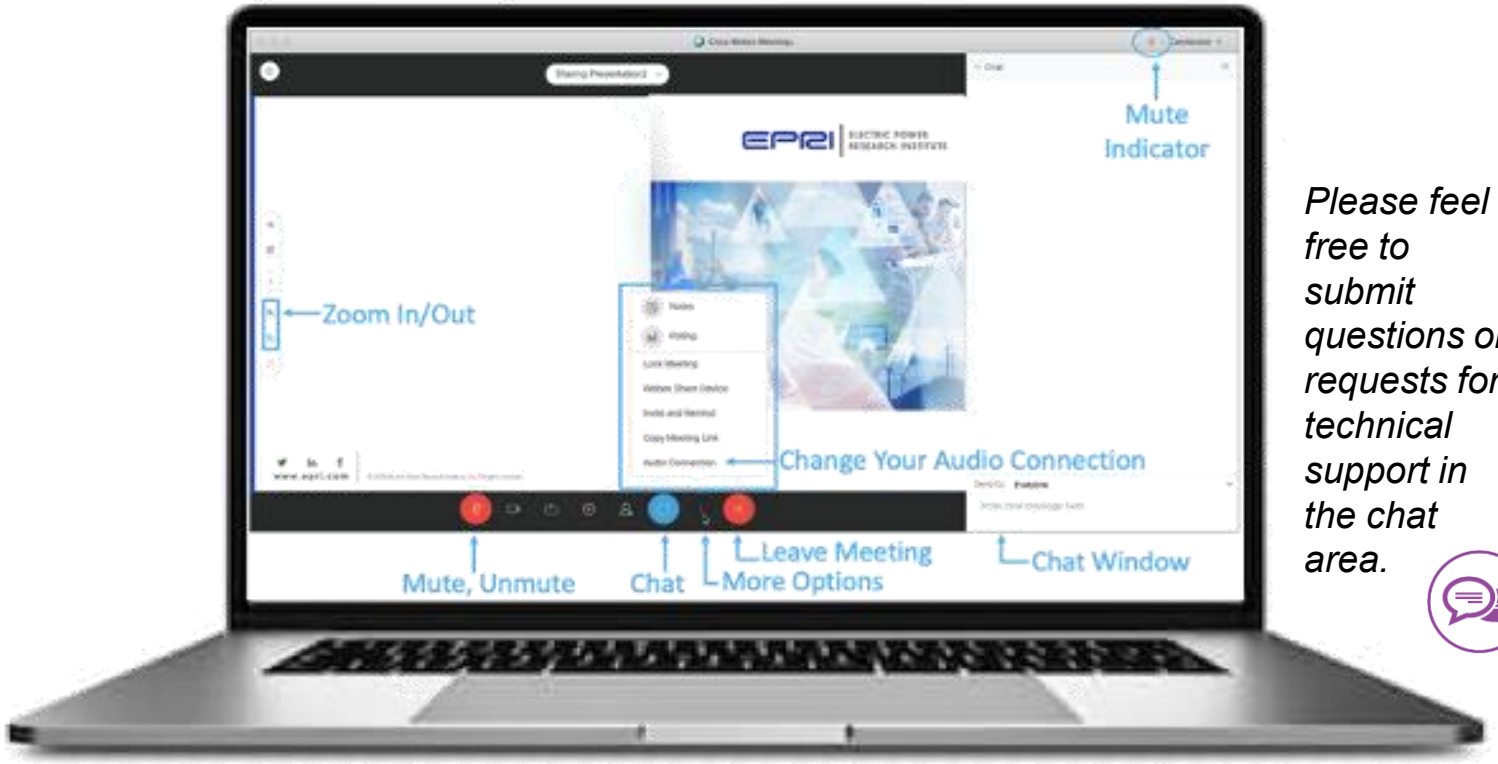
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

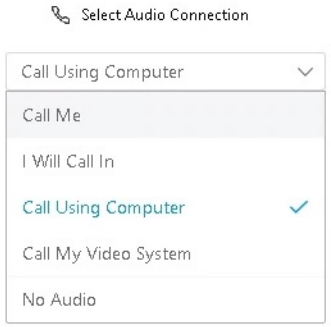
WEBCAST

Welcome!

The P35 Overhead Transmission 2027 Rollout will begin shortly.



Please feel free to submit questions or requests for technical support in the chat area.



AUDIO CONNECTION OPTIONS

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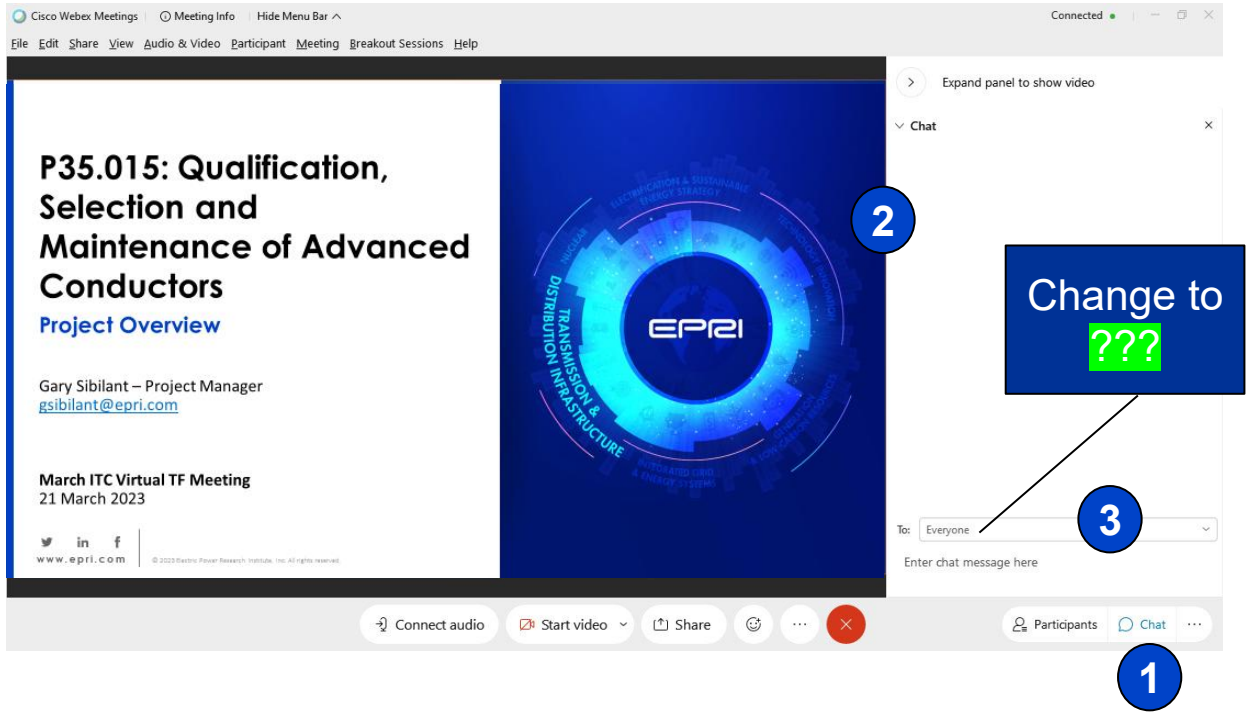
I Will Call In – Dial in from your phone: **1-855-797-9485 Code:243 604 56139**
Password: June18

Housekeeping and Recording Disclosure

- You have been muted upon entry, but please feel free to unmute and jump into the conversation at any time.
- Questions can be asked throughout the webcast – either directly or using the chat feature.
- Please note today's webcast is being recorded. Your participation provides your consent to the recording.
- We will upload the recording, a PDF of the slide deck, and notes to the EPRI Website for your records.



Any questions?

Overhead Transmission (Program 35)

2027 Program Rollout

Rachel Moore: Program Manager
Justin Bell
Alessandro Berredo
Fabien Besnard
David Folk
Camille Le Mauff
Pierre Marais
Neal Murray
Tim Shaw
Gary Sibilant

Agenda

90-min to Provide 2027 High-Level Project Objectives and Plans

01 Program Overview

02 Supplemental Project Highlight

03 Insulators Force

35.011 Polymer & Composite Insulators
35.012 Porcelain & Glass Insulators

04 Live Working Task Force

35.010 Live Working

05 Lightning & Grounding Task Force

35.006 Lightning Performance & Grounding

06 Line Design Task Force

35.005 Ductile Iron & Composite Structures
35.007 Line Design
35.008 Line Resiliency

07 Inspection & Assessment Task Force

35.001 Inspection & Assessment
35.002 Conductor, Shield Wire, and Hardware Corrosion
35.003 Structure and Sub-Grade Corrosion
35.004 Traditional Conductors and Connectors
35.018 Line Switches

08 High Voltage Direct Current Task Force

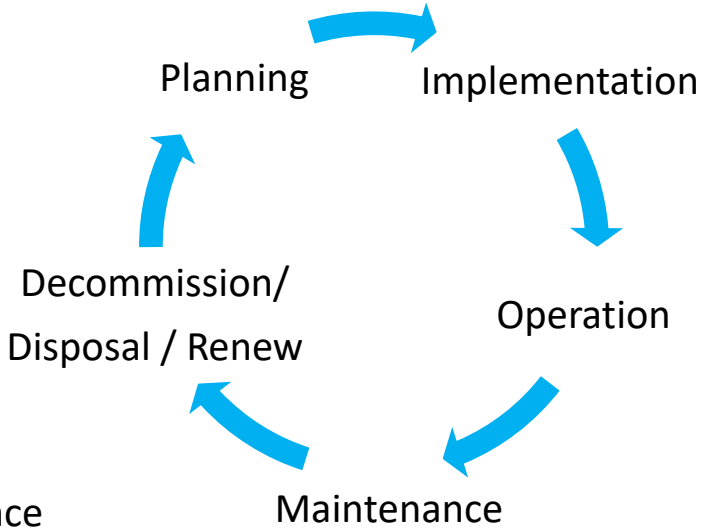
35.019 HVDC Lines

09 Increased Transmission Capacity Task Force

35.013 Line Ratings & Increased Power Flow
35.014 High Temperature Operations
35.015 Advanced Conductors & Connectors

Program Overview

Researching for the Full Life Cycle of the Overhead Transmission System



Increase Safety & Reliability

- Appropriate Selection of Assets/Systems
- Guidance and Training on Installation and Operation
- Empirical Testing to Understand Performance and Degradation of Assets/Systems
- Evaluation of Inspection Methods
- Software Tools for Design and Operation Analysis

Reduce Cost

- Reduce Unexpected Outages
- Streamline Inspection & Maintenance
- Improve Workmanship/Work Practices

Increase Use of Clean Energy

- Increased Transmission Capacity through Line Ratings, High Temperature Operations, Advanced Lines, HVDC

Overhead Transmission has 16 Projects Organized into 7 Task Forces

Inspection, Assessment, & Maintenance

35.001 Inspection & Assessment
35.002 Conductor, Shield Wire, & Hardware Corrosion
35.003 Structure & Sub-Grade Corrosion
35.004 Traditional Conductors & Connectors
35.018 Line Switches

Line Design

35.005 Ductile Iron & Composite Structures
35.007 Line Design
35.008 Line Resiliency

Lightning & Grounding

35.006 Lightning Performance & Grounding

Live Working

35.010 Live Working

Insulators

35.011 Polymer & Composite Insulators
35.012 Porcelain & Glass Insulators

Increased Transmission Capacity

35.013 Line Ratings & Increased Power Flow
35.014 High Temperature Operations of Traditional Conductors
35.015 Advanced Conductors & Connectors

High Voltage Direct Current Transmission

35.019 HVDC Lines

Save the Date - Transmission & Substations Task Force Meeting

EPRI Charlotte Office, Charlotte, NC

August 10th – 13th

August 2026

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

In-person Meeting

Program 34 - T&S Asset Management Analytics:

- Transmission Asset Management Analytics

Program 35 - Overhead Transmission:

- Inspection and Assessment
- Lightning Performance and Grounding of Transmission Lines
- Line Design
- Live Working
- Insulators
- Increased Overhead Transmission Capacity

Program 36 - Underground Transmission:

