COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF TELECOMMUNICATIONS AND CABLE

CRC Communications LLC, d/b/a OTELCO, Complainant, v. Massachusetts Electric Company d/b/a National Grid, and Verizon New England Inc., Respondents.	D.T.C. 22-4

PRE-FILED TESTIMONY OF DR. LAWRENCE M. SLAVIN ON BEHALF OF CRC COMMUNICATIONS LLC, d/b/a OTELCO

July 11, 2021

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LAWRENCE M. SLAVIN, PH. D.
ON BEHALF OF
CRC COMMUNICATIONS LLC, d/b/a OTELCO

I. INTRODUCTION

A. WITNESS IDENTIFICATION

Q. Please state your name, title and business address.

A. My name is Dr. Lawrence M. Slavin. I am the principal of Outside Plant Consulting Services, Inc., a private practice specializing in standards, guidelines, and construction methods for outside plant facilities in the telecommunications and power industries. My address is Outside Plant Consulting Services, Inc., 15 Lenape Avenue, Rockaway, NJ 07866.

Q. Please summarize your educational and professional experience and qualifications.

A. I received a B.S. in Mechanical Engineering from The Cooper Union for the Advancement of Science and Art. I then pursued an M.S. in Engineering Mechanics at New York University, where I also received my Ph.D. in Mechanical Engineering. My professional background includes a wide range of consulting experiences in various roles in the telecommunications industry, including investigation of issues related to the power industry. Among my many activities, I have provided technical support for American Society of Civil Engineers (ASCE) Manual No. 111, "Pole Reliability Based Design of Utility Pole Structures."

I currently represent the national telephone industry, via the Alliance for Telecommunications Industry Solutions, on the National Electrical Safety Code (NESC) Committee. I actively participate on various NESC subcommittees, including the relevant Subcommittee 4 (Overhead Lines – Clearances) and Subcommittee 5 (Overhead Lines – Strength & Loading), as well as on Subcommittee 7 (Underground Lines), Interpretations Subcommittee, Executive Subcommittee and Main Committee. I also serve on Accredited Standards Committee 05, responsible for several utility standards, including the relevant *ANSI O5.1, Wood Poles, Specifications and Dimensions.*

Additionally, I have written several articles in industry journals and publications, including recently in IAEI (International Association of Electrical Inspector) Magazine, *Highlights of the next edition of the National Electrical Safety Code*, and have chaired panel sessions for the benefit of the industry on behalf of the NESC. I am author of the recently published book *Overhead Distribution Lines – Design and Applications*, by Wiley–IEEE, and am a contributor to the *Telcordia Blue Book – Manual of Construction Procedures.* Additional details summarizing my background, training, and professional activities are attached to my testimony as Exhibit A.

In addition to my work on the NESC Committee, I have been, and/or continue to be, involved in several state regulatory commission proceedings involving various aspects of pole attachments and clearance and loading requirements, including matters arising in Florida, Connecticut, Georgia, and California.

B. PURPOSE OF TESTIMONY

Q. Please explain the purpose of your testimony.

A. I was asked by representatives of OTELCO to discuss the practice of pole "boxing" (or "opposite side" construction), as it relates to efficient construction techniques for overhead communication lines and compliance with appropriate safety codes and industry practices. The ability to use this method, as opposed to the installation of a new, larger pole, increases the feasibility of providing broadband services to the public. Verizon and National Grid, however, have disallowed this practice to OTELCO, resulting in this formal complaint proceeding. In their responses, Verizon and National Grid claim there are issues related to boxing, including safety and complications to future work. My testimony addresses these issues.

C. SUMMARY OF TESTIMONY

Q. Would you briefly summarize the areas upon which you are testifying?

A. My testimony addresses:

(1) The benefits of using boxing (or opposite side construction) to avoid costly make-ready, including pole replacements;

(2) The concerns raised by Verizon and National Grid pertaining to boxing (or opposite side construction), including potentially more complicated pole removal and issues related to climbing and safety; and

(3) Technical issues pertaining to attaching communications lines below Verizon.

III. TESTIMONY

Q. Could you explain how the NESC and safety considerations apply generally to pole attachments?

A. Yes. As stated in the Abstract of the NESC (2017):

> This Code covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of (1) conductors and equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines.

