Ronald D. Willoughby, PE

Position:	**Executive Consultant**
Years' Experience:	45+
Education:	Honorary Professional Degree of EE – University of Missouri-Rolla (MO Univ. of Science & Tech)(MS&T) Post Graduate Studies – Carnegie-Mellon Univ (CMU) MSEE Power Engineering – Carnegie-Mellon Univ. BSEE – University of Missouri-Rolla (UMR) Professional Engineer (PE) License – Pennsylvania

Key Qualifications:

Distribution Grid Modernization Planning: Systematic/incremental addition of smart grid devices; with technology, performance, and cost central to the planning process.

Renewables Integration and Impact on Utility Grid: Power system analysis/operation, architecture, configurations, distributed generation strategies, market analysis, portfolio analysis, wind power and PV integration.

Conservation Voltage Reduction (CVR): Using smart grid data points and controllable VAR sources to regulate distribution voltages in near real time to reduce demand, lower peaks (kW), and save energy (kWh).

Transmission & Distribution Planning: Power flows; reliability analysis; transient & long-term stability; load shedding; reconfiguration schemes; contingency analysis; root cause analysis; distributed generation; energy storage strategies; protection/coordination; systematic replacement/upgrade strategies; and special protection systems (SPS).

Advanced Protection, Automation & Control: Sensor, communication, sectionalizing, controllable VAR sources, voltage control, expert systems, demand, and energy reduction application strategies.

Distribution Substation Design and Specifications Review: Modular Integrated Transportable Substation (MITS) application, design, specification, and implementation; renewables integration; volt/VAR control; substation upgrades; and distribution automation/protection strategies.

Patents & Publications

Earned U.S. Software Patent 6549880 for *Improving Reliability of Electrical Distribution Networks* (2003).

More than 60 publications relating to electric power systems analysis and operation.

Project Types

Distribution Grid Modernization Planning: Systematic/incremental addition of smart grid devices; with technology, performance, and cost central to the planning process.

Conservation Voltage Reduction (CVR): Using smart grid data points and controllable VAR sources to regulate distribution voltages in near real time to reduce demand, lower peaks (kW), and save energy (kWh).

Renewables Integration: Main substation, collector systems, protection and control.

Power System Energy Use: Technical and non-technical loss evaluation and improvement measures; with specific expertise in island power systems.

Power System Automation: Application of sensor/communication packages, sectionalizing equipment, and SCADA systems to achieve performance targets.

Power System Reliability: Preventive actions and sectionalizing strategies to achieve reliability performance targets.

Power System Protection: Protection/coordination; systematic replacement/upgrade strategies.

Root Cause Analysis (RCA): For unexplained electric power system events.

Knowledge Management: Use cases for technical procedures associated with power system analysis/operation, expert systems, architecture, and configurations.

Project Management: Transmission analysis, distribution analysis, system protection, and reliability improvement.

Training: Power system design, reliability, protection, stability, and operation.

Representative Project Experience

Conservation Voltage Reduction (CVR)

- Project Manager and Technical Lead for Commonwealth Edison Company (ComEd) feasibility study to quantify energy and demand savings using distribution Voltage Optimization techniques. Objectives: 1) Minimize cost by initiating feeder upgrades to achieve minimum performance thresholds. 2) Maximize energy savings by optimizing performance while staying within Total Resource Cost (TRC) constraints.
- Co-Instructor of CVR workshop customized to meet specific ComEd engineering and energy efficiency department needs.
- Co-founder of a CVR Industry Consortium to guide CVR research, work with industry groups, develop policy recommendations, promote implementation strategies, and document the results.
- Technical lead for project commissioned by DOE to conduct a comprehensive study across the USA on CVR, including deployment strategies, costs, benefits, barriers, and potential solutions, through a broad market outreach effort.

Advanced Protection, Automation, & Control for Transmission & Distribution

- Co-Chaired (with the Director of R&D at We-Energies) Distribution Vision 2010 LLC (DV2010), a consortium of Investor Owned Utility (IOU) companies. Mission: To create and execute a roadmap of equipment and service requirements important to cost-effectively operating a reliable electric distribution system; 2002-2006. DV2010 was accountable to CEOs and CFOs of member utilities.
- Led EPC and turnkey solutions in support of electric utility companies for electrical distribution automation, medium voltage modular substations (distribution centers), and wind farm electrical distribution systems (from the base of the turbine towers through interconnection to the utility grid); 1985-1988.
- Invited by the Director of Power & Energy Initiative at the University of Pittsburgh to be an Instructor for a graduate course on Smart Grid Technologies & Applications. Subject: Substation Automation and Protective Relaying; on-going.
- Participated in U.S./Canada Power Outage Task Force led by the Department of Energy (DOE), Natural Resources Canada, and the North American Electric Reliability Council (NERC) created to study the blackout of August 14, 2003, the largest electrical outage event in U.S. history.
- Led comprehensive Root Cause Analysis (RCA) for PJM executive management in response to a July 1999 low voltage condition stemming from record peak loading conditions on the bulk transmission system. Proactive corrective measures prevented future occurrences.

Renewables Integration and Impact on Transmission & Distribution Systems

- Invited by Prime Minister of Curacao to represent USA in 1st Annual Durable Energy Conference in Curacao to address renewables integration issues for the transmission and distribution system; March 2012.
- Invited by CEOs of Wind-2-Power-Systems (W2PS) and Hudson Energy to represent USA for conference in Madrid to cover PV integration, grid integration, energy storage, and DC infrastructure issues; February 2012.
- Invited by CARILEC to chair two sessions on Transforming the Electricity Grid at the Renewable Energy Forum, St Thomas, U.S. Virgin Islands; September 2011. CARILEC represents CEOs, COOs, and CFOs for 33 island utilities in the Caribbean.

Transmission & Distribution Planning

- Led distribution grid modernization planning efforts, focused on systematic and incremental addition of smart grid devices, with technology, performance, and cost central to the planning process
- Led EPC and turnkey solutions for electric distribution automation, medium voltage modular substations (distribution centers), and wind farm distribution systems (from base of turbine towers through interconnection to utility grid). Accountable for success of these focused areas when measured against sales and margin goals, internal and

external budget constraints, and overall customer satisfaction. Routinely augmented internal direct staff with external resources according to project needs. Matrix managed project teams to effectively utilize project resources.

- Co-founder of industry-wide consortium focused on strategic, business, regulatory, and technical issues associated with Conservation Voltage Reduction/Regulation (CVR) at investor-owned utilities, electric cooperatives, and municipals.
- Managed commissioning and public relations for comprehensive distribution line installation in the city of Smolensk, Russia. Project was collaborative effort between U.S. Trade & Development Agency (TDA) and Cooper Power Systems (CPS); 2002-2004.
- Developed distributed CVR measures to conserve energy and reduce overall losses without compromising end-user reliability or power quality.
- Developed emergency generation integration strategies for major industrial complexes in the USA.
- Conducted comprehensive seminar on electric power systems for the Ministry of Water and Power in Peking, China; 1984.
- Performed international power systems studies on power flow, transient stability, shunt compensation, load shedding, motor starting, loss formula development, short circuit, and protective device coordination; 1974-2000. Interfaced with Engineering Planning Managers.
- Led projects sponsored by the Pacific Power Association (PPA) for power system energy analysis and loss reduction on 20 islands in the South Pacific, 10 with U.S.-style power systems, and 10 with European-style power systems. Interfaced directly with CEOs and PPA throughout study.
- Taught Westinghouse Advanced School on Power System Stability; 1980-1988.

Professional Development Activities

NERC Compliance; IEC 61850; DMVP (DMEDI) Process Improvement; Professional Development Seminars on Management (Management Grid, Management Techniques, Team Building); Interpersonal Skills; Time Management; Managing the Software Project; Sales Techniques; SPIN Sales Training; Pricing Strategies; Finances; Technical Writing; Safety; Problem Solving & Decision Making; IEEE Seminars on Relay Coordination and Reactive Power Control; Root Cause Analysis; Reliability Analysis; Intellectual Property; Environmental Compliance; Corporate Ethics; Toastmasters International.

Company Affiliations

Willoughby Consulting, Raleigh, NC (2012 to Present)

Executive Consultant, Electric Power Systems Planning & Operation - Owner

Modular distribution substation application, specification, and implementation. Quantifiable Conservation Voltage Reduction (CVR) assessments for energy efficiency energy savings (kWh) and peak power reduction (kW); CVR application strategies. Emergency backup

power supply needs assessment and solution strategies for large industrial/commercial facilities. Portfolio analysis, go-to-market strategies, and operations support related to electric power systems. Specific service areas include transmission and distribution planning, renewables integration strategies, energy efficiency measures, system protection strategies, distribution automation schemes, data management, and business plan development.

River Consulting Group (RCG), Clayton, GA (2018 to Present)
Executive Consultant - Contract

Advisory services related to distribution grid modernization planning efforts involving systematic and incremental addition of smart grid devices, with technology, performance, and cost central to process.

ABB, Inc. (ABB), Raleigh, NC (2016 to 2017)
Executive Consultant - Contract

Advisory services related to distribution grid modernization planning efforts involving systematic and incremental addition of smart grid devices, with technology, performance, and cost central to process.

Advanced Microgrid Solutions (AMS), San Francisco, CA (2015 to 2017)
Executive Consultant - Contract

Advisory services regarding business strategy, competitive intelligence, and energy services pricing strategies related to the company's business development efforts.

Applied Energy Group (AEG), New Brunswick, NJ (2012 to 2015)
Principal, Executive Consultant - Contract

Energy efficiency (savings) analysis methods, project procurement, and project execution. Innovative applications of existing technologies to advance the art. Industry-wide investigations. Direct responsibility for project teams, including subcontractors.

Dell Innovation Services, Peoria, IL (2012 to 2014)
Vice President, Electricity Transmission & Distribution - Contract

Design and apply substations (including modular) for emergency power supply. Develop electrical site one-line diagrams and associated loading profiles. Conduct power demand audits.

KEMA, Raleigh, NC (2006 to 2012)
Vice President, Electricity Transmission & Distribution

Strategic leadership of the U.S. technical T&D practice in North America, focusing on client issues related to electric power system T&D planning, asset management, protection and reliability, advanced technology applications, and future power systems. Direct responsibility for team of 30 professionals.

Cooper Power Systems, Franksville, WI (1989 to 2006)
Director, Industrial Development & Technical Services Marketing; Manager, Systems Integration Solutions; Director, Thomas A. Edison Technical Center; Manager, Systems Engineering Group

Technical solution development for electrical distribution automation, substations, distribution operating centers, and wind farm integration. Accountable for sales, margins, budget, and customer objectives. Directed project teams to matrix manage overall resources (which included marketing, sales, and engineering staffs) to promote services, identify

opportunities, and secure business. Participated in strategic alliances and acquisitions. Managed high power laboratory (500 MVA short circuit generator), high voltage laboratory (2 million volts), and full materials laboratory, with direct responsibility for a team of 110 professionals. Managed group responsible for Modular Integrated Transportable Substation (MITS) application, design, specifications, implementation, and support (69 kV and below) (10 MVA and below).

Westinghouse Advanced Systems Technology, Pittsburgh, PA (1974 to 1988)
Manager, Transmission Planning Section; Manager, T&D Software Services

Responsible for a staff of 8 involved in the application of technical transmission and distribution software, including marketing and customer service.

Black & Veatch Consulting Engineers, Kansas City, MO (1971 to 1974)
Coop student while with the University of Missouri - Rolla

Professional Memberships

- IEEE – Life Senior Member
- IEEE Power Engineering Society – Senior Member
- IEEE Industrial Applications Society – Senior Member
- Phi Kappa Phi – Member
- Eta Kappa Nu – Member
- Tau Beta Pi – Member
- Kappa Kappa Psi – Member
- Wake County NC – Precinct Election Official (2017-2019)

Professional Recognition

2016 Achieved **Life Member** status for the Institute of Electrical and Electronics Engineers (**IEEE**).

2012-14 Invited **Instructor** for **University of Pittsburgh** graduate course on *Smart Grid Technologies & Applications*. Subject: *Substation Automation and Protective Relaying*.

2013 Co-Founder of an industry-wide ***CVR Consortium*** focused on increasing energy savings by resolving strategic, business, and technical issues preventing more wide-spread deployment by electric utility companies.

2012 Earned ***Order of the May*** honors recognition from Carnegie-Mellon University for more than 10 years of continous and consistent support. Citation includes these words: “This special order honors those who embody all the best characteristics for which the society was originally founded in 1947.”

2011 Invited **Chairman**, 2 Sessions, *Transforming the Electricity Grid*, **Carilec Renewable Energy Forum**, September 20-21, St. Thomas, U.S. Virgin Islands.

2003 Awarded ***Honorary Professional Degree of Electrical Engineering***, Univ of MO-Rolla (UMR), based on "outstanding professional and personal achievements"

2003 Elected **President**, *Academy of Electrical & Computer Engineers*, UMR

2001 Elected VP, *Academy of Electrical & Computer Engineers*, University of Missouri-Rolla

2001 Co-Chair, Steering Committee to develop **Distribution Vision 2010 LLC (DV2010)**, consortium of Investor Owned Utility (IOU) companies

2001 Appointed **Chairman**, Technical Paper Committee, USA National Committee, **CIRED**

2000 Appointed to ***Industry Advisory Council***, Rensselaer Polytechnic Institute (RPI), NY

1998 Appointed to ***Industrial Liason Council (ILC)*** for the College of Engineering and Applied Science, University of Wisconsin-Milwaukee

1997 Elected to ***Academy of Electrical & Computer Engineers***, University of Missouri-Rolla for "outstanding contributions to the profession of electrical engineering and for leadership in the community and profession." Requires minimum 20 years experience to qualify.

1991 Selected for **USA Trade Mission** on Electric Power to East Germany. Represented USA distribution equipment technologies. [E & W Berlin concrete wall fell Nov 1989]

1989 Appointed to ***Industry Advisory Council***, University of Missouri-Rolla (UMR).

1985 *Westinghouse* ***Engineering Achievement Award*** for "high level technical contribution to the development and implementation of profitable engineering courses in the Electric Utility and Industrial markets."

1985 ***Senior Member*** status for Institute of Electrical & Electronics Engineers (**IEEE**).

1984 Elected *Chairman* of the <u>only</u> **Quality Circle** in operation at Westinghouse Advanced Systems Technology (AST)

1982 Appointed to <u>first</u> ***Engineering Advisory Council*** for Westinghouse AST

1978 Earned ***PROFESSIONAL ENGINEER (PE) License*** from the Commonwealth of Pennsylvania

1972 Received *Outstanding Bandsman* award from Kappa Kappa Psi band fraternity

1969 **Valedictorian** and **Student Council President**, Grandview Senior High School

Publications

Ronald Dean Willoughby, PE

Willoughby, Ronald D, Bob Grant, and George Fandos. "Unbiased 360-Degree DER Evaluations and Assistance," EnergyCentral - Utility Professionals Group, April 20, 2020.

Willoughby, Ronald D. "Why Do It?," *EnergyPulse* from Energy Central – Intelligent Utility, March 21, 2018.

Willoughby, R., S. K. Gill, E, Zhang, J. Silvers. "Distributed Energy Resources Supporting Power Grid Reliability," CIGRE US National Committee, 2016 Grid of the Future Symposium, November 2016.

Willoughby, Ronald D. "Grid Modernization is Like Remodeling a House," Energy Central - Electric Power Systems Planning & Operation, July 20, 2016.

Willoughby, Ronald D. "The Power of Incrementalism," *EnergyPulse* from Energy Central - Communications & Security, February 10, 2016.

Willoughby, Ronald D. "Aging Workforce Presents Knowledge Management Opportunities," *EnergyPulse* from Energy Central - Human Resources, November 13, 2015.

Willoughby, Ronald D. "SEPB CVR Proposal Response Review," Report for AEG for TVA on behalf of SEPB, PO 916082, June 8, 2015.

Willoughby, Ronald D. "Distribution Automation and Conservation Voltage Reduction," *EnergyPulse* from Energy Central - Grid Operations; April 17, 2015.

Willoughby, Ronald D. "CVR Fundamentals," White Paper, January 5, 2015.

Willoughby, Ronald D., et al. "Final Report - Voltage Optimization (VO) Feasibility Study," AEG for ComEd VO Study, Contract No. 01146430, January 6, 2015.

Willoughby, Ronald D. "Order of the 9's," *EnergyPulse* from Energy Central - Grid Operations, June 2, 2014.

Willoughby, Ronald D. "Analysis Paralysis," *EnergyPulse* from Energy Central - Business Corporate, January 16, 2014.