- Underground Transmission

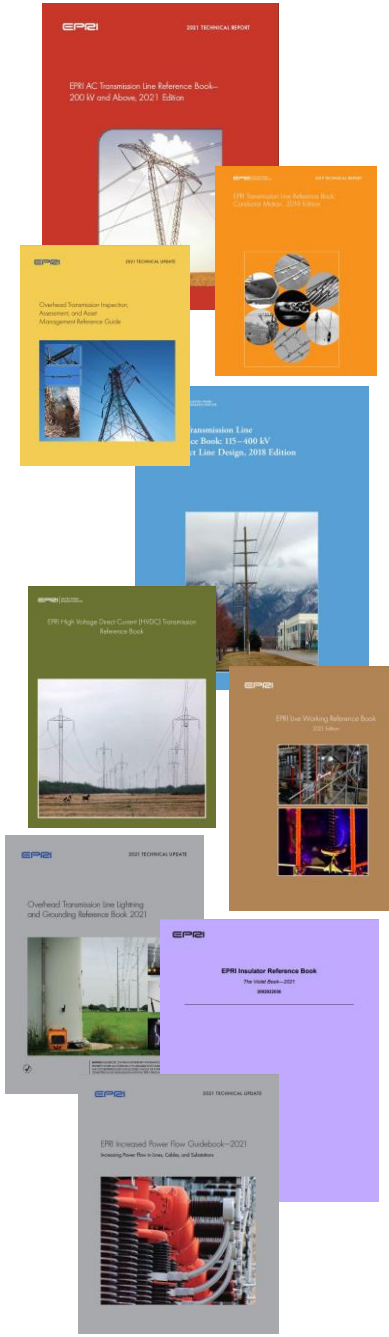
Program 37 - Substations:

- Circuit Breakers and Gas Insulated Substations and Lines
- Physical Security
- Balance of Substations and Substation Corrosion Management
- Voltage and Current Measurements for Monitoring Asset Conditions
- Transformer Life Management and Bushings

Cross-Cutting:

- HVDC Systems

*Task Force information is subject to change



10 Reference Books

RED BOOK
AC Transmission Line 200kV and Above Reference Book

ORANGE BOOK
Conductor and Structure Motion Reference Book

YELLOW BOOK
Overhead Transmission Inspection, Assessment, and Asset Management Reference Guide

BLUE BOOK
115– 400 kV Compact Transmission Line Design Reference Book

OLIVE BOOK
High Voltage Direct Current (HVDC) Transmission Reference Book

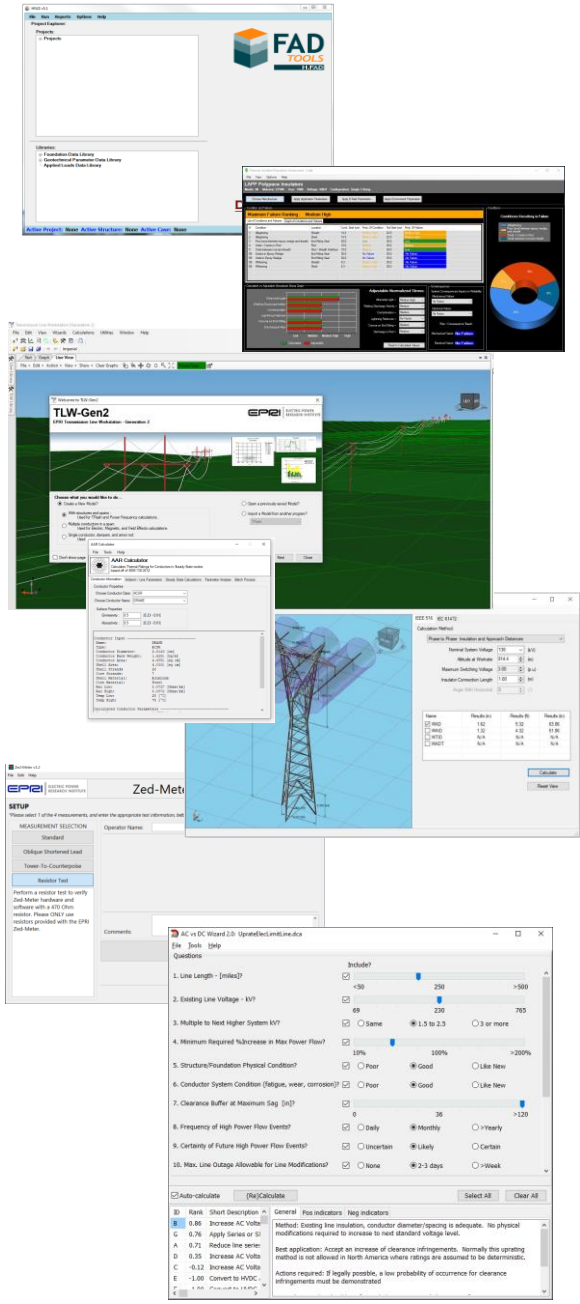
TAN BOOK
Live Working Reference Book

GRAY BOOK
Overhead Transmission Line Lightning & Grounding Reference Book

VIOLET BOOK
Insulators Reference Book

PLATINUM BOOK
Increased Power Flow Guidebook

RUST BOOK
Corrosion Management Reference Book



12 Software Applications

Insulator Calculation Engine (ICE)

Transmission Ratings Workstation TRW Overhead Transmission Line Module

Minimum Approach Distance Calculator (MAD Calculator)

High-Temperature Conductor (HTC) Matrix

Transmission Line Workstation – Gen 2 (TLW-Gen2): HVDC Electrical Effects

Transmission Line Workstation – Gen 2 (TLW-Gen2): Design Module (incl. Electrical Effects, LCC & Vibration calculations)

Transmission Line Workstation – Gen2 (TLW-Gen2): Lightning & Grounding and Power Frequency

Polymer Insulator Population Assessment Tool (PIPA)

Increased Power Flow Wizard (IPFWiz)

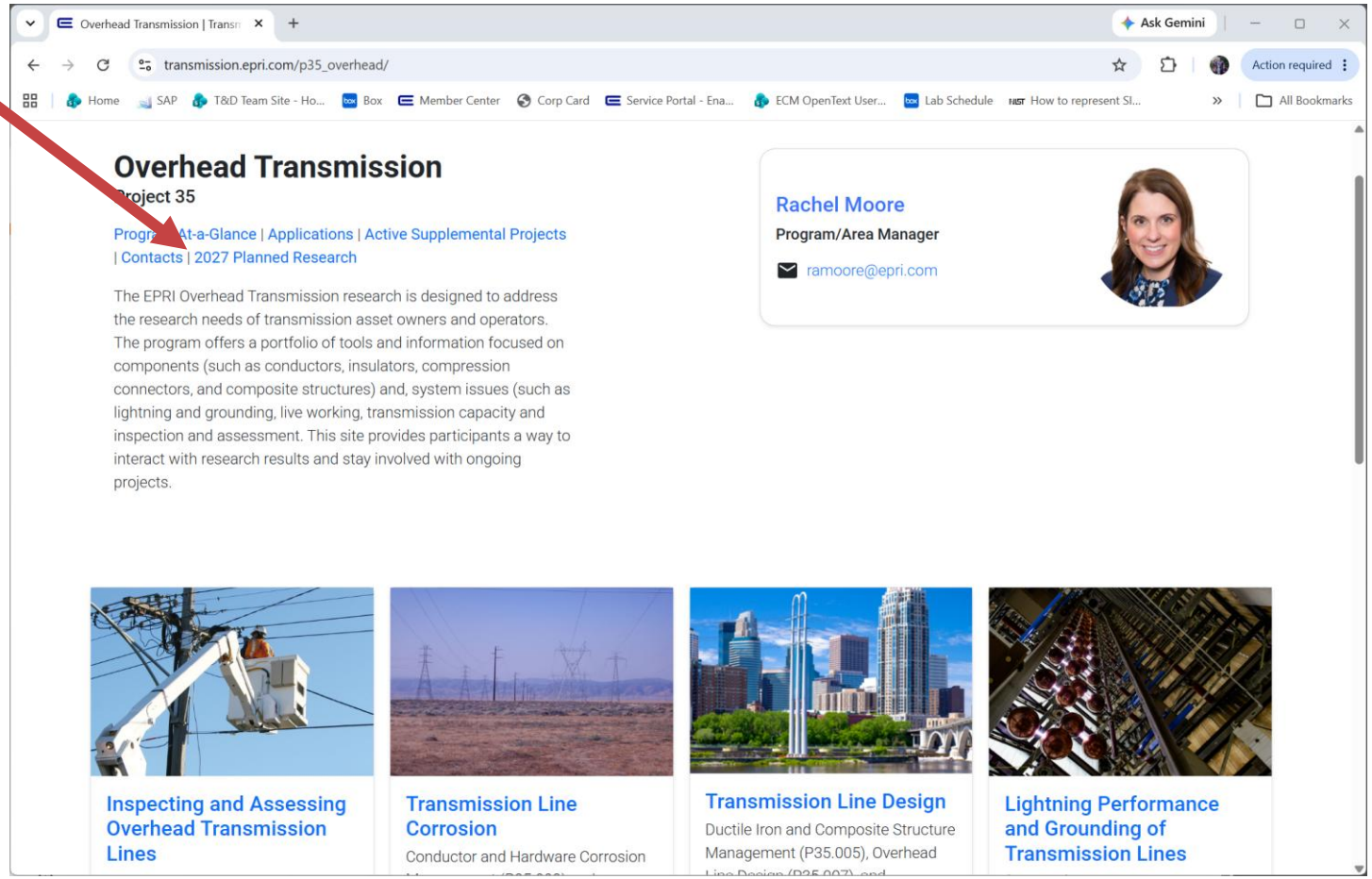
AC to DC Line Conversion - DC Convert Software

Optimal Line Tension Calculator (Op10)

NESC Clearances Calculator

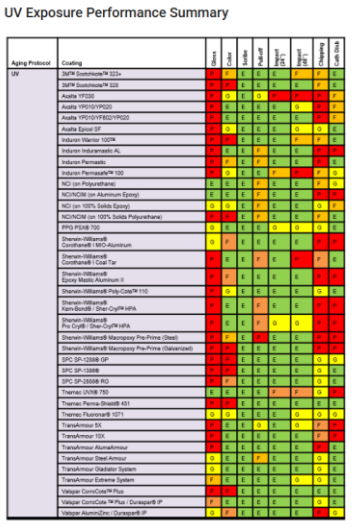
Transmission Resource Center

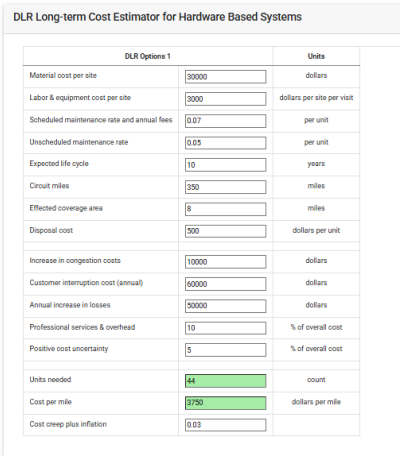
- Transmission.epri.com
- 2027 Planned Research

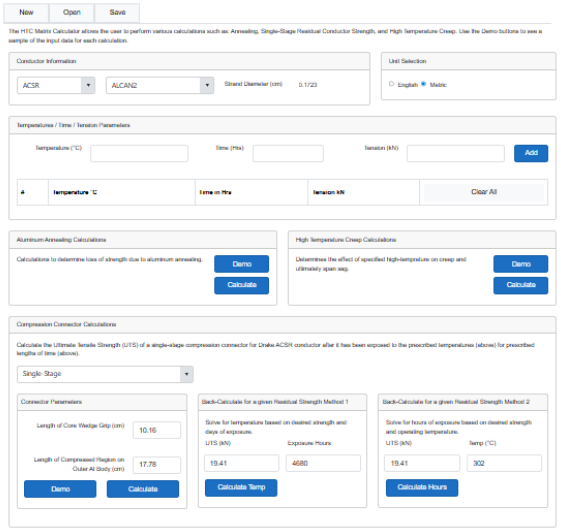


Transmission Resource Center

- References
  - Reference Books
  - Field Guides
  - Software Demos
  - Training Videos
  - Corrosion Maps (35.002 & 35.003)
  - Ground Conductivity and Lightning Flash Density Maps (35.006)
  - Insulator Aging Chamber Report (35.011)
  - Insulator Vintage Guides (35.011 & 35.012)
  - Summary of Carbon Core Conductor Qualification Testing (35.015)
  - Survey Template for Commissioning of New Line Switches (35.018)







