

ON-LINE PARTIAL DISCHARGE CABLE MAPPING

Without maintaining a periodic testing program all failures will come as a surprise, unplanned, inconvenient and quite possibly very expensive in time and resources.

With recent world wide turmoil in the financial markets, new electrical upgrades may go on hold; this has the effect of having to rely on existing aged electrical networks. International demand for Coal, Oil and Petrol, Iron ore, Gold, Alumina, Aluminum, Nickel, LNG, Copper, Iron and Steel, and Dairy products, all rely on High Voltage systems that had a design life of 25 years, 25 years ago!

PREVENTATIVE MAINTENANCE PROGRAM

If diagnostic insulation testing had been included in the preventive maintenance program it may have been possible to plan maintenance or replacement of these cables at a time when the line was inactive thereby minimising costs.

Using 'On Line Partial Discharge Cable Mapping' means testing high voltage assets such as underground cables, through joint, switchboards and terminations while the circuit is still in-service, with no interruption to the operation.

ARRANGE ALTERNATIVE SUPPLY

By undertaking an annual inspection program it is now possible to predict when to switch out a HV cable before it fails. To example, arranging alternative supply in advance is a smart move, especially when a mine is working beneath the natural water table and relies on pumping water to keep their mine operational and dry!

ANNUAL TESTING PROGRAM

1. A yearly program of On Line Partial Discharge cable and switchgear surveys / mapping is carried out on substations on a rotational bases.
2. In the second year a sample of the previously surveyed HV assets (cables and switchgear) should be resurveyed to maintain confidence in the results of previous tests. This will provide on-going trending and build a case history of the particular cable and its ageing characteristics. Critical cables whose failure is costly due to production deadlines and plant downtime should be tested more often in conjunction with other assets that were not surveyed the previous year.

CASE STUDY

A recent On Line Partial Discharge Survey of a coal mine operation in Australia showed an 11kV feeder with two locations of high partial discharge. By using PD detection and mapping of cables it was possible to locate the source of this discharge:

- One source was a pitch filled joint,
- The second source was a pending termination switchgear failure.

We advised the client that the termination in the switchgear had a higher probability of failure compared to the paper lead pitch filled in-line joint. A planned outage occurred and the suspect termination was replaced. A second PD survey carried out showed the levels of Partial Discharge had reduced. This allowed rescheduling of repairs to the joint until suitable access / loading had dropped (It was not possible to cut off the load to the cable).

SUMMARY

Operations were then advised of the pending power failure. This allowed Operations to offload the feeder concerned, and back supply



Figure 1 Failed termination located by Partial Discharge Engineers. Failing to locate this in a timely manner would have resulted in Figures 2 & 3 occurring.

load via a healthy electricity supply, leaving electrical maintenance crews to attend to defects identified in the Partial Discharge report. Shift Roster Superintendent comments: "Having a planned shift roster, without an unplanned electrical outage is a shift bosses dream!" The alternative approach is not to use this field service and face the following consequences:

- The damage caused by a termination failure can be catastrophic and in most cases will cause a forced outage on the entire HV switchboard. (See photos of damage HV switchboard caused by a termination failure below).



Figure 2 Termination failure, lead to entire HV switchboard failure (The rust is caused by foam used by the fire brigade)



Figure 3 Remains of failed termination (Original cause of failure)