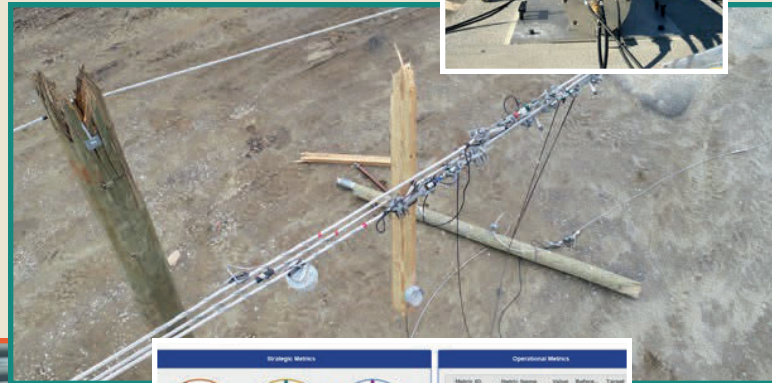
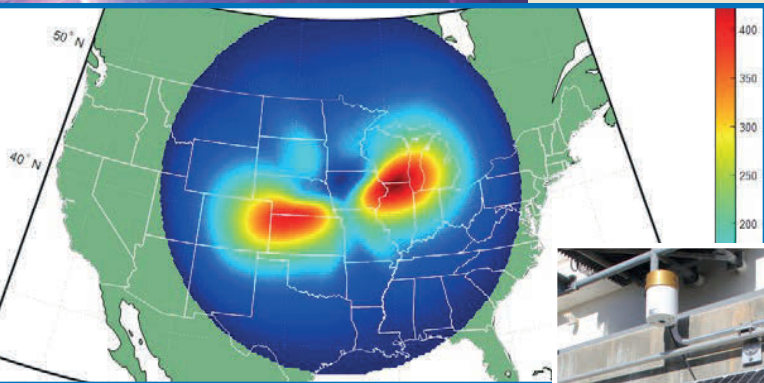


## Transmission and Distribution Infrastructure (TDI) Applications

July 2022



# Transmission and Distribution Infrastructure (TDI) Applications

EPRI's TDI team is comprised of world-class power industry experts in T&D infrastructure, maintenance, asset condition assessment, monitoring and root cause analysis. EPRI offers a wealth of knowledge gained from more than 50 years of RD&D experience delivered to over 45 U.S. and international energy companies that support our TDI work.

Additionally, EPRI's Transmission and Substation laboratories, located in Lenox, MA and Charlotte, NC, are available to conduct third party unbiased performance tests of assets. These tests can enable a better understanding of asset performance under extreme weather stress and enable the ability to determine the benefits of design modifications which increase resilience and reliability.

EPRI offers customized applied technology research and testing solutions to provide data driven guidance and decision support to help manage T&D assets.



## T&D Asset Forensics of Failure Analysis

T&D asset failures such as transformers and switches can significantly impact system operation, reliability, and safety. These failures are frequently difficult or impossible to predict, and can sometimes seem random. These failures are driven by degradation mechanisms and stressors that lead to specific failure modes. In the absence of sophisticated online monitoring data, a forensic analysis may be the best opportunity to learn why a component failed and if there is a risk to the remaining fleet. EPRI's T&D asset forensics can help prepare for the future by improving specifications, inspections, or maintenance practices.



Distribution switches were found to be heating in the field. A forensic analysis identified corrosion at the contact points that was the cause of the localized heating. Further analysis identified a design issue as the root cause, leading to improved utility specifications to prevent this issue in the future.

## Electromagnetic Pulse Testing & Design Support

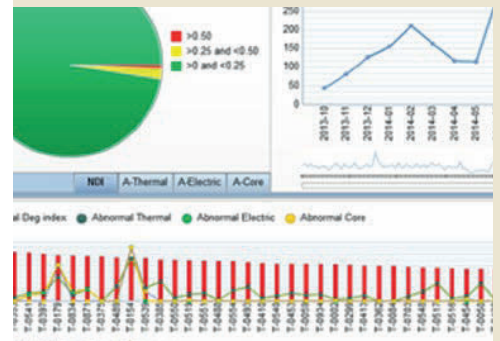
High-Altitude Electromagnetic Pulse (HEMP) has long been identified as a threat to global power grids and can disrupt unhardened power systems over large geographical areas. EPRI can perform comprehensive analysis of potential HEMP impacts, identify, and design potential mitigation options, and provide engineering guidance to ensure proper application of hardening strategies.



RS105 guided wave facility.

## T&D Asset Analytics Support Applications

Energy companies face a number of challenges in maintaining and managing assets, aging infrastructure, stringent operating requirements, financial constraints, and retiring expertise. To address these challenges, utilities are considering or are adopting analysis-based decision processes to improve maintenance and reliability, and to minimize equipment costs and risks. Data driven analytical decision processes must understand existing performance, determine required performance, project future performance, and develop actions to bridge gaps. EPRI has in-house expertise, an industry-wide database, and has developed tools and a variety of advanced data science (e.g. statistics, machine learning, natural language processing etc.) techniques to assist in implementing such data driven analytical decision processes.



Example of Integrating EPRI's Power Transformer Expert System Software with Enterprise Wide Asset Health System.

## Radio Frequency (RF) Monitor Deployment & Analysis

EPRI's Radio Frequency (RF) Monitors are a one-of-a-kind suite of designed and manufactured in the USA\* sensors that provide real time monitoring information on the health of a range of transmission line and substation assets. The RF monitors communicate wirelessly to a base station that relays the information to EPRI or utility-hosted servers which enable stakeholders to view asset health information and can trigger alerts and alarms through advanced analytics covering a real time remote window of the monitored asset's performance. The RF monitors are developed in collaboration with utilities to identify and apply lessons learned through use-cases.

