NETWORK RELIABILITY

The process for determining not only the condition of the insulating materials within service aged switchgear, but the plants general 'well-being' follows a very successful formula.

By Greg Linton, HV Diagnostic Services

Regular Partial Discharge testing as part of an overall condition monitoring strategy is a major factor in meeting network reliability performance targets. The process for determining not only the condition of the insulating materials within service aged switchgear, but the plants general 'well-being' follows a very successful formula. Begin with a location survey, then if results warrant, a period of continuous monitoring, investigation and correction of the fault, and finally a re-test to confirm a measurable improvement to readings.

PD Location Survey → Continuous Monitoring →

Investigate & Maintain → Re-test

The distribution substation featured here has undergone an annual Partial Discharge Location survey since 2000 with a period of continuous monitoring added in both 2005 and 2006. It contains six 11kV Oil Filled Circuit Breakers circa 1965 and is located on customer premises. In this case problems began to emerge just prior to the switchboard's 40th anniversary:

2001 Survey Green
2002 Survey Blue, low Ultrasonic present
2003 Survey Green
2004 Survey Red, Investigate Ultrasonic - replace 2x CT's
2005 Survey Blue, No Ultrasonic, TEV slight increase, Monitor green
2006 Survey Blue, Ultrasonic return, TEV increase, Monitor red, Investigate

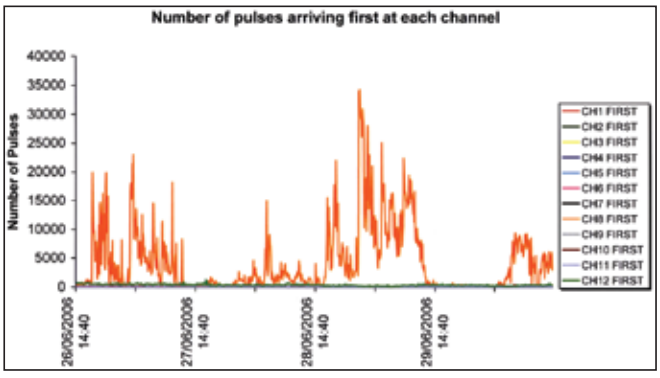
The colours above are based on graded reports as follows:

Green – OK Retest 2 years **Blue – Retest 6-12 Months**

Red – Action Required

CONFIRMED SOURCE OF ACTIVITY

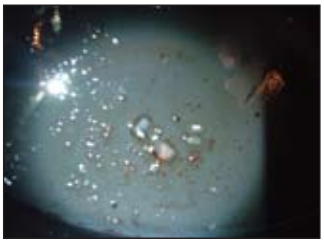
The work undertaken in 2006, commencing in June with a Location Survey, identified a return of previous Ultrasonic activity from the CT Chamber together with a further rise to Transient Earth Voltage levels. It was with great anticipation just days later that we installed one of our Partial Discharge Monitors for a period of continuous monitoring. These results confirmed a source of discharge activity from channel 8 positioned on the Switch Tank as illustrated in the following graph.



A consistent 28dB was recorded throughout the entire 4 days, which is right on the threshold for acceptable levels in Switch Tanks. The high number of pulses, peaking at 35,000 also suggested that further investigation was now necessary.

An outage to that feeder and subsequent inspection in October revealed two separate problems. First, the last remaining original CT was suffering from corrosion to the earthing shim. This is a known failure mode specific to this model and age switchgear and was not entirely unexpected. Second, the switch tank was opened and the oil changed. A loose turbulator and broken buffer washers were discovered internally and also corrected.

Corrosion to earth shim of CT



Shattered pieces of Buffer in bottom of tank

VALIDATING THIS PROACTIVE APPROACH

The follow-up survey later that month confirmed a general reduction to TEV levels by approximately 10dB, particularly Feeder 4 while the background level remained basically unchanged. The surface discharge from its CT chamber had also ceased validating this proactive approach to maintenance.

As a result of their continuing preventative maintenance program, the Asset owner will preserve its excellent reliability record into the future. While this Substation had proven more of a challenge than many, through correctly recognizing a deteriorating trend, the experience of HV Diagnostic Services was able to pinpoint the source of activity and advise accordingly.

AIR 11 METAL WORK 16

PANEL NAME	SWITCH POSITION (OPEN, CLOSED, EARTHED, ABSENT)	BUSBAR 1 UPPER/FRONT	BUSBAR 2 LOWER/REAR	SWITCH TANK	CT CHAMBER	VOLTAGE TRANSFORMER	TERMINATION BOX	BAND JOINTS /END CAPS BUSBAR 1	BUSBAR 2
Feeder 1	C	16		23	18		-		
Feeder 2	C	18		19	16	17	-		
Feeder 3	C	16		20	19		-		
Feeder 4	C	21		26	18		-		
Feeder 5	C	17		23	18		-		
Feeder 6	C	14		16	13		-		

Location Survey results – June 2006

AIR 6 METAL WORK 14

PANEL NAME	SWITCH POSITION (OPEN, CLOSED, EARTHED, ABSENT)	BUSBAR 1 UPPER/FRONT	BUSBAR 2 LOWER/REAR	SWITCH TANK	CT CHAMBER	VOLTAGE TRANSFORMER	TERMINATION BOX	BAND JOINTS /END CAPS BUSBAR 1	BUSBAR 2
Feeder 1	C	11		15	13		-	-	
Feeder 2	C	11		15	12	13	-		
Feeder 3	C	7		12	9		-		
Feeder 4	C	7		15	9		-		
Feeder 5	C	8		12	10		-		
Feeder 6	C	9		10	10		-	14	

Re-test following Maintenance – October 2006

Whilst other service-providers emphasize their latest equipment, we prefer to get on with the business of delivering quality information using well established methods and proven technology to our clients.

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