The NESC is widely recognized as a "basic" safety code. While a utility may decide to exceed the rules of the NESC in order to create an even "safer" environment, it is also recognized that it is necessary to balance various issues when attempting to provide essential (lifeline) services to the public. Such services include electric supply and communications, including the increasing need for broadband. Accordingly, the use of joint-use construction is, and always has been, a balance between the need to provide as safe a working environment as possible and the ability to practically deliver critical electric supply and communications services. Indeed, it would be considerably "safer" to utilize separate structures for delivering these two types of services, rather than combine them on the same structure. However, in most cases having two separate structures for electric and communications facilities is not a viable solution, as evidenced by the extensive joint-use of poles throughout the country.

Q. Please explain the meaning of a "boxing" or "opposite side" construction.

A. The practice of pole boxing refers to the installation of cables or wires running in the longitudinal direction, along the line, on opposite sides of the pole, as illustrated in Figure 1:

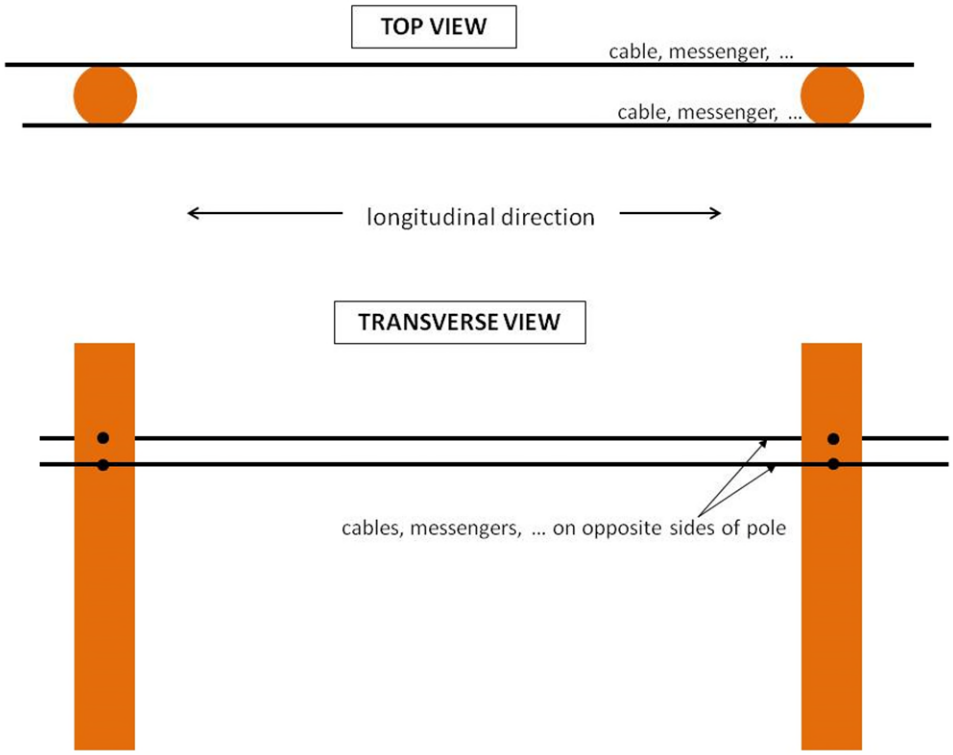


Figure 1

Because of the potential benefits in its usage to an attacher, albeit with possible inconveniences to both the party using it as well as other parties, including the pole owner, this practice has been somewhat controversial.

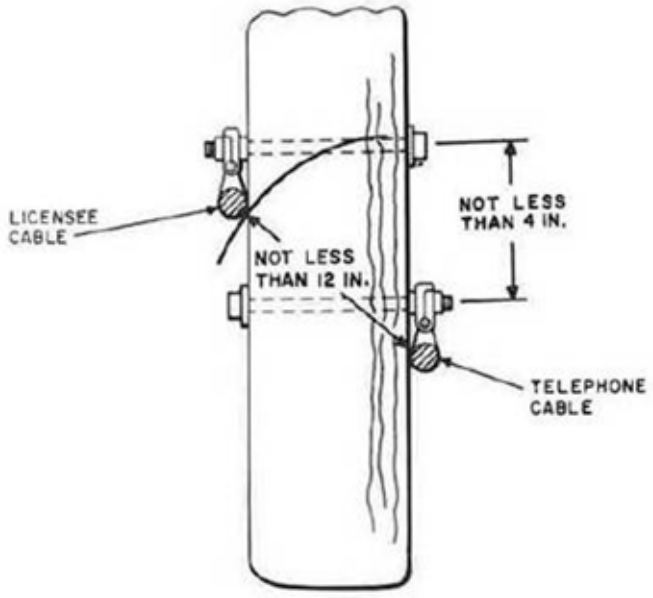
Q. What are the benefits of opposite side construction?

