G&W Electric

Engineered to order. Built to last.

CASE STUDY

Oncor

Understanding Your Power System: A Case Study of One Utility's Approach

The history of power distribution in North America is a tale of innovation, competition and evolution. The AC-DC wars of the late 19th century culminated in the 1893 Chicago World's Fair, where AC power emerged victorious, shaping the future of electrical systems in the United States.

As technology advanced and the demand for electricity grew, underground cabling became necessary, leading to the development of various insulation technologies. By the mid-20th century, high-pressure oil-impregnated cables, polyethylene (PE) cables and ethylene propylene rubber (EPR) cables were introduced, with crosslinked polyethylene (XLPE) cables following in the 1980s and 1990s. This rich history has resulted in a diverse mix of vintage and modern equipment within utility systems, necessitating a deep understanding of these systems to ensure efficient operation and maintenance.

This case study explores how Oncor, a major utility company in North Central Texas, undertook a comprehensive project to document and understand their system with the help of G&W Electric.

The challenge: Gathering Knowledge on Legacy Infrastructure

At Oncor, senior operations maintenance engineer Tina Carson faced the challenge of addressing the decades-long informational gap in the installed system, with documentation dispersed across multiple locations, making it difficult to organize and manage effectively.

The solution: A Systematic Documentation Approach with Multiple Partners

Recognizing the need for a more systematic approach, Carson decided to start fresh, integrating verified historical information into a new system. This led to a project involving G&W Electric and a contractor for site visits to verify and document the company's broad range of installed equipment, as well as its current state of repair.

Defining Project Scope

To achieve a comprehensive understanding of the system, Oncor and G&W Electric defined the project scope to include several key areas of information gathering:

- **Name Plate Information:** Collecting design voltage, pressure rating, serial numbers and the style of termination or catalog number. This information is crucial for tracking maintenance, ensuring proper rating for the HPFF system pressure, and smooth communication with the manufacturer for replacements.

  Design voltage was required to determine which terminations have capacitors and will also require periodic power factor testing. G&W Electric 230kV and 345kV terminations have capacitors. Their power factor values are labeled right on the name plate for easy comparison. This information also helped determine where the design voltage was increased to allow for increased creepage in higher polluted areas.

  Year of manufacture was collected wherever available to allow for accurate aging of the termination. This enabled Oncor to determine if repair parts are available and to gain a better understanding of the expected life remaining of the terminations.

- **Termination Features:** Noting the availability and location of drain valves for dissolved gas analysis and vacuum access during repairs, and associating phases for easy identification in the field.

- **Condition Assessment of Terminations and Stand-Offs:** Documenting any visible failure mechanisms such as arcing, leaks, and cracks. This helps identify trends in issues, such as a higher incidence of cracked stand-off insulators near airports. This can lead to standardization of vulnerable components on the grid.

- **Image Collection:** Capturing visual support of information and condition to create a baseline for monitoring.

- **Overall Count Confirmation:** Ensuring an accurate count of terminations on the system.

Defining Resources

The project required the collaboration of internal Oncor resources and external partners:

Internal Oncor resources included patrol teams responsible for maintenance of substations, providing access and escorting inspectors. Separate engineering teams were designated owners of the information and upgrades of substations, providing support and sign-off from management.

External partners included G&W Electric, which provided technical support, historical records, and double-checked information for replacements. Also coming aboard was a contractor/splicer experienced in identifying and assessing various states of terminations, offering unbiased assessments and explaining findings to Oncor personnel.

Oncor saw many positives from bringing a manufacturer onto the project. G&W Electric was able to provide product manager support, deep knowledge of what information would be needed and the ability to analyze the information. The company also facilitated access to historical records that might be missing from the utility's files. Looking ahead, engaging a main manufacturer enabled Oncor to get quick responses without having to dig for information in case of replacement events. And G&W Electric acted as a double-checking layer for Oncor when ordering replacement parts.

Benefits of adding a splicer to the mix included the contractor's experience with handling terminations in various states, skill in working with internal components and ability to render unbiased assessments. The splicer brought additional know-how on Ohio Brass HPFF terminations, which haven't been manufactured since 1985.

Safety considerations were paramount, with PPE requirements including FR clothing, safety shoes and hardhats. The project team also had to maintain safe working clearances around live equipment, as no outage was taken during inspections.

Once the permissions were obtained, the schedule and route were developed. The engineer utilized her system knowledge to create an efficient route from substation to substation. Patrolmen from each district were assigned to act as project team escorts in their area.

Oncor then aligned timing expectations with splicer inspection and set up communication channels to ensure delays or other concerns would be promptly and properly addressed.