- Tools
  - ACSR and ACSS End of Life Calculator for Corrosion (35.002)
  - New Life Cycle Decision Tools (35.003)
  - Coating Selection and Application Tool (35.003)
  - Steel Pole Residual Strength Calculator (35.003)
  - Cathodic Protection Selection and Application Tool (35.003)
  - Gray Book Applets (35.006)
  - Lightning Impulse Strength and Surge Impedance Calculators (35.006)
  - Red Book Applets (35.007) – partial
  - Minimum Approach Distance Calculator (35.010)
  - Temporary Grounding Calculator (35.010)
  - All-Dielectric Self-Supporting (ADSS) Application (35.011)
  - Mechanical Failing Tensile Load Assessment (35.012)
  - Conductor Resistance Conversion Calculator (35.013)
  - Sunrise-Sunset Calculator for Day-Night Ratings (35.013)
  - Solar Flux Calculator (35.013)
  - Switch Ratings Calculator (35.013)
  - Wave Trap Ratings Calculator (35.013)
  - Aluminum Annealing and High-Temperature Creep Calculators (35.014)
  - Whip Testing (35.018)

Support from Subject Matter Experts







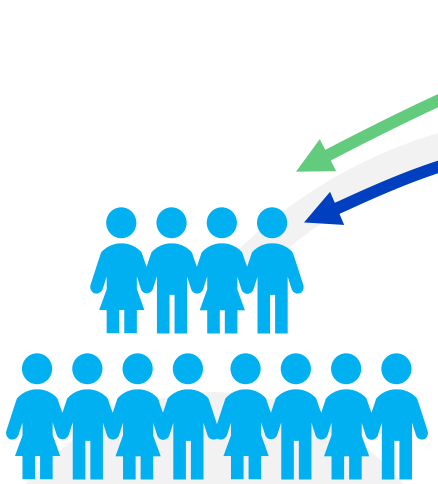



2026 P35 (Overhead Transmission) Project Contacts

Project Number	Proposed New Name	Project Manager	Contact Info
P35.001	Inspection and Assessment	Fabien Besnard	fbesnard@epri.com, 704-595-2966
P35.002	Conductor, Shield Wire, and Hardware Corrosion		
P35.003	Structure and Sub-Grade Corrosion	Neal Murray	nmurray@epri.com, 704-595-2624
P35.004	Traditional Conductors and Connectors	Rachel Moore	ramoore@epri.com, 704-595-2095
P35.005	Ductile Iron and Composite Structures	David Folk	dfolk@epri.com, 704-595-2482
P35.006	Lightning Performance and Grounding	Camille Le Mauff	clemauff@epri.com, 704-595-2742
P35.007	Line Design	Pierre Marais	jpmarais@epri.com, 704-595-2495
P35.008	Line Resiliency		
P35.010	Live Working	Alessandro Berredo	aberredo@epri.com, 704-595-2806
P35.011	Polymer and Composite Insulators	Tim Shaw	tshaw@epri.com, 704-595-2734
P35.012	Porcelain and Glass Insulators		
P35.013	Line Ratings and Increased Power Flow	Justin Bell	jbell@epri.com, 518-445-3712
P35.014	High Temperature Operations	Rachel Moore	ramoore@epri.com, 704-595-2095
P35.015	Advanced Conductors and Connectors	Gary Sibilant	gsibilant@epri.com, 704-595-2598
P35.018	Line Switches	Alessandro Berredo	aberredo@epri.com, 704-595-2806
P35.019	HVDC Lines	Gary Sibilant	gsibilant@epri.com, 704-595-2598

Supplemental Project Highlights

4 Ways to Engage at EPRI



Annual Portfolio Projects (ARP)

- **Variety of mainstream research questions**
- **Short, medium, long tasks that may roll from year to year**

Collaborative Supplemental Projects

- **May be developed to**
  - Accelerate research
  - Research area that is of interest to narrow group
- **Research is integrated into ARP after completion**
- **Self Directed Funds (SDF) may be applied**

Single-Funder Supplemental Projects

- **May be developed for**
  - Application of technology or methodology
  - Narrow focus
  - Failure or degradation analysis
- **Research is integrated into ARP after completion**
- **Self Directed Funds (SDF) may be applied**

Billable Service Agreements

- **Similar to Single-Funder Supplementals, but research is not shared with the ARP**

Active Supplemental Projects

Supplemental Projects

Supplemental projects at EPRI are specialized research, development, and demonstration initiatives that fall outside their standard annual research portfolio. These projects are typically initiated in response to specific needs expressed by EPRI members or stakeholders. If you need research support and have an idea for a new supplemental project, either single-funder or collaborative, please reach out to Rachel Moore RaMoore@EPRI.com. P35, Overhead Transmission is currently seeking participation for the following supplemental projects.

Associated Annual Research Project

- ☐ Cross-Cutting
- ☐ 35.001 Inspection and Assessment
- ☐ 35.002 Conductor, Shiled Wire, and Hardware Corrosion
- ☐ 35.003 Structure and Sub-Grade Corrosion
- ☐ 35.007 Line Design
- ☐ 35.010 Live Working
- ☐ 35.011 Polymer and Composite Insulators
- ☐ 35.012 Glass and Porcelain Insulators
- ☐ 35.013 Line Ratings and Increased Power Flow
- ☐ 35.014 High Temperature Operations
- ☐ 35.015 Advanced Conductors and Connectors
- ☐ 35.018 Line Switches

Research Area

- ☐ Cross-Cutting
- ☐ Increased Transmission Capacity
- ☐ Inspection and Assessment
- ☐ Insulators
- ☐ Lightning Performance and Grounding
- ☐ Line Design
- ☐ Live Working

Supplemental Type

- ☐ Collaborative
- ☐ Single-Funder

Project Name	Project Contact	Email
765kV Line Design	Rachel Moore	ramoore@epri.com
Concrete Inspection Technologies	Neal Murray	nmurray@epri.com
Corrosion Impact Study: Cellular Equipment on Utility Structures	Evan Hess	ehess@epri.com
Design and Installation of Vibrated Steel Caissons: Phase 2	David Folk	dfolk@epri.com
Direct Embedment Foundation Backfill Performance	David Folk	dfolk@epri.com
Effects of Pipelines and Railroads on Transmission Line Structure Corrosion Rates	Evan Hess	ehess@epri.com
EPRI U For Transmission	Robert Haromszeki	rharomszeki@epri.com
Evaluating the Efficacy of Drone Based Insulator Inspection Tools	Tim Shaw	tshaw@epri.com
Evaluation of High Emissivity Coated Conductors	Gary Sibilant	gsibilant@epri.com
Evaluation of Optical Fiber as an Overhead Transmission Line Monitoring Sensor	Daniel Malan	dmalan@epri.com
Failure Analysis of Overhead Transmission Assets	Rachel Moore	ramoore@epri.com
Fleet Management Approach to Structure and Foundation Corrosion Management	Neal Murray	nmurray@epri.com
Grid-Enhancing Technologies (GETs)	Drew McGuire	dmcguire@epri.com
Guidance for DLR Equipment Specification and Assessment	Justin Bell	jbell@epri.com

Transmission Resource Center

Evaluating Drone-Based Insulator Inspection Tools

- **Project Overview**
  - Utilizes drones for efficient inspection of transmission line insulators.
  - Aims to assess various inspection technologies in a controlled environment.
- **Objectives**
  - Document effectiveness of drone-based tools in identifying anomalies.
  - Provide reliable data to help utilities reduce unplanned outages.
- **Benefits**
  - Enhanced reliability and safety through improved inspection data.
  - Cost savings on inspections and emergency repairs.
- **Participation Details**
  - Estimated cost per utility: $50,000.
  - Minimum participation: 5 utilities.

Concrete Inspection and Assessment Technology Evaluations

Background:

Concrete degradation occurs for a host of reasons and represents risk when the reinforcing steel (rebar) integrity is compromised. Unless the concrete spalls to reveal the reinforcing steel, the condition of the rebar is often unknown.

Objective and Scope:

- The project objective is to evaluate the features and limitations of each inspection tool or technique and provide an understanding of the optimal construction standard and environment for implementation.
- The project scope is to evaluate technologies, categorize them as a screening or a predictive technology, and then assign levels of accuracy, risk and cost to implement.

Project Value:

- Each utility may then implement these technologies in the proper conditions to understand if the asset is structurally sound.
- This new learning may increase transmission grid and substation reliability, reduce risk of structural failure to the utility and increase safety to the public and utility workers.

SPN 3002028743 Concrete Inspection Evaluations

Technical Contacts

Neal Murray at 704.595.2624 (nmurray@epri.com)

Weathering Steel - Laboratory and Field Evaluation of Patina Forma

Background

- Weathering steel offers the benefits of extended service life when it is installed in favorable environments, but when used outside of those conditions it is vulnerable to extensive corrosion at bolt details and the coating system interface.

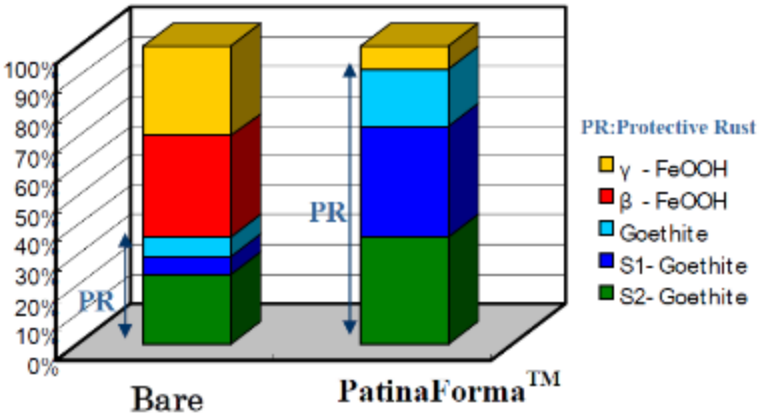
Objectives and Scope

- EPRI has identified a coating formulation that is designed to chemically accelerate the oxide formations on weathering steel.
- The formulation will be evaluated in a controlled environment using the EPRI coating test protocol to determine the efficacy of this conversion system.
- The formulation will then be evaluated in the field to determine operational limitations.
- The results are anticipated to support both application at manufacturing plant but also for field repairs on structures that have not converted to Goethite oxide.

Value

This technology may significantly change current maintenance practices from a scheduled replacement to a structure coating program.

