

Partial Discharge Testing for Cables

- *Performed online without disrupting plant or facilities, or offline when required*
- *Non-destructive, non-invasive predictive maintenance tool*
- *Optimizes capital expenditures and improves system reliability*
- *Helps eliminate unplanned outages and lost profit as a result of system downtime*
- *Identifies and prioritizes cable sections and terminations for replacement*
- *Focus on the right cables for targeted investment - minimizes unnecessary spending*



Condition Assessment of Cables

Partial Discharge can occur at voids, gaps and similar defects in medium and high voltage cable systems. If allowed to continue, partial discharge will erode the insulation, usually forming a tree-shaped pattern of deterioration (electrical tree) and eventually result in complete breakdown and failure of the cable or accessory. Such failures cause unplanned power outages, loss of plant production, equipment damage, and/or personnel injury. Data obtained through Partial

Discharge testing and monitoring can provide critical information regarding the quality of insulation and its impact on cable system health. By detecting and trending partial discharge, it is possible to observe its development over time in order to assist asset managers with strategic decisions regarding the repair or replacement of the cable—prioritizing capital and MRO investments before an unexpected outage occurs.

Integrated Partial Discharge Solutions for Cables

Emerson's integrated Partial Discharge testing and monitoring solutions include both online and offline testing, and periodic and continuous monitoring of your cables. Depending on your specific operating requirements and application, Emerson can customize a program that best fits your needs. Choose from the following:

- *Online Partial Discharge Testing*
 - *Handheld Survey*
 - *Periodic Partial Discharge Testing*
 - *Continuous Online Monitoring*
- *Ultrasonics*
- *Offline Partial Discharge Testing*
- *Tan Delta*
- *Very Low Frequency Testing (VLF)*

Problem Identification

Using our integrated Partial Discharge testing and monitoring solutions, our test engineers can identify:

- *Defective Cable Insulation*
- *Location of Defects*
- *Extent of Insulation Degradation*
- *Defective Splices*
- *Defective Terminations*

Measuring Method

Performed on XLPE, EPR, PILC and CLX Armored Cable, the measuring method applied is capable of detecting and localizing discharges in any cable lengths in medium and high voltage cable circuits from 4kV up to 345kV.

Innovative Technology

Emerson's innovative technology is the most advanced, flexible and robust technology on the market today, suitable for both online and offline testing. PD measurements are made using a range of calibrated sensors that are either inductively, capacitively or acoustically coupled to the cable. Signals are captured synchronously across the 60 Hz power cycle via our test application enabling the test engineer to observe phase-related patterns of discharge, online and in real-time. Emerson's analysis application provides an automatic PD criticality level for the cable based on magnitude and number of PD pulses per power cycle. Our equipment also includes a built-in RF noise reduction function, separates the pulses into PD type (cable PD, switchgear PD, etc.) while automatically sorting out electrical "noise" pulses using a single frequency spectral subtraction to reduce RF noise. The online cable PD mapping technology enables the accurate detection of PD location to an accuracy of less than 1% of the cable length up to approximately 3 miles of cable. This mapping technology applies the same Time-Of-Flight (TOF) analysis of PD signals as used in the offline cable PD location methods, with the key advantage of being able to be conducted online.

Online Partial Discharge Testing

Performed without disrupting plant or facility operations, Emerson's Online Partial Discharge testing is a non-destructive, non-invasive

predictive maintenance tool that assesses the condition of aging cable systems including splices and terminations. With Emerson's innovative online technology, accuracy is improved through the use of the cable PD mapping software and by testing multiple points of attachments over shorter cable lengths—not a viable option with offline testing. Another distinct advantage is its ability to test branched circuits on network feeders. And, the cost to perform online testing is relatively inexpensive compared with offline testing that requires interruption of service and production. For critical facilities that operate 24x7, this is perhaps the single best option for detecting insulation condition.