A. The installation of longitudinal runs of cables on opposite sides of the poles – i.e., boxing – is an efficient, cost-effective means of adding communications cables to existing poles, and

may be used to avoid the immediate need for an expensive pole replacement operation. The procedure is consistent with the safety rules of the NESC, as well as the industry practices provided in the Telcordia *Blue Book – Manual of Construction Procedures*. It is recognized that future pole replacements, as *may* occur at some time in the future, *may* be more difficult – and possibly more expensive – to accomplish. If and when that happens, it would be incumbent upon the cost-causer (the party utilizing this practice) to incur the related incremental expenses, with an additional obligation to facilitate the operation, possibly by temporarily detaching its lines from pole(s), as necessary.

Q. In National Grid's Response to the Complaint, they argue that "boxing" would require "implementing a significant modification to National Grid's construction policies which are essential to preserving system reliability and worker and public safety." (*See* National Grid Response at p. 22.) I will ask you to address each of the points National Grid and Verizon raise concerning the practice of "boxing," but first, is "boxing" or "opposite side" construction consistent with the NESC?

A. Yes. The use of boxing is consistent with the safety rules of the NESC, as well as the industry practices provided in the Telcordia *Blue Book – Manual of Construction Procedures*. For instance, the 2017 edition of the *Blue Book* illustrates recommended spacings and clearances when cables are placed on opposite sides of the pole:



Boxing is therefore an accepted procedure and entirely appropriate when it facilitates delivery of advanced communication services, without which the provision of such services may not be feasible.

Q. Do you consider "boxing" or "opposite side" construction to be an important construction alternative for deployment of competitive broadband services?

A. Yes. As the communications industry evolves, accompanied by the increasing need for and deployment of broadband services, the ability to install the associated cables on existing infrastructure is becoming increasingly difficult. A commonly encountered issue is that of insufficient space on the utility poles, consistent with industry requirements and practices. The available space for additional communications cables on an existing pole is limited by the clearances to the ground below, required separation between communications lines and from the electric supply lines above. Within these constraints,

however, it is possible to place cables, including support messenger/strand, on opposite sides of the pole ("boxing"), as illustrated in Figure 1. This procedure may be the most practical, efficient, and cost-effective means of adding the new facilities, avoiding the considerably more difficult, time consuming and costly alternative of a pole replacement. The latter procedure encompasses the detachment of existing facilities, including electric supply and other communication lines, removal of the existing, presumably healthy, pole and the installation of a new, larger pole, followed by the reattachment of all the previously removed facilities, and finally by the installation of the originally requested lines. This pole replacement alternative is therefore a relatively complicated, expensive task, in comparison to placing the additional communications lines on the opposite side of the pole. Notably, Verizon recognizes that boxing can be an appropriate option on joint-use poles, particularly "when the use of any other available method(s) would be unreasonably costly to one or both Parties." (*See* Wolanin Affidavit Exhibit D ¶ 1.) Indeed, this is the situation presently being addressed, for which OTELCO requests such consideration.

Q. The potential for interference with the climbing space is one of the primary arguments National Grid and Verizon give against the practice of "boxing." For instance, National Grid states that "[t]he use of "boxing" techniques will usually make a pole unclimbable by electric utility workers." (*See* National Grid Response at p. 22.) How do you respond to these concerns?