- Reduced Risk of Structural Damage and Resulting Outages
- Increased Service Life for In-Service Structures
- Increased safety for utility personnel and the public

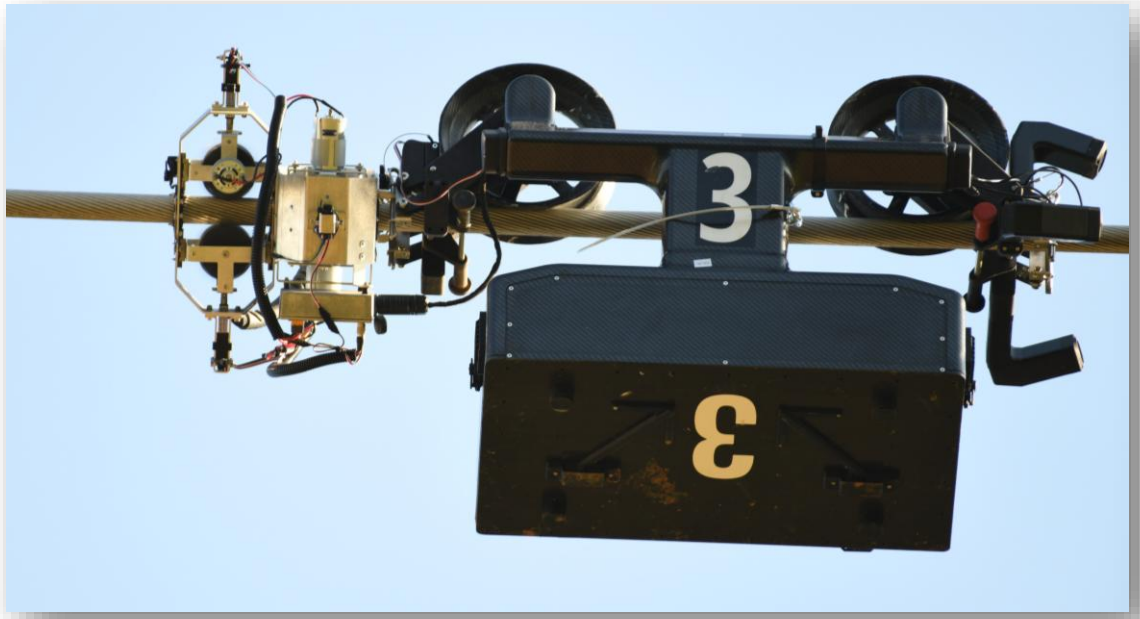


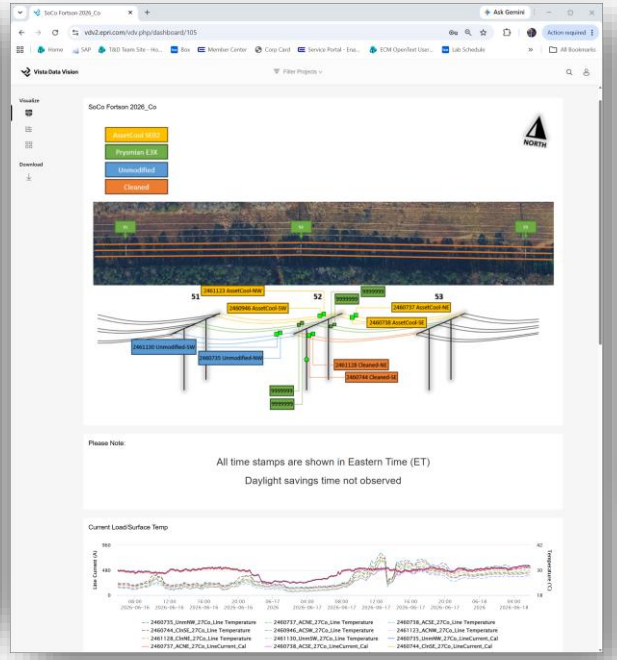
Neal Murray

- nmurray@epri.com
- 704.595.2624 office
- 704.340.8331 mobile

Robotically Applied High Emissivity Coatings for Overhead Conductors Monitored Field Demonstration

- **Objective:** Compare thermal performance of two brands of high emissivity coatings with aged and cleaned conductors
- **Cost:** $80k (can be split between ‘26 and ‘27)



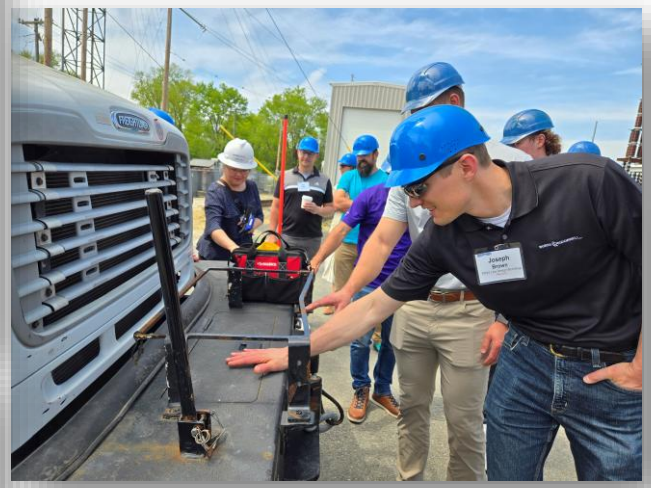


Rachel Moore
ramoore@epri.com
704-595-2095

Measuring Thermal Performance in the Field

765kV Line Design

- **Objective:** Further fundamental understanding of extra-high voltage transmission line design through information sharing and research
- **Cost:** $100k (can be split between ‘26 and ‘27)



Upcoming Events!

765kV Line Design Workshop: September 14th-16th

S. Africa (Eskom) Tour: October 5th-9th

Rachel Moore
ramoore@epri.com
704-595-2095

Insulator Task Force

35.011: Polymer & Composite Insulators
35.012: Porcelain & Glass Insulators

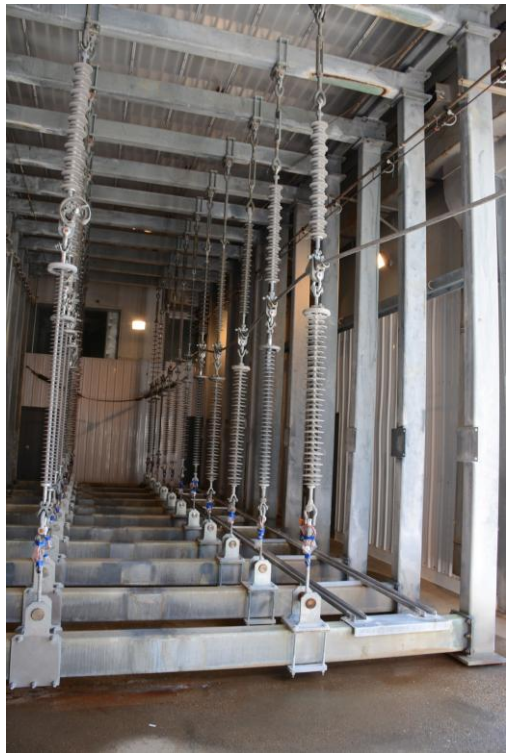
35.011 Polymer & Composite Insulators &
35.012 Porcelain & Glass Insulators

Tim Shaw
Project Manager
tshaw@epri.com

35.011 Polymer and Composite Insulators

How can the weather shed bond be evaluated without destroying it?

Is it possible to age insulators fast with less cost and space?



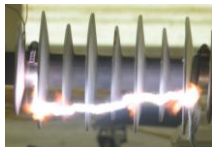
How long do insulator last?

35.011 Polymer and Composite Insulators

Reports/Guides

- Aging Chamber Report
- Insulator Reference Book (The Violet Book)

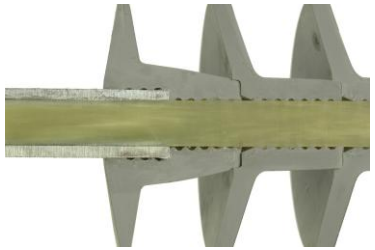
- Using steep impulse testing to find insulator defects



- Field Guide: Polymer Insulators
- Trending and Analysis of Polymer Insulator Failures

Online Resources/Calculators

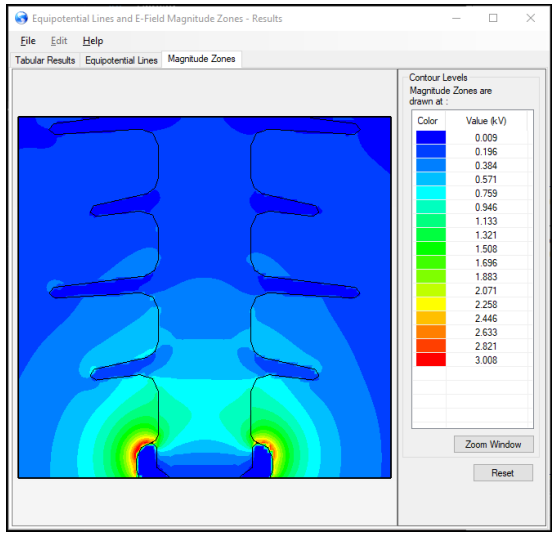
- All Dielectric Self Supporting (ADSS) Application
- Polymer Insulator Vintage Guide



- Polymer Insulator Population Assessment (PIPA) Application

Desktop Software

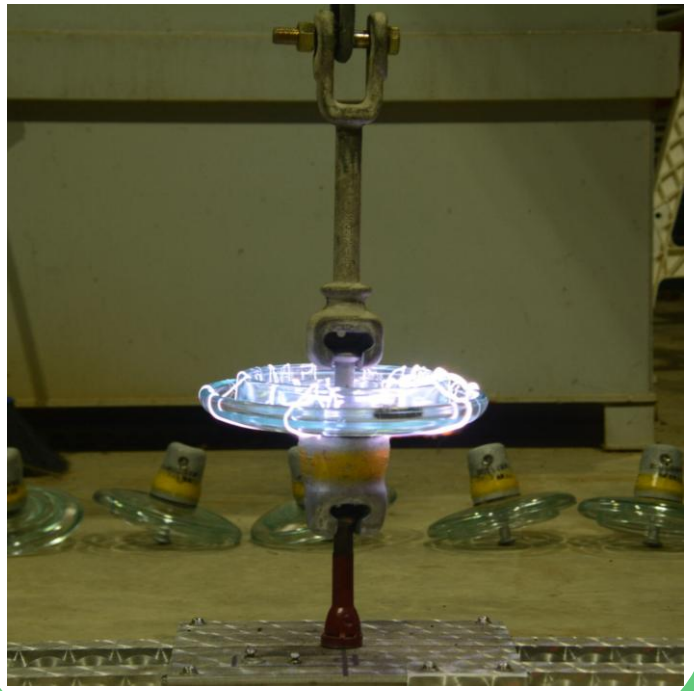
- Insulator E-field Modeling Software (Insulator Calculation Engine [ICE])



35.012 Porcelain and Glass Insulators

When should porcelain insulator be replaced?

How to test toughened glass quality?



Are rubber coatings effective in real service conditions?

35.012 Porcelain and Glass Insulators

Reports/Guides

- Insulator Reference Book (The Violet Book)

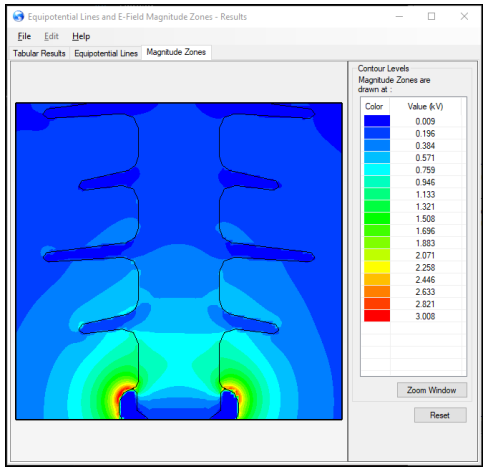
- Study of the Performance of Rubber Coated Glass Insulators in Testing and In Service
- Review of Steep Front Impulse Performance of Glass Insulators

Online Resources/Calculators

- Mechanical Failing Tensile Load Assessment
- Lessons Learned from Porcelain Insulator Failures
- A Study of How Glass Insulators Break

Desktop Software

- Insulator E-field Modeling Software (Insulator Calculation Engine [ICE])



Live Working Task Force

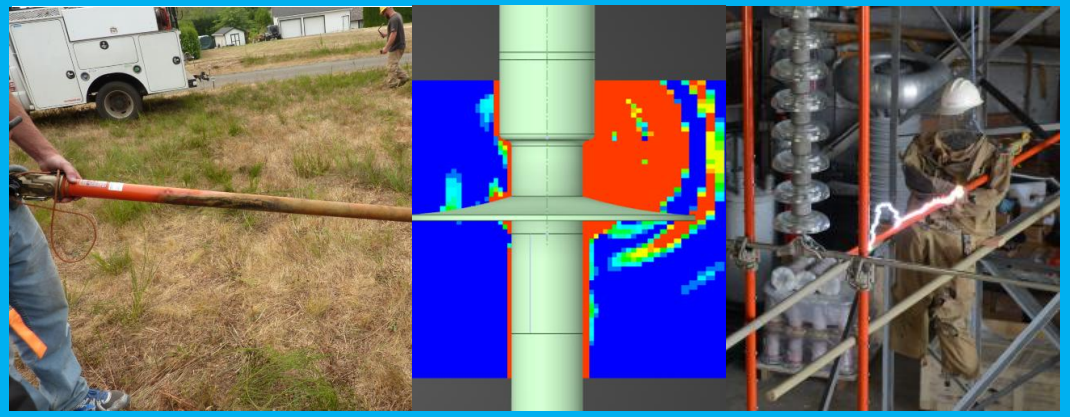
35.010: Live Working

35.010 Live Working

Alessandro Berredo
Project Manager
aberredo@epri.com

35.010 Live Working

What are the root-causes of the past insulating stick flashovers



How do insulating sticks perform in realistic weather and operating conditions?

