National Electrical Safety Code (NESC) Update



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- 2017 NESC Code released
 Code Making Process
 - Code Making Process
- Major Relevant Changes
- Active Areas of Discussion
- Construction Blue Book (SR-1421)







IEEE STANDARDS ASSOCIATION

National Electrical Safety Code[®] c2-2017



Codes in





Advancing Technology for Humanity

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

California Public
Utilities Commission

Overhead Electric Line Construction



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



NESC Purpose & Scope



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<u>Purpose</u> = The practical safeguarding of persons, utility facilities, and affected property during the installation, operation, and maintenance of <mark>electric supply and communications facilities</mark>.

<u>Scope</u> - 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, 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.

"NESC is Not a Design Guide or Instruction Manual "

<u>Personal View</u> – However, the code is used as defacto minimum baseline to build off for design/engineering calculations. Extra safety factors and clearances are added to provide the highly reliable and resilient networks desired. A network designed to just meet minimum safety, clearance and strength rules is not wise network and facility planning.



Relevance of NESC



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NESC - Adopted by most States and municipalities through legislative and/or regulatory (PUC) process after a review

- Automatic use of latest edition.
- Adoption of specific issue/date
- Some do piecemeal adoption (e.g., Washington State does not adopt Part 4 in entirety)
- Some States have separate independent codes (e.g., General Orders 95, 128.... in California)

Contractual basis of Joint-Use and Pole Agreements & Inter-Company Contracts.



Adoption & Use









Revision Process



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- <u>5-year</u> revision schedule plans in progress to enable accelerated changes
- Administered by IEEE Institute Electrical & Electronics Engineers
- Technical decisions made by Subcommittee (SCs) based on proposals
- Correlation/Coordination SC1, Main, Exec Committees, Standards Committee
- 2017 Edition (released August 2016)
- Public change proposals (CPs) → due by July 2018 → NESC Working Groups and industry discussions already underway
- SC action on proposals on Sept/Oct 2018 \rightarrow 2022 Preprint issued (Sept. 2019)
- Public Comments (PCs) on Preprint \rightarrow May 2020 \rightarrow action on PCs by Oct 2020
- Review by Main & Exec. Committees Jan-through May 2021
- Final Draft of 2022 NESC released May 2021 -> ANSI Approval → Release of 2022 Code scheduled for August 2021
- Applies on adoption by PUC, State legislative or local AHJ bodies



Multi-Step

PEG

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Process

Open Process - Multiple Public & Internal Review Steps

Active outreach efforts (IEEE) underway to add input

- Alternative energy generation and storage industry players
- Regulatory commissions (PUCs)
- Users and Stakeholder Communities
- Working Groups Industry and SC/IEEE driven
- Initial Public Inputs set tone and likely directions for code development → encourages early input

Appeals Process (rare event)

Adoption Variations – State by State, PUC.



Representation

(through ATIS)



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C2 Standards Committee - Oversight responsibility (ANSI review & Interpretation Requests

6 of the 7 NESC Technical 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





MAJOR CHANGES TO 2017 CODE



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Numerous clarifications and refinements with general objectives to improve the practical and consistent implementation of code and harmonize rules with industry best practices and work rules

- <u>Definitions</u> power and communications equipment & adding definitions for their normal allocated spaces on a pole
- Grounding & Bonding Rule 094 on ground rods, Rule 096 on allowed grounding exceptions, and Rules 097 (097G) & 384 pertaining to intersystem bonds
- Reorganization of rules (215 & 279) dealing with placement of Guys and Insulators to better protect public and workers
- Grades of Construction (Section 24 –> Table 242-1)
- Part 4 Work Rules alignment/harmony with new OSHA Rules
 - Arc Flash..... MAD distances..... Fall protection....



