

RE-EVALUATING OIL FILLED CABLES USING ON-LINE PARTIAL DISCHARGE

Oil filled cables that have been in-service for over 25 years are supposed to be bullet proof - that was 25 years ago. In 2005 we are now asking the same cable to do another 25 years but with more load, and with a decreasing availability of in-house expertise.

The practicality of getting transmission cables out of service in today's commercial environment for planned maintenance or evaluation is getting harder and harder. To overcome this challenge new technology has been developed that can successfully evaluate the condition of terminations and stop-joints, while the cable is in-service!

REVEALED THE FOLLOWING DEFECTS

In a recent Australian survey of 66 & 275kV oil filled cables, all testing was done on-line, under normal system operating conditions. Key areas such as end cable terminations, cross bonding pits and stop joints were surveyed. This On-Line Partial Discharge survey revealed the following defects:

1. One oil filled cable with an open / high resistance earth on an end termination. *This is serious as the sheath of the cable is effectively floating and not tied down to a solid station earth which is essential in the event of a fault.*
2. One failed cross bonding joint box. *This causes a higher sheath current in that particular section of cable. If the asset owner had known of this fact, he may have chosen to down rate the entire cable to allow for this condition.*
3. Incorrect lightning arresters fitted at cable terminations. *This caused high corona discharge and would in-effective in the event of a lightning strike.*

All of the above conditions were found during the On-Line Partial Discharge Survey and would be practically impossible to detect off-line.

OIL STOP-JOINTS

The oil stop joint was "mapped" out and an acoustic survey was conducted. It is not uncommon for discharges to occur in cable that have been in service for over 25 years with varying maintenance levels.



View of an exposed stop-joint prior to On-Line Partial Discharge survey.

END TERMINATIONS

End terminations are also a source of Partial Discharge. When these areas are surveyed it not only checks the section of cable from the stop joint to the termination, but effectively all hardware associated the termination.



View of a typical SF₆ cable termination.

ANNUAL MAINTENANCE

The following annual maintenance testing needs to be considered for oil-filled cables:


1. On-Line Partial Discharge Testing
2. Sheath Testing
3. DGA Oil Samples
4. SF₆ gas sampling of end terminations
5. Oil Pressure Alarm tests

All of the above testing should be evaluated by an experienced cable Partial Discharge engineer, rather than evaluating each test in isolation to the rest of the tests.

FINANCIAL CONSIDERATION

High voltage maintenance is dependent on the financial benefits. In each case, if there is no benefit, there is no point in doing the work. Advance warning of faults that will cause the cable to fail (as listed above) allows a sufficient timeframe for strategic / maintenance planning for replacement or additions to be implemented.

CONCLUSION

The full turnkey project from start to final report was completed in one week. Whilst the client showed concern about the updated status of this asset, they were pleased they had time to put in place the recommended strategy to minimise plant down time. 

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