What are the impacts of high current on conductive suits?

What are the limits of load bearing applications and humidity on LW ropes?

35.010 Live Working

Reference Books/Field Guides

Live Working Reference Book

- 27 Technical Chapters
- 7 Technical Appendices
- New Chapter or Chapter Update

Live Working Rope Field Guide

Online Resources/ Calculators

Minimum Approach Distance Calculators

Minimum Number of Sound Insulators Calculator

Live Working Rope – Compilation of Electrical Testing Results

GIS-based Form - Testing and Field Inspection of Insulating Tools

Maintainability Aspects for Line Designers New

Reports/Guides

Conductive Suit Subject to Current

Insulating Stick Flashover Investigation - Full Scale Testing

Effects of High Temperature on Tools and Suits

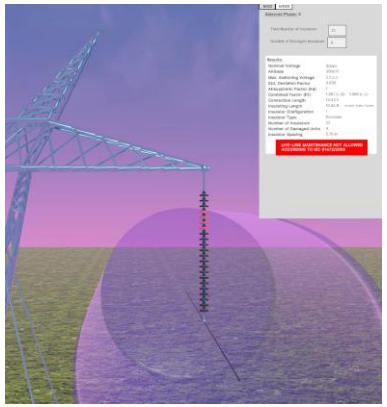
Performance of Insulating Stick Cleaning Products

LW Rope – Load Bearing Applications.

Desktop Applications

Minimum Approach Distance Calculators

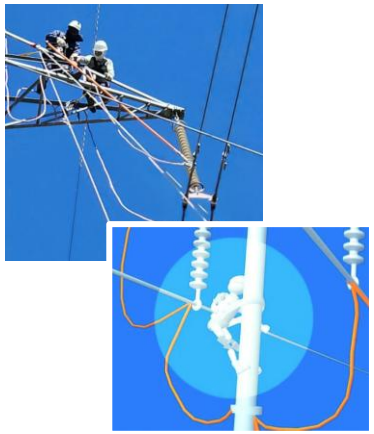
Minimum Number of Sound Insulators Calculator



Training

Live Working TPG Video Update

- Fundamentals of Temporary Protective Grounding



Lightning & Grounding Task Force

35.006: Lightning Performance & Grounding

35.006 Lightning Performance & Grounding

Camille Le Mauff
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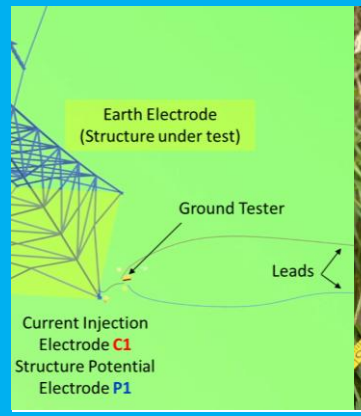
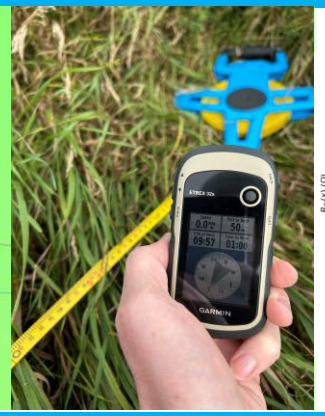
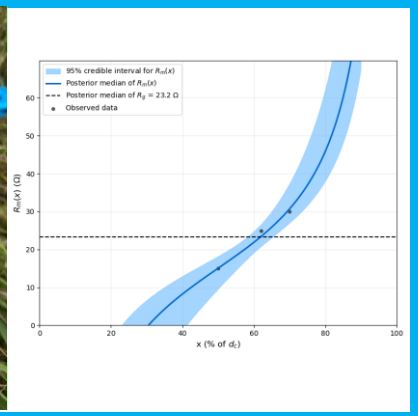
clemauff@epri.com

35.006 Lightning Performance and Grounding

How can we increase confidence in grounding measurements?

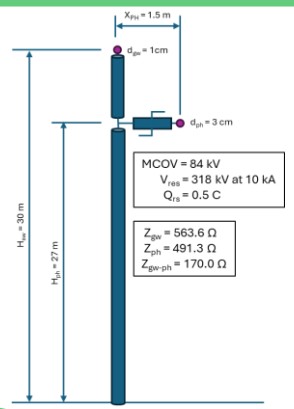


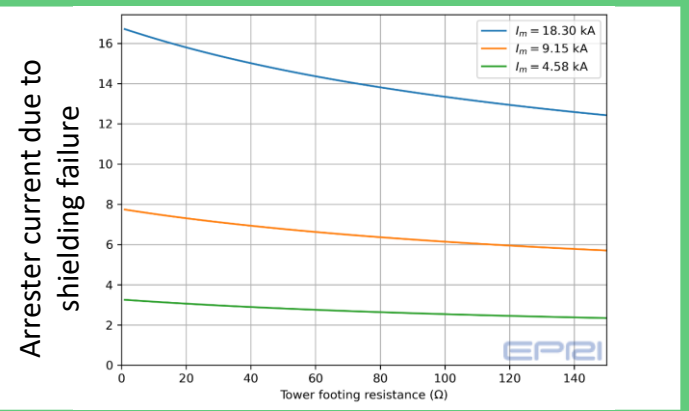




How can we avoid lightning-related failures of OPGW?

How to select surge arresters?





What is the lightning impulse strength of brace post insulators?

CFO?

35.006 Lightning Performance and Grounding

Reference Book & Training

Gray Book
- Provides reference material to learn about both lightning performance and grounding
- Updated to align to newest research and standards

In-Person training on TLW-Gen2: TFlash

Online Resources/ Calculators

Surge arrester selection tool

Lightning arc class calculator for OPGW specification

Lightning impulse strength calculator

Structure surge impedance calculator

Ground Flash Density (GFD) and soil resistivity maps

Planned Reports

Estimating uncertainty of grounding measurements with fall-of-potential method

Improvements for the Lightning Arc Test for OPGW and class selection methodology

Lightning impulse tests on brace post insulators

Desktop Applications

TLW-Gen2: TFlash module
- Lightning performance calculations

TLW-Gen2: Power frequency grounding module
- Fault current distribution
- Circulating currents

Hardware Tools

New Zed-Meter (grounding impedance tester for lightning applications)

Ground resistance monitoring solution (weather-related variations)

Surge arrester DC assessment tester

Line Design Task Force

35.005: Ductile Iron & Composite Structures
35.007: Line Design
35.008: Line Resiliency

35.005 Ductile Iron & Composite Structures

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P35.005 Ductile Iron and Composite Structures

What is the lifespan of FRP composite poles?

How do ductile iron and composite structures stack up in a competitive market?

How do FRP crossarms respond to accelerated weathering?

How do ductile iron poles react to mechanical loading?

P35.005 Ductile Iron and Composite Structures

Reports/Guides

- Geographic Variations in FRP Composite Weathering
- Optimal Pole Material Selection Guide: 2027 Edition – Lattice Structures
- Mechanical Testing of Accelerated-Aged Fiber Reinforced Polymer Composite Crossarms
- Ductile Iron Application Guide: 2027 Edition – Cantilever Tests of Ductile Iron Poles

Online Resources/Calculators

- Coupon Testing of Ductile Iron Pole Materials
- Recommendations for Grounding of Composite Utility Poles
- Ductile Iron Coating System Assessment
- Ductile Iron Structure Basics Training
- Effects of Accelerated Aging on Composite Poles

35.007 Line Design &
35.008 Line Resiliency

Jean-Pierre Marais
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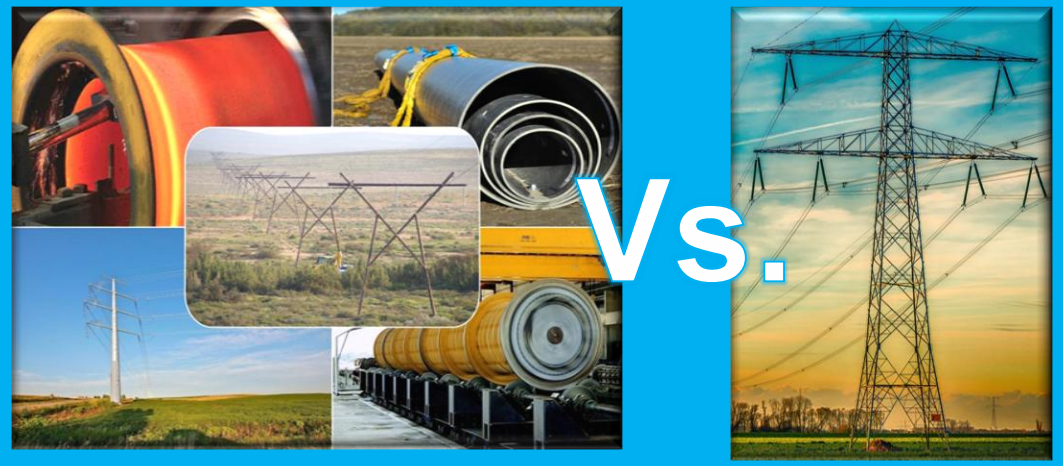
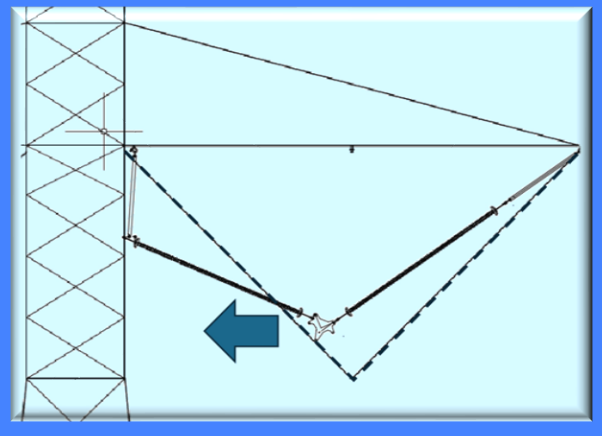
35.007 Line Design

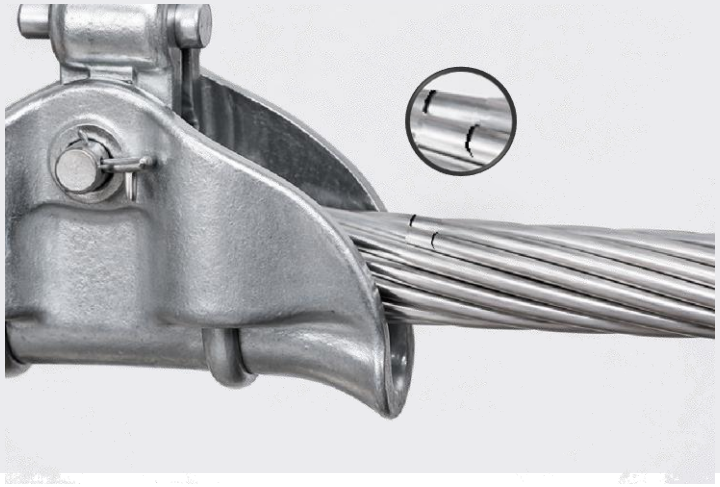
What is the real cost for lattice towers?