Willoughby, Ronald D. "CVR and the Lost Revenue Conundrum," *EnergyPulse* from Energy Central, August 9, 2013.

Willoughby, Ronald D. "Time to Take a Second Look at Conservation Voltage Regulation?" *Intelligent Utility Update*, June 4, 2013.

Willoughby, Ron, Kellogg Warner. "Voltage Management: A Hidden Energy Efficiency Resource," GTM Research *Energy Efficiency Newsletter*, May 7, 2013.

Willoughby, Ron, Kellogg Warner. "Conservation Voltage Regulation: An Energy Efficiency Resource," IEEE *Smart Grid Newsletter*, April 10, 2013.

Willoughby, Ronald D. "Thinking Through Grid Modernization: It's a Chinese Puzzle – Moving Each Piece Moves Another," article written by Phil Carson of *Intelligent Utility Daily* after an exclusive interview with Mr. Willoughby, June 17, 2012.

Willoughby, Ronald D. "Power System Automation Drives Need for Data Acquisition," *Distributed Energy* Magazine, April 2012.

Willoughby, Ronald D. and Juan Gers. "IEC 61850 Primer," DNV KEMA *TECH Notes*, April 2012.

Willoughby, Ronald D. "Power System Automation Drives the Need for Smart Grid," DNV KEMA *Sherpa* Web Site, December 1, 2011.

Willoughby, Ronald D. "System Automation Drives Need for Data Acquisition," *Electric Light & Power* Magazine, November 2011.

Willoughby, Ronald D. "System Automation Drives Need for Data Acquisition," *PowerGrid International* Magazine, September 2011, pp 52-56.

Willoughby, Ronald D. "The 'Next Big Thing,'" article written by Phil Carson of *Intelligent Utility Daily* after an exclusive interview with Mr. Willoughby, April 21, 2010.

Willoughby, R. D., S. French Smith, S. Varadan. "A Knowledge Framework for Sustaining Business Growth and Success," Panel Session Submission 2010TD0574, IEEE T&D World Conference & Exposition, April 2010, New Orleans.

Willoughby, R. D. (Contributing Expert). *Utility of the Future*, Volume 2, *The Promise of Energy Storage*, KEMA, December 2009.

Willoughby, R. D. "The Evolving Convergence of Distribution Automation and Advanced Metering Infrastructure," KEMA Automation Insight, June 2007.

Willoughby, R. D. and L. A. Kojovic. "Integration of Distributed Generation In A Typical USA Distribution System," CIRED 2001, Amsterdam Netherlands, June 2001.

Willoughby, R. D. "Order of the 9's," Cooper Power Systems *SETUP* Newsletter, Summer 2000 Edition.

Willoughby, R. D., P. Avery, et al. "Economic Solutions To Power Quality and Reliability Problems," American Power Conference *Proceedings*, Chicago, IL, April 10-12, 2000.

Willoughby, R. D. and L. A. Kojovic. "Digital Models Simulate Physical Test Facilities," *IEEE Computer Applications in Power* Magazine, April 1995.

Willoughby, R. D., C. A. McCarthy, et al. "Power Quality and Reliability Services," Electric Power '99 Conference *Proceedings*, Baltimore MD, April 1999.

Willoughby, R. D., C. Gilker, and E. Strauss. "Education Highway for the Practicing Engineer: What Next in the Age of Deregulation?" Systems Engineering Group Bulletin SE9901, February 1999.

Willoughby, R. D. and S. R. Mendis. "Harmonic Filters Provide The Key To Plant Reliability," PPE Magazine, April 1996.

Willoughby, R. D. and L. A. Kojovic. "Computer Methods for Simulations of Power Lab Tests & Electrical Apparatus Operations in Power Systems," TESLA II Millennium, Belgrade, Yugoslavia, October 1996.

Willoughby, R. D., C. Gilker, et al. "Training for TODAY'S Practicing Electrical Distribution Engineer," Systems Engineering Group Bulletin SE9402, Cooper Power Systems, August 1994.

Willoughby, R. D. and K. Argiropoulos. "Hybrid Surge Arrester Technology," US Technology for the Production, Transmission, & Distribution of Electric Power Seminar, Berlin, Germany, October 1991.

Willoughby, R. D. and K. Argiropoulos. "Overcurrent Protection Devices for Overhead Distribution Systems," US Technology for the Production, Transmission, & Distribution of Electric Power Seminar, Berlin, Germany, October 1991.

Willoughby, R. D. and K. Argiropoulos. "Voltage Regulation Equipment for Overhead Distribution Systems," US Technology for the Production, Transmission, & Distribution of Electric Power Seminar, Berlin, Germany, October 1991.

Willoughby, R. D. and S. R. Mendis. "Power Quality Problems in Electric Power Systems," US Technology for the Production, Transmission, & Distribution of Electric Power Seminar, Berlin, Germany, October 1991.

Willoughby, R. D., et al. "Electrical Studies for an industrial Gas Turbine Co-Generation Facility," IEEE Industrial Applications Society (IAS) *Transactions*, July/August 1989.

Willoughby, R. D., R. W. Johnson, and R. A. Whiteside. "Computer-Aided Protective Device Coordination: Advantages," Congress on Protective Systsems for Electrical Installation, Puerto la Cruz, VZ, July 29-31, 1987.

Willoughby, R. D. , et al. "A Key to Plant Reliability: System Studies," Pakistan Electrical Conference, February 1987.

Willoughby, R. D., and S. Rubino. "Power Systems Studies can P4redict and Resolve Harmonic Resonance Problems in Industrial Planrs," IEEE Petroleum and Chemical (PCIC) *Conference Record*, September 1985.

Willoughby, R. D., J. A. Juves, and A. Batenburg. "Utility Survey of Methods for Minimizing the Number and Severity of System Separations," *Final Report*, Electric Power Research Institute, EPRI EL-3437, Project 1952-1, March 1984.

Willoughby, R. D. "Limitations on Local Shunt Compensation Studied with WESTCAT™," the Westinghouse *AST/Group News*, Pittsburgh, Pennsylvania, Winter 1983/84.

Willoughby, R. D. "New Program for Modelling Induction Motors," the Westinghouse *AST/Group News*, Pittsburgh, Pennsylvania, Summer 1983.

Willoughby, R. D. and J. A. Juves. "Computer Software for the Analysis of Industrial Power Systems," Westinghouse Industrial Applications *Workshop Proceedings*, Philadelphia, Pennsylvania, April 19-20, 1983.

Willoughby, R. D., J. A. Juves and S. S. Waters. "A Streamlined Procedure fro Obtaining Regulatory Approval for New Transmission Lines," *Final Report*, Electric Power Research Institute, EPRI EL-1404, Contract TPS-733, December 1982.

Willoughby, R. D., R. W. Powell, and T. E. Szabo. "The Effects of Shunt Compensation on Local Generation Requirements," Fourth (4th) Conference on Electric Power Supply Industry *Proceedings*, Bangkok, Thailand, 1982.

Willoughby, R. D. and S. S. Waters. "Modeling Induction Motors for System Studies," IEEE Industrial Applications Society (IAS) *Transactions*, San Francisco, California, 1982.

Willoughby, R. D. and P. M. Myers. "Special Industrial System Studies to Insure Plant Reliability," IEEE Petroleum and Chemical (PCIC) *Conference Record*, St. Louis, Missouri, 1982.

Willoughby, R. D. and J. A. Juves. "Justification and Approval of New Electric Transmission Lines: A Procedure," *Workshop Proceedings*, Electric Power Research Institute, EPRI EL-2190, Contract WS 79-230, December 1981, Section 1.

Willoughby, R. D. and S. S. Waters. "Procedure for Conducting a Transient Stability Study," IEEE Midwest Power Symposium *Conference Record*, University of Illinois, October 1981.

Willoughby, R. D. and E. R. Taylor, Jr.. "Practical Application Limit for Shunt Compensation Before Generation Addition," Pennsylvania Electric Association (PEA) Biannual System Planning Committee Meeting *Record*, Hershey, Pennsylvania, September 1981.

Willoughby, R. D., R. S. Hahn, S. Dasgupta, and E. M. Baytch. "Maximum Frequency Decay Rate for Reactor Coolant Pump Motors," IEEE *Transactions* on Nuclear Science, Vol NS-26, No. 1, February 1979, pp. 863-870.

Willoughby, R. D. and R. W. Johnson. "Stability Study Commentary and Interpretation of Computer Printout for Sonatrach LNG Plant Electrical Power System," *Final Report*, Report No. AST-75-1000-08, Westinghouse Advanced Systems Technology, Pittsburgh, Pennsylvania, June 1975.

Willoughby, R. D. and J. W. Skooglund. "Transient Stability Study for Central Nuclear de Almaraz," *Final Report*, Report No. AST-75-1023, Westinghouse Advanced Systems Technology, Pittsburgh, Pennsylvania, May 1975.

Willoughby, R. D. and R. W. Johnson. "Load Flow Study Commentary and Interpretation of Computer Printout for Sonotrach LNG Plant Electrical Power System," *Final Report*, Report No. AST-75-1000-06, Westinghouse Advanced Systems Technology, Pittsburgh, Pennsylvania, April 1975.

Willoughby, R. D. and R. W. Johnson. "Protective Device Coordination Study Commentary and Interpretation of Computer Printout for Sonotrach LNG Plant Electrical Power System," *Final Report*, Report No. AST-75-1000-04, Westinghouse Advanced Systems Technology, Pittsburgh, Pennsylvania, March 1975.

Willoughby, R. D. and R. W. Johnson. "Short Circuit Study Commentary and Interpretation of Computer Printout for Sonotrach LNG Plant Electrical Power System," *Final Report*, Report No. AST-75-1000-02, Westinghouse Advanced Systems Technology, Pittsburgh, Pennsylvania, February 1975.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: April 15, 2022 **Date of Response: April 27, 2022**
Data Request No. DOE 5-005 **Page 1 of 3**

Request from: Department of Energy

Witness: Freeman, Lavelle A

Request:

Refer to the Settlement Agreement (March 11, 2020) in Dkt. No. DE 19-139 and both of the Company's LCIRP filings. In the Settlement Agreement (March 11,2020) in Dkt. No. De 19-139, the Company agreed that it would meet certain specifications (a/k/a responsibilities) for its next LCIRP submission(s). The specifications were described in the Settlement Agreement (S/A) at pp 4 through 6, approved by the Commission in Order No. 26, 362 at 5-6 (June 3, 2020) (referencing the Company's 2020 LCIRP commitments). Has the Company met all of the specifications? Please explain in detail. Please provide any matrix, summary, listing, checklist, or cross reference between the Company's responsibilities as described in the Settlement Agreement (3/11/2020) (Docket No. DE 19-139) pages 4 through 6, and the sections of the Company's LCIRP filing(s) to demonstrate that the Company's responsibilities/specifications were met. The specification/responsibility topics include:

a. Comprehensiveness of 2020 LCIRP
    i. Load Forecast
    ii. Assessment of Distribution System requirements
    iii. Assessment of Demand Side Management Programs
        1. NWS Candidates
        2. Detailed NWS Potential Analysis
        3. Incorporation of NWS into Utility Planning
b. Planning Criteria Revisions

Response:

Appendix A of the October 1, 2020 filing provides a summary of the Company's compliance with the LCIRP requirements set forth in RSA 378:38, RSA 4-E:1, and the Settlement Agreements approved by the Commission in Docket No. DE 19-139 and Docket DE 17-136.

As set forth in Appendix A, the Company complied with the Settlement Agreement approved in DE 19-139 as follows:

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: April 15, 2022 **Date of Response: April 27, 2022**
Data Request No. DOE 5-005 **Page 2 of 3**

Load Forecast
The forecast of future demand for the Company's service area is described in Section 5.1 of the LCIRP. Details are provided in Appendices B (regional level) and C (substation level).

Assessment of Distribution System Requirements
The October 1, 2020 LCIRP filing provides the following assessments: Equipment Ratings (Section 5.2), Bulk Substations and Feeders (Section 5.3), Non-Bulk Substations (Section 5.4), Distribution Circuit Planning (Section 5.5), Distribution System Planning Criteria (Section 5.6), and Smart Grid (Section 10 and Appendix J). The Distribution System Planning Guide is provided in Appendix D.

The October 1, 2020 LCIRP filing Appendix K (Grid Needs Assessment) includes information on the grid needs estimated at greater than $250,000 for Bulk Substations, Non-bulk Substations, and distribution lines.

The October 1, 2020 LCIRP filing Appendix L (Project Authorization Forms) provides approval documentation for non-bulk substation and distribution line projects approved by the New Hampshire Project Approval Committee or the Solution Design Committee.

The March 31, 2021 LCIRP Supplemental filing (Appendix B, C, D, E and F) provides planning studies and project approval documents related to numerous substation and line projects.

Assessment of Demand Side Management Programs

Demand Side Energy Management programs are described in the October 1, 2020 LCIRP filing (Section 11).

NWS Candidates
As described in the October 1, 2020 LCIRP filing Appendix A, Section 2 (Bates pages 55-56), the Company developed a list potential non-wire solutions candidate that was shared with Commission Staff and the Office of Consumer Advocate in August 2020.

Detailed NWS Potential Analysis
Following selection of the Loudon Substation as the location for the detailed NWS analysis, the Company included the NWS analysis as Appendix A-2 to March 31,2021 Supplemental filing (Bates pages 47-86). The Company also provided the Non-Wires Alternative Framework describing the screening tool used to conduct the Loudon Substation analysis as Appendix A-1 of its supplemental filing.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: April 15, 2022 **Date of Response: April 27, 2022**
Data Request No. DOE 5-005 **Page 3 of 3**

Incorporation of NWS into Utility Planning
The October 1, 2020 LCIRP filing (Section 11.4) describes how NWS alternatives are incorporated into utility planning. See also the Distribution System Planning Guide (October 1, 2020 LCIRP filing Appendix D, section 4.8.3) and the NWA Framework provided in the March 31, 2021 LCIRP Supplemental filing (Appendix A-1).

Planning Criteria Revisions
The Planning Criteria Revisions are described in Section 5 of the LCIRP. Appendix D of the LCIRP also provides the newly developed Distribution System Planning Guide that will be the basis for distribution system planning at Eversource. As noted above, the Company's supplemental filing included a description of the non-wires alternative screening tool.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: May 16, 2022 **Date of Response: May 27, 2022**
Data Request No. DOE 6-003 **Page 1 of 2**

Request from: Department of Energy

Witness: Hebsch, Jennifer J

Request:

Reference data response DOE 4-2. Please supply the following information for the T&D Engineering Standards Bookshelf:
a. "Screen Shot of Books" in pdf format of what the user sees when the Bookshelf is initially accessed.
b. Table of contents for each book/standard in the Bookshelf.
c. Process for adding-to and/or updating Bookshelf contents.

Response:

a. Attachment DOE 06-003(a) is a pdf screen shot of the Standards Bookshelf.

b. Attachment DOE 6-003(b) includes the table of contents, as applicable, for each book in the Standards Bookshelf.

Distribution System Engineering Manual – Only the front page/contents of this book is attached.
Emergency Procedures – Only the front page/contents of this book is attached.
Maintenance Program - EMP – Only the front page and index for this book is attached.
Material – Only the front page/contents of this book is attached.
New Services – The front page of the book is attached with the NH Requirements for Electric Service Connections table of contents.
Overhead – Only the front page/contents of this book is attached.
Specifications – Only the front page/contents of this book is attached.
System Planning – All table of contents attached.
Tool & Equipment – Only the front page/contents of this book is attached.
Transmission & Substation – All table of contents attached.
Underground - Only the front page/contents of this book is attached.
Work Methods – Two levels into the table of contents of this book is attached.