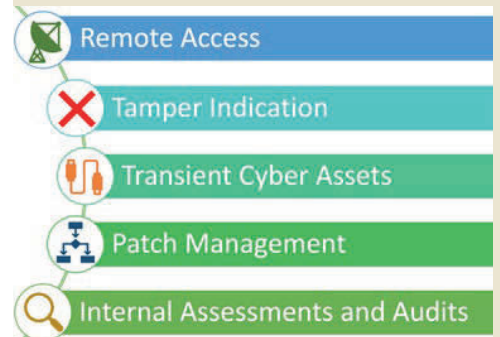
\*Some microelectronics may be of foreign origin



A suite of RF sensors have been developed for overhead transmission and substation applications. This is an example of a Clamp-on leakage current sensor installed on a porcelain disc insulator.

## Cyber Security

The power sector's mission-critical infrastructure is a target for cyberattacks. EPRI's Cyber Security Assessment Applications help energy companies identify and prioritize risks to reliable and resilient grid operations and develop appropriate policies, strategies, and practices to mitigate those risks tailored to company-specific needs. EPRI's focus on utility operational technology (OT) environments and extensive experience delivers a rich knowledgebase to benefit utilities. The team translates EPRI's unique foundation of cyber security research and development activities and practical knowledge into applications that deliver a holistic, 360-degree view of utility OT cyber security performance and program strengths and weaknesses. The outcome of applying an EPRI cyber security assessment is recommendations of objectives, tasks, and timelines to address vulnerability gaps and improve cyber security performance in your prioritized areas.



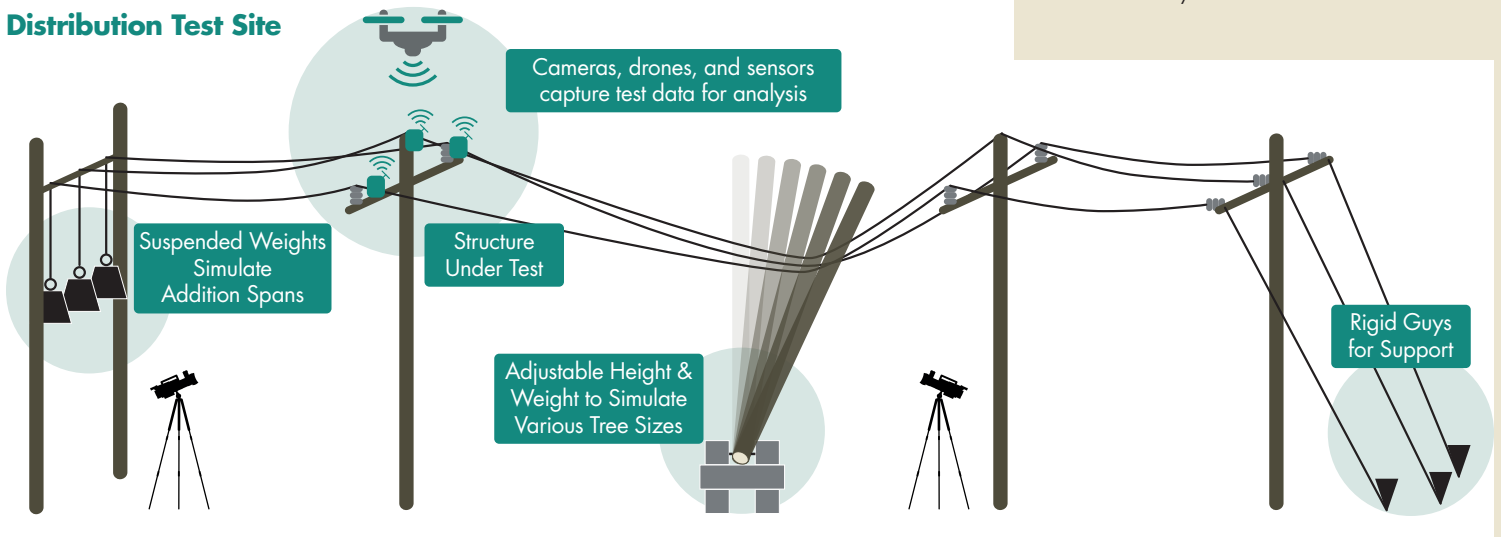
## Distribution Structural Resiliency Testing

Whether wood, steel, composite, or concrete, distribution structures are a deceptively complex engineered system designed to last for decades and withstand extreme environmental events, all while being continually subjected to physical forces and required to perform in a reliable and predictable way. Increased expectations for reliable electricity drive the need to improve performance during normal operations. In addition, major weather events necessitate improved resilience and reduced restoration time. EPRI's laboratories and test capabilities can help energy companies understand how designs perform, and what can be done to further improve performance.



The full-scale overhead structure test facility exposes lines to midspan tree strikes to investigate structural failure modes and identify opportunities to improve structure resiliency.

### Distribution Test Site



## Why EPRI?

EPRI's unique laboratory capabilities and technical expertise make EPRI the leading choice for resiliency, structural, and electrical testing for transmission and distribution engineers. The test team includes experts in structural, electrical, design, and materials engineering. The team's deep technical expertise means that you not only get world-class testing, but there is also a team of people that understand the broader implications of design choices and modifications.

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