

Exo Creates Digital Twins of Century-old Electrical Towers to Determine How to Keep Them in Service

Bentley Applications Accurately Measured Corrosion and Loads, Eliminating the Need to Construct Costly New Towers

TRANSMITTING HYDRO POWER ACROSS THE OHIO RIVER

Talented engineers are discovering ways to make bigger, more efficient, and greener paths to generate electricity. But even the perfect power generation station can't contribute without a reliable means of transmitting that electricity. The Ohio Falls Generating Station, built on the Ohio River in Kentucky nearly a century ago, depends on two vintage lattice towers to transmit electricity across the water. As the towers were built at the same time as the station, they gradually weathered and weakened over time. Utility LG&E and KU Energy realized that they needed to address the situation so Ohio Falls could deliver power for decades to come.

The utility brought in Exo Inc. to determine the best way to address the aging towers. Though an obvious solution would be to construct new towers, the client hoped to avoid that scenario. "The alternative to reuse is to permit, design and build a new crossing in another location at an estimated cost of USD 60 million to 100 million," said Michael Miller, vice president, engineering services at Exo. To prevent that massive expense, Exo had to first determine whether the towers could be restored and kept in service.

WORKING AROUND CORROSION AND OVERSTRESS

After Exo performed a thorough inspection of the two towers, they determined that remediating them would hinge on two key restoration initiatives. The first is reinforcing various steel elements that would not safely meet the structural loading hazards of wind and ice for the crossing. The second is to encapsulate various riveted joints that were suffering from crevice corrosion.

Though their work would require Exo to gather detailed knowledge of every inch of the towers, there was little information available to them. "There are no existing detailed drawings available for these towers, and these towers were one of the first uses of weathering steel prior to the use of the term," said Miller. The organization needed a way to transform individual photographs of the towers into a detailed digital model that would help them determine the best way to repair the steel structures.

ACCURATE CAPACITY MEASUREMENT

Exo soon determined that Bentley's Power Line Systems™ applications would enable them to create an accurate digital twin of the towers, giving them greater insight into their current status. They first incorporated drone-acquired photographs of the site into iTwin Capture, eliminating the need for risky manual inspections.

Using iTwin Capture, Exo obtained accurate measures of the crevice corrosion degradation due to weathering and corrosion. "Crevice corrosion is a common corrosion in bridges and other structures that occur when either painting degrades, or when weathering steel is used without regard to proper connection detailing for wet and dry cycles," said Miller. Using PLS-CADD, they modeled the high-voltage 169-kV transmission line to produce structural loads for the tower models.

PINPOINTING WHERE REPAIRS ARE NEEDED

With an accurate digital twin of the towers, Exo could directly measure the gaps in each gusset plate connection, which were then structurally assessed to help determine the current load capacities of the joints. "The use of PLS-CADD allowed to accurately model the tension, vertical, and transverse wire loads in each of the conductors under a wide variety of weather

PROJECT SUMMARY ORGANIZATION

Exo Inc.

SOLUTION

Transmission and Distribution

LOCATION

Louisville, Kentucky, United States

PROJECT OBJECTIVES

- ◆ To determine how to remediate two century-old electrical transmission towers.
- ◆ To use a digital twin to determine the scope of the repair work needed.

PROJECT PLAYBOOK

iTwin® Capture, PLS-CADD®, PLS-GRID®, PLS-TOWER™

FAST FACTS

- ◆ Two electrical towers that deliver hydro power across the Ohio River had corroded over time.
- ◆ Exo used Bentley applications to accurately measure the state of the towers and their structural load capacities.
- ◆ The digital twin of the towers helped Exo determine where to focus remediation efforts.

ROI

- ◆ Remediating the towers rather than removing them and building new ones saved the client USD 80 million.



“The use of PLS-CADD and PLS-TOWER with iTwin Capture Modeler has saved the utility approximately 80 million dollars on this project and prevented project delays of up to 10 years to obtain permits.”

– Michael D. Miller, Civil/Structural Engineer, Exo Inc.

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conditions, including the National Electric Safety Code (NESC) and utility-specific wind and ice load combinations,” said Miller. The modeled load was then applied to the tower models, enabling them to evaluate their overall capacity and pinpoint areas that needed reinforcements .

Using the results of their analysis, Exo identified an effective solution for addressing corrosion on the towers and extending their life. “The use of creating

a digital twin of both the towers was paramount for this project. It could not have been accomplished in any other way,” concluded Miller. Exo estimates that the cost of remediating the towers will be one-tenth of the cost of fully replacing them, for an estimated savings of USD 80 million. Additionally, remediation required much less time-consuming permits that would be needed for a replacement. Remediation work is now in progress, with zero effect on the continued transmission of hydroelectric power.



The digital twin of the towers helped Exo determine where to focus remediation efforts.



The estimated cost of remediating the towers is just one-tenth of the cost of replacing them.