Active Areas of Discussions



- Need to make NESC more flexible and responsive
- NESC/NEC Demarcation & Conflicts
- Congestion Management of multiple communications operators/licensees
 - Working Space
 - Clearances
 - Wireless
 - FTTX Build-Outs
- Pole Loading Calculations
- Work Rules
 - Arc Flash Risk Assessment
 - In and around power generation and storage sites





Drivers for NESC Changes & Discussions PE



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PRIMARY = REACTIVE

- Problems, issues and conflicts revealed during active use of NESC
 - Joint-Use Agreement Conflicts Wireless, Wireline, Power, Light Rail...
 - Problems during Engineering/Design/Planning activities
 - Regulatory Inspections FCC, PUC, OSHA and AHJ Compliance
 - Tests & Inspections part of routine work, planned, documented
 - Field incidents, accidents, and legal cases

<u>SECONDARY</u> = PROACTIVE (5 year code cycle can limit reaction time)

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



NESC Equipment Definitions



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<u>Electric Supply Equipment</u>. - 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.

 <u>Communications Equipment</u>. - 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. Both codes recognize that communications equipment can include servers and routers and their powering supplies.



Space Definitions



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<u>communication space</u>. 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.



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).



Demarcation



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Demarcation Between Codes



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- At 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



Modernize & Keep

Code Up to Date



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Code needs to keep up with technological change and IoT World

Internal Code Issues – mostly driven by IEEE

- On line tools and internet delivery of codes, guidance and services
 MOOCs (Massively Open Online Courses)....
- Outreach to old and new stakeholders through NESC summits and workshops
- standards.ieee.org/about/nesc
 www.standardsuniversity.org/videos
- Interim code change processes shorter turn-around times

External – Joint use agreements and relations between companies and with PUCs

- Congestion and Conflicts Technical & Commercial 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
 - 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



Grounding & Bonding



2017 NESC Changes :

Rule 096 – Exception to 4 grounds per mile added to accommodate long spans under water, across valleys, etc... Rule 097 – Bonding between power and communications (097G) Rule 384C (Part 3 - Underground Lines) – add Note "This rule does not prohibit bonding communication metallic enclosures to supply pole grounds provided all affected parties are in agreement."

Open Issues :

Rule 094B – Ground Rod Materials and sizes

- Galvanized Steel versus Copper Clad Steel
- Trade versus actual sizes

Rule 099 – Intersystem Bonding at House (Demarcation Poin.

– 14 AWG versus 6 AWG







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 -- separate grounding conductors
- 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.
- 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

Telcordia supported the 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.
 Further editorial improvements may help – under review.

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Rule 097G 2017 Language



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2017 NESC -

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.



Intersystem Bonding (097 & 099)



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- Rule 097 Bonding Power and Communications Grounds
 - Bond to power ground or MGN, if possible
 - Alternates Single ground rods or Ground beds (3 rods) or bond to reinforced concrete vaults may be needed
 - Bond grounding systems together if within 6 feet
- 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).



CONGESTION



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NESC Part 2 Aerial Plant



- Space Definitions (previous 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
 - Engineering designs and configurations → Blue Book and other design and engineering guidance documents.

• 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



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Powering Circuits for Communications



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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

 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.



Powering Circuits for Communications



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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 safety concerns on the 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.





Guys Insulators



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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
- Protect both Public on ground and workers in aerial plant









Construction Grades

Pole Loading



- Construction Grades Reorganized & Clarified (Table 242-1)
 - More clearly define where and when each Grade is applicable
 - Grade N used for temporary & emergency work, private rights of way and service drops
 - Grade B = highest grades for joint use & railroad crossings
 - Grade C = most often for communications poles
 - **Open Issues for resolution or continued work Next Cycle**
 - 60 foot exemption Retained
 - **"K additive constant**" Retained for present but expected to eventually be replaced with new ice/wind loading factors and addition of Non-Linear Design methods in next code cycles.





Work Rules (NESC Part 4)



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

- NESC changes partly 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 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 \rightarrow use 5 cal/cm² 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."
- Telecommunications Circuits are inherently safe GR-1089 and ATIS
 0600315 standards limit voltages & currents.







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.