A. Unfortunately, the practice of "boxing" has had negative connotations and is sometimes disallowed as an otherwise viable option for third-party attachers for the placement of their additional lines. However, the possible obstruction of the climbing space on the otherwise

unoccupied side of the pole is irrelevant in most cases due to the wide-spread usage of aerial lifts or bucket trucks, or the use of ladders in rare cases when poles are not as accessible. For example, the Maine Public Utilities Commission considers the following as an unreasonable restriction for the joint-use of utility poles:

> **Boxing.** A prohibition on boxing poles (i.e., placing cables on both the road side and the field side of a pole) which can be safely accessed by emergency equipment and bucket trucks or ladders provided that such technique complies with the requirements of *applicable codes*. [italics added]

Interestingly, the practice of boxing is compliant with the most appropriate "applicable code" – the NESC – independent of the possible use of bucket trucks or ladders. Although the NESC is not formally adopted in every state, it is generally recognized or reflected in the industry practices throughout most of the country, including territories. Rule 236G of the NESC addresses "Climbing space past longitudinal runs not on support arms," referring to cable installations as illustrated in Figure 1, and states (NESC-2017):

> Longitudinal runs on racks, or cables on messengers, are not considered as obstructing the climbing space if the location, size, and quantity of the cables permit qualified workers to climb past them.

Prior to the 2007 edition, this sentence had language that required the wires to be covered with rubber protective equipment or be otherwise guarded, before climbing past them. However, as explained in the formal response to NESC Interpretation Request 563:

For your information, the change was made to reflect common work practices. *For the most part, workers were not covering communication cables when climbing past them and it was determined that such action was not a safety issue.* Note that energized electric facilities must be covered in accordance with Part 4 Rules for the Operation of Electric Supply and Communications Lines and Equipment. [Italics added]

It is noted that the Telcordia *Blue Book – Manual of Construction Procedures* (2017) clearly shows the use of boxing in its Figure 3-1 (Clearance Between Licensee-Owned and Communications Company), as illustrated above, as an accepted practice, referring to third-party attachments on poles, albeit with a 4-inch minimum vertical spacing between strand mounting bolts. Indeed, the *Blue Book* illustrates (Figure 5-4) an appropriate (double ended) suspension bolt for facilitating such an operation, presumably for the convenience of the ILECs (Incumbent Local Exchange Carrier) utilizing boxing for their own purposes. (Several examples of boxing by ILECs or other parties on Verizon-occupied poles are shown in the declaration of David Allen, although apparently not using this type of hardware.) The *Blue Book* is a well-respected, widely-used document in the communications industry and may be referenced in pole attachment agreements – including in the agreement in question with Verizon.

Q. **Is the use of "boxing" consistent with the clearance requirements of the NESC?**

A. Yes. Not only is the practice of boxing compliant with the rules for climbing space as specified in the NESC (Rule 236G) and the installation practices of the Telcordia Blue

Book, the resultant installation is also consistent with the clearance requirements of the NESC, regarding the separation between cables in the communication space. NESC Rule 235H does stipulate a 12-inch spacing between messengers at the pole (but can be reduced by agreement of the parties), which is properly interpreted as applying in the vertical direction. However, Rule 235D indicates that the separation must satisfy either the vertical clearance or horizontal clearance, but not both simultaneously. While this rule is not necessarily directly applicable to communication lines, the combination of NESC Rule 012C ("accepted good practice" in the absence of "particulars not specified"), NESC Table 235-1 (6-inch horizontal clearance between open communication conductors), the clearance envelope of NESC Figure 235-1, and a typical local pole diameter of approximately 10-inches (based on the ANSI O5.1 wood pole standard), indicates the resulting separations are NESC-compliant.

Figure 3-1 of the *Blue Book* is somewhat more conservative than the NESC, requiring a 12-inch clearance between the cables on opposite sides of the pole, although measured in a diagonal (radial) direction. This requirement would also be satisfied, considering the typical local pole diameter (10-inches), the required minimum 4-inch vertical bolt spacing for a third-party attachment, and gaps between the cables and the pole surface, ensured by the third-party's mounting bracket, as necessary.

Neither the NESC nor the Blue Book address the pole replacement process, but it may be assumed that reasonable precautions will be taken, as described above, possibly by temporarily detaching the lines installed on the opposite side of the pole, as necessary.

Such precautions would also presumably apply to Verizon-occupied poles already utilizing this procedure in the examples shown in the declaration of David Allen.

Q. In its Response, National Grid states that "[e]xisting communications attachments placed on one face of a pole are installed with a spacing of 12 inches from center-to-center," and argues that "[i]nstalling an additional attachment on the opposite side of the pole requires an additional hole in the pole in line with the existing holes, creating a weak spot in the pole …" (*See* National Grid Response at 22.) Do you agree with National Grid's assessment?