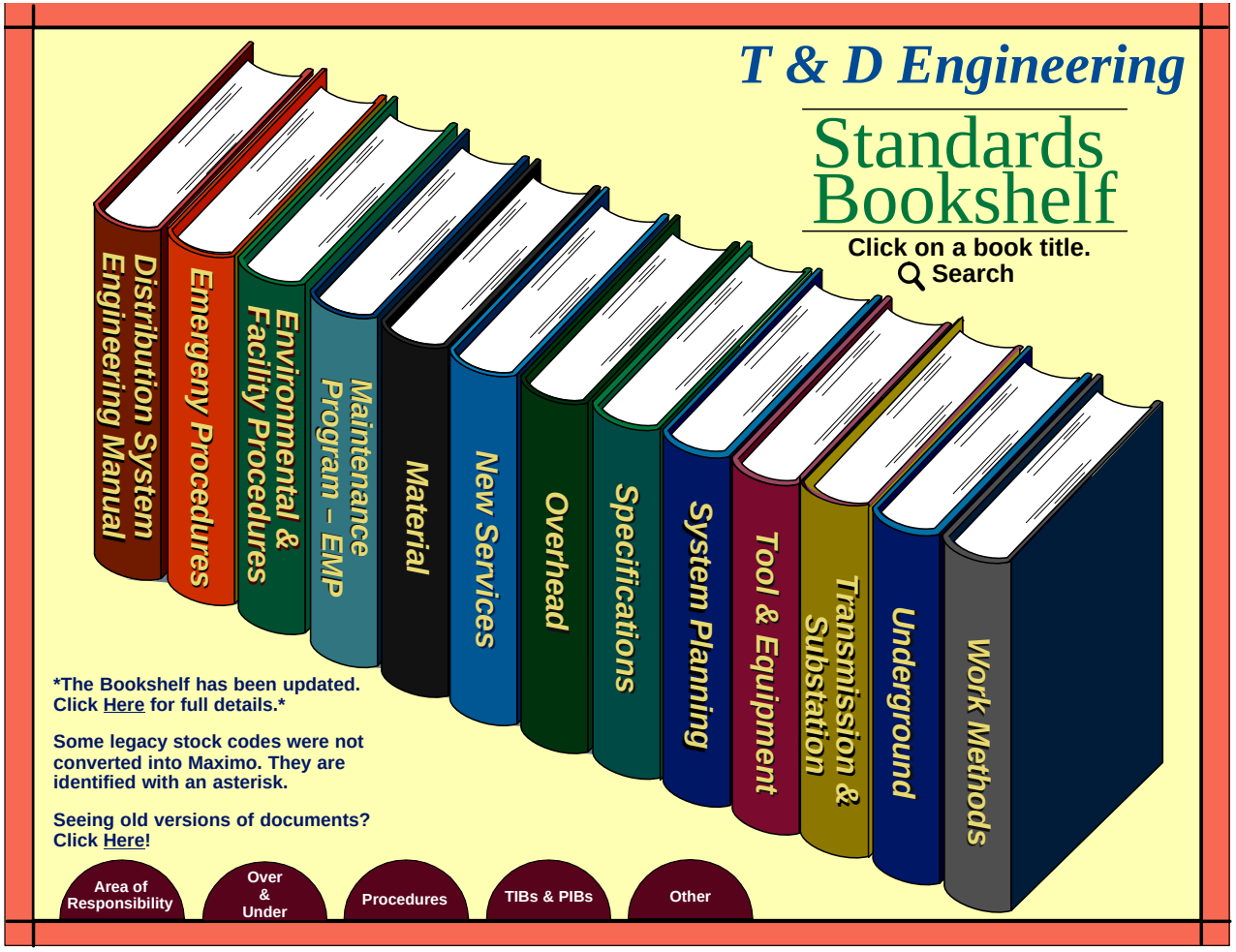
Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: May 16, 2022 **Date of Response: May 27, 2022**
Data Request No. DOE 6-003 **Page 2 of 2**

The Company's **Environmental and Facility Procedures** is no longer populated and therefore is not included in Attachment DOE 6-003(b).

c. Attachment DOE 6-003(c) is TD Procedure - TD003 Document Control Process which describes the process for adding-to and/or updating Bookshelf contents.

Docket DE 20-161
Data Request DOE 6-003
5/16/2022
Attachment DOE 6-003(a)
1 of 1



Distribution System Engineering Manual

01 – General
02 – Reliability
03 – Economics
04 – Calculations
05 – Design General
06 – Overhead Design
07 – Underground Design
08 – Conductors
09 – Arresters
10 – Protection
11 – Switches & Switchgear
12 – Capacitors
13 – Regulators
14 – Transformers
15 – Overhead Services & Secondaries
16 – Underground/DB Service & Secondaries
17 – Power Quality
18 – Substation
19 – Distributed Generation

Common Abbreviations:
By Name
By Abbreviation

Index of Distribution Engineering Reports (DERs)

Eversource Standard Consolidation

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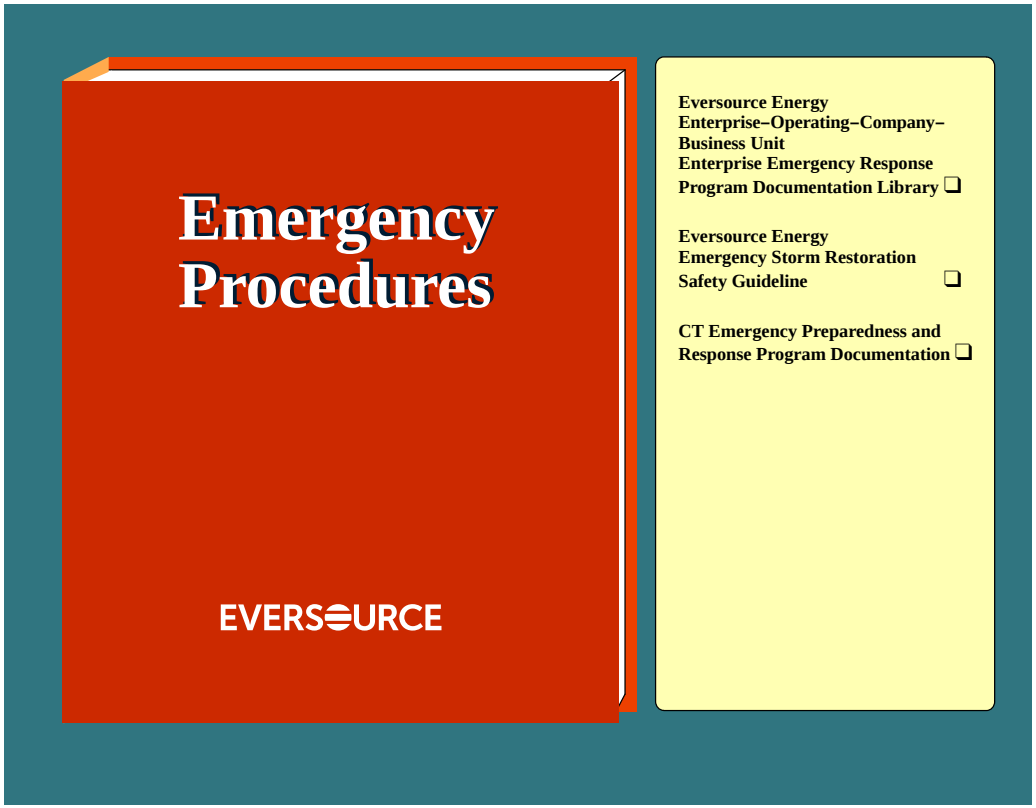
Emergency Procedures
EVERSOURCE
Eversource Energy
Enterprise–Operating–Company–Business Unit
Enterprise Emergency Response Program Documentation Library ❑
Eversource Energy
Emergency Storm Restoration Safety Guideline ❑
CT Emergency Preparedness and Response Program Documentation ❑

Eversource Maintenance Program

Maintenance Books

- Transmission & Distribution System
- Gas System

User Feedback System

- Submit New Feedback
- Feedback History
- Print User Feedback Form

EVERSOURCE

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Spare			
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Substation Property Inspection	5.56	3	8/31/2016
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Spare			
Switches, Disconnect	5.15	4	7/1/2015
Switches, Substation Vacuum	5.31	3	7/1/2015
Switches, Transfer	5.47	2	6/1/2015
Switches, Underground	5.51	2	7/1/2015
Switchgear, Metal-Clad	5.65	2	7/1/2015
Switchgear, Pad-Mounted	5.34	3	7/1/2015
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Touch Potential	5.62	2	7/1/2015
Transformer, Coupling Capacitor Voltage (CCVT)	5.71	0	6/1/2015
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Transformers, Potential	5.43	5	6/2/2021
Transformers, Station Service	5.67	0	6/1/2015
Transformers, Substation	5.58	5	7/1/2015
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Spare			
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Material Book

By Name

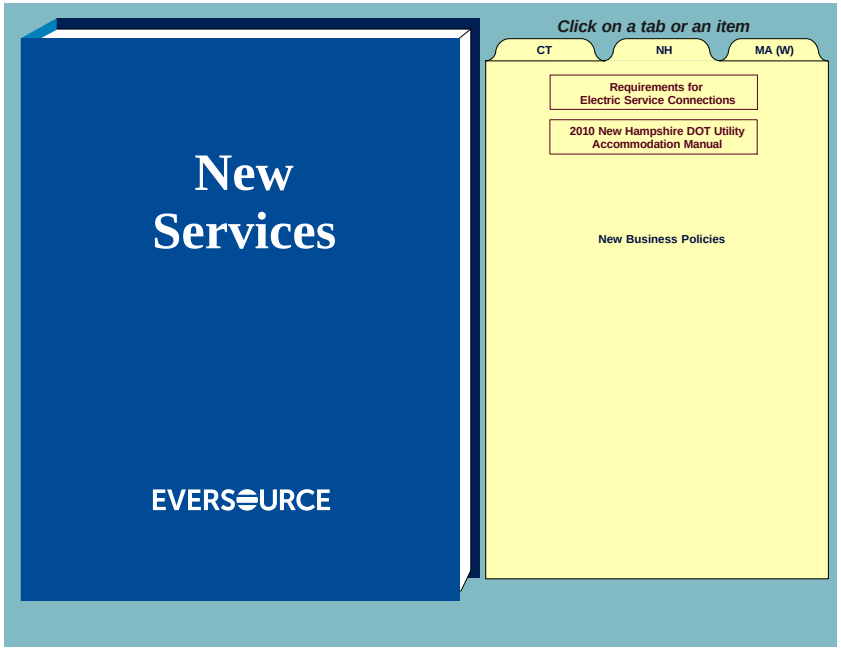
A B C D E F G H I J K L M N O P R S T V W Y

Catalogs

Common Abbreviations:
By Name
By Abbreviation

Legend
MSL

EVERSOURCE


New
Services
EVERSOURCE
Click on a tab or an item
CT
NH
MA (W)
Requirements for
Electric Service Connections
2010 New Hampshire DOT Utility
Accommodation Manual
New Business Policies

REQUIREMENTS FOR
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Overhead Distribution

Construction Standards

00 – General
03 – Construction Guidelines/ Line Sensors
04 – Clearances
05 – Poles
06 – Anchors, Guys & Pole Class
07 – General Information/ Antennas
08 – 4.8kV Pre-Build
09 – Conversions Minimum Reconstruction
10 – Distribution Pole Tops
11 – 27.6 kV & Multiple Circuits
12 – Risers
13 – Secondaries
14 – Services
15 – ADSS Fiber Optic Cables

OH DTR Locater

Search

Construction Standards

16 – Arresters & Grounds
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18 – Cutouts and Solid Blade Disconnects
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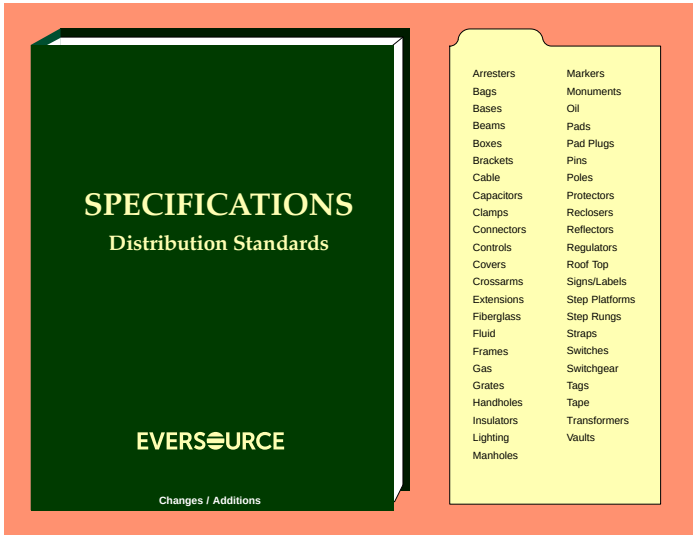
19 – Capacitors
20 – Regulators
21 – Lighting
32 – Conductors – General
33 – Connectors & Splices
35 – Metering
36 – Distributed Generation

Common Abbreviations:
By Name
By Abbreviation

EVERSOURCE
Changes / Additions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Distribution Standards
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Changes / Additions
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Lighting
Manholes
Markers
Monuments
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Pad Plugs
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Poles
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Reflectors
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Roof Top
Signs/Labels
Step Platforms
Step Rungs
Straps
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Switchgear
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Tape
Transformers
Vaults

System Planning

System Planning Manual

- Transmission
- Distribution
- DER

System Planning

- Distributed Generation Policies
- SysPlan Index

Technical Information

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System Planning

System Planning Index

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2.0	Transmission Reliability Standards	All	SYSPLAN 001	0	4/20/2018
3.0	Transmission Planning Procedure - Transmission System Modeling	All	SYSPLAN 002	1	1/20/2019
4.0	Transmission Planning Procedure - Bulk Power System Assessment Methodology	All	SYSPLAN 003	2	11/10/2011
5.0	System Planning Procedure - Major Project Planning and Development Process	All	SYSPLAN 004	1	7/14/2008
6.0	Planning Assessments of Pilgrim Nuclear Power Station Transmission and Back-up Supply	All	SYSPLAN 005	1	3/29/2010
7.0	Determining Transmission System Facility Ratings on the EMA Transmission System	EMA	SYSPLAN 006	2	6/10/2016
8.0	Calculation and Documentation of Auto Transformer Ratings	EMA	SYSPLAN 007	0	5/15/2014
9.0	Calculation and Documentation of Bulk Distribution Transformer Ratings	All	SYSPLAN 008	1	6/11/2008
10.0	Bulk Distribution Substation Assessment Procedure	All	SYSPLAN 010	1	8/1/2018
11.0	Evaluation of Distributed Generation Interconnection Applications	All	SYSPLAN 011	0	3/15/2013
12.0	Transmission Interconnection Process Roadmap	All	SYSPLAN 012	0	8/21/2012
13.0	Eversource EMA Load Shedding Program	EMA	SYSPLAN 014	1	12/30/2014
14.0	Consequential Load Loss Guideline	All	SYSPLAN 015	0	4/20/2018

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System Planning

RETIRED System Planning Index

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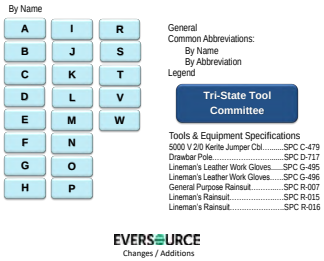
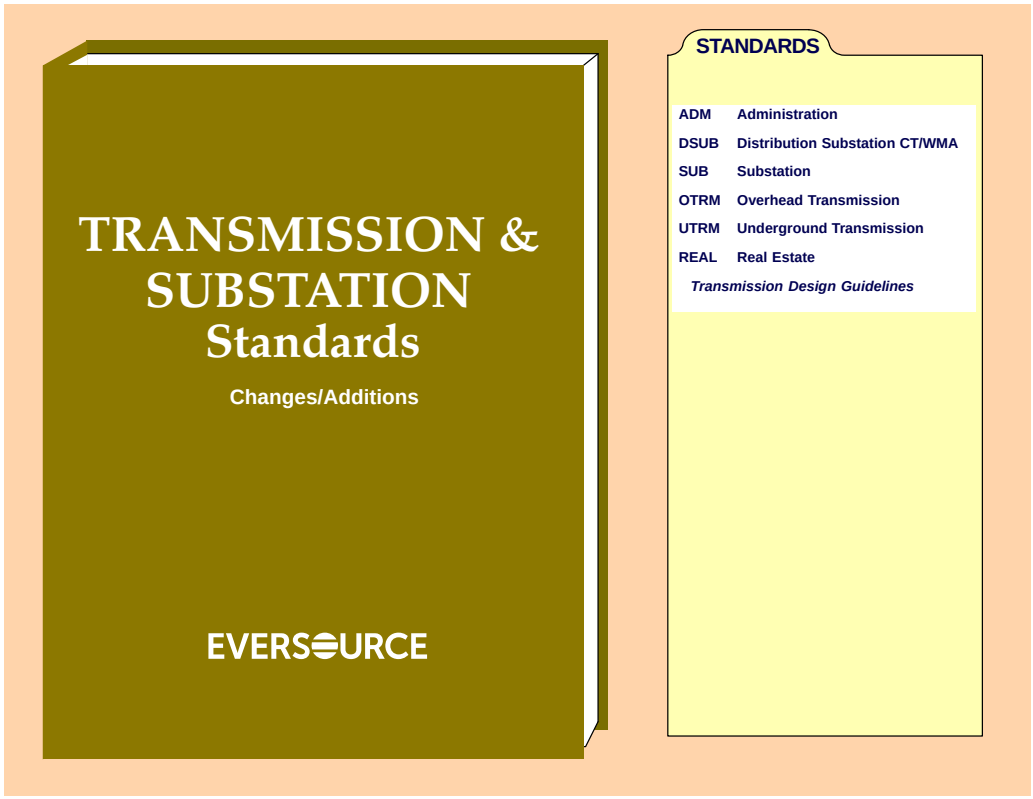
Tool & Equipment Book