Energy Storage Batteries



- DALLAS, TX MARCH 14 16, 2017
- **Rule 420G Liquid cell Batteries** (Section 14)
 - Keeping up with new battery technologies \rightarrow 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, Zn-air, Li-ion lithium ion technologies variety of chemistries



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





Paths Forward



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Active Support and Monitoring Activities

- Propose and support clarifying revisions to bonding Rule 097G
- Improve clarity of 235H clearances between communications lines
- Monitor discussions on pole loading
 - Support retention of Grade N & 60 ft exemption
 - Monitor "K additive Constant" debate to help ensure consistency
- Monitor GO 95 activities for new ideas to avoid or those to emulate
- Support OSHA harmonization efforts for improvements in arc flash, fall protection, MAD – NESC Part 4
- Support new revision to Battery rule 420 G (WG leader)
- Construction Blue Book Issue 6
 - Wireless Facility Issues











Blue Book – Manual of Construction Procedures	
Overview	
General	
Aerial Plant	
Wireless Facilities (NEW)	
Underground Plant	
Buried Plant	
Bonding & Grounding – Customer Locations	
Cable Guards	
Fiber Optic Facilities (FTTX) - Deployment	
Symbols – Grid and Mapping Diagrams	
Informational Commentaries	







- **1.** Size 500+ pages = 38% increase in size
- 2. Harmonize with latest NESC and NEC national safety codes.
- **3.** Commentaries and clarifications added based on field problems, issues, and concerns over previous 6 years.
- 4. New Wireless Chapter (Chapter 15) and incorporation of wireless facilities information in other chapters
- 5. Updated Fiber Optic network (FTTX) Chapter 27
- 6. Expanded guidance and details on Grounding and Bonding issues – primarily in chapters 10 and 25









Thanks for Your Attention









Scope & General Safety

<u>Chapter 1 Introduction</u> - expanded commentary on scope and purpose and how specifications, codes and standards fit together to help create reliable, resilient networks.

Chapter 2 – General – New/Revised sections include

- 2.1.2 Make-safe or Made-Safe
- 2.1.3 MAD values small minor changes
- 2.1.4 Use and Maintenance of Rope
- 2.2.1 Powering of communications equipment
- 2.2.2 Electric Safety of Communications Circuits Arc Flash
- 2.10.1 Steam lines
- 2.14 Wireless Facilities
- 2.17 Personal protection Equipment (PPE) gloves







<u>Chapter 3 – Aerial Clearances</u> – Revised/Updated sections

3.2 - Clearances – updated and clarified per NESC

3.7 - Communications Antennas – now new Chap 153.8.1 – Pole placement relative to roadway and use of reflector markers

3.10 - Service Drop masts guidance

<u>Chapter 4 – Strand</u> - various parts of 4.1 to 4.5 sections were revised, corrected and updated. New application commentary (Sec. 4.6) covering different strand size and material choices as well as needs for coastal regions.

Chapter 5 – Pole Line Hardware –

Chapter 6 – Guying

Chapter 7 – Insulating Guys

These Chapters 5-7 had various sections were revised, corrected and updated in general ways to clarify guidance or update with latest NESC (Rule 215C for Insulating Guys) and cross references to latest Telcordia GRs and relevant industry standards.









<u>Chapter 8 – Anchors and Guy Rods</u> - expanded discussion on anchor types, anchor rod positioning, with new

- 8.9 Anchor verification position and strength
- 8.10 Removal of anchor/rods

<u>Chapter 9 – Suspension Strand</u> – False Dead Ends and Slack Spans - Figures were revised, updated and corrected with commentary added to clarify the network applications for these configurations.

<u>Chapter 10 – Bonding and Grounding in Aerial Plant</u> - Sections were added to expand on the objectives of, and rationale to, changes to NESC Rule 097 and 384. Chapter 10 material was correlated with other related grounding and bonding issues discussed in new Chapter 15 (*Wireless*) and Chapter 25 (Grounding & Bonding at Customer Premises).

<u>Chapter 11 – Identification in Aerial Plant</u> - Doubled the size of the chapter and expanded descriptions and choices for aerial markers of cable plant, guy markers and other identification for aerial plant along with cross references to other marking/labeling requirements for facilities - for the pole (Chapter 12) and for wireless equipment (Chapter 15).