A. No. As I stated above, the *Blue Book* considers the boxing of third-party attachments to be an accepted practice on poles where there is a minimum 4-inch vertical spacing between strand mounting bolts. In fact, Verizon's guidelines permit strand mounting bolts to be as close as four inches. (*See* Affidavit of David L. Wolanin at Ex. B, § 3.2.3.) Notably, National Grid does not include a reference to a specification that requires a minimum spacing of 12 inches between bolt holes for attachments. The NESC, similarly, does not contain such a requirement. This is likely because the greatest bending loads and associated stresses for a distribution pole typically occur at or near the ground line, and not in the vicinity of the attachments or their bolt holes. Thus, bolt holes in the communications space are generally not a significant or critical issue.

Q. Another argument typically given against "boxing" – and one that both National Grid and Verizon put forth in their responses to OTELCO's Complaint (*see, e.g.*,

National Grid Response at p. 22; Verizon Response at p. 10) – is that it complicates the future pole replacement process. Can you respond to this criticism?

A. Yes. It is recognized that the process of boxing a pole may result in a potentially more complicated, more costly pole replacement process. Such a process, however, may occur many years in the future, and may never be an issue, depending upon other events that may occur prior to that time (e.g., undergrounding). In any case, it would be reasonable to require that the "cost-causer" (third-party attacher) reimburse the pole owner(s) for any incremental expenses, with an additional obligation to facilitate the operation, possibly by temporarily detaching its lines from pole(s), and lowering or diverting them, as necessary. On balance, this would represent a much more reasonable and equitable alternative than imposing the major delay and cost of replacing an existing, otherwise healthy pole.

Q. In the Affidavit of David L. Wolanin, he claims that "[n]one of the poles identified by Otelco in Exhibit E to the Allen Declaration is suitable for boxing," and attaches his "assessment of the circumstances of each of those poles on a pole-by-pole basis …" (*See* Affidavit of David L. Wolanin, ¶ 11 and Ex. E.) Can you respond to Mr. Wolanin's assessment?

A. Yes. Regarding the 14 "boxing" examples in Exhibits E to the Allan and Wolanin declarations, my responses fall into several categories:

- Examples No. 1, 6, 8, 12: Wolanin claims these are "complicated" poles and "boxing" would add additional difficulties to future work on the poles, including

"climbing" and/or pole replacement. While it is possible that some poles may not be accessible by bucket truck, it does not necessarily preclude access by other means, such as using a ladder. To the extent that a subsequent pole replacement may be more difficult, the previous discussion regarding the obligation of the attacher to facilitate the operation by temporarily detaching its lines from pole(s), and lowering or diverting them, as necessary, would apply. In any case, for such difficult situations, the immediate make-ready alternatives, possibly requiring a pole replacement, may be similarly problematic, rendering boxing as the most practical solution – consistent with Verizon's "practicable" criteria. (*See* Wolanin Affidavit Exhibit D ¶ 1.)

- Examples No. 2, 3, 4, 10, and 14: Wolanin claims the make-ready is "not overly-complicated," and the apparently little expense of make-ready work (typically $1,450) does not justify the possible additional difficulty of boxing. However, it is not clear on what basis he makes this economic decision; OTELCO would seemingly be in the best position to evaluate the impact of make-ready charges especially factoring in all of the poles in a given project.

- Examples No. 5, 9, 13, and 14: Wolanin considers the additional pull due to a boxed cable to be problematic on these poles. However, the tension due to an additional cable – regardless of which side of the pole it is mounted – will have a similar effect on the tendency to pull the pole over, which condition is restrained by the guying system. The guying system, however, may be checked to confirm it is sufficient for

the additional attachment, and may be strengthened, as necessary. This would be considerably more reasonable and cost-effective than replacing the pole and still having to install an appropriate guying system.

- Example No. 7: Wolanin concedes that the pole in question is already boxed, but that "[u]pon further review," "lowering the current attachment of the cable company and one of Verizon MA's facilities would create enough room for Otelco's attachment … without the need to replace the pole." However, Wolanin does not indicate what the cost would be to OTELCO or how much time it would take to lower the existing facilities, as compared to boxing, which would require no make-ready work.

- Examples No. 11 and 13: Wolanin claims that no make-ready work is required by Verizon, and therefore the pole should not be boxed, However, Wolanin's response ignores the fact that costly make-ready work may be required of other entities with facilities attached to the pole.