TRANSMISSION &
SUBSTATION
Standards
Changes/Additions
EVERSOURCE
STANDARDS
ADM Administration
DSUB Distribution Substation CT/WMA
SUB Substation
OTRM Overhead Transmission
UTRM Underground Transmission
REAL Real Estate
Transmission Design Guidelines

Northeast Utilities
Administrative Transmission Line Standards

Key:
00 Completed Standard
00 Incomplete Standard

---

00 Index
01 Preparation, Review, and Approval of Transmission Standards
02 Master Standards List
03 Spare
04 Control of As-Built (Record) Drawings
05 FTP Site Access
06 Incorporation of Documents into Transmission Standards by Cover Sheeting
08 – 99 Spare
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Rev 0 – Original Index Posted 07/28/08

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Northeast Utilities
Administrative Transmission Line Standards

Key:
00 Completed Standard
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00 Index
01 Preparation, Review, and Approval of Transmission Standards
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05 FTP Site Access
06 Incorporation of Documents into Transmission Standards by Cover Sheeting
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Key:
SUB 000 Posted
SUB 000 Unposted

SUB 001	Index
SUB 002	Substation Primary One Line Diagrams
SUB 003	Basic Electrical Symbols – CL&P, WMECO
SUB 004	Drawing System
SUB 005	Nomenclature
SUB 006	SUB 006 345kV/115kV Substation Standards Design Criteria
SUB 007	Standard Voltages and Phasing
SUB 008	Substation Safety and Nomenclature Signs (Refer to TD 189)
SUB 009	Thermal Ratings
SUB 010	Substation Site Development
SUB 011	General Arrangements and Typical Designs
SUB 012	Substation Foundation Design
SUB 013	System 1 and System 2 Wiring Separation
SUB 014	Substation Ground
SUB 015	Substation Perimeter Fencing
SUB 016	Design of Substation Steel Structures
SUB 017	Bus Structural Design and Analysis
SUB 018	Disconnect Switch Application Guide
SUB 019	Outdoor Lighting
SUB 020	Cables
SUB 021	Capacitor Banks
SUB 022	Control Enclosure Components
SUB 023	Substation Electrical Clearances
SUB 024	Power Transformers, Reactors, Line Traps
SUB 025	Circuit Breakers, Circuit Switchers
SUB 026	Communications
SUB 027	Key Interlocking
SUB 028	Metering and Telemetering Testing
SUB 029	Protection & Control
SUB 030	Single & Three Line Diagrams, Panel Layouts, Phasing Diagrams
SUB 031	Relay and Control Circuit Fuse Wiring & Connections
SUB 032	Spare
SUB 033	Standard Installation Detail Drawings
SUB 034	Conduit and Trench Systems
SUB 035	SCADA Systems
SUB 036	Substation Sound Level Criteria
SUB 037	Backup Generator & Accessories

SUB 038	Substation Batteries & Chargers
SUB 039	Surge Protection
SUB 040	Direct Stroke Lightning Protection
SUB 041	Substation Security (Retired – replaced by SUB 022.9)
SUB 042	Equipment Structural Loading
SUB 043	Coupling Capacitor Voltage Transformer (CCVT) Standard Drawings
SUB 044	Spare
SUB 045	Spare
SUB 046	Animal Proofing Application Guide
SUB 047	Secondary Oil Containment for Electrical Equipment
SUB 048 -	088 Spare
SUB 049	Protection and Control using IEC 61850 Protocol
SUB 090	Telecommunication Structure Design & Analysis
SUB 091	Substation Physical Hardening Protection
SUB 092 -	098 Spare
SUB 099	Design Basis Manual

Revision History

Rev 0 – Original Index Posted 11/10/05
Rev 1 – Changes to section 3,6,13,27,35,42,44,45
Rev 2 – Added section 8
Rev 3 – Relabeled section 30, 31, 32, 33 and 34
Rev 4 – Added section 90
Rev 5 – Added section 42 posted 12/1/06
Rev 6 – Included PSNH drawing number in 004
Rev 7 – Added Section 47 posted on 04/27/07
Rev 8 – Added SUB 006 Ground Survey. Removed Conduit and Trench Systems from SUB 013 11/23/2007
Rev 9 – Added competely rewritten SUB 13 Wiring Separation (to conform to NPCC criteria) 2/28/2007
Rev 10 – Changed SUB 017 title from Bus, Insulators and Fittings to Bus Structural Design & Analysis 5/09/2008
Rev 11 – Added in SUB 046 Animal Proofing
Rev 12 – Changed Font to Gray on unposted Standards. Updated Header & Footer.
Rev 13- Removed Sub 32 Contents to Sub 29 and Changed Sub 29 title to Protection and Controls
Rev 14 – Added SUB 091, Substation Physical Hardening Protection; changed title from Northeast Utilities to Eversource.
Rev 15 – Added SUB 043 link; changed SUB 031 Wiring Diagrams to SUB 031 Relay and Control Circuit Fuse Wiring & Connections as a result of the removal of the Wiring Diagrams Index 12/15/2015
Rev 16 – Removed SUB 041 and indicated replacement standard 11/1/2017
Rev 17 – Added Section 030 for new standard SUB 030.1 09/06/2019

Key:
SUB 000 Posted
SUB 000 Unposted

SUB 101 Index
SUB 102 Substation Equipment Procurement Summary
SUB 103 Unused
SUB 104 Unused
SUB 105 Unused
SUB 106 Ground Survey (refer to OTRM 106)
SUB 107 Unused
SUB 108 Unused
SUB 109 Unused
SUB 110 Unused
SUB 111 Unused
SUB 112 Foundations
SUB 113 Unused
SUB 114 Grounding
SUB 115 Chain Link Perimeter Fence
SUB 116 Structures
SUB 117 Substation Insulators
SUB 118 Disconnect Switches
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SUB 136 Substation Sound Levels
SUB 137 Backup Generator & Accessories
SUB 138 Station Batteries & Chargers

SUB 139 Surge Protection
SUB 140 Direct Stroke Lightning Protection
SUB 141 Substation Security
SUB 142 Fabrication of Structural Steel for Northeast Utilities Substations
SUB 143 Capacitor Voltage Transformers
SUB 144 Oil Filled Voltage Transformers
SUB 145 Current Transformers
SUB 146 Unused
SUB 147 Unused
SUB 148 Switchgear
SUB 149 – 189 Spare
SUB 190 Telecommunication Structure Design & Analysis
SUB 191 Substation Physical Hardening Protection
SUB 192 Dynamic VAR Compensation
SUB 193 – 198 Spare
SUB 199 Unused

Revision History

Rev 0 – Original Index Posted 11/14/05
Rev 1 – Changes to Section 113,126,128,130,135,137,138,139,140,141,144,145
Rev 2 – Added section 108 9/15/2006
Rev 3 – Added SUB 106 and Moved Conduit and Trench Systems to 134 10/29/2007
Rev 4 – Changed title of SUB 115 from "Fencing" to "Chain Link Perimeter Fence".
Rev 5 – Changed title of SUB 137 from "Emergency" to "Backup"
Rev 6 – Changed Font to Gray on unposted Standards. Updated Header & Footer.
Rev 7 – Added (activated) SUB 117 11/24/2015
Rev 8 – Added (activated) SUB 192 01/09/2018

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SUB 000 Under Development

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SUB 204	Unused
SUB 205	Unused
SUB 206	Unused
SUB 207	Unused
SUB 208	Substation Safety and Nomenclature Signs (Refer to TD 189)
SUB 209	Unused
SUB 210	Site Development
SUB 211	Unused
SUB 212	Concrete Foundations
SUB 213	Wiring Separation
SUB 214	Grounding
SUB 215	Chain Link Perimeter Fence
SUB 216	Structures
SUB 217	Bus, Insulators and Fittings
SUB 218	Disconnect Switches
SUB 219	Outdoor Lighting
SUB 220	Cables
SUB 221	Capacitor Banks
SUB 222	Control Enclosure
SUB 223	Unused
SUB 224	Power Transformers, Reactors, Line Traps
SUB 225	Circuit Breakers, Circuit Switchers
SUB 226	Communication Systems
SUB 227	Unused
SUB 228	Metering
SUB 229	Protective Relaying
SUB 230	Switchboard Devices & Event Recording
SUB 231	Unused
SUB 232	Unused
SUB 233	Unused
SUB 234	Duct Banks
SUB 235	SCADA Systems
SUB 236	Unused
SUB 237	Backup Generator & Accessories
SUB 238	DC Battery & Charging System Installation and Testing

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SUB 240 Direct Stroke Lightning Protection
SUB 241 Substation Security
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SUB 243 345-kV Capacitor Voltage Transformers
SUB 244 Potential Transformers
SUB 245 Current Transformers
SUB 246 Unused
SUB 247 Unused
SUB 248 – 289 Spare
SUB 290 Telecommunication Structure Design & Analysis
SUB 291 – 298 Spare
SUB 299 Unused

Revision History

Rev 0 - Original Index Posted 11/18/05
Rev 1 - Changes to Section 210,212,213,214,228,229,230,237,238,
Rev 2 – Added section 208 9/15/06
Rev 3 – Added SUB 206 and Moved Conduit and Trench Systems to 234
Rev 4 – Changed Font to Gray on unposted Standards. Updated Header & Footer
Rev 5 – Changed Northeast Utilities to Eversource; updated title of SUB 202.

Key:
OTRM 000 Posted
OTRM 000 Unposted

OTRM 000	OTRM Design Standards Index
OTRM 001	Spare
OTRM 002	Transmission Line Design Process
OTRM 003	Drawing Numbering System
OTRM 004	Plan and Profile CAD Requirements
OTRM 005	Design Considerations for Air Navigation Safety
OTRM 006	PLS-CADD Design Standards
OTRM 007	HOLD
OTRM 008	HOLD
OTRM 009	Spare
OTRM 010	NU Standard Structure Types
OTRM 011	Spacing of Transmission Lines in Rights-of-Way
OTRM 012	EMF Calculation Protocol
OTRM 013	Life Cycle Cost Evaluations for CL&P & WMECO
OTRM 014 – 019	Spare
OTRM 020	Project Specifications
OTRM 021	HOLD
OTRM 022	HOLD
OTRM 023	Right of Way Encroachments and Uses (Superseded by M7-EN-3003)
OTRM 024 – 029	Spare
OTRM 030	Right-of-Way Vegetation Initial Clearance for 115kV, 230-kV, and 345kV Transmission Lines
OTRM 031	Structure Worksite and Access Areas
OTRM 032	HOLD
OTRM 033	Spare
OTRM 034 – 049	Spare
OTRM 050	Guidelines for Blasting near Utilities
OTRM 051	Transmission Line and Substation Terminal Structure & Lightning Mast Foundations
OTRM 052	HOLD
OTRM 053 – 058	Spare
OTRM 059	Communication Antennas on Transmission Structures
OTRM 060	Extreme Wind & Ice Loading on Transmission Line Structures
OTRM 061	HOLD
OTRM 062	HOLD
OTRM 063	Natural Wood Pole Structures
OTRM 064	Structure Grounding and Counterpoise
OTRM 065	Lightning Arresters
OTRM 066	Transmission Line Terminal Structures

OTRM 067	Overhead to Underground Transition Structures (69/115kV only)
OTRM 068	HOLD
OTRM 069	HOLD
OTRM 070	Wire Sizes, Design Tensions and Deadends, Modeling of Wires & Cables
OTRM 071	Fiber Optic OPGW, ADSS, & Shield Wire
OTRM 072	Mitigation of Wind Induced Conductor Motion
OTRM 073	Insulators and Devices
OTRM 074	Transmission Phase Designaton
OTRM 075	Overhead Transmission Line Ampacity and Thermal Ratings
OTRM 076	Conductor Shielding
OTRM 077	Clearance of 69kV, 115kV, 345kV Conductor to Ground & Other Facilities
OTRM 078	Conductor Clearances within the Supporting Structure (115kV & 345kV)
OTRM 079	AM Radio Noise Consideration – 345-kV Conductor Corona
OTRM 080	Audible Noise Guide
OTRM 081	Evaluation of Stationary Conducting Objects in ROW
OTRM 082	AC Interference Studies

Revision History

Rev 0 -- Original Index Posted 11/22/05
Rev 1 -- Several Additions to Index 8/4/06.
Rev 2 -- Changes to Sections 10 thru 13 11/17/06
Rev 3 -- Upgraded and Changed Index Layout 3/01/2007
Rev 4 -- Changed OTRM 006 from Aerial Laser Survey Criteria to PLS-CADD Design Standards. Also changed approved from RLO to KMS 1/22/2008
Rev 5 -- Revised title of OTRM 070 to include "Deadends" 1/28/2008
Rev 6 -- Revised title of OTRM 064 slightly 1/29/2008
Rev 7 -- Added 070.1
Rev 8 -- Changed Font to Gray on unused Standards. Updated Header & Footer
Rev 9 -- Changed Northeast Utilities to Eversource; changed series numbers in use from Spare to HOLD 07/13/2016
Rev 10 -- Updated title of OTRM 011 03/13/2018

Key:
OTRM 000 Posted
OTRM 000 Unposted

OTRM 100 OTRM Procurement Standards Index
OTRM 101 Spare
OTRM 102 HOLD
OTRM 103 HOLD
OTRM 104 HOLD
OTRM 105 Unused
OTRM 106 LiDAR Acquisition Requirements and Feature Codes
OTRM 107 Property Survey
OTRM 108 Engineering/Design Survey
OTRM 109 Spare
OTRM 110 Wood and Steel Structures Material Matrix
OTRM 111 HOLD
OTRM 112 HOLD
OTRM 113 HOLD
OTRM 114 – 119 Spare
OTRM 120 HOLD
OTRM 121 HOLD
OTRM 122 HOLD
OTRM 123 Unused
OTRM 124 – 129 Spare
OTRM 130 HOLD
OTRM 131 HOLD
OTRM 132 HOLD
OTRM 133 Spare
OTRM 134 – 149 Spare
OTRM 150 HOLD
OTRM 151 HOLD
OTRM 152 Soil Boring and Testing Requirements OH Transmission Facilities
OTRM 153 – 158 Spare
OTRM 159 HOLD
OTRM 160 Technical Requirements for Steel Pole Structures
OTRM 161 Technical Requirements for Lattice Steel Structures
OTRM 162 Glue-Laminated Wood Transmission Structures
OTRM 163 Natural Wood Pole Transmission Structures
OTRM 164 Resistance and Resistivity Measurements
OTRM 165 HOLD
OTRM 166 HOLD
OTRM 167 HOLD
OTRM 168 HOLD

OTRM 169 HOLD
OTRM 170 HOLD
OTRM 171 Technical Requirements for Composite Optical Ground Wire
OTRM 172 HOLD
~~OTRM 173 Specification for 115 kV Polymer (NCI) Insulators~~ (Cancelled- NCI use banned)
OTRM 174 HOLD
OTRM 175 HOLD
OTRM 176 HOLD
OTRM 177 HOLD
OTRM 178 HOLD
OTRM 179 AM Radio Broadcast Frequency Signal Strength Measurements along Proposed EHV Rights-Of-Way
OTRM 180 HOLD
OTRM 181 HOLD
OTRM 182 HOLD
OTRM 183 - 189 Spare
OTRM 190 UAS, Survey Inspection, and Photography of Transmission Lines
OTRM 191 - 197 Spare
OTRM 198 Inspection and Supplemental Treatment of Transmission Wood Poles (formerly OTRM 268)
OTRM 199 Inspection and Supplemental Treatment of Transmission Steel Structures

Revision History

Rev. 0 – Original Index Posted 11/22/05.
Rev. 1 – Several Additions to Index 8/24/06.
Rev. 2 – Revised Index Layout and Added 152 8/1/07.
Rev. 3 – Added 107 & 108
Rev. 4 – Changed Font to Gray on unposted Standards. Updated Header & Footer. 7/23/08
Rev. 5 – Unknown changes
Rev. 6 – Changed Northeast Utilities to Eversource; changed series numbers in use from Spare to HOLD 07/13/2016
Rev. 7 – Updated title of OTRM 152 05/14/2018
Rev. 8 – Added OTRM 190 and OTRM 199 5/31/18
Rev. 9 – Added OTRM 198 6/14/18