Other online testing and monitoring solutions for cables include permanently mounted sensors for "hard to access areas" or areas that pose a safety concern, short-term continuous monitoring for those cables that require monitoring under load for an extended period of time, and permanent continuous monitoring systems for the most critical cables in your system—including those that are nearing the end of their useful life, or have demonstrated high levels of partial discharge through other testing methods.

Ultrasonics

All electrical equipment produces a broad range of sound. The basic electrical problems that produce distinct ultrasound waves that can be detected by Ultrasonic Testing include partial discharge, corona and tracking. Ultrasonic

measurement is most powerful on a comparative basis and will significantly increase the reliability of correct detection of partial discharge when used with other Emerson online partial discharge testing technologies.

Offline Partial Discharge Testing

Offline Partial Discharge Testing offers a significant advantage over other technologies because of its ability to measure the cable system's response to a specific stress level and predict its future performance without creating a fault. Offline testing is also known for its ability to pinpoint the exact defect location on field-aged cables, enabling the asset manager to accurately plan for maintenance and/or repair. Offline testing is also commonly used in conducting acceptance testing on newly installed equipment. For systems already in service, the challenge is that the equipment must be taken out of service for the test to be performed. When de-energization is preferred, Emerson can conduct offline testing as part of your predictive maintenance program.

Tan Delta

Another offline testing solution for cables includes Tan Delta testing which is a diagnostic tool that can measure the level of deterioration of the cable and be able to predict the life expectancy. It is also useful for rating your cables on a scale from high quality to low to enable the asset manager to prioritize cable repair and/or replacement. A significant advantage of Tan Delta testing is that it can detect Water



trees, which are a major original source of insulation failures in aged extruded cables.

Very Low Frequency Hipot Testing (VLF)

VLF is primarily used to evaluate insulation deterioration in cables and is one of the least expensive ways to check the AC integrity of cables to determine pass or fail which is often the first level of testing asset managers do to prioritize cable condition for maintenance decisions.

Site Visit

The site visit is performed by our technical staff and includes a comprehensive review of an up-to-date electrical single line diagram and a physical check of your cable systems including splices and terminations. The actual characteristics and partial discharge activities are monitored

and recorded in accordance with the test plan. Once all the measurements have been taken, offsite data analysis is performed to correlate measurements to the single-line drawing and analyze actual PD signatures.

Report of Findings

Upon completion of the site visit, data collection and analysis, we will provide a written engineering report containing detailed information about the test results, the condition of your cable and accessories, recommendations for prioritizing replacement or corrective actions, and a proposed follow-up testing schedule. Each cable tested will be rated green, yellow, orange, or red and a recommended action will be provided. The measured PD magnitude will also be documented for trending purposes.

PLIC Cables	0 pC - 3,000 pC	Discharge within acceptable limits
	3,000 pC - 6,500 pC	Some concern, monitoring recommended
	6,500 pC - 10,000 pC	Some concern, regular monitoring recommended
	> 10,000 pC	Major concern, repair or replace

XLPE Cables	0 pC - 250 pC	Discharge within acceptable limits
	250 pC - 350 pC	Some concern, monitoring recommended
	350 pC - 500 pC	Some concern, regular monitoring recommended
	> 500 pC	Major concern, repair or replace

PD Tolerance Levels for MV Cables

Maximize Uptime

Partial discharge testing plays a critical role in determining the health of your electrical assets and ensuring maximum uptime. Partial discharge testing provides asset managers with the critical information to target maintenance resources to the areas that require the most attention.

Depending on your specific operating requirements and application, Emerson can help you develop and implement the right combination of technology, online or offline, to meet your maintenance requirements. Improve operational efficiency and worker safety by working with the experts at Emerson.

Emerson—Your Partner in Reliability

From installation to operation, only Emerson has the knowledge and experience to seamlessly integrate all the essential services to deliver “high nines” reliability required by today’s critical facilities. Look to us as your partner. We’ll be with you every step of the way with the right combination of technology, people, and services. Contact Emerson to realize the true potential of your assets.

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