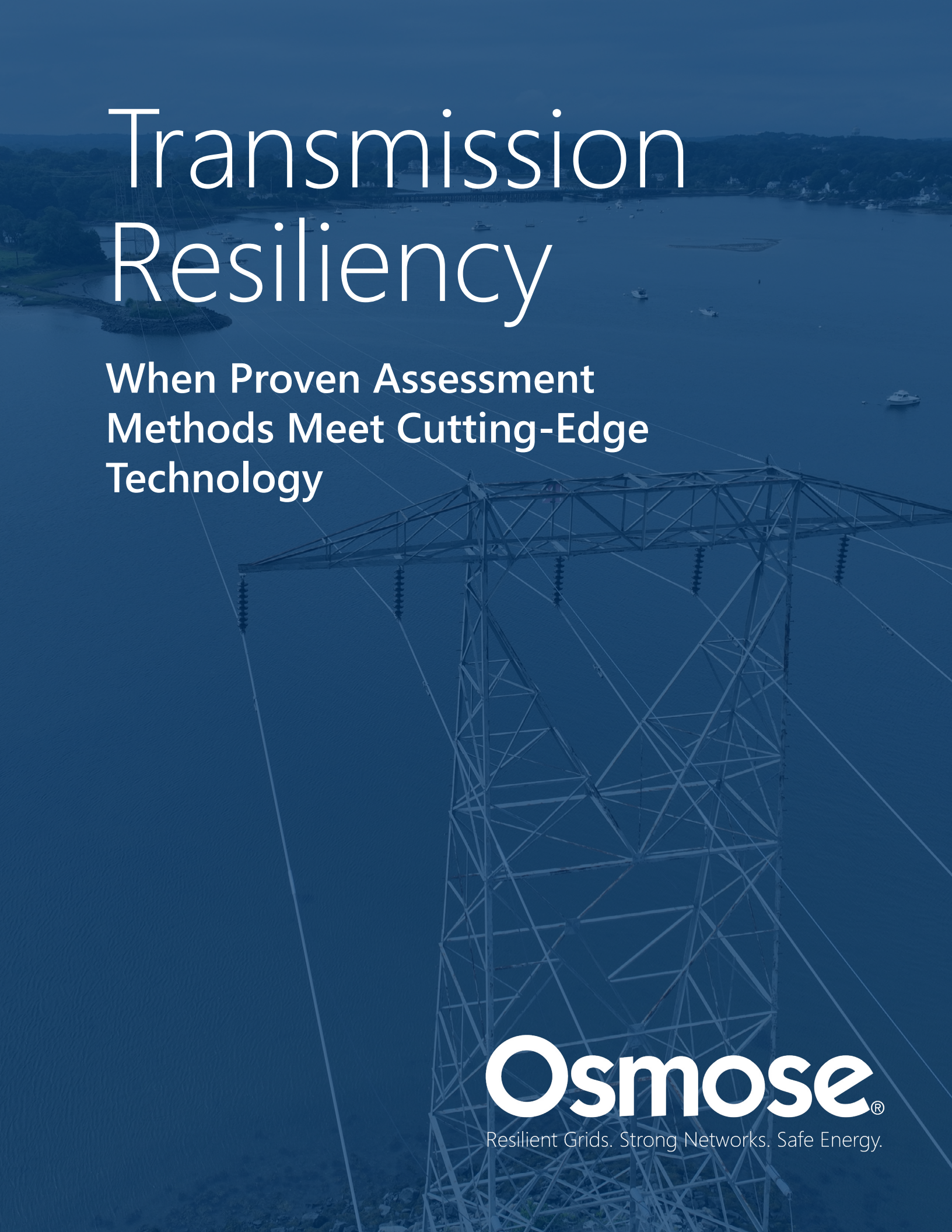


Transmission Resiliency

When Proven Assessment Methods Meet Cutting-Edge Technology

Osmose®

Resilient Grids. Strong Networks. Safe Energy.

Decades old transmission structures were built to withstand the test of time and whatever Mother Nature would blow their way. However, extreme weather events have now become more severe and more frequent, causing ever-aging structures to become more vulnerable to degradation, damage, and corrosion, ultimately resulting in weakened structures.