Q. In Exhibit. B, Section 3.1 Make-Ready Alternatives, of the Affidavit of David L. Wolanin, it states: "There are several reasons why Verizon will not allow Licensees to attach their facilities below Verizon facilities on a pole", for which the sag characteristics of Verizon's typically heavier copper cables are proposed as a factor. Do you agree with this rationale?

A. No. While there are various reasons for the Verizon to retain the lowest position on the pole, the heavier weight of their cables should not be one of them. A company attaching a lighter weight cable below can add sufficient sag in its line to account for that of the heavier

line above. Nor should weather be a problem. In particular, the related Response of Verizon to the Pole Attachment Complaint, as submitted by Alexander Moore, states:

> "… allowing much lighter third-party attachments below Verizon MA's heavy copper cables on the pole can result in facilities crossing each other at the mid-span between poles, because the heavier copper cables will sag more than the lighter facilities, including in response to *changing weather conditions*." [Italics added]

The incremental increase in sag due to severe (i.e., NESC specified) weather conditions, including ice or high temperature, depending upon the specific details of the installations (span length, messengers, sizes of the cables, …), may be essentially the same, or even less, for an already installed heavy copper cables than that of a smaller, lighter fiber cable. Thus, if a fiber cable installed below the Verizon cable would have (1) sufficient clearance above the surfaces below, under NESC conditions (½ inch radial ice or 120º F), and (2) initially (at installation) meet the minimum 4-inch mid-span clearance to the Verizon cable above, the installation would be NESC-compliant. Furthermore, the mid-span clearances between the cables may actually increase under the severe weather conditions, making "crossover" less, not more, likely to occur.

IV. CONCLUSION

Q. Do you swear that your testimony is true and accurate to the best of your knowledge?

A. Yes.

Q. Does this conclude your pre-filed testimony?

A. Yes.

EXHIBIT A

Outside Plant Consulting Services, Inc.

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ABOUT OUTSIDE PLANT CONSULTING SERVICES, INC. (OPCS)
Dr. Lawrence M. Slavin

Outside Plant Consulting Services, Inc. (OPCS) was established in the year 2002 to help meet the needs of the telecommunications and power industries in establishing standards, guidelines and practices for outside plant facilities and products. The OPCS Group provides related support services for field deployment, and product evaluation and analysis. Dr. Lawrence (Larry) M. Slavin, Principal of OPCS, has extensive experience and expertise in such activities, based upon his many years of service at AT&T/Lucent Bell Telephone Laboratories (Distinguished Member of Technical Staff) in telecommunications product design and development, followed by a career at Telcordia Technologies (Bellcore) in its research and professional service organizations. (See attached Experience and Education.)

As Principal Consultant and Manager/Director of the Network Facilities, Components, and Energy Group at Telcordia, Dr. Slavin was responsible for professional services related to the telecommunications industry. These activities included technical leadership in developing installation practices and "generic requirements" documents, introducing new construction methods, and performing analyses on a wide variety of technologies and products (poles, duct, wire and cable, electronic equipment cabinets, flywheel energy storage systems, turbine-generators, …). Throughout his long career, he has had a leading role in the evolution of many telecommunications related fields and disciplines -- including aerial and buried plant design and reliability; advanced construction and cable and duct placement techniques; copper pair, coaxial, and fiber-optic technology; flywheel energy storage systems; physical design and development of hardware and electronic and electro-optic systems ("SLC 96" digital loop carrier, …); cable media and equipment reliability studies; exploratory fiber-optic hardware development; and systems engineering.

Dr. Slavin has been a member of numerous industry and professional committees and organizations, often in a leadership position (see attached Industry Activities). He is the author of numerous industry technical papers, reports or documents (partial Bibliography attached, with resume), as well as the editor and primary author of ASCE Manual No. 118, *Belowground Pipeline Networks for Utility Cables*, published by the American Society of Civil Engineers. Dr. Slavin is also author of the recently published book ***Overhead Distribution Lines – Design and Applications***, by Wiley–IEEE, and is a contributor to the **Telcordia *Blue Book - Manual of Construction Procedures***.