<u>Chapter 12 – Pole Testing and Inspection</u> - updated the chapter with numerous changes to better match current up-to-date practices and approaches with pole inspection programs.

<u>Chapter 13 – Pole Loading and Strength Requirements</u> - Pole Loading the strength overview - The chapter was revised with explanatory commentary on latest changes in NESC and expanded discussions of the design and engineering factors that need to be considered. Applicable construction grades and pole loading stresses are discussed.

<u>Chapter 14 – Supply Equipment in or Near the Communications Space</u> - The chapter was revised and updated with several changes with added cross references on power supply boxes and with the new wireless Chapter.







<u>Chapter 15 - Wireless Facilities</u> - This new chapter covers wireless issues such as RF exposure and appropriate/recommended locations for wireless antennae and support facilities on joint-use structures including

- 15.1 Overview of wireless components and regulatory areas
- 15.2 RF Exposure Pole Markings and Labels
- 15.3 Pole Marking
- 15.4 Mechanical, Electrical and spatial concerns for joint use on poles
 Working Space... Climbing Space... Electrical Safety
- 15.5 Locations choices antenna on poles cross arms... +++
- Wireless concerns are also covered in
 - Clearances Chapter 3
 - Grounding/Bonding chapters 10 and 25
 - Powering of equipment chapter 14
 - GR-3171 (Wireless Infrastructure), GR-3178 (WiTF facilities)
 - Support hardware/cabling GR-3174, other GRs & Industry Standards















<u>Chapter 16 – General precautions and Work Rules for Manholes</u>

- Added details on Handholes, smaller vaults , corrosion in manholes

Chapter 17 – Testing Manhole Atmosphere and Ventilating Manholes

 Small additions and corrections made throughout the chapter to help clarify issues and expand on some of the issues already covered.

<u>Chapter 18 – Bonding Cables in Manholes and Handholes</u> - expanded discussions to better cover Handholes

<u>Chapter 19 – Identification Markers for Underground Cable</u> - new Section 19.6 added covering a discussion on *Locating Technologies for Buried and Underground Plant*

<u>Chapter 20 – Sealing Conduits and Ducts</u> - expanded discussions to include microduct products, revised listing of commercial sealants and plugging materials, added triplex/Multi-plex split plugs discussion and different tapes used in conduit facilities.







<u>Chapter 21 – Buried Plant Construction -</u> enhancements and clarifications to buried plant issues on GR-902 handholes, and application notes.

<u>Chapter 22 – High-Speed, Blown Cable Installation System</u> - Minor revisions mostly plus new information and calculations for cable placement distances able to be accomplished with the HASB systems.

<u>Chapter 23 – Direct Buried Innerduct Construction Guidelines - Minor revisions mostly</u> plus new information on Microtrenching (23.4.4)

<u>Chapter 24 – Directional Drilling (HDD)</u> - Minor revisions mostly plus new information and calculations in Sec 24.7 for predicted Mini-HDD Pull Load vs. Safe Pull distance

<u>Chapter 25 – Bonding and Grounding – Drop Cables & Service Wires</u> - Revised to match latest NESC and NEC changes and has been expanded to include design and engineering guidance on grounding/bonding at the customer premises NID (demarcation points).

<u>Chapter 26 – Cable Guards – Vertical risers</u> - Minor revisions and enhancements with added discussion of transition cable between buried and aerial plant







<u>Chapter 27 – Fiber Optic (FTTX</u>) - Was updated and revised in general for fiber optic networks and with information on Flexnap type cables and microduct usage.

Chapter 28 – Symbols for Grid and Mapping Diagrams - Minor revisions,

Appendices updated and revised

- Appendix A Loading Maps in NESC NESC commentary on clearances, pole loading/strength and related geographical zones and districts
- Appendix B NESC commentary on active issues in NESC technical subcommittee discussions and those that are expected to cause changes next cycle.
- Appendix C Historical reference material 1911 Rules for Troublemen
- Appendix D References