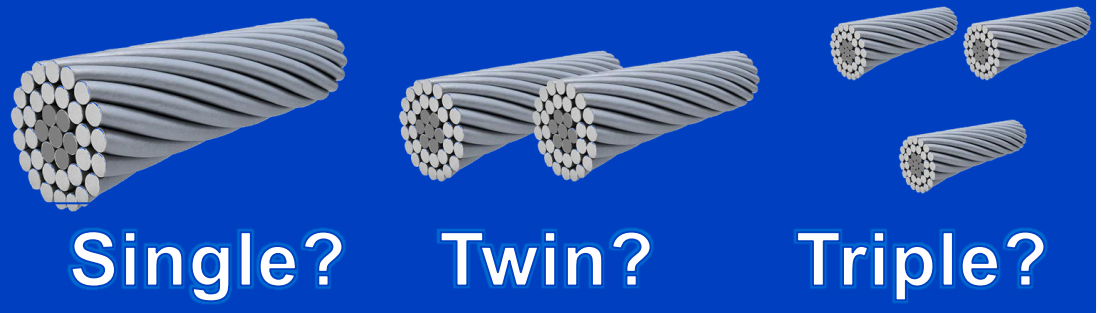
What is the allowable compression on glass and composite v-strings?



Will ACSS fatigue differently to ACSR ?



How can I determine the optimal number of sub-conductors?

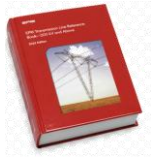


35.007 Line Design

Reference Books/Field Guides

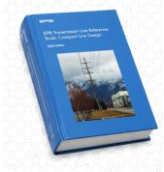
Red Book – Electrical design of AC Line

- 1200 pages



Blue Book - Compact Line Design

- Electrical design and conductor motion considerations



Online Resources & Software

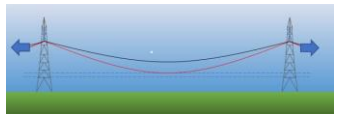
Transmission Resource Center:

- Web- based Red Book Applications

Software:

TLW Gen 2
AC Line effects
Single conductor
Vibration
Life Cycle Cost

- **Op10**



Reports

- **Quantifying the Real Cost of Overhead Line Support Options**
- **Allowable compression in V-String Insulators**
- **Safe Design Tension Limits of ACSS Conductor**
- **Revisiting Conductor Creep – Accuracy &, re-tensioning applications**
- **Optimal conductor selection and bundle design**

Workshops / Training

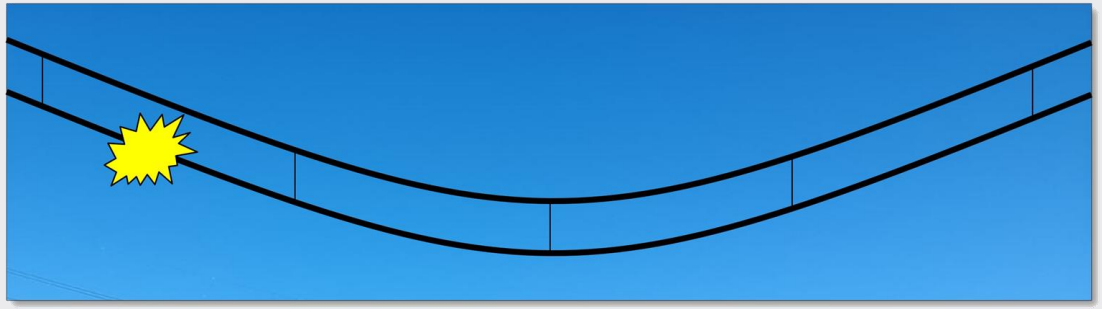
Transmission Line Design Bootcamp

35.008 Line Resiliency

Can we achieve safer, faster emergency restoration?

How can I design and determine appropriate intervals for anti-cascade structures?

Will bundled conductors allow reduced broken wire impact factors?



How can I repair damaged traditional and advanced conductors ?

35.008 Line Resiliency

Reference Books

Orange Book – Conductor motion & Structure vibration

Reports

- **Quantification of Transverse Cascading Loads: 2027 Edition**
- **Broken Wire Loads for Bundled Conductors**
- **Reliability and Repair Methods for Damaged Traditional and Advanced Conductors**
- **Learning from Failure - Case Studies in Improved Engineering: 2027 Edition**
- **Rapid ERS tower**
  - **Final Production Plans**

Workshops / Training

Orange Book Seminar 3 – Designing for Galloping and Ice Shedding

Inspection & Assessment Task Force

35.001: Inspection & Assessment
35.002: Conductor, Shield Wire, and Hardware Corrosion
35.003: Structure and Sub-Grade Corrosion
35.004: Traditional Conductors and Connectors
35.018: Line Switches

35.001 Inspection & Assessment &
35.002 Conductor, Shield Wire and Hardware Corrosion

Fabien Besnard
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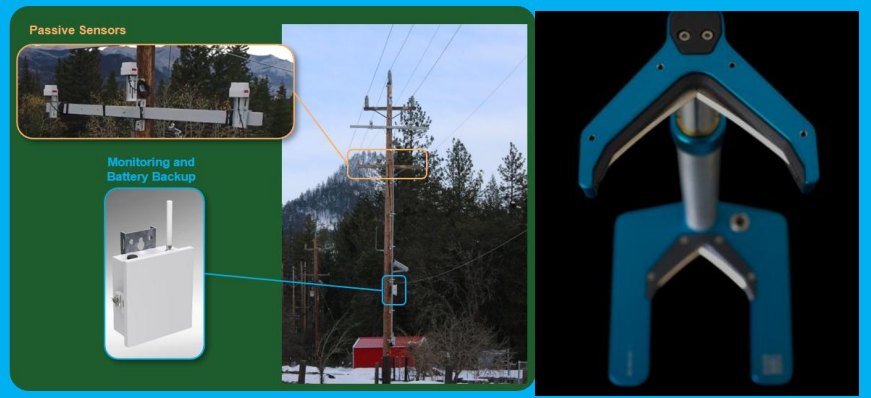
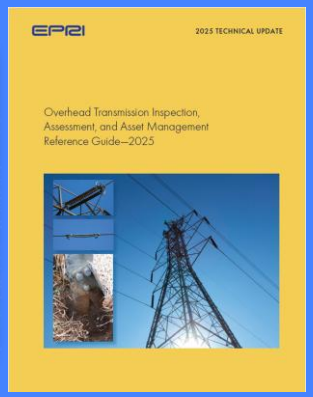
35.001 Inspection & Assessment

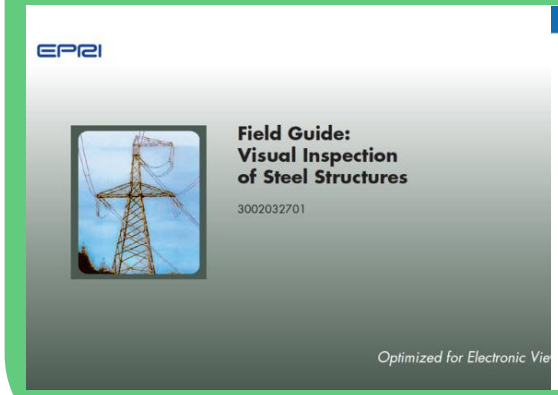
What are the new and emerging technologies for overhead line inspection ?

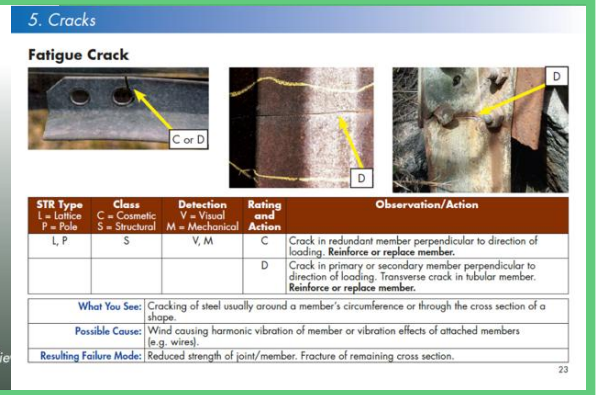


Where can I find training materials for early-career engineers?



How can I quickly assess the health of an asset in the field?





How can I optimize the use of drones for overhead lines inspection?

35.001 Inspection & Assessment

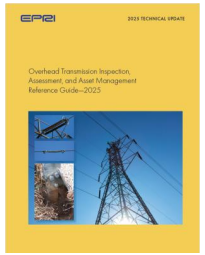
Reference Books/Field Guides

Overhead Transmission Inspection, Assessment, and Asset Management Reference Book

- 3 Volume
- 31 Technical chapters

Field guides

- 17 field guides



Online Resources

Transmission Resource Center:

- The Daytime Discharge Inspection of Transmission Lines Field Guide
- Visual Inspection of Porcelain and Glass Disc Insulators Field Guide
- Assessing the BATCAM's Ability to Detect Corona

Reports

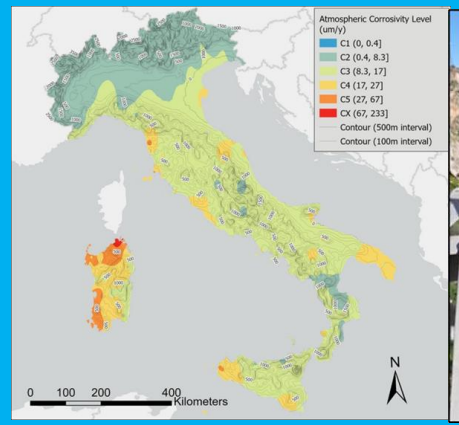
- **Evaluation of LiDAR Inspection Technologies**
- **Evaluation of Insulator In-service Inspection Tool**
- **Best Practices for Integrating Online Monitoring with Inspection and Maintenance Programs**

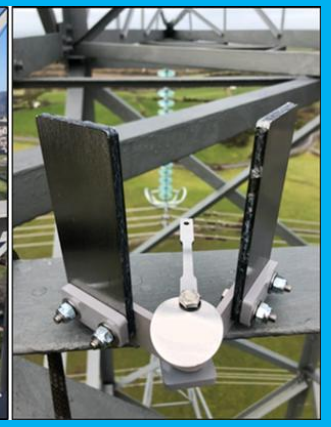
Workshops / Training

- **UAS Workshop (in collaboration with Distribution and Substation)**

35.002 Conductor, Shield Wire, and Hardware Corrosion

How can I optimize corrosion inspection ? How to know where to inspect more frequently?





How to efficiently inspect for corrosion damages? NDE vs Sampling?

How to calculate, predict, and estimate the remaining life of an asset based on corrosion degradation?

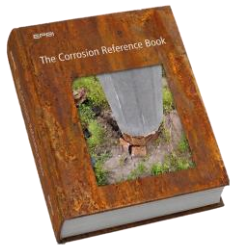
What assets exist on the market that can withstand severe corrosive? Manufacturer claims and EPRI testing.

35.002 Conductor, Shield Wire, and Hardware Corrosion

Reference Books/Field Guides

Corrosion Reference Book (The Rust Book)

- 4 Technical Chapters
- 3 Technical Appendices
- New Chapter on Atmospheric Corrosion and Conductor Corroison



Online Resources/ Calculators

- **Atmospheric Corrosion Map guidelines**
- **Core Conductor Corrosion Calculator**
- **Corrosion evaluation case study**

Reports/Guides

- **Guidelines for Atmospheric Corrosion Mapping**
- **Conductor Selection for Corrosive Environments**
- **Corrosion Condition Assessments of In-Service Conductors or Conductor Failure**
- **Aluminum Corrosion in Overhead Conductors**
- **Shield Wire Corrosion Resistance**

Workshops

- **Corrosion and Corrosion Control Workshop**
- **Info Sharing Session – Design in Extreme Environments**

35.003 Structure & Sub-Grade Corrosion

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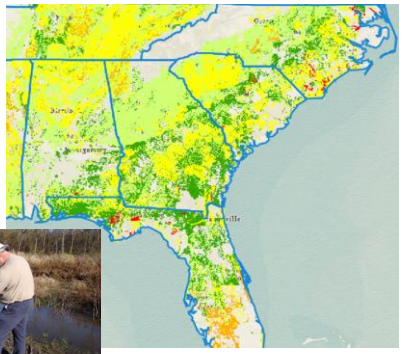
35.003 Structure and Foundation Corrosion Management

What causes corrosion on my structures and foundations?

- Airborne Contaminants from Industry
- Coastal Environments
- Road Salts Broadcasting
- Mineral Outcroppings
- Urban Pollution
- Moisture
- Temperature
- Corrosive Soils

How do I find corrosion on my structures and foundations?

