

Case Study

Mining | Tronox | Offline Assessment of 33kV Cables



Cable condition assessment involves some form of electrical tests that are usually performed on de-energised (offline) and energised (online) cable systems. There are several cable insulation tests available which include, very low frequency (VLF), partial discharge (PD) and tan delta (TD).



Client background

The client is a vertically integrated producer of titanium dioxide and inorganic chemicals. This is achieved by mining and processing titanium ore, zircon and other materials.

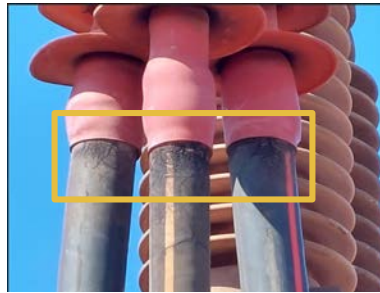
Electricity is used for many purposes in this type of business, where the required electrical power is obtained through a substation. Should the client experience downtime of the 33kV electrical plant, the result would be a loss of production and severe repair or replacement costs.

As a result, Martec was called out by the client to conduct a comprehensive assessment of the 33kV cables. An online assessment was conducted using Martec's partial discharge frequency system Analyser (PDFSA) technology. The assessment results revealed high partial discharge (PD) activity in the terminations. This was verified by an offline PD test involving switching the circuit off and testing it while energised by a test set. This allows the user to measure the cable insulation system's response to a specific stress level as voltages can be raised to multiples of U_0 (nominal voltage to earth).

Key challenges

Signs of treeing, which could be related to tracking discharges, were identified on the 33kV cables.

Sometimes the cable jacket is compromised during installation or handling of the cables. A damaged jacket is often a first indication that further problems may be encountered.



Water ingress in the cable causes neutral or shield corrosion and water tree development, eventually leading to premature cable insulation failure.

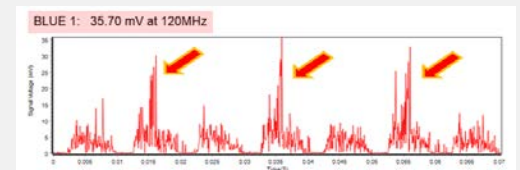
Value add – online assessment

- The online PD assessment was conducted using cost-effective PDFSA technology, identifying defects before they become failures.
- High PD signals detected during online condition assessment should prompt an investigation by visual inspection.

Value add – offline assessment

- **PD Mapping** displays the measured PD level in a location-resolved way over the length of the cable.
- **Tan Delta (TD)** is a measure of the dielectric's ability to withstand breakdown and a measure of the dielectric losses. The recommended procedure for TD testing would be for the voltage to be first set at $0.5U_0$ and then raised to $1.5U_0$ in increments of $0.5U_0$. A maximum withstand value at $2U_0$ may also be used as a final testing step.

PDFSA signals – termination PD activity



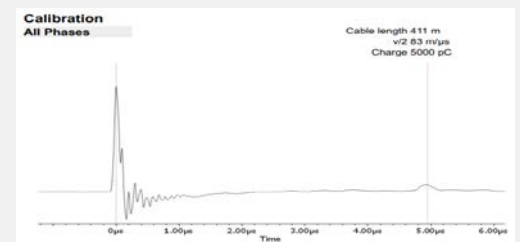
Martec intervention

Martec conducted a comprehensive online assessment using the advanced partial discharge frequency system analyser (PDFSA) diagnostic system in conjunction with ultrasound condition assessment technology. The results revealed high PD activity on the cable terminations. This prompted a visual inspection which identified signs of PD activity in the form of treeing on the cable terminations. In addition, an offline (VLF, Tan-Delta, PD) assessment was conducted to verify the condition of the cable's insulation system in response to the voltage being raised to multiples of U_0 . A final recommendation was made that these terminations should be closely monitored by conducting online PD assessments on a six-monthly basis until replacement is required.

Tools and technology used

- Partial discharge frequency system analyser (PDFSA)
- Ultrasound scanning
- Offline (VLF, TD and PD) test set
- Visual inspections

Offline assessment results



PD mapping