Full structure replacement and line rebuilds are costly and time-consuming, requiring years of planning and extended outages. Understanding the health of aging structures is crucial, especially when time and resources are constrained.

Facing those budget constraints, anticipated high replacement costs, and incomplete records, one New England utility knew its aging transmission structures had decades of exposure to nature's elements and needed a thorough understanding of several of its remote transmission lines, varying in structure types and materials. The utility did not have the original structure or as-built drawings, further proving the need to understand its structure health and performance to plan for the future.

With impending replacement costs on the horizon, what the utility needed was a top-to-bottom structural assessment and a way to simulate extreme weather events to find weakened structural areas for a targeted approach to strengthening and restoration. What it needed was a partner with decades of experience, specializing in transmission infrastructure and structural integrity management.

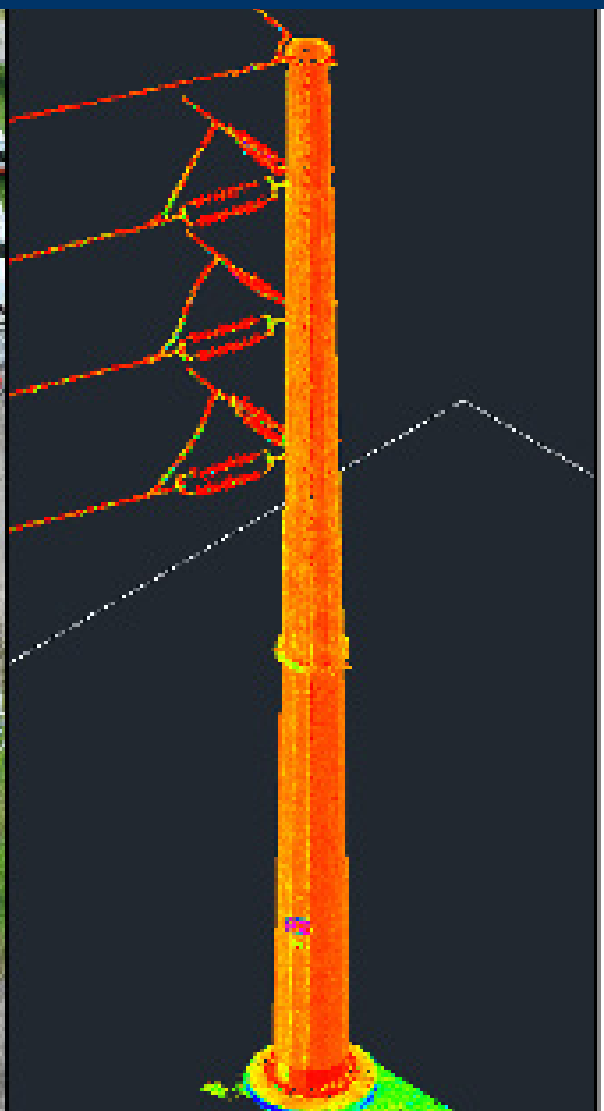
The New England utility selected Osmose® Utilities Services to develop a custom, comprehensive structural resiliency assessment project. During the assessments, data was collected on the entire structure, including below groundline foundation assessment, overhead assessment using an Uncrewed Aerial System (sUAS or drone), and a resiliency analysis using Bentley/Power Line Systems - Computer Aided Design and Drafting (PLS-CADD), Pole Analysis and Design (PLS-POLE), and Tower Analysis and Design (TOWER) software. Because the original structure drawings were unavailable, Osmose employed ground-based terrestrial LiDAR to collect detailed point cloud imagery of the structures which was then used to create digital 3D models for analysis.

