Client Reference

Wind Farms | Online PD and Offline (VLF, Tan-Delta, PD) Assessments - Ensuring Plant Availability and Reliability

Condition monitoring ensures stability, long service life and reliability of critical assets. This is achieved through identifying component damage and/or wear before complete failure, thus avoiding equipment downtime and costs associated with replacement parts.

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Client Background

Martec conducted comprehensive online partial discharge (PD) and offline (VLF, tan-delta and PD) assessments at two wind farms in southern Africa. One wind farm can generate approximately 341,000 MWh of renewable energy annually, preventing around 384,000 tons of carbon emissions from fossil fuel power plants.

Conducting condition assessments at these plants to ensure continuous and reliable operation is paramount.
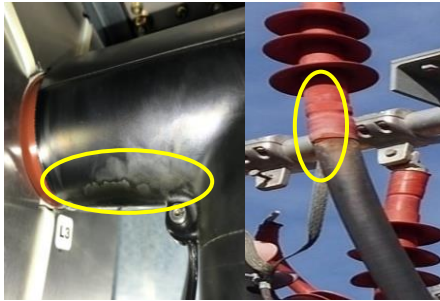
Key Challenges

- Contamination and moisture ingress can lead to partial discharge.
- Circulating currents on single-core cables due to improper installation.
- Medium voltage (MV) joints and terminations not installed under quality assurance processes can lead to premature equipment failures.

Findings and Observations

- Well-defined PD patterns were identified during the online assessment.
- Visual inspections identified signs of PD on the "C" type connectors.
- Signs of leakage current defects were identified on the terminations of the main transformers.
- PD levels higher than acceptable limits were detected during the offline assessment of the cables.

Value Add

- The online assessment was conducted with the plant running normally, thus not negatively affecting production targets.
- More advanced technologies that can detect electrical discharges within the switchgear and terminations were utilised.
- The VLF, tan-delta and PD assessment detected defects from cable terminations.
- Visual inspection identified defects before they could turn into failures.
- Risk condition levels were assigned to the assessed components.
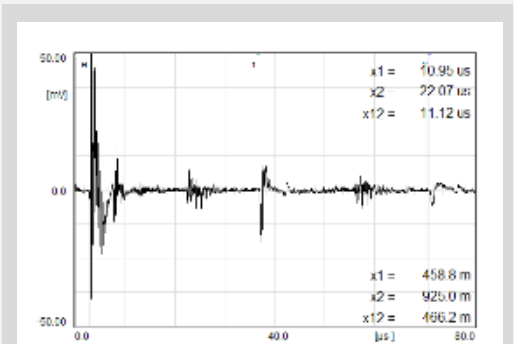
Calculated cable length was 925m at 77m/µS

Martec Intervention

- Martec conducted a comprehensive online PD assessment using advanced technologies to ascertain the overall condition of the plant.
- A visual inspection was done to identify signs of PD on the assessed components.
- On another wind farm, Martec conducted an offline (VLF, Tan-Delta and PD) assessment on feeder cables.
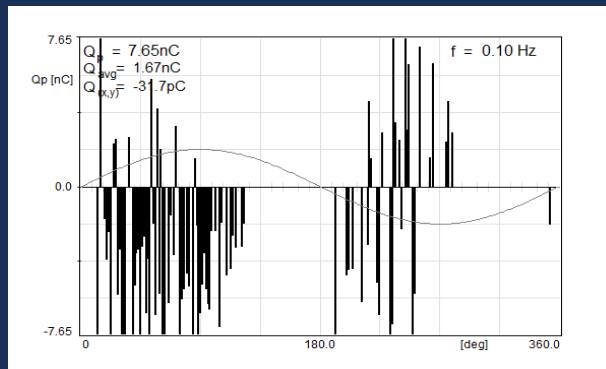
PD levels of up to 3825pC were detected coming from the cable terminations.

Tools and Technology used

- Partial Discharge System Analyser (PDFSA)
- Ultrasound
- Visual inspections
- Open-end PD sensors
- Offline (VLF, tan-delta and PD) test equipment
- Implementing risk interpretation guidelines

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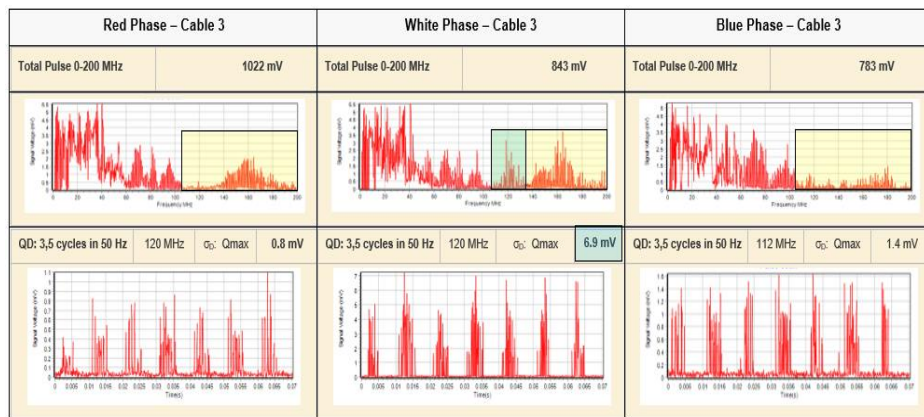
We use advanced technologies like VLF, tan-delta, and PD assessments to detect defects in cable terminations without disrupting production. Our proactive approach, including visual inspections and risk assessments, ensures operational excellence and minimises downtime.

Risk Level	Condition	Recommendation	Actions
Level 0 Conduct Assessment	No assessments were conducted. Condition Unknown	Implement periodic 6 monthly condition assessment	6 monthly data acquisition, analyse raw data and compile technical reports.
Level 1 No PD Acceptable	No deterioration detected and the insulation condition is in a health status.	No immediate action is required. Visual inspect during scheduled maintenance.	6 monthly data acquisition, analyse raw data and compile technical reports.
Level 2 Low – Moderate Acceptable	Low deterioration detected within the insulation system..	Visual inspect during scheduled maintenance.	6 monthly data acquisition, analyse raw data and compile technical reports.
Level 3 Moderate – High Warning	Moderate deterioration of the insulation system placing the insulation condition in a warning status.	Visual Inspect during scheduled maintenance.	6 monthly data acquisition, analyse raw data and compile technical reports.
Level 4 High Action Required	Advanced deterioration of the insulation system. High electrical discharges were identified.	Repair or replace defected components. Re-assess on completion of repairs.	Inspect and investigate the defects as soon as possible to avoid premature failures.
Level 5 Major Intervention Required	Major deterioration of the insulation system. Destructive electrical discharges were identified. Poor status.	Repair or replace defected components. Re-assess on completion of repairs	Inspect and investigate the defects as soon as possible to avoid premature failures.

Throughout the years, it has been proven that PD indicates danger to the life of insulation. PD measurement is one of the most important diagnostic methods used to indicate insulation condition. It should be noted that these condition levels are based on Technical Papers and Martec's own experience of partial discharge and partial arcing assessments, around the world and are not based on single absolute or definitive figures as there are many interrelated factors. The levels given are meant as a guideline only, dependant on voltage levels, insulation material properties and operating conditions. They do nevertheless provide a basis for developing a risk indication for in-service HV and MV plant.