- Screen my service territory using the soil corrosivity maps for steel, zinc and copper.
- Select the “at risk” structures in the severe zones first, then prioritize the balance of population.
- Go to Transmission.EPRI.com, select the 3rd Tile and use the “Steel Pole Inspection” procedure.



Is the asset in serviceable condition?

- Fleet Management Suite
  - Go to Transmission.EPRI.com
    - Select the 3rd Tile
    - Input the loading criteria and “as built” information to determine the “Utilization Ratio” in the structural analysis.

How do I arrest or slow the corrosion rate on my structures and foundations?

- Fleet Management Suite
- Go to Transmission.EPRI.com
- Select the 3rd Tile
- Select the appropriate coating system based upon your environment or design a cathodic protection system for your structure size.

P35.003 Structure and Foundation Corrosion Management

Reports/Guides

- Coating Selection and Application
- Engineered Backfills - Conductive Concrete Evaluation
- Corrosion Assessment of Weathering Steel Transmission Structures Field Guides (Tier 1 and Tier 2)
- Inspection of Transmission Line Foundations Field Guide
- Sacrificial Anode for Transmission Line Structures Field Guide
- Visual Inspection of Steel Structures Field Guide
- Visual Inspection of Wood Structures Field Guide

Online Resources/Calculators

Steel Pole Management Suite Development:

- Steel Pole Inspection
- Atmospheric and Soil Corrosivity Maps
- Steel Pole Strength Calculator WebApp
- Coating Selection and Application WebApp
- Cathodic Protection Design and Installation WebApp

Reference/ Training

- Corrosion and Corrosion Control Workshop
- 
  Corrosion Reference Book “The Rust Book”
- Call me, we are an online resource

35.004 Traditional Conductors and Connectors

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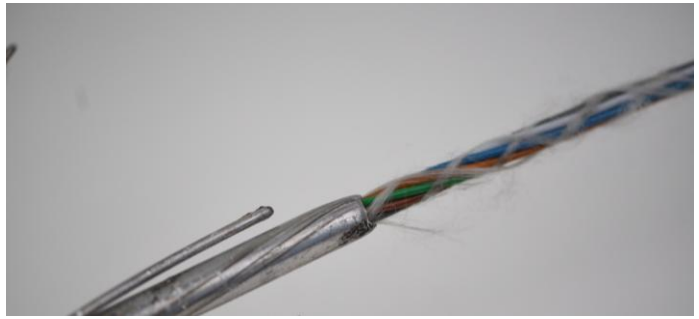
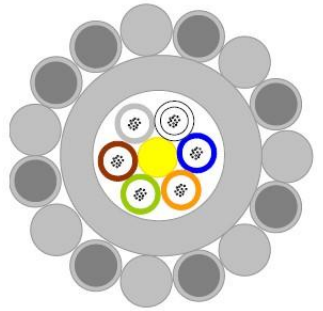
35.004 Traditional Conductors and Connectors

How do new single stage compression connector designs perform?

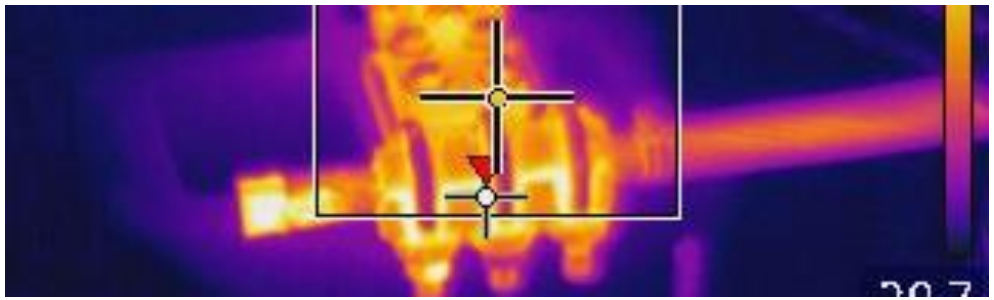
What are the fundamental characteristics of OPGW and how do they degrade?





How does improper installation of 2-stage compression connectors affect their performance?

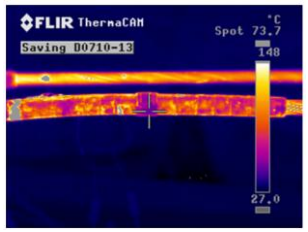
What are the most effective methods and techniques for measuring the performance of t-tap connectors?



P35.004 Traditional Conductors and Connectors

Field Guides

- Construction and Inspection of Compression Connectors for Overhead Transmission Lines Field Guide
- Infrared Thermography for Overhead Transmission Lines Field Guide
- Inspection of Conductors for Overhead Transmission Lines Field Guide



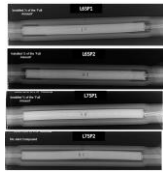
Reports/Technical Guidance

- Use of Optical Fiber Ground Wires in Overhead Transmission Systems
- Evaluation of Aged Traditional Conductors and Connectors

- Traditional Conductor and Connector Inspection Guide
- Traditional Conductor and Connector Management Guide

Online Resources/Calculators

- **Reference:** Overview of Causes of Compression Connector Failure
- **Reference:** Visual Inspection
- **Reference:** Dimensioning of Compression Connectors
- **Reference:** Radiography of Compression Connectors



- **Reference:** Resistance Measurement of Connectors
- **Video Training:** Connectors 101

35.018 Line Switches

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35.018 Line Switch Management

What are the electrical and mechanical limitations of quick break whips?

Is there such a thing as a line switch silver bullet design?

What failure modes affect line switch components, and their typical time to failure?

How do different bearing system designs perform under condensation conditions?

35.018 Line Switch Management

Reports/Guides

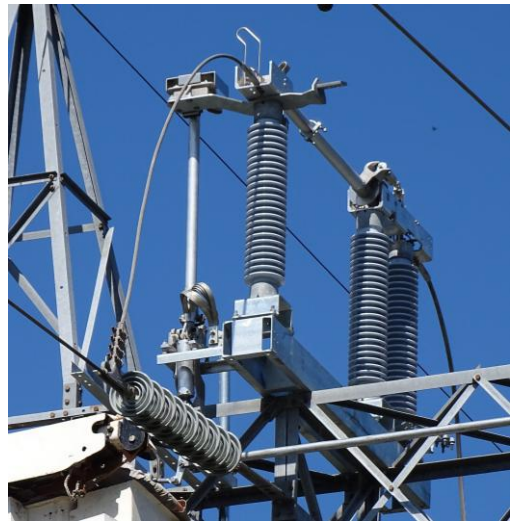
- Quick Break Whip Test Results and Modeling
- Practical Installation Guide for Line Switches
- Inspection and Maintenance Guide of for Line Switches

Online Resources/Calculators

- Quick Break Whip Testing – Intro on Interrupting Capacitive Currents
- Whip Testing Preliminary Results
- Line Switch Commissioning 101
- Catalog of Component Degradation and Failure Modes
- GIS-based Form for Commission of New Line Switches

Workshops

- Line Switch Inspection and Maintenance Workshop



HVDC Task Force

35.019: HVDC Lines

35.019 HVDC Lines

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gsibilant@epri.com

35.019 HVDC Lines

What affects the performance of HVDC Lines?

- Corona Performance
- Insulator Performance
- Corrosion Performance

What are the optimal design and refurbishment practices for Ground Electrodes and Electrode Lines?

Existing Electrode and Electrode Line Best Practices for Design, Refurbishment and Maintenance

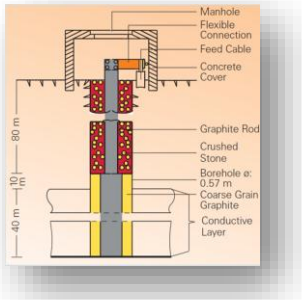
What are the key parameters in HVDC Line Design, and which tests need to be performed?

HVDC Line Design Information and Testing Performed to Determine Component Performance

35.019 HVDC Lines

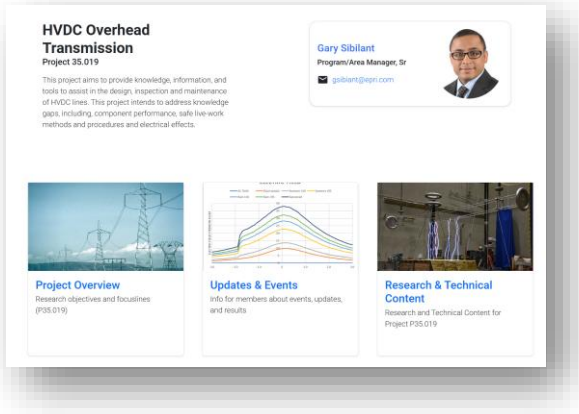
Reports/Guides

- Ground Electrode and Electrode Line Maintenance and Refurbishment
- HVDC Transmission Line Parameter and Testing Guide
- HVDC Reference Book
- HVDC Transmission Line Design Guide



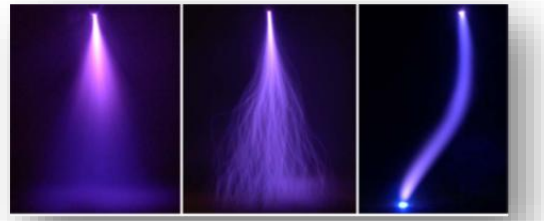
Online Resources/Calculators

- HVDC Resource Center
https://transmission.epri.com/hvdc/



Desktop Software

- TLW Gen 2 – HVDC Electrical Effects Module



Increased Transmission Capacity Task Force

35.013: Line Ratings & Increased Power Flow
35.014: High Temperature Operations
35.015: Advanced Conductors & Connectors

35.013 Line Ratings & Increased Power Flow

Justin Bell
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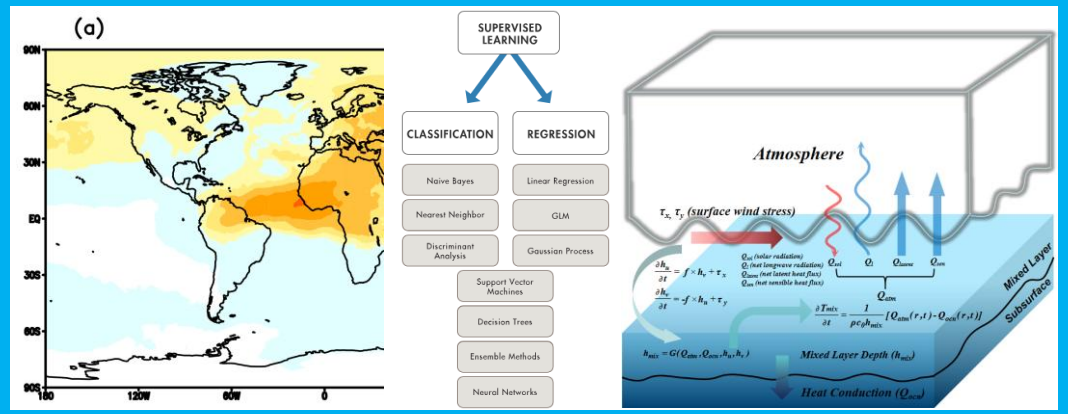
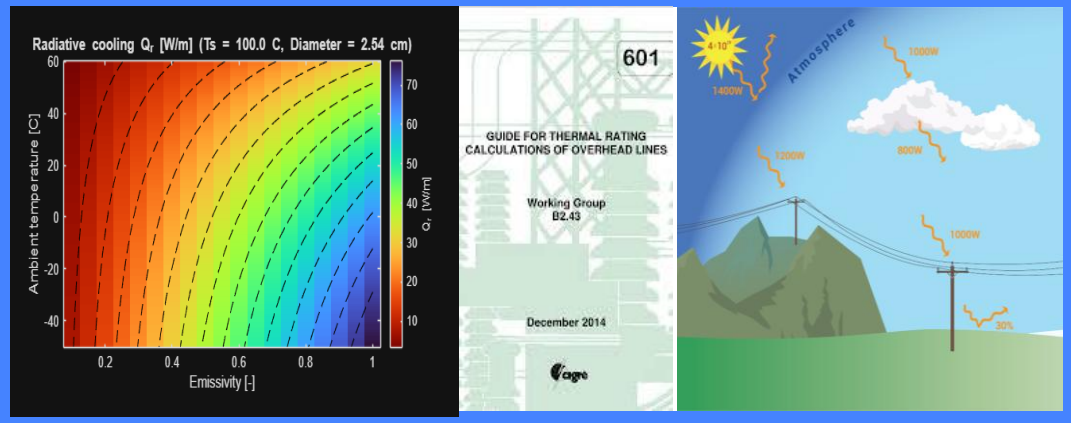
35.013 Increased Powerflow and Ratings

If DLR forecasting relies on public weather data, can we do it ourselves for no cost?