Project Execution

The project kicked off with an on-site meeting at the first substation to align all parties on data-gathering expectations, scheduling, and resources. For each substation, a paper form was completed with details such as substation name, circuit name, serial numbers for each line phase, condition assessments of the termination (including defects discovered, such as arc spots, cracks and leaks) and stand-off insulators. Photos of each termination and overall setup were taken to aid the splicer in repairing and for future installations. This information was then digitized into organized folders for easy access.

The digitized data was then processed by G&W Electric, where the product manager compiled a detailed report with recommendations. The report included a section for each substation, outlining the collected information in a user-friendly format.

Actionable Analysis

The collected data was used to categorize the condition of substations as Good (no visible damage, minor aging, or minor leaks), Fair (signs of aging with minor leaks that need monitoring) or Poor (visible damage such as leaks, cracks or arcing.)

The report included tables summarizing the condition of terminations and stand-off insulators, along with recommendations for replacements where necessary.

For the G&W Electric terminations, the serial numbers were cross-referenced to the G&W Electric drawing numbers and catalog numbers. For the obsolete Ohio Brass terminations, cross references were not available. However, the rest of the information was included if available.

Actionable Analysis

Some terminations had missing identifiers due to damaged nameplates or obstructions. In cases where other units in the grouping were identifiable, educated assumptions about the origin of the others were made based on historical purchasing trends. In cases where none of the terminations in a group could be identified, they were flagged in the report so the utility could inspect for any indicators the next time they took an outage. In the meantime, the terminations were assumed to match the age of the cable installation.

For terminations or stand-offs where replacement would be needed soon, the recommended replacement was outlined. If replacement or maintenance was recommended, pictures showing the damage or leak were included for easy reference.

After the field work was completed, the project team decided to detail if and where valves were located on the termination. This was important to the engineer to help determine if getting oil samples for dissolved gas analysis was possible from the units. This would allow her to develop a sampling schedule as part of routine maintenance. Because pictures of every termination were already in hand, that change was easily implemented.

Results and Impact

Upon receiving the detailed report, Oncor's engineering team reviewed the findings and held a conference call with G&W Electric's product manager for a clarifying walk-through. The report provided a consolidated view of the system, offering valuable insights into the condition of terminations and guiding maintenance and replacement schedules.

The project also highlighted the importance of a systematic approach to documentation and the value of collaboration with knowledgeable partners. Oncor integrated the collected information into their central database, creating templates for future projects to maintain up-to-date records.

As a result of the project, Oncor established annual training of its patrols to understand the substation components and streamline the incoming data on their status. The utility also placed terminations on a maintenance cycle following current maintenance best practices.

Important Lessons Learned

Critical lessons emerged from the project in the following areas:

Pre-Inspection Preparation: Ensure clear communication of expectations and template information between all parties. That means asking about template information being used by the contractor, having meetings focused on expectations prior to field data collection, and discussing expectations for the final report, including format.

Fieldwork Adjustments: Review images after the initial data-collection outings to set team expectations and make any needed adjustments in approach. Deploy cameras with strong zoom capabilities for places where ladders are not present. Err on the side of budgeting extra time for the data collection and analysis.

Future Inspections: Utilize drones for riser structure inspections to gather more comprehensive data.

Via discussions with G&W Electric, Oncor gained a better understanding of the serial number format and the information it provides. G&W Electric also provided education on failure mechanisms to help Oncor identify early signs of aging terminations, enabling them to schedule replacement projects and order terminations without facing the higher fees associated with expediting projects.

Obtaining a better understanding of its system assets provided additional benefits to Oncor as well. Working with the manufacturer provided a double-check on correct replacement equipment ordering and expedited response times during failures.

Starting fresh with a systematic approach offered a current snapshot of Oncor's installed infrastructure base, providing up-to-date information they now use to better manage upgrade and repair schedules. This approach reduces the need for reactive measures, saving time and money over the long term.

Proof of Concept

Understanding your power system is critical for efficient operation and maintenance. Oncor's project to document and assess their system, with the help of G&W Electric and a splicer contractor, demonstrated the importance of a structured approach to information gathering and analysis.

By leveraging internal resources and external expertise, Oncor was able to gain valuable insights into its own legacy systems, streamline maintenance practices, and ensure the long-term reliability of its power system. This case study confirms the significant short- and long-term benefits utilities can gain from thorough system mapping and proactively managing on-grid infrastructure upgrades and replacement—with the right partners supporting the journey at every step.

AUTHORED BY
Tina Carson – Oncor
Kate Thompson – G&W Electric

CONTACT US
305 West Crossroads Pkwy
Bolingbrook, IL 60440 USA
Phone: 708.388.5010 | Fax: 708.388.0755

www.gwelectric.com

G&W Electric
Engineered to order. Built to last.

GWCS36-2024 09/2024