ULTRASONIC OR TEV?

By Greg Linton, HV Diagnostic Services Ltd

What is the difference and why do we use both Ultrasonic and TEV when locating Partial Discharge? This article will serve to explain the differences between the two methods in widest use round the world today.

Partial Discharge Testing is a well established system for measuring the insulation performance inside high voltage Switchgear. However, for it to be of most benefit, the testing must be performed using complementary techniques, otherwise you are not being presented with all the facts.

The term "Partial Discharge" is somewhat generic and its most commonly recognised form is Corona discharge. This is often heard from overhead structures, particularly when atmospheric conditions suit, with the resulting damage over time to components well known about.

ULTRASONIC DISCHARGE

This "Corona" can also be described as Ultrasonic discharge because of the frequency range it occupies and can be identified early on, using a suitably tuned detector, well before any audible signal allows human ears to hear it.

Within Switchgear these "surface" discharges generally occur due to differences or interruptions in the electrical stress surrounding an insulating component and can result from inadequate clearances, sharp metal corners and edges, or simply dirt and debris. As an airborne signal, a clear path is required between the discharge and transducer to allow transmission and detection of the signal. This limits its use to air insulated components only, the typical areas being dry termination boxes and the switchtank bushings, shutters and spouts. It is also well suited for the online testing of MSU's and other modular epoxy insulated ring main units.

TRANSIENT EARTH VOLTAGE

By contrast, the Transient Earth Voltage (TEV) method developed by EA Technology of the UK, allows activity to be located through any insulating medium provided there is a break in the metal skin between cabinets and covers. The formation of a fast moving electromagnetic waveform at the insulation breakdown and its associated capacitively transferred charge can be detected on the switchgears outer surface. TEV will therefore find defects within oil and pitch filled components and would seem to be the only method required.

However, very rarely is the same defect identified by both methods. This is due to the fundamental differences between the "types" of discharge. Ultrasonic is almost always between phases or off into the air, which incidentally can become ionized providing the perfect environment for discharge to continue. TEV indicates a leakage to earth through voids or damage to the insulation and it is this breakdown that is revealed by the range of instruments developed by EA Technology.

ULTRASONIC CASE STUDY

A routine substation survey in August 2004 located a discharge of 20% FSD from the breather of a CT chamber. This activity, originally measured at 12% in 2002, was definitely on the increase and the deterioration is typically exponential-like as the discharge gains momentum. The TEV readings quite rightly appeared normal and were unchanged from previous surveys. An inspection under a scheduled outage discovered discharge surrounding an earthing shim between layers of gasket material of the CT (see figure 1). The faulty component was replaced and a subsequent re-test has shown the installation free of any discharge activity.

Figure 1

TEV CASE STUDY

The annual visit to a Waikato Industrial site towards the end of 2004 revealed an unexpected increase in levels to one substation over the previous 12 months. The highest reading was recorded on the unused busbar end cap of an oil filled fuse switch (see figure 2). Although the background level was unchanged, indicating it was not external noise, the discharge was affecting all readings on the switchboard (see figure 3). The decision was made to replace the offending switch in a controlled manner prior to the beginning of their busy season. An investigation by the switch manufacturer confirmed that they found the likely source of the discharge around the teflon washers installed on the end of the buss connectors under the red cover identified. The substation was again surveyed in Feb 2005 with the readings returning to the levels previously recorded.

Figure 2

Figure 3

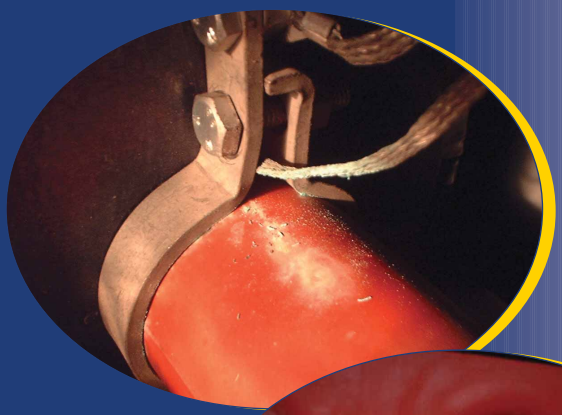
METAL WORK 14						METAL WORK 15					
BAR 2 REAR	SWITCH TANK	CT CHAMBER	VOLTAGE TRANSFORMER	TERMINATION BOX	BAND JOIN /END CAP BUSBAR	BAR 2 REAR	SWITCH TANK	CT CHAMBER	VOLTAGE TRANSFORMER	TERMINATION BOX	BAND JOIN /END CAP BUSBAR
				5	1					18	1
				4	8					19	20
	5			5			18			17	
				3	4					21	17
	2			2	2		26			23	27
	3			1	3		25			22	29
	3				4		26				36

2003 Readings 2004 Levels

CONCLUSIONS

- Early detection of developing faults and timely repair does improve network reliability and is a cost effective way to manage maintenance.
- Both TEV and Ultrasonic measurements need to be made to truly assess the condition of HV Switchgear.
- PD testing is not just for aged gear. Benchmark surveys soon after commissioning provide confidence now and allow meaningful comparison in the future.
- The importance of an annual test program is highlighted above, not only to identify significant changes but to allow deferment of works on minor problems to when they are actually needed.

PARTIAL DISCHARGE



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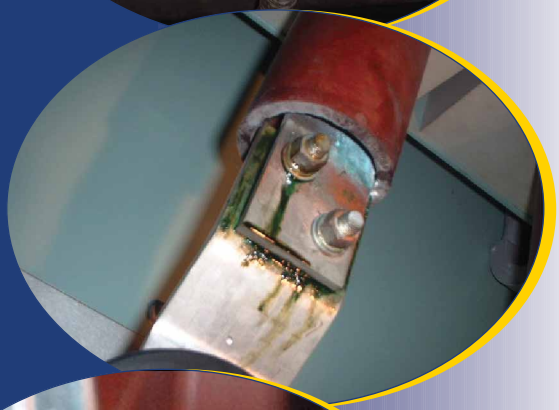
- Aged PILC Cable condition assessment and/or new XLPE circuit acceptance tests.
- Backup and support from EA Technology, UK with access to innovative products and services for HV asset owners and the Electrical Supply Industry.



Full details on website www.hvds.co.nz

Contact Greg Linton for further information.
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