Key:
OTRM 000 Posted
OTRM 000 Unposted

OTRM 200 Index
OTRM 201 Spare
OTRM 202 HOLD
OTRM 203 HOLD
OTRM 204 HOLD
OTRM 205 Unused
OTRM 206 Construction Staking and As-Built Surveying Requirements
OTRM 207 HOLD
OTRM 208 HOLD
OTRM 209 Spare
OTRM 210 HOLD
OTRM 211 HOLD
OTRM 212 HOLD
OTRM 213 HOLD
OTRM 214 – 219 Spare
OTRM 220 HOLD
OTRM 221 Transmission Line Construction - General
OTRM 222 Operation of Equipment on Eversource Rights-of-Way
OTRM 223 Unused
OTRM 224 – 229 Spare
OTRM 230 Vegetation Clearing Procedures and Practices for Transmission Line Sections
OTRM 231 Access Roads and Structure Work Site
OTRM 232 Identification and Warning Signs
OTRM 233 Spare
OTRM 234 – 249 Spare
OTRM 250 Drilling and Blasting
OTRM 251 Transmission Line, Substation Terminal Structure, and Lightning Mast Foundations
OTRM 252 HOLD
OTRM 253 – 258 Spare
OTRM 259 HOLD
OTRM 260 Steel Pole Installation
OTRM 261 Transmission Line Steel Lattice Towers
OTRM 262 Laminated Wood Pole Structure Construction
OTRM 263 Wood Pole Structures
OTRM 264 Counterpoise Installation General Specification
OTRM 265 HOLD
OTRM 266 HOLD

OTRM 267 HOLD
~~OTRM 268 Inspection and Supplemental Treatment of Transmission Wood Poles~~
(RENUMBERED OTRM 198)
~~OTRM 269 Inspection and Supplemental Treatment of Transmission Steel Structures~~
(RENUMBERED OTRM 199)
OTRM 270 Overhead Conductor Wire Sizes & Design Tension
OTRM 271 HOLD
OTRM 272 HOLD
OTRM 273 HOLD
OTRM 274 HOLD
OTRM 275 HOLD
OTRM 276 HOLD
OTRM 277 HOLD
OTRM 278 HOLD
OTRM 279 HOLD
OTRM 280 HOLD
OTRM 281 HOLD
OTRM 282 HOLD
OTRM 283 - 299 Spare

Revision History
Rev. 0 – Original Index Posted 11/22/05.
Rev. 1 – Several Additions to Index 8/24/06.
Rev. 2 – Deleted OTRM 229 (Best Management Practices) 8/24/06.
Rev. 3 – Updated and changed Index Layout 3/01/2007
Rev. 4 – Changed Font to Gray on unposted Standards. Updated Header & Footer. 7/23/08.
Rev. 5 – Changed number from OTRM 201 to 200. Verified Standard Titles. Removed OTRM 281. 4/3/2009
Rev. 6 – Updated title of OTRM 251
Rev. 7 – Changed series numbers in use from Spare to HOLD 07/13/2016
Rev. 8 – Added OTRM 268 and OTRM 269
Rev. 9 – Updated title of OTRM 222
Rev. 10 – Removed OTRM 269, which was renumbered OTRM 199
Rev. 11 - Removed OTRM 268, which was renumbered OTRM 198

Key:
UTRM 000 Posted
UTRM 000 Unposted

UTRM 000	UTRM Design Standards Index
UTRM 001	Cross Reference to OTRM Standards
UTRM 002	Transmission Safety and Environmental Design Considerations
UTRM 003	Spare
UTRM 004	Spare
UTRM 005	Spare
UTRM 006	Spare
UTRM 007	Spare
UTRM 008	Spare
UTRM 009	Cable Thermal Ratings
UTRM 010	Spare
UTRM 011	Spare
UTRM 012	Spare
UTRM 013	Unused
UTRM 014	Spare
UTRM 015	Spare
UTRM 016	Power Cable Structures and Bridge Attachments
UTRM 017	Spare
UTRM 018	Spare
UTRM 019	Spare
UTRM 020	Unused
UTRM 021	Spare
UTRM 022	Unused
UTRM 023	Spare
UTRM 024	Spare
UTRM 025	Spare
UTRM 026	Spare
UTRM 027	Spare
UTRM 028	Spare
UTRM 029	Spare
UTRM 030	Spare
UTRM 031	Spare
UTRM 032	Spare
UTRM 033	Spare
UTRM 034	Unused
UTRM 035	Unused
UTRM 036	Unused
UTRM 037	Unused
UTRM 038	Spare

Docket DE 20-161
Data Request DOE 6-003
5/16/2022
Attachment DOE 6-003(b)
Page 36 of 49

UTRM 039 Spare
UTRM 040 Spare
UTRM 041 Spare
UTRM 042 Spare
UTRM 043 Spare
UTRM 044 Spare
UTRM 045 Spare
UTRM 046 Spare
UTRM 047 Spare
UTRM 048 Spare
UTRM 049 Spare
UTRM 050 Drilling and Blasting (Refer to OTRM 050)
UTRM 051 Unused
UTRM 052 Unused
UTRM 053 Spare
UTRM 054 Spare
UTRM 055 Spare
UTRM 056 Spare
UTRM 057 Spare
UTRM 058 Spare
UTRM 059 Spare
UTRM 060 Spare
UTRM 061 Spare
UTRM 062 Spare
UTRM 063 Spare
UTRM 064 Sheath Bonding and Grounding
UTRM 065 Spare
UTRM 066 Termination Structures
UTRM 067 Spare
UTRM 068 Spare
UTRM 069 Spare
UTRM 070 Unused
UTRM 071 Cable – Fiber Optic
UTRM 072 Unused
UTRM 073 Spare
UTRM 074 Phasing (Refer to OTRM 074)
UTRM 075 Cable Thermal Ratings
UTRM 076 Spare
UTRM 077 Clearance Requirements
UTRM 078 Spare
UTRM 079 Unused
UTRM 080 - 091 Spare
UTRM 092 Pre-cast Concrete Splice Vaults (refer to UTRM 192)
UTRM 093 – 099 Spare

Revision History
Rev. 0 - Original Index Posted
Rev. 1 – Changed Font to Gray on unposted Standards. Updated Header and Footer.
Rev. 2 – Changed to UTRM 000, Updated standard titles.

Key:
UTRM 000 Posted
UTRM 000 Unposted

UTRM 100 UTRM Procurement Standards Index
UTRM 101 Cross Reference to other Applicable Standards
UTRM 102 Unused
UTRM 103 – 008 Spare
UTRM 109 Thermal Sand
UTRM 110 Fluidized Thermal Backfill (FTB™)
UTRM 111 Spare
UTRM 112 Spare
UTRM 113 HPFF Pipe and Accessories
UTRM 114 – 119 Spare
UTRM 120 Cathodic Protection
UTRM 121 Spare
UTRM 122 Factory Fabricated Pressurization Plant for HPFF Cable
UTRM 123 Spare
UTRM 124 Spare
UTRM 125 Spare
UTRM 126 Spare
UTRM 127 Spare
UTRM 128 Spare
UTRM 129 Spare
UTRM 130 Spare
UTRM 131 Spare
UTRM 132 Spare
UTRM 133 Spare
UTRM 134 Unused
UTRM 135 Unused
UTRM 136 Unused
UTRM 137 Unused
UTRM 138 Spare
UTRM 139 Spare
UTRM 140 Spare
UTRM 141 Spare
UTRM 142 Spare
UTRM 143 Spare
UTRM 144 Spare
UTRM 145 Spare
UTRM 146 Spare
UTRM 147 Spare
UTRM 148 Spare

UTRM 149 Spare
UTRM 150 Unused
UTRM 151 Unused
UTRM 152 Soil Boring and Testing Requirements UG Transmission Lines
UTRM 153 Spare
UTRM 154 Spare
UTRM 155 Spare
UTRM 156 Spare
UTRM 157 Spare
UTRM 158 Spare
UTRM 159 Spare
UTRM 160 Spare
UTRM 161 Spare
UTRM 162 Spare
UTRM 163 Spare
UTRM 164 Unused
UTRM 165 Spare
UTRM 166 Unused
UTRM 167 Spare
UTRM 168 Spare
UTRM 169 Spare
UTRM 170 Cable – XLPE, EPR, HPFF
UTRM 171 Unused
UTRM 172 Thermocouple Temperature Monitoring System
UTRM 173 XLPE Cable Support and Restraint System
UTRM 174 Unused
UTRM 175 Terminations – XLPE, EPR, HPFF
UTRM 176 Spare
UTRM 177 Unused
UTRM 178 Spare
UTRM 179 Underground Cable Splices
UTRM 180 – 191 Spare
UTRM 192 Pre-cast Concrete Splice Vaults
UTRM 193 – 199 Spare

Revision History:
Rev. 0 – Original Index Posted
Rev. 1 – Changed Font to Gray on unposted Standards. Updated Header & Footer.
Rev. 2 – Changed from UTRM 101 ot UTRM 100. Updated Standards Titles

Key:
UTRM 000 Posted
UTRM 000 Unposted

UTRM 200	UTRM Construction Standards Index
UTRM 201	Cross Reference to other Applicable Standards
UTRM 202	Transmission Safety and Environmental Construction Considerations
UTRM 203	Spare
UTRM 204	Spare
UTRM 205	Spare
UTRM 206	Spare
UTRM 207	Spare
UTRM 208	Spare
UTRM 209	Unused
UTRM 210	Spare
UTRM 211	Spare
UTRM 212	Spare
UTRM 213	HPFF Pipe and Accessories Installation
UTRM 214	Spare
UTRM 215	Spare
UTRM 216	Spare
UTRM 217	Spare
UTRM 218	Spare
UTRM 219	Spare
UTRM 220	Unused
UTRM 221	Spare
UTRM 222	Pressurization Plant Installation
UTRM 223	Spare
UTRM 224	Spare
UTRM 225	Spare
UTRM 226	Spare
UTRM 227	Spare
UTRM 228	Spare
UTRM 229	Spare
UTRM 230	Spare
UTRM 231	Spare
UTRM 232	Spare
UTRM 233	Spare
UTRM 234	Duct Bank Construction
UTRM 235	Conduit Material and Installation
UTRM 236	Marking of Underground Cable Systems in Rights-of-Way
UTRM 237	Post Construction Duct and Pipe Cleaning and Inspection
UTRM 238	Spare

UTRM 239 Spare
UTRM 240 Spare
UTRM 241 Spare
UTRM 242 Spare
UTRM 243 Spare
UTRM 244 Spare
UTRM 245 Spare
UTRM 246 Spare
UTRM 247 Spare
UTRM 248 Spare
UTRM 249 Spare
UTRM 250 Drilling and Blasting (Refer to OTRM 250)
UTRM 251 Horizontal Directional Drilling
UTRM 252 Pipe Jacking and Boring
UTRM 253 Spare
UTRM 254 Spare
UTRM 255 Spare
UTRM 256 Spare
UTRM 257 Spare
UTRM 258 Spare
UTRM 259 Spare
UTRM 260 Spare
UTRM 261 Spare
UTRM 262 Spare
UTRM 263 Spare
UTRM 264 Unused
UTRM 265 Spare
UTRM 266 Unused
UTRM 267 Spare
UTRM 268 Spare
UTRM 269 Spare
UTRM 270 Cable – XLPE, EPR, HPFF
UTRM 271 Temperature Monitoring and Communication Cable Installation
UTRM 272 Temperature Monitoring Thermocouple Installation
UTRM 273 Spare
UTRM 274 Unused
UTRM 275 Unused
UTRM 276 Spare
UTRM 277 Unused
UTRM 278 Spare
UTRM 279 Unused
UTRM 280 291 Spare
UTRM 292 Precast Concrete Vault Installation
UTRM 292.1 Retrofit of Concrete Splice Vault with Round Frame and Cover

UTRM 293 – 299 Spare

Revision History
Rev 0 – Original Index Posted 12/19/05
Rev 1 – Additions to Index Section Descriptions 11/03/2006
Rev 2 – Added UTRM 234 & 235
Rev 3 – Changed Font to Gray on unposted Standards. Updated Header and Footer
Rev 4 – Changed from UTRM 201 to 200. Updated Standards Titles.
Rev 5 – Added UTRM 292.1

Northeast Utilities
Real Estate Standards

Key:
REAL 000 Posted
REAL 000 Unposted

REAL 000 Index
REAL 001 Property Disposition Checklist
REAL 002 Real Estate Revenue Lease/License Procedure
REAL 003 Surplus Property Review
REAL 004 Corporate Approval To Divest Of Real Estate

Revision History

Index			
Northeast Utilities **Approved by: KMS**	**Real Estate**	**REAL 001** **Page 1 of 2**	**Rev 0** **11/14/2008**

Underground & URD Distribution

Construction Standards

00 – General

32 – Cables
33 – Connectors
35 – Metering
36 – Distributed Generation
42 – Clearances
43 – Tagging / Identification / Labeling
54 – Secondary / Service
56 – Grounds / Bonds
58 – Transformers
60 – Switchgear / Switches

Construction Standards

61 – Controls / Sensing / Communication
62 – Fault Indicators / Fuses
63 – Foundations / Box Pads / Handholes
64 – Joints / Splices / Tubing
65 – Miscellaneous Equipment / Tools
66 – Special Projects
67 – Terminations
Risers
76 – Manholes / Vaults / Conduits / Ducts
84 – Network / Conventional

UG DTR Locater

Search

Common Abbreviations:
By Name
By Abbreviation

EVERSOURCE
Changes / Additions

Work Method Categories

Operation & Maintenance of Equipment & Material

- Overhead (01 – 25)
- Substation & Transmission (51 – 75)
- Underground (26 – 50)

Description: These categories cover control box functionality, switch/ reclosure operation, breaker maintenance and testing, pad-mount equipment operation,

Procedures and Tools

- Material Handling, Tool Operation, Phasing, Safety, Shared Practices, Voltage Testing, Work Site Setup, etc. (76 – 100)

Description: "Procedures and Tools" cover procedures and processes that can be used system wide (OH, UG, Stations, etc.) as well as how to use and operate specific tools.

WMS Locater

Search

EVERSOURCE

Changes / Additions

Overhead Work Methods

Overhead Equipment & Material	Overhead Equipment & Material
01 – Other, OH	07 – Lighting
02 – Anchoring & Guying	08 – Pole, Hardware & Inspections
03 – Capacitors	09 – Reclosers, Pole-Top
04 – Connectors	10 – Regulators
05 – Cutouts, Fuses, Switches, & Sectionalizers	11 – Transformers, Pole-Top
06 – Insulators, Arrestors & Fault Indicators	

WMS Locater
Search

Common Abbreviations:
By Name
By Abbreviation

EVERSOURCE
Changes / Additions

Underground Work Methods

Underground Equipment & Material
26 – Other, Pad-mounted & UG
27 – Joints, Splices & Terminations
28 – Transformers, Pad-mounted & UG
29 – Switches & Switchgear
30 – Reclosers, Pad-mounted

Underground Equipment & Material
56 – Network Protectors
58 – Secondary & Tertiary Network Operations
59 – Sectionalizers & Switches
60 – Transformers (Power)

Note: The above categories are from the "Substation & Transmission" index page. All "Back to Index" buttons will link to the Substation index.

WMS Locater
Search

Common Abbreviations:
By Name
By Abbreviation

EVERSOURCE
Changes / Additions

Substation Work Methods

Substation & Transmission Equipment & Material
51 – Other, Substation
52 – Other, Transmission
53 – Cables & Conductors
54 – Circuit Breakers
55 – Individual & Mobile Substation
56 – Network Protectors

Substation & Transmission Equipment & Material
57 – Relays, CT's & PT's
58 – Secondary & Tertiary Network Operations
59 – Sectionalizers & Switches
60 – Transformers (Power)
61 – Batteries and Battery Banks

WMS Locater

Search

Common Abbreviations:
By Name
By Abbreviation

EVERSOURCE
Changes / Additions

Procedures & Tools
76 – General / Other
77 – Other, Overhead
78 – Other, Substation & Transmission
79 – Other, Underground
80 – Battery Operated Tools
81 – Cable
82 – Conduit & Underground Chambers
83 – Fault Locating
84 – Hand, Hydraulic & Pneumatic Tools
85 – Personal Protective Equipment

Procedures & Tools
86 – Preventive Maintenance / Inspections, Other (Non-Equipment)
87 – Rigging, Lifting & Handling
88 – Safety & OSHA
89 – Grounding
90 – Testing & Troubleshooting
91 – Voltage Testing & Phasing
92 – Wire – (All Voltages & Types)

WMS Locater
Search

Common Abbreviations:
By Name
By Abbreviation

EVERSOURCE
Changes / Additions

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022 **Date of Response: March 07, 2022**
Data Request No. DOE 4-029 **Page 1 of 2**

Request from: Department of Energy

Witness: Labrecque, Richard C, Freeman, Lavelle A

Request:

Please define the following for the 3 sets of planning criteria provided in the above Excel spreadsheet, i.e., DOE 4-28.1 Attachment 1:
a. When each was/is used, including first use.
b. How each is used and by whom.
c. How each will be used going forward and by whom, including which is the Company's first choice.
d. What has been done and planned by the Company to help Staff better understand the need for three sets of criteria, and the potential consequences if the preferred set is not accepted/approved by Staff.