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Industry Activities (Present and Past**)**

- **National Electrical Safety Code Committee**
  - **Represents the national telephone industry, via Alliance for Telecommunications Industry Solutions, ATIS**
  - **Executive Subcommittee**
  - **Main Committee**
  - **Interpretations Subcommittee**
  - **Subcommittee 4 (Overhead Lines – Clearances)**
  - **Subcommittee 5 (Overhead Lines – Strength & Loading)**
  - **Subcommittee 7 (Underground Lines)**
- **Accredited Standards Committee ASC-O5**
  - ***ANSI O5.1, Wood Poles, Specifications and Dimensions***
  - ***ANSI O5.2, Wood Products, Structural Glued Laminated Timber for Utility Structures***
  - ***ANSI O5.3, Wood Products, Solid Sawn-Wood Products and Braces***
- **ASCE 7 Icing Subcommittee**
- **ASCE Utility As-Built Standards Committee**
- Transportation Research Board
  - Utilities Committee, AFB70
- Pole Reliability Based Design (RBD) Committee, ASCE
  - *Reliability-Based Design of Utility Pole Structures*
- ASCE Journal of Pipeline Systems Engineering and Practice, Associate Editor
- **Committee F17 on Plastic Piping Systems, ASTM**
  - **Subcommittee F17.67 on Trenchless Plastic Pipeline Technology**
  - **Task Group Leader for development of HDD Standard ASTM F1962**
  - ***ASTM F1962, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings***
- Trenchless Installation of Pipelines (TIPS) Committee, ASCE
  - *Manual of Practice No. 118 for Belowground Pipeline Networks for Utility Cables, Chair*
  - *Manual of Practice No. 115 for Pipe Ramming Projects, Vice-Chair*
  - *Manual of Practice No. 112 for Pipe Bursting Projects*
- Plastics Pipe Institute (PPI)
  - Municipal Advisory Board
  - *TR-46, Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe*
- Center for Underground Infrastructure Research and Education (CUIRE)

    - Industry Advisory Board

- North American Society for Trenchless Technology (NASTT)
    - Charter Member
    - Chair of Directional Drilling Subcommittee
- Trenchless Technology Center, Louisiana Tech University
    - Industry Advisory Board
- Missouri Western State College
    - HDD Steering Committee

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The Use of the High Air-Speed Blown-Cable System for Placing Optical-Fiber Cables in Innerduct, Tenth Annual National Fiber Optic Engineers Conference, 1994

Establishment of an Environmental Test Facility for Fiber-Optic Components at Morgan-City-Amelia, LA, Tenth Annual National Fiber Optic Engineers Conference, 1994

The Use of Direct-Buried Semi-Flexible Duct (Innerduct) to Create an Upgradeable Loop Distribution Plant , Bellcore Report, 1994

The Application of Trenchless Technology for Fiber-in-the-Loop Upgrades of Telecommunications Facilities, Bellcore Report, 1994

The Effect of Innerduct Design on the High Air-Speed Blown-Cable Technique, Bellcore Report, 1993

The Use of Direct-Buried Semi-Flexible Duct (Innerduct) for Distribution Applications, Bellcore Report, 1993

Cable Installation Tests in Direct-Buried Innerduct, Bellcore Report, 1992

Removing the Copper Pairs of Telecommunications Cables to Facilitate Fiber-in-the-Loop Upgrades, International NO-DIG '92, 1992

Proposed Generic Requirements and Practices Compatible with High Air-Speed Blown-Cable Installation Systems, Bellcore Report, 1992

Fiber-to-the-Home Evolving in Telephone Local Networks, Underground Focus, Jan./Feb.1992

"Quiet Evolution" Promises All-Fiber Phone Lines, Pipeline & Utilities Construction, Dec.1992

Temperature Cycling Tests on Fiber Drop in Flooded Flexible Duct, Bellcore Report, 1991

The Use of Flexible Duct for Buried Drops, Bellcore Report, 1991

New Cable Installation Methods for FITL Upgrades in Established Areas with Buried Plant, Bellcore Report, 1991

The Use of Small Lawn Plows to Install Buried Drops for FITL Upgrades, Bellcore Report, 1990

Education

Ph.D. - Mechanical Engineering, New York University, 1969

Master of Science - Engineering Mechanics, New York University, 1963

Bachelor of Science - Mechanical Engineering, The Cooper Union, 1961

Awards

- ASCE Outstanding Reviewer, Journal of Pipeline Systems Engineering and Practice, 2013
- Best Paper Award, *Maxi-HDD Pull Loads for Entry and Exit Points at Different Elevations*, International Conference on Pipelines and Trenchless Technology, Beijing 2011 (ICPTT 2011)
- ASCE Outstanding Reviewer, Journal of Pipeline Systems Engineering and Practice, 2010, 2013, 2016
- Certificate of Recognition, Sigma Xi - The Scientific Research Society, The Picatinny Chapter, *Flywheel Energy Storage Systems for the Telephone Outside Plant*, 1996
- 1983 Bell Laboratories Distinguished Technical Staff Award for Sustained Achievement

