The Power of Permanently Installed HFCT Sensors

As online partial discharge (PD) detection becomes a standard practice in the electrical industry, more networks are investing in sensor technology that enables continuous condition monitoring without supply interruptions.

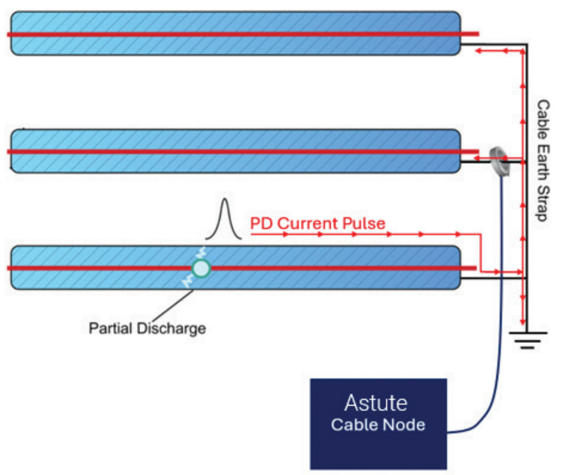
One effective method is the application of permanently installed High-Frequency Current Transformer (HFCT) sensors. Traditionally, HFCT sensors are clamped around the earth screen of a high-voltage (HV) termination and used to detect PD in both switchgear and HV cables.

However, accessibility to the HV earth screen presents a challenge. In many modern switchgear designs, HV terminations are earthed within the cable chamber, limiting direct access to the attached HFCT. To overcome this, many companies are opting for permanently installing HFCT sensors within the cable chamber.

INTEGRATION WITH PD TESTING PROGRAMS

When permanently installing HFCT sensors, it is essential to consider their integration into an existing partial discharge testing program. For point-in-time testing, where switchgear and cables undergo annual PD assessments, HFCT sensors enhance testing accuracy by providing consistent and repeatable data. This enables asset managers to design targeted test programs focused on either HV cable runs or associated switchgear, ensuring a more precise evaluation of network health.

When HFCT installations are widespread, they enable online cable mapping, which provides a comprehensive assessment of HV feeder health. By mapping entire feeders, asset managers can generate a network heatmap, allowing for better localisation of PD defects and a more strategic approach to maintenance planning.



A key advantage of this approach is the significant reduction in false positives. Since permanently installed HFCT sensors allow for consistent and repeatable measurements, asset managers can differentiate between actual PD activity and external noise or transient signals. This minimises unnecessary interventions and ensures that maintenance plans are focused on genuine defects, improving network reliability and reducing operational costs.

By integrating HFCT sensors into a routine condition monitoring program, asset managers can collect consistent, high-quality data, facilitating accurate PD trend analysis over time.

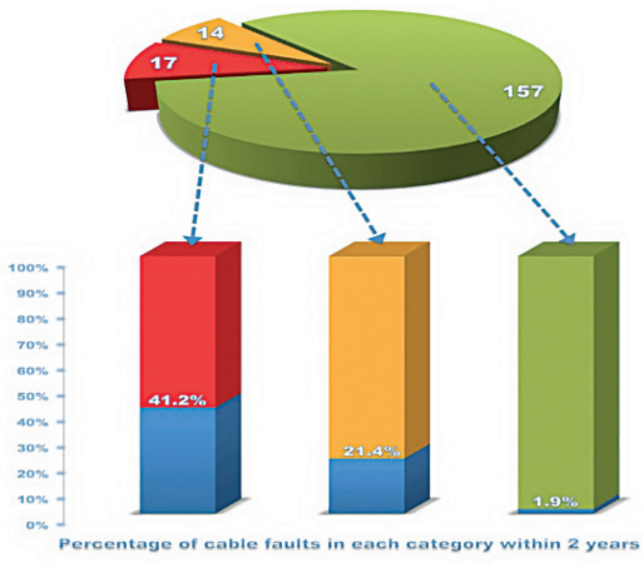
Permanently installed HFCT sensors support both periodic testing and continuous monitoring. During testing, data filtering can be applied to focus on either switchgear or HV cable runs, providing an unmatched level of diagnostic control. Few other PD testing methods offer such flexibility, making HFCT sensors an invaluable tool for long-term asset management and network reliability.

A NETWORK CASE STUDY

A network operator used this methodology to test 191 33kV cables with the EA Technology Cable Data Collector. The results were categorised as:

- **Green:** No PD detected
- **Amber:** PD detected; retesting recommended in 6 months
- **Red:** High PD levels, indicating significant degradation

Over a two-year monitoring period, 41% of cables in the red category and 21% of cables in the amber category experienced failures. In contrast, only 1.9% of cables in the green category failed.



These findings confirm that HFCT-based testing provides high-quality condition monitoring data, empowering asset owners to prioritise maintenance and replacement plans, enhance network reliability, and reduce maintenance costs.

MONITORING CRITICAL ASSETS WITH 24/7 HFCT SENSORS

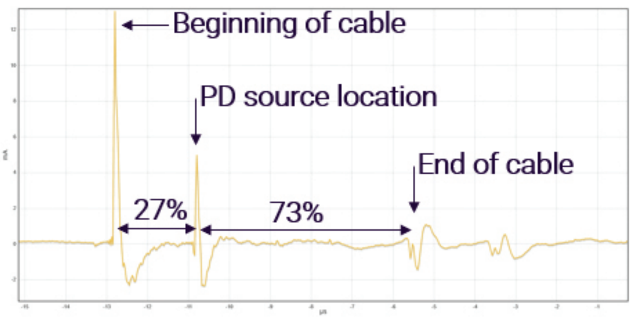
Beyond periodic testing, permanently installed HFCT sensors enable continuous monitoring of known PD sources and provide network-wide risk reduction when installed at primary substations. By integrating an Astute Monitor as the data capture device, asset owners can track real-time PD trends, ensuring early identification of evolving defects before they lead to failures.

The true value of HFCT monitoring lies in its ability to provide detailed waveform analysis, allowing asset managers to differentiate between PD types, severity levels, and defect locations. By examining PD waveform characteristics—such as pulse magnitude, repetition rate, and phase-resolved patterns—it is possible to distinguish between internal, surface, or corona discharge and assess the progression of degradation over time.

When applied to a known PD source, real-time data significantly improves outage planning. Asset managers can closely monitor the degradation rate of identified issues, allowing them to adjust maintenance schedules—either accelerating planned outages to prevent failure or deferring work if conditions remain stable. This data-driven approach helps optimise maintenance resources while improving network reliability.

Long-term monitoring of critical assets also makes it possible to detect early-stage degradation that might otherwise go unnoticed. In the initial phase of deterioration, some PD issues are only active for minutes or hours per day, making them difficult to capture through periodic testing alone. A 24/7 monitoring system ensures these intermittent issues are identified early, allowing them to be trended and analysed until they reach a stage where intervention is required.

This proactive approach supports optimised maintenance strategies, ensuring repairs are timely yet cost-effective, ultimately reducing overall network maintenance costs while enhancing asset longevity.



CONCLUSION

Permanently installed HFCT sensors provide a cost-effective solution for detecting and monitoring partial discharge in high-voltage networks. By enabling both periodic testing and continuous monitoring, they enhance asset reliability, reduce failures, and support proactive maintenance—ensuring a smarter, more resilient power network with optimised operational efficiency. T&D

Contact EA Technology for more information
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