Response:

Of the three criteria being compared in DOE 4-28.1 Attachment 1, only two are documents that set System Planning criteria: ED-3002 and the Distribution System Planning Guide (DSPG 2020). The third document being referenced is a system study report that references the criteria in the Distribution System Planning Guide. The following responses compare the use of ED-3002 and the Distribution System Planning Guide.

a. Of the different documents guiding New Hampshire System Planning design criteria, the first is ED-3002, which was originally issued January 10, 2003. This document was the primary guidance for NH System Planning until SYSPLAN-010 was revised.

   SYSPLAN-010 was a criteria document created in 2014. In 2018, the first effort to bring all planning criteria of the different operating companies into one document occurred. The revised SYSPLAN-010 document was adopted by all three states on August 1, 2018 and supersedes ED-3002. However, some specific planning criteria not addressed by SYSPLAN-010 are still applicable from ED-3002.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022 **Date of Response: March 07, 2022**
Data Request No. DOE 4-029 **Page 2 of 2**

The Distribution System Planning Guide, adopted September 22, 2020, is today's primary document for system planning criteria, rating, and planning methodology. The DSPG 2020 supersedes SYSPLAN-10 and ED-3002, by extension. However, some specific items not addressed by the DSPG 2020 are still applicable in SYSPLAN-010 and ED-3002.

b. All documents are used by New Hampshire Distribution System Planning for criteria on how to study the distribution system and ensure system capacity needs are fulfilled, and system voltage remains within limits for base case and contingency scenarios.

ED-3002: Portions not superseded by DSPG 2020 and SYSPLAN-010, used by New Hampshire
SYSPLAN-010: Portions not superseded by DSPG 2020, used by Connecticut, Massachusetts, and New Hampshire
DSPG 2020: Used by Connecticut, Massachusetts, and New Hampshire

c. The Company's primary distribution system planning criteria document is the Distribution System Planning Guide, released in 2020. Any items not addressed by the DSPG 2020, are supplemented, first by SYSPLAN-010 and then by ED-3002. Based on changing roles and responsibilities, some items are still referenced in SYSPLAN-010 by Transmission Planning and in ED-3002 by Distribution Engineering, until replacement guides/policies can be written.

d. The new Distribution System Planning Guide was included in the Company's initial filing in this docket. Eversource's initial filing highlighted the implementation of the new DSPG and changes to the criteria were described. Subsequent to the initial filing of the LCIRP, Eversource and Staff discussed the new planning criteria at a technical session. The Eversource response to data request DOE 4-028 provides additional details. Eversource is committed to these new criteria as a means to ensure system reliability under various single contingency events. Customers will be exposed to the risk of prolonged outages if the system is not planned and designed to these criteria.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022 **Date of Response: March 10, 2022**
Data Request No. DOE 4-002 **Page 1 of 1**

Request from: Department of Energy

Witness: Hebsch, Jennifer J

Request:

Please provide a copy of the latest distribution standards for Eversource and any studies or memos supporting any recent changes covering the minimum requirement for Class 2 poles, covered wire, pole construction configuration, etc.

Response:

Eversource is providing the following Standards in Attachment DOE 4-002 (1):

- Distribution System Engineering Manual (DSEM)
- Overhead Construction Standards
- Underground Construction Standards

To access the above books, perform the following:

1. Unzip the files to a separate directory
2. Open the file called Standards.pdf
3. This opens the "bookshelf" with the three books in it.
4. Click on the book title which will open the book and allow the user to open the various table of contents and documents.

Additional supporting information is also included:

- Attachment DOE 4-002(2) – Eversource Policy: Use of Steel Poles on Distribution Lines

Note that Eversource is working on a topic-by-topic review to consolidate its standards so that each section identifies enterprise-wide as well as operating company level standards within the section. Some standards apply to certain operating companies while others apply to all operating companies.

Use of Steel Poles on Distribution Lines

EVERSOURCE

This policy applies to Eversource NH installations

Responsibility

All Engineering and Operations personnel are expected to understand and abide by this policy.

Policy

New poles installed in Eversource three phase lines in distribution Rights-of-Way are to be direct embedded self-weathering steel poles, class and height to be determined by the Transmission Line Engineering group.

The use of steel poles in other situations such as for single phase lines, jointly owned facilities, or other special situations is by exception only and requires approval from managers or above in Operations and Engineering.

Steel poles shall not be used for service poles.

See the attached Supervisor Briefing Sheet for additional information.

Revision History

0	Created new policy, *effective 10/3/2019*	

Use of Steel Poles on Distribution Lines

Steel Pole FAQ (Sabre weathering steel poles)

1. **Are there Eversource standards for steel poles?** Refer to Section 10 of the Overhead book, 9.1--9.4.

2. **Do we build to 200 kV BIL?** Steel Construction in the Distribution ROW is built to 350BIL - Wood construction is built to 200 kV BIL. Consult OH Standards book for correct material.

3. **What do we use for guy attachments? Our current attachment has teeth**. Consult Standards - on angles and dead ends where a guy will be attached, a Tee Plate is used on steel construction (SC:532221). It is flat and will sit flush to the pole.

4. **Can we equipotentially ground on a steel pole? How to ground?** Equipotentially grounding a line is done in almost the same way as a wood pole. The only difference is that you can use a step rung to attach a ground to in lieu of the cluster bracket; however, a cluster bracket is also an acceptable method.

5. **Should caulk guns be purchased - how much caulking is required?** Caulk or RTV is required to seal the drill holes to keep out moisture after a bolt is inserted.

6. **How do you drill holes or work in the air if steps are only on one side?** The preferred method would be to drill the poles on the ground before they are set. Poles now have step rung brackets on three sides above the neutral to assist with drilling and reaching outside phases. To reach outside phases where only one side has steps, a diving board can be utilized or hot stick methods.

7. **Is there a special type of rubber to be used on these poles?** No, the rubber we use on wood poles provides the same insulating value regardless of the material it is covering. Proper inspection of rubber goods and Insulate/Isolate techniques shall be followed when working on steel poles.

8. **Can we glove out of the bucket on an energized steel pole?** Yes, these poles can be worked energized using proper PPE and insulate/isolate methods.

9. **Can the Skylift lift and set steel poles?** The Skylift is limited by weight - use lifting chart on machine to determine if the machine can handle the load. Listed below are the 5 most common size distribution poles and their weight.

Height/Type	Weight
40’ Class I	818 lbs.
45’ Class I	946 lbs.
50’ Class I	1,078 lbs.
45’ H1	993 lbs.
50’ H1	1,137 lbs.

10. **Who is responsible for setting and working on the steel ROW poles? Can the AWC’s ask for help from the Transmission group?** *The AWC’s are responsible for all distribution lines in their*

Use of Steel Poles on Distribution Lines

area both off-road and road side. If there is a need for an off-road machine, call the Supervisor on-call and the determination will be made whether the Transmission group will be able to assist, or a contractor will be called.

11. **If an off-road machine is needed for assistance, who takes the lead?** In a non-storm event and the Transmission group is called to an event in the ROW, they will generally send one or two guys with the machine to assist the crew currently working.

12. **Where are the steps? How many are needed? What is the process for installing the step?** Each work center was issued a cage of steps to use if needed. The number of steps is determined by pole size but generally they require 15-20 depending on application. A PowerPoint Presentation is available showing the installation of the steps - contact your supervisor if you were not shown the PPT.

13. **What belts are required to climb?** Steel Poles can be climbed with either a climbing belt, a Ladder belt or a harness. *100% fall arrest must be maintained at all times*. When climbing - the best method is to loop the climbing belt or lanyard around a step above you and take a few steps up. Next, take a separate belt or lanyard and loop it around a step above you. Repeat process until you get to your desired location.

14. **Are we going to be trained on how to climb using 100% fall arrest?** A video will be available on how to climb a steel pole.

15. **Are we going to be trained in the rapid rail system?** Rapid Rail is a fall arrest system used on Transmission structures. This system is not used on the Distribution system.

16. **Are these poles set with a strap or chain?** There is no difference between setting a wood pole and steel pole as far as work procedures go.

17. **Is there a cluster bracket we can use to hang equipment to avoid drilling holes?** Currently there is no approved bracket, holes must be drilled to attach equipment.

18. **Copper ground wire is exposed at the bottom of the pole, will this get stolen?** Most of the D-ROW system is well off road and the likelihood of this wire being stolen is low. The pole is made of steel and will act as a ground in the event the wire is stolen.

19. **How do we use the mag drill to drill holes?** Consult the owner's manual that came with the drill to become familiar with it. A video is also being made available to show the operation of the unit on a steel pole.

20. **Where is pole top equipment mounted on the poles?** Refer to OH standards on the equipment that is being installed. There is no change between wood and steel poles - same measurements will be used.

21. **How do we perform pole top rescue on these poles?** It is the same method we currently use for wood poles.

Attachment JED/RDW-5 is CONFIDENTIAL. Since the bulk of the information is confidential, this page is a placeholder for Bates 00106-00133 and content has been omitted in its entirety.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: April 15, 2022 **Date of Response: April 27, 2022**
Data Request No. DOE 5-009 **Page 1 of 1**

Request from: Department of Energy

Witness: Paruta, Marisa B

Request:

Refer to Eversource's Response to DR DOE 4-016. Please provide any planning studies, calculations, estimates or evaluations of the impact on customers' retail distribution rates ($ per kWh, $ per customer-month or any other customer measure used by the Company) if the capital forecast included in Attachment DOE 4-016 Page 3 were completed, implemented and/or constructed by the Company, and the Company were to request recognition of these capital amounts in retail distribution rates at current, approved or expected ROI, depreciation, and customary recovery of taxes, O&M and other expenses. Please provide all supporting workpapers.

Response:

See Attachment DOE 5-009 for an illustrative presentation and calculation of the impact on revenue requirements if the capital forecast included in Attachment DOE 4-016, page 3, were completed, implemented and/or constructed by the Company. For purposes of this illustrative presentation, the Company used several assumptions that were based on: (1) historical information, including the capital structure, rate of return, whole life depreciation rates, property tax rates, income tax rates, plant retirements, and sales volume, consistent with the most recently filed Docket No. DE 19-057 2020 Step Adjustment (Step #2) for calendar year 2020 plant in service, approved on July 30, 2021, and the most recent base distribution rate case Settlement Agreement, approved on December 15, 2020, and (2) forecasted assumptions, including accumulated depreciation, that were developed using information available at the time the calculation was compiled.

In addition, the Company has developed a measure of the impact of these capital investments to base distribution rates, and to a typical residential bill. The cumulative incremental revenue requirements of $54.5 million over the period 2021-2026 (see Attachment DOE 5-009, page 1) if applied to current rates would result in an overall average increase of 0.388 cents/kWh, and would vary on a class basis, as shown in Attachment DOE 5-009, page 7. A typical residential customer using 600 kWh in a month would see an increase of $5.89, or 4.4% (see Attachment DOE 5-009, page 8).

Public Service Company of New Hampshire
d/b/a Eversource Energy
Docket No. DE 20-161
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ILLUSTRATIVE REVENUE REQUIREMENT

Line	Description	Year-Ending 12/31/2020 (A)	Year-Ending 12/31/2021 (B)	Year-Ending 12/31/2022	Year-Ending 12/31/2023	Year-Ending 12/31/2024	Year-Ending 12/31/2025	Year-Ending 12/31/2026	Reference
1	Total Utility Plant in Service	$ 2,345,505,174	$ 2,451,293,636	$ 2,556,772,098	$ 2,663,304,560	$ 2,770,613,023	$ 2,878,916,485	$ 2,994,162,947	Page 2, Line 1
2	Accumulated Provision for Depreciation	633,383,630	678,518,775	727,145,733	774,886,383	831,957,767	892,557,751	954,518,363	Page 2, Line 2
3	Net Utility Plant	$ 1,712,121,544	$ 1,772,774,861	$ 1,829,626,366	$ 1,888,418,178	$ 1,938,655,256	$ 1,986,358,734	$ 2,039,644,584	Line 1 - Line 2
4	Gross Plant Change (year over year)		$ 105,788,462	$ 105,478,462	$ 106,532,462	$ 107,308,462	$ 108,303,462	$ 115,246,462	Line 1 Current Col. - Line 1 Prior Col.
5	Net Plant Change (year over year)		$ 60,653,317	$ 56,851,504	$ 58,791,812	$ 50,237,078	$ 47,703,478	$ 53,285,851	Line 3 Current Col. - Line 3 Prior Col.
6	Rate of Return		6.87%	6.87%	6.87%	6.87%	6.87%	6.87%	Page 3, Line 8
7	Gross Revenue Conversion Factor		1.37142	1.37142	1.37142	1.37142	1.37142	1.37142	Page 4, Line 7
8	Return		$ 5,713,974	$ 5,355,816	$ 5,538,607	$ 4,732,690	$ 4,494,007	$ 5,019,906	Line 5 x Line 6 x Line 7
9	Depreciation Rate		3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	Page 5, Line 71
10	Depreciation		$ 1,910,579	$ 1,790,822	$ 1,851,942	$ 1,582,468	$ 1,502,660	$ 1,678,504	Line 5 x Line 9
11	Property Tax Rate		2.06%	2.06%	2.06%	2.06%	2.06%	2.06%	Page 6, Line 3
12	Property Taxes		$ 2,174,903	$ 2,168,529	$ 2,190,199	$ 2,206,152	$ 2,226,609	$ 2,369,350	Line 4 x Line 11
13	Total Revenue Requirement		$ 9,799,456	$ 9,315,168	$ 9,580,747	$ 8,521,310	$ 8,223,275	$ 9,067,760	Line 8 + Line 10 + Line 12

Public Service Company of New Hampshire
d/b/a Eversource Energy
Docket No. DE 20-161
Attachment DOE 5-009
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ILLUSTRATIVE DISTRIBUTION PLANT

Line	Description	Year-Ending 12/31/2020	Year-Ending 12/31/2021	Year-Ending 12/31/2022	Year-Ending 12/31/2023	Year-Ending 12/31/2024	Year-Ending 12/31/2025	Year-Ending 12/31/2026	Reference
		(A)	(B)						
1	Total Utility Plant In Service	$ 2,345,505,174	$ 2,451,293,636	$ 2,556,772,098	$ 2,663,304,560	$ 2,770,613,023	$ 2,878,916,485	$ 2,994,162,947	Line 9 below
2	Accumulated Provision for Depreciation	633,383,630	678,518,775	727,145,733	774,886,383	831,957,767	892,557,751	954,518,363	Step 2/Company Forecast
3	Net Utility Plant	$ 1,712,121,544	$ 1,772,774,861	$ 1,829,626,366	$ 1,888,418,178	$ 1,938,655,256	$ 1,986,358,734	$ 2,039,644,584	Line 1 - Line 2
4	Gross Distribution Plant Change (year over year)		$ 105,788,462	$ 105,478,462	$ 106,532,462	$ 107,308,462	$ 108,303,462	$ 115,246,462	Line 1 Current - Line 1 Prior
5	Net Distribution Plant Change (year over year)		$ 60,653,317	$ 56,851,504	$ 58,791,812	$ 50,237,078	$ 47,703,478	$ 53,285,851	Line 3 Current - Line 3 Prior
6	Beginning Plant Balance	$ 2,250,917,651	$ 2,345,505,174	$ 2,451,293,636	$ 2,556,772,098	$ 2,663,304,560	$ 2,770,613,023	$ 2,878,916,485	Step 2/Prior Year Line 9
7	Additions	123,141,060	134,342,000	134,032,000	135,086,000	135,862,000	136,857,000	143,800,000	Step 2/Base Capital Forecast
8	Retirements	(28,553,538)	(28,553,538)	(28,553,538)	(28,553,538)	(28,553,538)	(28,553,538)	(28,553,538)	Step 2 Retirements
9	Ending Plant Balance	$ 2,345,505,174	$ 2,451,293,636	$ 2,556,772,098	$ 2,663,304,560	$ 2,770,613,023	$ 2,878,916,485	$ 2,994,162,947	Line 6 + Line 7 + Line 8

Public Service Company of New Hampshire
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COST OF CAPITAL PER DE 19-057

Line	Description	Fixed Percentage	Cost	Rate of Return	Reference
		(A)	(B)	(C) = (A) x (B)	
1	Short-Term Debt	2.44%	2.07%	0.05%	
2	Long-term Debt	43.15%	4.08%	1.76%	
3	Common Equity	54.41%	9.30%	5.06%	
4	Total Capital	100.00%		6.87%	Line 1 + Line 2 + Line 3
5	Weighted Cost of				
6	Debt			1.81%	Line 1 + Line 2
7	Equity			5.06%	Line 3
8	Cost of Capital			6.87%	Line 6 + Line 7

Public Service Company of New Hampshire
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COMPUTATION OF GROSS REVENUE CONVERSION FACTOR

Line	Description	12/31/2020	12/31/2021	12/31/2022	12/31/2023	12/31/2024	12/31/2025	12/31/2026	Reference
1	Operating revenue percentage	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	
2	Less: New Hampshire corporate business tax	7.700%	7.700%	7.700%	7.700%	7.700%	7.700%	7.700%	
3	Operating revenue percentage after state taxes	92.300%	92.300%	92.300%	92.300%	92.300%	92.300%	92.300%	Line 1 - Line 2
4	Federal income tax rate	21.000%	21.000%	21.000%	21.000%	21.000%	21.000%	21.000%	
5	Federal income tax	19.383%	19.383%	19.383%	19.383%	19.383%	19.383%	19.383%	Line 3 x Line 4
6	Operating income after federal income tax	72.917%	72.917%	72.917%	72.917%	72.917%	72.917%	72.917%	Line 3 - Line 5
7	Gross revenue conversion factor	137.142%	137.142%	137.142%	137.142%	137.142%	137.142%	137.142%	1 / Line 6

Note: Amounts shown above may not add due to rounding.