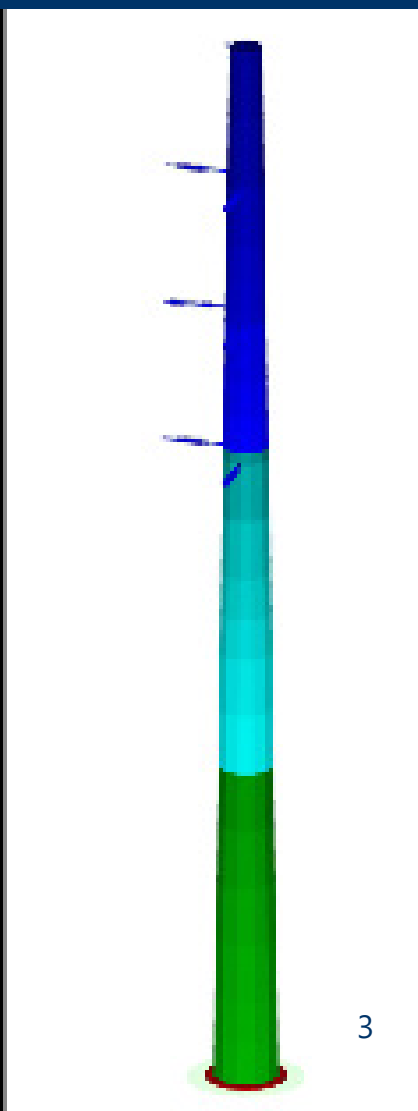
The 3D digital models of the structures were loaded into PLS-CADD and studied under current-day code-required load cases and pertinent extreme weather event scenarios. Bent members, above-grade corrosion, missing bolts, and other hardware defects were meticulously catalogued.

With over 25 years of experience, Osmose's transmission structure assessment and analysis engineering expertise was the cornerstone to the utility's proactive approach. The ground-based assessment allowed crews to closely examine the foundations above grade, transitional zone, and below grade to identify any weakened areas of the foundational structure. The sUAS assessment offered overhead visual insight into components and connections from angles inaccessible from the ground level – far beyond what traditional visual assessment methods provide.

Also factored into the analysis, the LiDAR device collected current-state information on the structures, including section loss from corrosion that may have occurred since the original construction.

In addition to the structural analysis, a study was conducted to evaluate how alternative conductors would impact the performance of the structures. Osmose replaced the existing conductors and shield wires in the digital structure models with new conductors and optical ground wires (OPGW), as instructed by the utility. They then compared the structural loading results with those from the current conditions and conductor configuration.





The Role of PLS-CADD

This project included various steel and wood structure types, including monopoles, lattice towers, H-frames, guyed pull-off structures, and a structure with a telecommunications array attachment. Additionally, the transmission lines were comprised of varying conductor types and voltages, thus bolstering the importance of PLS-CADD for analysis and modeling. The Osmose team then processed the LiDAR data and imported the information into PLS-CADD, enabling them to model the lines in their current state and place the structures geographically within the same model, regardless of material type.

The LiDAR data from PLS-CADD was able to be viewed in PLS-POLE and PLS-TOWER, which allowed for detailed, efficient structure modeling. The software provided the ability to mix and match material types within the same models. Wood H-frame structures with steel crossarms, and the structure with a telecommunication array antenna were able to be modeled exactly as they are in the field.

Once the 3D structure models were complete, they were placed into the PLS-CADD models and the loading analysis was performed.

Each conductor was studied using the finite element setting (FE) within PLS-CADD, which allowed Osmose to model and simulate their behavior under new design tension and temperature levels (initial conditions) and how they would behave over time under constant load and stress (creep conditions). A vast database of manufacturers' conductor libraries was available within PLS-CADD, allowing Osmose to streamline the alternative conductor analysis.

Osmose also utilitized the Structure Wind Rating Report – a feature that automatically and incrementally increases the wind loads on a structure until a member reaches overstress. This tool allowed Osmose to understand how each structure would behave under an extreme wind event beyond standard design code requirements without creating hundreds of additional load cases in the software.

Misplaced, lost, or outdated drawings and documentation of decades-old structures often force utilities to consider full replacement as the only viable option.

However, Osmose's comprehensive, full structure assessment provided this utility with a clear understanding of its structures' health and a pathway to informed, data-driven decisions for the future resilience and reliability of its structures. Backed by robust and fully integrated data, Osmose was able to provide efficient, cost-effective restoration and upgrade recommendations compared to the costly and time-intensive replacement option. With this recommendation roadmap, the utility can bring their structures up to current code requirements and enable them to remain in service for decades to come.

To learn more about Osmose's transmission assessment solutions, contact us at steel@osmose.com or visit us at www.osmose.com/transmission-resiliency-solutions.com.

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