

WESTCO Electrical & Equipment Corp. Case Study

Proactive Fault Detection in High-Voltage Assets with Doble Spark P3



The Challenge

A major national grid corporation responsible for **high-voltage** power transmission was facing the critical challenge of ensuring the long-term reliability of its electrical assets, including **power transformers**, **switchgear**, and **generator** components. Traditional **offline testing** methods for the detection of insulation **system deterioration** required taking equipment out of service (**downtime**), were time-consuming, and could miss intermittent or incipient faults.

The primary technical challenge was the accurate and reliable detection of **Partial Discharge (PD)** activity in energized equipment (i.e., **in-service testing**). PD—a localized dielectric breakdown of a small portion of a solid or fluid **electrical insulation system**—is a well-established **precursor to failure** that can lead to catastrophic **short circuits** and extended system **outages**. The utility needed a universal, portable, and highly sensitive diagnostic tool to:

- ①  Perform **periodic maintenance** and assessment on a wide range of assets.
- ②  Accurately measure the **magnitude** and identify the **pattern** of PD signals despite high levels of **Electromagnetic Interference (EMI)** and background noise inherent in a substation environment.
- ③  Differentiate true PD activity (e.g., **void discharge**, **slot discharge**) from non-threatening **nuisance signals**.

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The Solution

The utility selected the **Doble Spark P3 Universal Partial Discharge (PD) and Electromagnetic Interference (EMI) Analyzer** for its advanced and versatile diagnostic capabilities. The Spark P3 is an **in-service testing** instrument that utilizes a **Software Defined Radio (SDR)** detector, enabling it to measure a wide frequency spectrum from **9 kHz up to 2 GHz**.

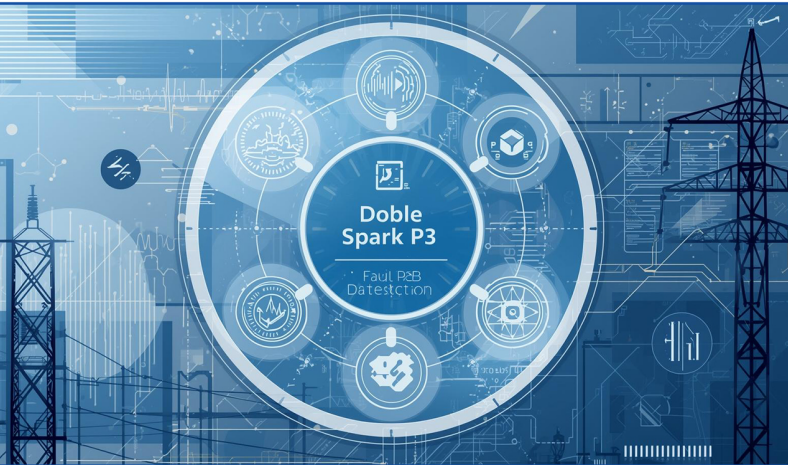
The implementation involved the following key technical aspects:

- ✓  **Universal Sensor Compatibility:** The Spark P3's wideband detection range allowed the utility to use a variety of sensors on different assets, including **High Frequency Current Transformers (HFCT)** on ground connections, **UHF antennas** for switchgear and power transformers, and **Acoustic Emission (AE)** sensors for pinpointing discharge locations (acting like a "stethoscope" for the equipment).
- ✓  **Advanced Analysis Modes:** The equipment provided essential diagnostic data through various modes, including **Spectrum Analysis**, **Time-Resolved Analysis**, and, most critically, **Phase Resolved Partial Discharge (PRPD) Analysis**. The PRPD analysis was key to helping the engineers visualize the PD pulse distribution relative to the AC power cycle, allowing for effective **differentiation of partial discharge and nuisance signals** and classification of the specific fault type.
- ✓  **Automatic Signal Classification:** To aid field engineers with varying levels of expertise, the Spark P3 incorporates an **automatic signal classification system**. This feature simplifies the process of distinguishing genuine PD from external EMI, ensuring reliable and actionable results without requiring deep expert data interpretation for every reading.
- ✓  **Portability and Ruggedness:** As a lightweight, battery-operated, and ruggedized device, the Spark P3 was ideal for **on-site settings** across the extensive transmission grid, facilitating rapid deployment and testing during routine **Preventive Maintenance (PM)** schedules.

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The Impact

The deployment of the Doble Spark P3 resulted in significant improvements to the utility's asset management and maintenance strategy.

Business Result:

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Minimization of Unplanned Outages and Downtime: By detecting incipient faults—the **partial discharge**—before they escalated into a complete **dielectric breakdown** (short circuit), the utility could schedule repairs and asset replacements proactively during planned maintenance windows, drastically reducing the risk of costly, unscheduled **outages**.
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Enhanced Maintenance Efficiency: The **guided mode** and **automatic signal classification** reduced the time required for data acquisition and interpretation. This allowed maintenance teams to test more assets in less time and ensured that less-experienced operators could obtain **reliable results**.
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Optimal Capital Expenditure Planning: Accurate diagnostic data from the Spark P3 provided objective evidence of which assets were at the highest risk of failure. This data informed better planning for capital expenditure, ensuring that critical replacement or repair funds were prioritized for the most compromised assets.

Technical Result:

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Early Fault Detection and Severity Assessment: The Spark P3 successfully identified multiple high-magnitude PD sources in various assets (e.g., at cable terminations and in rotating machinery). By providing a clear **PRPD pattern** and **magnitude** reading, engineers could accurately determine the **severity** and nature of the underlying **insulation system deterioration**. This allowed the utility to move from reactive to truly **condition-based maintenance**.
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Effective Noise Suppression: The wide **frequency range** and advanced signal processing enabled technicians to effectively locate frequency ranges with minimal interference, significantly improving the **signal-to-noise** ratio and securing accurate **PD pulse** readings even in noisy substations.
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Comprehensive Asset Diagnostics: The universal capability allowed the same tool to be used for diagnostic sweeps across the entire fleet of **high-voltage assets**—from **generators** to **GIS (Gas-Insulated Switchgear)**—standardizing the diagnostic procedure across the grid.



Conclusion:

The Doble Spark P3 has proven to be an indispensable tool for the **in-service assessment** of **high-voltage electrical assets** within the national grid corporation. By delivering highly sensitive, wide-spectrum detection and advanced **Phase Resolved Partial Discharge (PRPD)** analysis, it transformed the utility's approach to **insulation system diagnostics**. The capability to detect and classify **partial discharge** activity in energized equipment provides the crucial early warning necessary to prevent catastrophic failure, ensuring system reliability, minimizing expensive **downtime**, and enabling a robust **condition-based maintenance** program.

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