

# THE BLACK ART OF DETECTING PARTIAL DISCHARGE

*Detecting Partial Discharge (PD) requires extensive experience and equipment suitable to undertake measurements on live In-Service High Voltage Equipment. This was put to the test recently in one of Australia's largest underground mines.*

**H**ow do you keep the Australian commodity exports running whilst maintaining an aging system? International demand for Coal, Oil and Petrol, Iron ore, Gold, Alumina, Aluminum, Nickel, LNG, Copper, Iron and Steel, Dairy products, all rely on HV systems that had a design life of 20 years, this was 10 years ago!

Any supporting infrastructure that reduces or stops the mine from recovering ore in times of a mining boom has a far greater financial effect in real dollars per hour, compared to mining in normal times.

The question being asked is "How do we manage the remaining asset life for the next 15-20 years, on existing assets?"

- The most important step would firstly be to use an experienced capable field contractor used to operating in the underground mining industry to undertake annual On-line Partial Discharge tests both on cables and switchgear.
- Secondly, do we know where the risks are within the company that will stop ore being produced? Also when and where will the next high voltage cable fault occur? (translate to \$/hour).
- Thirdly, is there an alternative supply to the substation (is the ring complete?). It is common for production to remove part of a ring to gain access to new ore seams.
- Fourthly, establish what substation will be affected by loss of power and when.
- And lastly, investigate in detail what cumulative or downstream damage will occur to other assets when a failure occurs on a major asset like substation feeding pumping equipment and how this affects ore recovery.

The end result is that if the above is not strictly adhered to prior to the commencement of the work it will effect mining operations, and can lead to huge company losses and put export orders at risk.

## CASE STUDY ONE

A large underground mine with 20 main substations installed at least 20 years ago started to fail due to high humidity, dust, poor ventilation and high temperatures up to 63°C, resulting in production deferring planned outages to undertake urgent maintenance.

The client wanted to know: Which substation and which cable would fail and in what order?

As part of this investigation we also provided the client with an accurate breakdown on what to expect and how to undertake repairs. This information is invaluable when planning a shut down. It allows for the correct materials and skilled labour to be pre-arranged and thereby reduce extension to the outage repair.

## SUMMARY

By undertaking an On-Line Partial Discharge survey on both incoming and outgoing feeder cables along with a detailed survey of the switchgear it was possible to provide the client with good quality information that could be relied on when making critical decisions for shutdown and maintenance.

## CASE STUDY TWO

Operating high voltage equipment in abnormal situations, requires an increase in overall maintenance strategy. The strategy required needs to suit both the environment and duty of operation, as the equipment ages the interval and type of maintenance given need to be reviewed.

TYPICAL FAULTS TRACED BY PD	
PARTIAL DISCHARGE FOUND	RISK TO MINE
Tracking within bus chamber at adjacent to bus tie	Complete substation failure
End tracking on bus-chamber – red phase	Complete substation failure
7 cables with PD	Failure to outgoing circuit / in some cases no alternative supply was available, resulting in mine production stopping
Terminations – combination of faults with actual terminations and or post insulators	As above
Current transformers within switchgear the PD was that excessive it also affected the secondary wiring of the same CT	As above

## SUMMARY

Production was then advised of the pending power failures in a particular area of the mine. This allowed production to shift operations to another area of the mine that had a healthy electricity supply, leaving electrical maintenance crews to attend to defects identified in the Partial Discharge report.



View of a termination with visible PD

Not all potential failures are visible – hence the need to have advanced PD detecting abilities. Hidden or invisible faults are those that need careful attention.

## THE PROPER APPROACH

It is absolutely vital that when a cable fault does occur that the right approach is undertaken. To provide a careful and logical approach to resolving the problem, HVS have provided a 'fault location log' which can be downloaded from [www.highvoltagesolution.com](http://www.highvoltagesolution.com) (NB: when printed on waterproof paper it is ideal for field use).