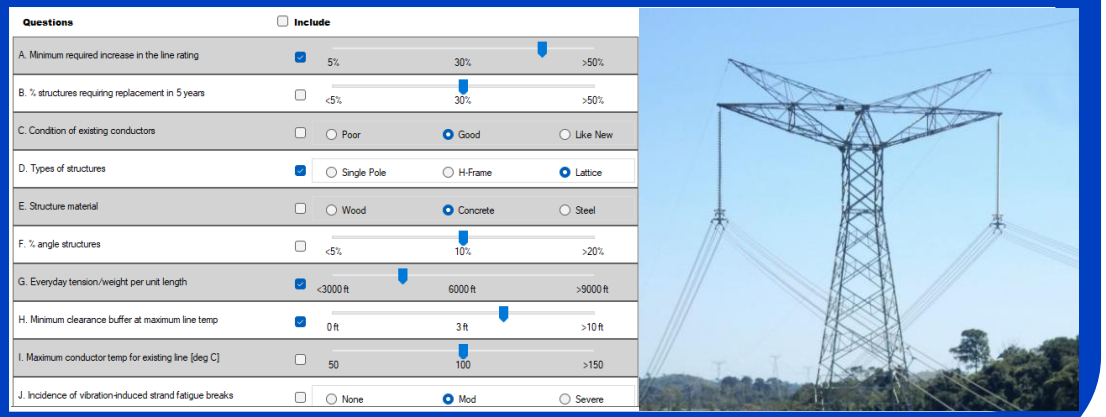


Why do ratings standards give different results? Which one should we trust?



What happens when drone DLR installs go wrong? How can we prevent it?

What options can increase capacity beyond 200%? When should we consider HVDC?



35.013 Increased Powerflow and Ratings

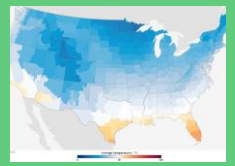
Increased Powerflow Guidebook

- Covers rating methods for all transmission assets
- Lines, underground cables, transformers, breakers, switches, traps
- Additional discussion of DLR and economics of common upgrades
- Updated to align with newest standards and guides

Online Resources

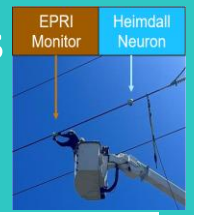
- AAR batch ratings, lines & substation equipment
- Tutorials on ratings standards
- LiDAR for uprating tools and planning calculator
- Increased capacity from increased operating temperatures
- Conductor emissivity and absorptivity testing

Planned Reports/ Guides



- Guidance for Unmanned Aerial Systems (UAS) Installation of Dynamic Line Ratings (DLR) Sensors
- Forecasted Ratings Update – Do It Yourself Dynamic Line Ratings (DLR) Forecasting
- Considering High Voltage Direct Current (HVDC) for Uprating
- Selecting Ratings Methods – IEEE, CIGRE, and International Standards

Dynamic Line Rating Tools



- DLR Technology database (61+ DLR providers)
  - Hardware limits, failure modes, and cybersecurity
- Life cycle costing tools, compare to traditional upgrades
- Collection of utility experiences presentations

Expanding Uprating Decision-Making Tools

- Alternative Ranking Tool (FERC 1920 & 2023) – guidance on what upgrades are a best fit and why
- St. Clair Capacity Tool – understand when to uprate and when to rebuild
- Cost/Benefit toolbox for >30 uprating methods

35.014 High Temperature Operations

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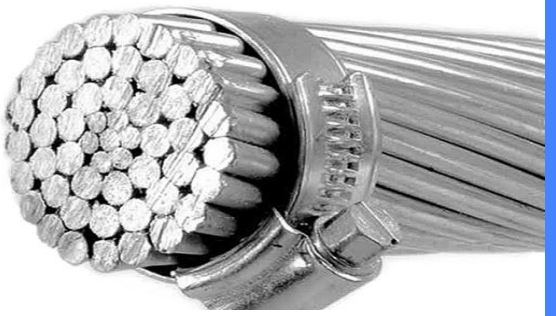
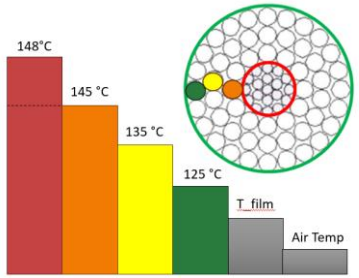
35.014 High Temperature Operations

What is the durability of robotically applied high emissivity coatings?

What are the annealing characteristics of aluminum alloys 6201 and AlZr in overhead transmission conductors?



What is the core temperature of my conductor and how does that effect the overall conductor sag?

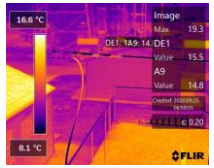


What is the corrosion rate of my steel core conductors at elevated temperatures?

P35.014 High Temperature Operations

Reports/Guides

- **Guide:** Guide for High-Temperature Operation of Overhead Lines



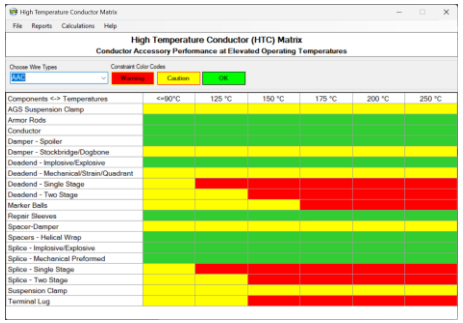
- **Report:** Radial Temperature Effects on Conductors and Ratings
- **Report:** Robotically Applied High Emissivity Coatings for Overhead Transmission Conductors

Online Resources/Calculators

- **Calculator:** Aluminum Annealing and High Temperature Creep Calculators
- **Research Summary:** Effect of High Temperature on Tensile Strength of Aluminum 1350-H19
- **Reference:** High Temperature Operation Standards

Desktop Software

- **High Temperature Conductor (HTC) Matrix**
  - Testing Summaries
  - Conductor Ratings
  - HTC Matrix Calculator
  - Sag Tension Calculator
  - Bare Conductor Resistance Calculator



35.015 Advanced Conductors and Connectors

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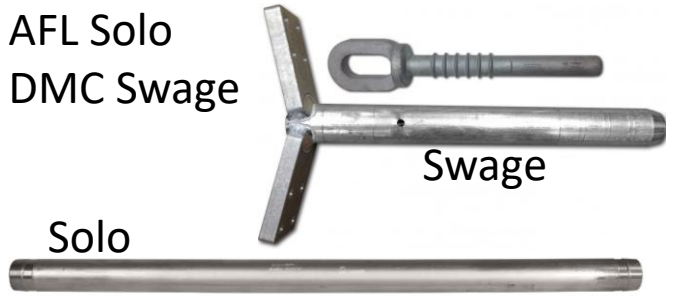
35.015 Advanced Conductors

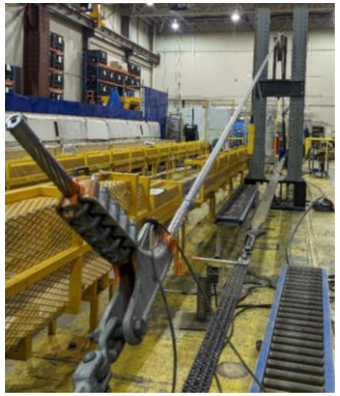
What are the Best Practices for Handling and Installation of Advanced Conductors?

Installation Tests
Manufacturers Guidelines
Failure Data

What are the Thermal-Mechanical Performance levels of new connectors?

New Connector Designs
AFL Solo
DMC Swage



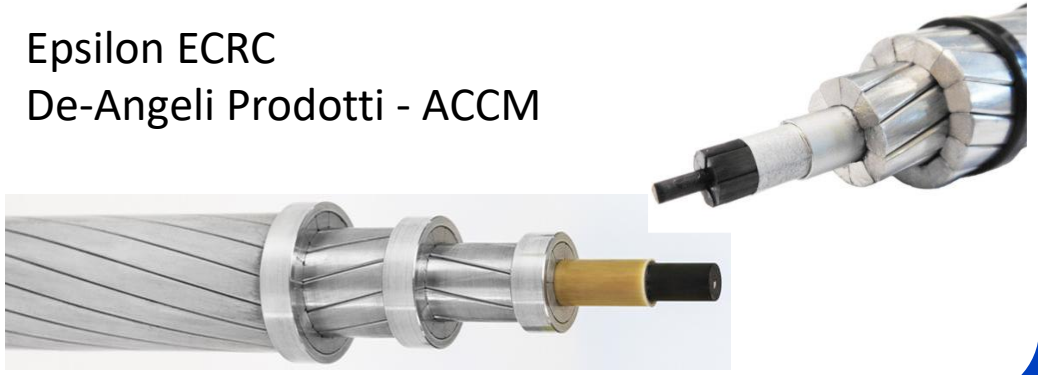


How do these conductors affect maintenance practices?

Effects of High Temperature on Workers and Tools
Effect of Tools on Conductors

What new conductors have come to market and how do they perform?

Epsilon ECRC
De-Angeli Prodotti - ACCM



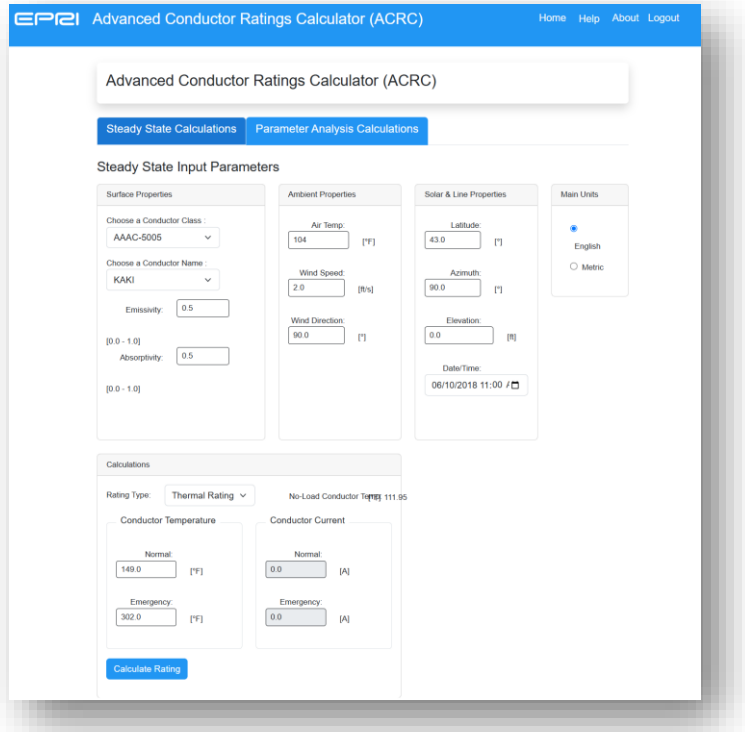
35.015 Advanced Conductors

Reports/Guides

- Carbon Core Conductor Qualification Testing: De Angeli Prodotti ACCM
- Carbon Core Conductor Qualification Testing: Summary of Previous Testing
- Guide for Selection and Application of Advanced Conductors
- Maintenance of Advanced Conductors

Online Resources/Calculators

- Advanced Conductor Rating Calculator



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P35.011	Polymer and Composite Insulators	Tim Shaw	tshaw@epri.com, 704-595-2734
P35.012	Porcelain and Glass Insulators		
P35.013	Line Ratings and Increased Power Flow	Justin Bell	jbell@epri.com, 518-445-3712
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