Experience

Experience 1990 – 2001 (Reverse Chronological Order)

Telcordia: Network Reliability, Operations and Deployment

- Principal Consultant representing the telecommunications industry on various professional organizations and forums. Has been a key member of the **National Electric Safety Code Committee (NESC)**, responsible for specifying safety standards for aerial and buried telecommunications and power facilities in the United States. (Had a leading role in the development of the 2002 edition of the NESC.) Has also been an important member on the ANSI-05 (Wood Poles) standards committee, as well as an active participant in training and certification activities for the directional drilling industry.

Telcordia: Physical Network and Product Integrity and Reliability

- Director of the Network Facilities, Components, and Energy Group. Managed large group (12 engineers) responsible for developing requirements, testing, and analysis of outside plant media, components, and powering for telecommunications applications, including installation guidelines, including ***Blue Book – Manual of Construction Procedures*.**
- Investigation of physical characteristics and related requirements of fiberglass reinforced aerial service wire to prevent problems such as previously experienced during severe winter storm.

Telcordia: Applied Research

- Development and deployment of low-cost utility construction and cable installation techniques to facilitate introduction of the "information superhighway" for the Regional Bell Operating Companies (RBOCs). Instrumental in introducing blown-cable installation technology in United States. Served as chairman of the Directional Drilling subcommittee of the North American Society for Trenchless Technology (NASTT), and was responsible for developing directional drilling standards for the American Society for Testing & Materials (ASTM).
- Investigation of feasibility of electro-mechanical (flywheel) energy storage systems, including containment studies, creation of industry specifications, evaluation of seismic implications, and coordination of industry-wide flywheel safety forum.
- Design and installation of full-scale environmental test facilities across the country for evaluating reliability of fiber-optic and coaxial transmission media and components.

Experience 1961 – 1989 (Reverse Chronological Order)

Bell Laboratories: Loop Transmission Systems

Has had numerous design and/or coordination responsibilities during this decade of rapid growth in metallic- and fiber-optic-based digital loop carrier systems. The following is only a partial list:

- Design and development of customer-premises remote terminal electronic cabinets, including cabinet design, integration of complex digital telecommunications equipment, addressing thermal design issues, and meeting Underwriters Laboratories (UL) and FCC requirements.
- Design and development of "Lightguide Distributing Unit" concept (received original patent).
- Exploring feasibility of optical data links for broadcasting video channels, including the design of the system architecture, overall analysis, and subsequent construction of working electronic/fiber-optic models.
- Planning and installation of metallic and fiber-optic cable and hardware facilities at the Bell Laboratories Lightwave Facility at Chester, NJ -- the showcase of AT&T/Lucent digital and optical networks and hardware systems.
- Physical design of SLC 96 digital loop carrier system
- Ensuring reliability of SLC 96 digital loop carrier systems, including coordination of field tracking and factory studies, and implementation of analytical techniques.

Bell Laboratories: Main Distributing Frame Systems & Hardware

The lack of understanding of this important interface between the central office and outside plant facilities led to numerous, widespread crises in the larger telephone exchanges throughout the country in the 1970s. Has had a leading role in advancing the state-of-the-art and general understanding of MDF systems, including:

- Coordinating design and development of various MDF protector and terminal block hardware.
- Establishing tools and methods for MDF rehabilitation.
- Producing the *MDF Planning and Engineering Guidelines*.

Bell Laboratories: Engineering Analysis & Applied Mechanics

Provided consultation services for numerous projects requiring expertise in engineering mechanics. The investigations included mathematical and computer modeling, as well as laboratory and field experiments, for investigating the following areas:

- Vulnerability of communications cables to nuclear attack.
- Buried waveguide systems, including potential hazards of earthquakes and the design optimization of welded waveguide couplings.
- Dynamic response of missile structures.

Bell Laboratories: Computer Program Systems Studies

- Developed various computer program systems for the AT&T Telstar project and US Navy applications.