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SUMMARY OF ESTIMATED SURVIVOR CURVES, NET SALVAGE PERCENT, ORIGINAL COST AND AND CALCULATED ANNUAL AND ACCRUED DEPRECIATION RELATED TO ELECTRIC PLANT AS OF DECEMBER 31, 2018 WHOLE LIFE DEPRECIATION - AMR RECOVERY OVER 9 YEARS

LINE	PLANT ACCOUNT	DESCRIPTION	SURVIVOR CURVE	NET SALVAGE PERCENT	ORIGINAL COST AS OF DECEMBER 31, 2018	CALCULATED ANNUAL ACCRUAL AMOUNT		CALCULATED ANNUAL ACCRUAL RATE		CALCULATED ACCRUED DEPRECIATION
1	(A)	(B)	(C)	(D)	(E)	(F)		(G)=(F)/(E)		(H)
2										
3		**ELECTRIC PLANT**								
4										
5		**INTANGIBLE PLANT**								
6										
7	303.00	MISCELLANEOUS INTANGIBLE PLANT	5-SQ	0	18,278,819.53	1,769,835		9.68		14,600,391
8	303.00	MISCELLANEOUS INTANGIBLE PLANT - AMR	5-SQ	0	2,864,448.00	95,483	*	3.33		2,660,846
9	303.20	MISCELLANEOUS INTANGIBLE PLANT - 10 YEAR	10-SQ	0	31,771,797.33	486,807		1.53	**	28,607,554
10										
11		**TOTAL INTANGIBLE PLANT**			**52,915,064.86**	**2,352,125**		**4.45**		**45,868,791**
12										
13		**DISTRIBUTION PLANT**								
14										
15	360.20	LAND AND LAND RIGHTS	75-R4	0	4,123,039.65	54,836		1.33		2,204,822
16	361.00	STRUCTURES AND IMPROVEMENTS	75-R3	(25)	26,387,975.26	438,700		1.66		6,187,652
17	362.00	STATION EQUIPMENT	55-S0.5	(25)	303,092,439.65	6,895,353		2.28		65,238,205
18	362.10	STATION EQUIPMENT - ENERGY MANAGEMENT SYSTEM	25-R2.5	0	3,155,937.71	126,238		4.00		1,015,444
19	364.00	POLES, TOWERS AND FIXTURES	53-R0.5	(90)	303,587,829.37	10,901,646		3.59		110,737,706
20	365.00	OVERHEAD CONDUCTORS AND DEVICES	55-R1	(35)	582,095,624.35	14,302,089		2.46		154,119,837
21	366.00	UNDERGROUND CONDUIT	60-R2	(40)	38,757,668.49	906,154		2.34		9,625,266
22	367.00	UNDERGROUND CONDUCTORS AND DEVICES	54-R1.5	(40)	133,741,822.05	3,463,913		2.59		42,368,714
23	368.00	LINE TRANSFORMERS	40-S0	(2)	262,481,157.73	6,693,270		2.55		73,140,846
24	369.10	OVERHEAD SERVICES	44-R2	(125)	81,721,434.74	4,173,922		5.11		47,501,588
25	369.20	UNDERGROUND SERVICES	55-R1.5	(125)	76,631,011.71	3,138,040		4.10		32,482,673
26	370.00	METERS	18-L1	0	44,821,891.75	2,479,416		5.53		19,961,157
27	370.00	METERS - AMR	18-L1	0	31,614,492.00	2,981,203	*	9.43		5,819,204
28	371.00	INSTALLATION ON CUSTOMERS' PREMISES	17-L0	(50)	6,563,781.88	578,892		8.82		3,082,834
29	373.00	STREET LIGHTING AND SIGNAL SYSTEMS	27-L0	(10)	5,130,537.46	208,813		4.07		2,083,777
30										
31		**TOTAL DISTRIBUTION PLANT**			**1,903,906,643.80**	**57,342,485**		**3.01**		**575,569,725**
32										
33		**GENERAL PLANT**								
34										
35	389.20	LAND AND LAND RIGHTS	65-R4	0	26,976.55	415		1.54		13,692
36	390.00	STRUCTURES AND IMPROVEMENTS	50-S0.5	(10)	84,363,470.03	1,854,713		2.20		20,052,815
37	390.10	STRUCTURES AND IMPROVEMENTS - LEASEHOLD	20-S0.5	0	50,859.53	2,543		5.00		19,095
38	391.10	OFFICE FURNITURE AND EQUIPMENT	20-SQ	0	9,755,154.62	487,758		5.00		4,695,337
39	391.20	OFFICE FURNITURE AND EQUIPMENT - COMPUTER EQUIPM	5-SQ	0	1,672,250.89	243,506		14.56		960,508
40										
41		*TRANSPORTATION EQUIPMENT*								
42										
43	392.00	OTHER	15-S4	15	30,225.00	1,714		5.67		14,507
44	392.10	CARS	6-L3	15	97,593.41	13,828		14.17		13,479
45	392.20	LIGHT TRUCKS	11-S1	15	8,605,166.97	664,878		7.73		2,687,250
46	392.30	MEDIUM TRUCKS	14-S3	15	2,764,714.96	167,791		6.07		767,426
47	392.40	HEAVY TRUCKS	15-S2.5	15	26,391,434.00	1,496,262		5.67		8,212,511
48	392.50	ROLLING EQUIPMENT	13-L2.5	15	1,321,753.47	86,396		6.54		235,242
49	392.60	TRAILERS	13-L3	15	4,958,571.11	324,117		6.54		1,661,871
50	392.70	ELECTRIC VEHICLE CHARGING STATION	10-R4	0	7,902.10	790		10.00		5,244
51										
52		*TOTAL TRANSPORTATION EQUIPMENT*			*44,177,361.02*	*2,755,776*		*6.24*		*13,597,530*
53										
54	393.00	STORES EQUIPMENT	20-SQ	0	3,257,904.89	162,895		5.00		1,109,379
55	394.00	TOOLS, SHOP AND GARAGE EQUIPMENT	25-SQ	0	14,194,677.76	567,787		4.00		4,037,342
56	395.00	LABORATORY EQUIPMENT	20-SQ	0	2,072,746.95	96,433		4.65		1,339,656
57	396.00	POWER OPERATED EQUIPMENT	15-L4	0	159,421.09	10,633		6.67		71,720
58										
59		*COMMUNICATION EQUIPMENT*								
60										
61	397.10	MICROWAVE	15-SQ	0	5,646,707.11	240,089		4.25		3,854,488
62	397.20	OTHER	15-SQ	0	22,098,802.35	1,279,811		5.79		10,667,691
63	397.30	GPS	5-SQ	0	443,487.30	54,399		12.27		366,151
64										
65		*TOTAL COMMUNICATION EQUIPMENT*			*28,188,996.76*	*1,574,299*		*5.58*		*14,888,330*
66										
67	398.00	MISCELLANEOUS EQUIPMENT	20-SQ	0	1,279,168.86	63,958		5.00		658,566
68										
69		**TOTAL GENERAL PLANT**			**189,198,988.95**	**7,820,716**		**4.13**		**61,443,970**
70										
71		**TOTAL DEPRECIABLE PLANT**			**2,146,020,697.61**	**67,515,326**		**3.15**		**682,882,486**
72										
73		**NONDEPRECIABLE PLANT**								
74										
75	301.00	ORGANIZATION			45,057.29					
76	360.10	LAND			5,830,013.57					
77	389.10	LAND			4,806,992.04					
78										
79		**TOTAL NONDEPRECIABLE PLANT**			**10,682,062.90**					
80										
81		**TOTAL ELECTRIC PLANT**			**2,156,702,760.51**	**67,515,326**				**682,882,486**
82										
83		* AMR METERS NET BOOK VALUE BEING DEPRECIATED OVER 9 YEARS								
84		** NEW ADDITIONS TO THIS ACCOUNT WILL BE DEPRECIATED USING A 10.00% RATE								
85										
86		Less Transportation Equipment				(2,755,776)				
87		**TOTAL ELECTRIC PLANT**				**64,759,550**				

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PROPERTY TAX RATE CALCULATION

Line	Description		Year-Ended 12/31/2020	Reference
1	Total Distribution Property Taxes	$	48,644,096	Step 2 CY 2020 Property Tax expense
2	Gross Distribution Plant In Service	$	2,366,075,567	Total Distribution Plant @ 12/31/2020
3	Gross Property Tax Rate		2.06%	Line 1 / Line 2

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Illustrative Distribution Revenue Allocation

		Source:
Current Rate Distribution Revenue	$ 417,434	Line 55, Column F
Estimated Requirements 2022-2026	$ 54,508	DOE 5 - 009 P1 Line 13
Proposed Distribution Revenue	$ 471,942	Line 11 + Line 13
Incremental Increase	$ 54,508	Line 15 - Line 11
Incremental Change	**13.06%**	Line 15 / Line 11

	A	B	C = B * Line 19	D = B + C	E	F = E - B	G = F / A	H = E / B
	Test Year 2018 Billed Sales	**Current Rate Distribution Revenue**	**D Change**	**Distribution Target**	**Proposed Rate Distribution**	**Difference Proposed vs Current**		
Rate	(MWh)	(Rev $000)	(Rev $000)	(Rev $000)	(Rev $000)	(Rev $000)	c/kWh	% Chg.
R	3,144,509	$ 236,433.4	$ 30,873.0	$ 267,306.5	$ 267,312.5			
R-TOD	462	40.6	5.3	46.0	40.6			
	3,144,971	236,474.1	30,878.3	267,352.4	267,353.2	$ 30,879.1	0.982	13.06%
R-WH	92,916	4,749.7	620.2	5,369.9	4,749.7			
G-WH	3,379	155.5	20.3	175.8	155.5			
LCS-R	36,777	781.2	102.0	883.2	781.2			
LCS-G	4,510	76.1	9.9	86.0	76.1			
	137,582	5,762.4	752.4	6,514.8	5,762.4	-	0.000	0.00%
G	1,715,822	100,361.8	13,105.0	113,466.9	100,361.8			
G-TOD	856	209.1	27.3	236.4	209.1			
	1,716,678	100,570.9	13,132.4	113,703.3	100,570.9	-	0.000	0.00%
G-SH	5,452	241.7	31.6	273.2	241.7	-	0.000	0.00%
GV	1,665,676	43,396.4	5,666.6	49,063.0	43,396.4	-	0.000	0.00%
LG	1,172,439	22,580.3	2,948.5	25,528.8	22,580.3	-	0.000	0.00%
B-GV	2,778	253.3	33.1	286.3	253.3			
B-LG	80,345	1,564.9	204.3	1,769.3	1,564.9			
	83,123	1,818.2	237.4	2,055.6	1,818.2	-	0.000	0.00%
EOL	11,371	2,149.1	280.6	2,429.7	2,149.1			
OL	17,130	4,441.0	579.9	5,020.9	4,441.1			
	28,501	6,590.2	860.5	7,450.7	6,590.2	0.0	0.000	0.00%
Total Retail	**7,954,422**	**$ 417,434.1**	**$ 54,507.7**	**$ 471,941.8**	**$ 448,313.2**	$ 30,879.1	0.388	7.40%

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Comparison of Rates Effective March 1, 2022 and Illustrative Rates for Residential Service Rate R

(A) Effective Date	(B) Charge	(C) Distribution Charge	(D) Transmission Charge	(E) Stranded Cost Recovery Charge	(F) System Benefits Charge	(G) Regulatory Reconciliation Adjustment	(H) Electricity Consumption Tax	(I) Energy Service Charge	(J) Total Rate
March 1, 2022	Customer charge (per month)	$ 13.81							$ 13.81
	Charge per kWh	**$ 0.05196**	$ 0.03046	$ 0.00458	$ 0.00743	$ (0.00032)	$ -	$ 0.10669	**$ 0.20080**
Illustrative	Customer charge (per month)	$ 13.81							$ 13.81
	Charge per kWh	**$ 0.06178**	$ 0.03046	$ 0.00458	$ 0.00743	$ (0.00032)	$ -	$ 0.10669	**$ 0.21062**

Calculation of 600 kWh monthly bill, by rate component:

	3/1/2022	Illustrative	$ Change	% Change in each Component	Change as a % of Total Bill
Distribution	$ 44.99	$ 50.88	$ 5.89	13.1%	4.4%
Transmission	18.28	18.28	-	0.0%	0.0%
Stranded Cost Recovery Charge	2.75	2.75	-	0.0%	0.0%
System Benefits Charge	4.46	4.46	-	0.0%	0.0%
Regulatory Reconciliation Adjutment	(0.19)	(0.19)	-	0.0%	0.0%
Electricity Consumption Tax	-	-	-	0.0%	0.0%
Delivery Service	$ 70.29	$ 76.18	$ 5.89	8.4%	4.4%
Energy Service	64.01	64.01	-	0.0%	0.0%
Total	$ 134.30	$ 140.19	$ 5.89	4.4%	4.4%

Attachment JED/RDW-6 is CONFIDENTIAL. Since the bulk of the information is confidential, this page is a placeholder for Bates 000143-000301 and content has been omitted in its entirety.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: April 15, 2022 **Date of Response: April 27, 2022**
Data Request No. DOE 5-004 **Page 2 of 2**

Least Cost Alternative Solution – the alternative solution with the least cost. As set forth in RSA 378:37, it is New Hampshire's energy policy that "least cost planning" requires selection of solutions that represent the "lowest reasonable cost" based on consideration of factors other than cost including reliability and diversity of energy sources.

378:37 New Hampshire Energy Policy. **–** The general court declares that it shall be the energy policy of this state to meet the energy needs of the citizens and businesses of the state at the lowest reasonable cost while providing for the reliability and diversity of energy sources; to maximize the use of cost effective energy efficiency and other demand side resources; and to protect the safety and health of the citizens, the physical environment of the state, and the future supplies of resources, with consideration of the financial stability of the state's utilities.

The Company takes these considerations into account when planning the distribution system.

Best Overall Alternative Solution – Eversource typically refers to this as the "Preferred Alternative." This is the alternative with the best combination of electrical performance, cost, future system expandability and feasibility to comprehensively address all of the identified needs in the required timeframe.

