Bonneville Power Administration Uses Daytime Corona Camera to Pinpoint Faulty Transmission Line Insulator

Success Story

The EPRI daytime corona detection camera enabled Bonneville Power Administration staff to identify a damaged interphase spacer by detecting corona that was otherwise invisible to inspectors.

Replacing the problem component during a scheduled maintenance outage helped avoid a costly failure that may have disrupted power system operations and customer service across a large portion of the Pacific Northwest.

As a predictive maintenance tool, the daytime corona can help utilities reduce maintenance costs while increasing service reliability.

"The daytime corona detection camera enabled us to identify and replace a faulty interphase spacer on a 500kV transmission line. Without this technology, we would not have been able to see the corona that indicated the presence of a damaged component." —Donald Ruff, Bonneville Power Administration

The Challenge

Maintenance costs are among the largest expense items in operating overhead transmission systems. Detecting faulty power system components before they cause problems helps reduce maintenance costs and improve reliability. Inspecting in-service equipment can be challenging, especially in cases of difficult-to-access transmission line components suspended high over inhospitable terrain. One telltale indicator of faulty components is corona or arcing activity—an electrical discharge that can cause damage to insulators, especially polymer (nonceramic) insulators. Discharge activity is nearly impossible to see in daylight, however, and night viewing is impractical and expensive.

The Solution

To help determine the condition of in-service transmission components, BPA turned to advanced technology—a daylight corona detection camera. The EPRI-developed camera lets users see corona during the daytime, enabling utility staff to perform in-service inspections and identify faulty components before they can lead to costly failures.

BPA recently used the camera to inspect components on its 500 kV Colstrip line, a three-phase double circuit line that carries power from Montana to Washington across the peaks and canyons of the Rocky Mountains. Crossing

the rugged landscape requires long spans between towers, and the structures face punishing winds. To protect the conductors from the effects of high winds, BPA installed polymer insulators between phases. These interphase spacers keep the conductors safely separated to prevent galloping and flashover that could cause mechanical and electrical failure. Because these spacers perform a critical role, inspecting their condition is essential—yet virtually impossible with conventional visual techniques. At the distances involved, binoculars and spotting scopes cannot detect small cracks or other defects that could lead to insulator failure—and perhaps to a costly forced outage.

Using the daytime corona camera, BPA staff clearly saw corona and arcing activity at one of the interphase spacers. During a scheduled maintenance outage, a maintenance crew used a spacer cart to replace the component—which proved to be cracking and deteriorating.

Further deterioration of the interphase spacer could have led to mechanical or electrical damage and possibly widespread disruption to the power system.

Instead, removing the cracked component from service will allow BPA and EPRI to investigate degradation mechanisms and apply the lessons learned to future preventive maintenance efforts.

Applications

The daylight corona camera supports preventive maintenance programs by detecting corona and arcing on overhead transmission and distribution lines and in substations. This reduces maintenance costs, minimizes unscheduled outages, and improves reliability. The camera can also locate sources of radio frequency interference and audible noise.

The camera works by blocking out sunlight and then capturing images of both the corona discharge and the object under investigation. A bi-spectral imaging process then superimposes the corona image on the object image to pinpoint the location of the discharge. The camera's high sensitivity and narrow field of view enable long-distance operation, allowing inspection of components that are difficult to access.

Guidelines

To help users to successfully apply the daytime corona camera, EPRI's Dr. Andrew Phillips has developed two practical references: *Guide to Corona and Arcing Inspection of Transmission Lines* (1001910) and *Guide to Corona and Arcing Inspection of Substations* (1001792).

These guidebooks present catalogs of discharge activity, infrared, and visual images that illustrate various conditions commonly affecting components used in transmission lines and substations. The guides are designed to aid utility field crews in assessing the condition of components, identifying specific problems, and determining a course of action based on a daytime corona inspection. The guides are also valuable tools for utility managers to use when considering whether to incorporate the daytime corona detection technology into a maintenance program.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

Technical Contact

Andrew Phillips, Program Manager, Transmission
704.595.2234 (aphillip@epri.com)

1014525 October 2006

Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304 • PO Box 10412, Palo Alto, California 94304-1338 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com