively grounded.

EXCEPTION: Fault-managed power system (FMPS) cables are permitted to operate without a conductive sheath or shield.

…….

This exception permits FMPS cable to not have shield. All other safety conditions (b) through (e) of 224B still apply. The allowance recognizes that the safety provide by a shield is replaced by the FMPS software system and its control features.

Fast Track Changes to 2023 Code for FMPS - 4

Revised 344A1(a) in NESC Part 3 Underground and Buried Plant

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

344. Communication cables containing special supply circuits

A. Special circuits operating at voltages in excess of 90 V ac or 150 V dc and used for supplying power in excess of 150 W solely to communications equipment may be included in communication cables under the following conditions:

1. Such cables shall have a conductive sheath or shield that shall be effectively grounded.

EXCEPTION: Fault-managed power system (FMPS) cables are permitted to operate without a conductive sheath or shield.

…….

This exception permits FMPS cable to not have shield. All other safety conditions (2) through (7) of 344A still apply. The allowance recognizes that the safety provide by a shield is replaced by the FMPS software system and its control features.