Transcript
Interview #: 62 Date: February 01, 2022 – 10:00 am
Interviewer(s): Ron Willoughby, Bob Grant, Joe DeVirgilio
Interviewee: Rick Labrecque, Manager NH Distribution System Planning (+)
Manager DER Planning (dual management role)

Excerpt Page 4:

Rick:	00:12:31	Whereas if you build a non-PTF chunk of system in say the outskirts of Maine and New Hampshire, and it's really only serving chunks of Maine or New Hampshire, it's not doing anything for the power flows around the grid. They're going to say, "Why should Connecticut and Mass pay for a chunk of that investment?" So they have a different cost recovery mechanism for that.
Bob:	00:13:00	Okay. I was just curious. I wasn't sure what that was. Go ahead, Ron.
Ron:	00:13:04	The New Hampshire Distribution System Planning Guidelines are actually part of the LCIRP for New Hampshire. Do those guidelines mirror the other two states and then identify the state exceptions or how do those guidelines compare with... Since you're trying to standardize as much as possible. Could you explain that?
Rick:	00:13:31	Yep. A couple of years ago there was a 3-state process to harmonize the planning criteria amongst the three states. They looked at existing practices, existing documentation, best practices, and develop this common distribution system planning guide. For the most part it is uniform throughout but there are exceptions in there that are called out if Mass, Connecticut, or New Hampshire has a particular difference. It's signaled in that document.
Ron:	00:14:21	Are the DER guidelines part of that or is that a separate document? I'm trying to remember.
Rick:	00:14:30	I believe there's a very short paragraph in there about DER. **We are creating our a new DER Planning Guide**, and that's been a long time coming. We're getting closer to the first final draft and it's going to be a living document. I think even more so than the Distribution System Planning Guide that the DER state of the art and criteria and standards and study methodologies are... We've come a long way but there's still new things that new technologies and new study methodologies and tools that haven't fully incorporated yet. So our plan is to get a DER planning guide, finalized, published that'll be 90% of all the good stuff and we'll just revise it as needed.

Bob:	00:15:41	When is that expected?
Rick:	00:15:45	Maybe by the end of the first quarter (2022). Some will definitely be there in the first half of the year.
Bob:	00:15:59	Let me ask you this. I know you're dealing with distribution, but at some point in distribution, you have to integrate your thinking with the transmission and substation folks because of the substations. How does that work from the planning perspective?

Transcript
Interview #: 19 Date: November 16, 2021 – 9:00 am
Interviewer(s): Ron Willoughby, Bob Grant
Interviewee: Ryan West, Director NH Grid Modernization

Excerpt Pages 12 and 15:

Page 12:

Hampshire is to really look at all the use cases. Let's work together here and say, all right, strategically, we want to do all of this. Here's the enabling stuff that we got to get to before we can apply it.

Ron: 00:37:12 For the difference between DMS and DERMS, DERMS is like a distribution SCADA, right? I mean, that's like transmission level at the distribution level. Is that DERMS?

Ryan: 00:37:23 Yes.

Eric: 00:37:24 And then DMS is a step back from that. Am I correct?

Ryan: 00:37:30 Yeah. Not necessarily. Let me define it because I know DMS and DERMS in the industry is used all over the place, and it is used all over the place and means different things. So for us, a **DMS** system is initially the core value there is reliability. So we look at it as the logic to automate our distribution devices optimally for restoration. So the FLISR capability (fault location, isolation and service restoration), that core functionality is reliability driven. And that's how we that's why we're implementing DMS and really trying to drive how we can operate the system more efficiently and respond to outages and really continue the improvement of reliability. So the DMS, for us, in our systems it is the GE products, the eCare distribution is the product, the DMS product.

Ryan: 00:38:39 It is very closely, I'll call it an integration, but it's essentially in line, we have a GE SCADA system. So it is two separate software tools, but very closely integrated because it is their whole package. So it is, in our realm, we have a SCADA combined T&D SCADA. We'll have the DMS is same package. We do have a separate OMS vendor, the Oracle OMS system. So for DMS, what we're deploying is again, that flow capability, the real time power flow is the basis. And then when we look forward, this is where I mentioned the VVO is an application module that we have to enable in the DMS, in the future. We're not doing that yet, but we want to enable that. And there's other, a contingency analysis tool is

in the DMS suite, but we're not implementing it right now. That's on the roadmap.

Ryan: 00:39:47 There's some other advanced applications that the product has that we're working our way toward. And then so for DERMS, we are, I would say, still evaluating the marketplace on DERMS. If you've, I'm sure you've probably attended a conference in the last five years, people, vendors called everything DERMS.

Ron: 00:40:10 Yeah.
Ryan: 00:40:15 And so they went from demand response systems to register just demand response to the other side where you've got utility scale

Page 15:

Ryan: 00:46:52 Not in the DERMS or CVR space, really. Nothing.

Bob: 00:46:59 Right. So you still got a dum system.

Ryan: 00:47:03 So the distribution automation program that where we... I don't know if you've heard yet or that there's the over 1700 devices on the system. That provides individual phase measurement for voltage currents, megawatts, MVAR. So we get a lot of information. And in an operator, we do have visibility into the power flow from device to device, right? And this is focused on the backbone. So it's on the three phase backbone of the system. And so the DMS, when we get the power flow solving, it gives us that next level all the way out to the ends of the distribution system.

Ron: 00:47:47 Now, the DMS. I had a note here that the phase one, I guess it's phase one for New Hampshire's to be completed in 2022. Are my notes correct on that?

Ryan: 00:47:59 That is correct, yep. [inaudible 00:47:59] service in 2022, yep.

Ron: 00:48:02 When you're doing levels of communication for that DMS, you have the local, let's say if it's a recloser, it can communicate obviously with itself, but it can communicate with other devices on that line. You move up to the substation. That's another level of communication. And then between substations is another level of communication. All those levels of communication, is that what's being implemented now for DMS?

Ryan:	00:48:32	Yeah. I'll quickly talk about the communication architecture. The automation strategy, if you will, was intended... When all those devices were deployed, it was intended with the end goal of having a DMS path logic to control them. So we don't have any peer to peer communication between devices in the field. And we also don't do any peer to peer communication of the substations. And that is based on the fact that we didn't want logic happening and then having the DMS come and have its logic to essentially do the same thing. So the communication structure is very much, we have the remote device communicating typically to the base station tower. And then that comes back to our data system. And that data system is processing all the data to present it to the DMS, for it to solve the... Just to have the logic for isolation and restoration current event. Right? So we don't do any of the peer to peer schemes on the distribution side.
Ron:	00:49:58	Everything is coming back to one place. Everything on the system is coming back to one place rather than intermediate places.
Ryan:	00:50:05	Correct.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022 **Date of Response: March 08, 2022**
Data Request No. DOE 4-020 **Page 1 of 1**

Request from: Department of Energy

Witness: WALKER, GERHARD, Freeman, Lavelle A

Request:

Please provide 2020-2021 NWA solution options for New Hampshire categorized as either accepted or rejected along with the corresponding reasons why (accepted or rejected).

Response:

The Company has conducted the full and detailed analysis on the following stations:

- Loudon Station

For Loudon Station, the Company has provided the results of the analysis in report format as part the Company's supplemental filing in this proceeding submitted on March 31, 2021 as Supplemental Appendix A-2.

One project that is in conceptual engineering and another that is in design engineering were both rejected for NWA.

- Monadnock Substation, presently in the design phase, has an asset condition issue with transformer TB40 and substandard station design (no transformer breakers nor high-side circuit switchers) in addition to N-1 contingent capacity limitations. Based on Eversource NWA suitability criteria, asset condition related projects are not typically considered for NWA solutions.

- Dover Substation, presently in the conceptual phase, has asset condition issues at the substation including an oil circuit breaker and electromechanical relays in addition to N-1 contingent capacity limitations of approximately 28.8 MW. A full NWA analysis was not performed since that magnitude of peak load was considered unachievable in the present NWA regulatory environment. In addition, based on Eversource NWA suitability criteria, asset condition related projects are not typically considered for NWA solutions.

All other design violations identified in the 2020-2029 Load Flow Study Report have yet to be studied within local area studies where a detailed NWA screening analysis will be performed to assess the feasibility of the solutions.

Transcript
Interview #: 13 Date: November 17, 2021 – 9:00 am
Interviewer(s): Ron Willoughby, Bob Grant
Interviewee: Digaunto Chatterjee, VP System Planning

Excerpt Pages 6 and 16:

Page 6

Ron:	00:18:09	We saw somewhere that you have... I forget the number exactly, somewhere between 400 and 500 installed megawatts for DER in New Hampshire. Is that an accurate number, or is that too high?
Digaunto:	00:18:26	That doesn't sound... That sounds too high. 107 is the precise number that is installed, eight megawatts are under construction, so yeah. 115 megawatts.
Ron:	00:18:38	And then I also read somewhere... Let me see...
Digaunto:	00:18:43	By the way, that's in our footprint. So it could be you have Unitell, and...
Ron:	00:18:46	Oh, okay. Okay.
Digaunto:	00:18:52	That may be where you're getting 400 MWs.
Ron:	00:18:53	It may be because there was a project, a large interconnection project, more than 200 megawatts a single interconnection. That doesn't sound like you guys though, right?
Digaunto:	00:19:03	Yeah, no. We will kick them out if they're trying to connect to our distribution system. We'll study them from transmission interconnection system.
Bob:	00:19:14	So let me ask this question. With those six sites in mind, how have you changed the distribution system, or some of these going directly to transmission or sub transmission, how have you changed your distribution requirements for them, and what you have to do on your circuit in order to accept them for two-way flow?
Digaunto:	00:19:42	First things first, hosting capacity maps have to be published, so just showing DER developers where, how much capacity you actually have to interconnect. That's just step one. So we've been using our Synergi tool for that in Massachusetts and Connecticut, we're about to roll it out in New Hampshire as well, so that's just step one. So you incentivize,

inform DER customers. The other thing, which is a much more complicated, scary topic, we'll get to it.

Digaunto: 00:20:24 We've now started to look at non-wires alternative (NWA) as one of the tools in the toolbox for our distribution system upgrades to the extent we have a capacity overload, and you have a large or a number of PDs down at the customer site, we have taken a position that we will consider those behind the meter customer cited PDs, as one of the many solutions to our... Call it feeder reconductoring or adding a new transformer, replacing transformers, so we build a very cutting edge tool (NWA Tool) that synthesizes all of this into one package and informs what is really the least cost, long-term, most cost effective solution, so you shouldn't to do.

Page 16

Ron: 00:48:48 Okay.

Digaunto: 00:48:49 A bulk electric system. High side is 115 kV. In New Hampshire we have high side, but some of these bulk transformers are 345 kV. You have 345 kV to 34.5 kV transformers. That's a bulk transformer, and then a lot of New Hampshire non-bulks are 13.8 kV to 4 kV. 34.5 kV to 13.8 kV. Those are non-bulks.

Ron: 00:49:13 So everything on the line, including transformers on the line, that's the distribution engineering folks?

Digaunto: 00:49:19 Distribution engineering takes care of that.

Bob: 00:49:23 He washes his hands [inaudible 00:49:25].

Ron: 00:49:23 Yeah, he quickly did that. Okay.

Bob: 00:49:33 I want to drop back because we're taking a whole different path in our 25 pages of questions here.

Ron: 00:49:40 It's okay.

Bob: 00:49:40 You get the cliff notes, we get the details. I just want to go back and talk a little bit about capital programs.

Digaunto: 00:49:47 Yeah.

Bob: 00:49:47 Can you explain your role in capital programs?

Digaunto:	00:49:51	Sure. So, capital program, broadly speaking, they're... I would say there are five broad categories. They're basic business, the stuff you've just got to do to connect new customers. You've got your grid modernization program and then you've got equipment obsolescence, and then you've got your distribution line work, and then finally distribution station work.
Digaunto:	00:50:22	So my role as VP system planning is twofold. It's number one, taking care of my own house. It is the substation projects that come out of system planning, making sure that their justification, their planning criteria violations are deeply grounded in foundational analysis, the rooted solid justification that I can testify in court that they are absolutely necessary. That's number one, making sure all of their system impacts are well grounded, submitted twice in new England for bulk transformers because it touches the transmission system. There's an I39 process, it's basically a... You have to do a transmission impact analysis.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022 **Date of Response: March 11, 2022**
Data Request No. DOE 4-001 **Page 1 of 2**

Request from: Department of Energy

Witness: Hebsch, Jennifer J, Johnson, Russel D, Freeman, Lavelle A, Labrecque, Richard C

Request:

Reference: Eversource's October 1, 2020 Least Cost Integrated Resource Plan ("LCIRP") and the March 31, 2021 Supplement ("Supplement"), including all Attachments (providing various area planning studies, solution selection forms, and project authorization forms.)

a. Please provide a table that lists each planned project Eversource has identified in its LCIRP (2020) and 2021 Supplement. Please indicate -- in the table-- if the project was the "least cost option." In the table, please list the "alternative options" (to resolve the same issue) and list the costs for the selected solution and each option. Please identify the sections of the 2020 LCIRP and Supplement, by bates numbered page, that reference the project and alternative options.

b. For each instance where the Company did not choose the least cost option discussed in the area planning studies, solution selection forms, and project authorization forms, please explain in detail why the project was selected. The explanation should be in narrative form, referencing the table.

c. Please provide supporting documents, including economic analysis and calculations.

Response:

The LCIRP (including the Appendices and the Supplemental filing) identifies projects in the following locations:

Group #1 - Original Filing Appendix K – this is a Grid Needs Assessment that lists numerous line and station projects >$250K.

Group #2 - Original Filing Appendix L – provides Solution Selection Forms ("SSFs")/Project Authorization Forms ("PAFs")/Initial Funding Requests ("IFRs") for 6 different projects.

Group #3 - March Supplement – Appendix C – this is a listing of Proposed Reliability Projects (distribution line reliability) that have been proposed but have not been funded by the 2021 or previous years capital budgets.

Public Service Company of New Hampshire d/b/a Eversource Energy
Docket No. DE 20-161

Date Request Received: February 18, 2022 **Date of Response: March 11, 2022**
Data Request No. DOE 4-001 **Page 2 of 2**

Group #4 - March Supplement – Appendix D – contains early versions of the IFRs for 20 System Planning projects that are in early development (SSFs have not been created).

Group #5 - March Supplement – Appendix E – contains early SSFs for White Lake, Dover, and Monadnock

Group #6 - March Supplement – Appendix F – contains PAFs for Distribution Line projects in the 2021 Capital Plan.

Response to Parts (a) and (b): Attachment DOE 4-001 provides the requested data for planned projects in Group #2, Group #5, and Group #6, totaling 37 projects.

The projects in Groups #1, #3, and #4 have either not progressed to the planned stage or are duplicates of projects included in Groups #2, #5, or #6.

Response to Part (c): Supporting documentation for these projects (SSFs and PAFs) are included in either the original LCIRP filing or the Supplement. For each project, specific additional supporting documentation is available on request.

Interview #: 16 Date: November 8, 2021 - 12:30 pm
Interviewer(s): Ron Willoughby, Bob Grant
Interviewee: Russel Johnson, Director NH Distribution Engineering

Excerpt Page 6:

*Well, here's something [00:27:00] we can spend about 20 minutes talking about. I'll start with the definition of what our **hit list worst performing circuit** is up here, which is a contribution to company [SAIDI 00:27:17] measure.*

Their approach here is considered a standard practice, but important to identify potential critical system weaknesses and move to ensuring all customers receive the same reliable service.

That's the nature of it. And, by the way, it's one year. [00:28:30] It's not a rolling four years. So what tends to happen is that you have perennial circuits that have to be... The 150 mile circuits that are serving 8,000 customers, just because of the exposure they have, are generally in the top 10. But then you have a great deal of volatility just by the fact that it only looks at one year.

34.5Kv designs allows a utility the opportunity to run very long circuits with less issues of voltage sage. However, by the very fact that the circuits are much longer, they are exposed to more opportunities for interruptions. This is particularly true for radial circuits. The solution if appropriate is to loop the circuit or tie it with another circuit to allow fault isolation, and limit the outage to the impacted line segment, thereby reducing the total number of customers impacted by the outage and reducing the total number of customer minutes out. RCG believes this is what Eversource is trying to accomplish.

I would have to say it's a consideration, but we're not focused on the top 10. And the reason why is because some of these circuits have been in the top 10 for a decade and [crosstalk 00:29:58] we spent tons of money on [00:30:00] them, addressing specific things. But I'll give you a perfect example was the 31 41 X circuit was always on the hit list because it was a massive circuit that fed somewhere between eight and 9,000 customers with no real backup. So

when we put a line from a Kingston, new Kingston substation [00:30:30] and tied it into the end of this and split the circuit in half, it dropped out of the top 10 immediately just because now we had a circuit tie, so you split it in half. And so my point is, is that yes, we're very aware of the circuits that are on the hit list.

The 31 41X circuit is an example of the long circuit issue we described. And they finally came to the conclusion to split the circuit. These kind of examples