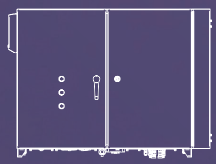


CONNECTING DATA TO DECISIONS

Case Study 2
345 kV Bushing Replaced in North America

Linking Total Transformer Monitoring & Actionable Information
to Drive Business Value for Utilities

camlin energy

345 KV BUSHING REPLACED IN NORTH AMERICA

Details
The correlation of partial discharges and bushing monitoring data was successful in identifying the problem at a very early stage, ultimately saving the transformer.

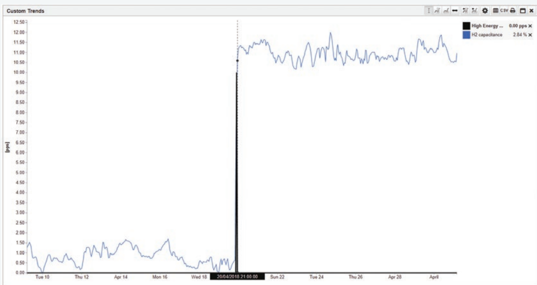
Evidence
High energy event was recorded in conjunction with a capacitance increase in the same phase.

Bushing and partial discharge monitoring was installed in 2018 on 504 MVA three-phase transformer in North America. The installed device had the same characteristics of the asset in Case #1 and was installed on a voltage tap on Westinghouse 1979 OIP bushings.

Similarly, to Case #1, a sudden step increase of the capacitance (C1) in bushing H2 was detected by the monitoring system, estimating a capacitance change in the order of 2.9%, which can correspond to a short circuit between two layers.

By looking at the data it was observed, once again, that a high energy event was recorded in conjunction with the capacitance increase in the same phase. Figure 1 shows the recorded data (not averaged, published every hour) and the partial discharge pattern. The event was characterized by impulses with significant magnitude (60 V peak-peak) and very small repetition rate (just 6 pulses per second), almost describing a sudden arcing activity. Recognizing the same correlation pattern (capacitance change + high energy event) seen in the KEPCO case, it was then suggested to the utility to take an oil sample of the bushings.

Figure 1. Capacitance increase in bushing H2 and high energy event recorded at the same time



The correlation of partial discharges and bushing monitoring data, along with proper offline tests, was successful in identifying the problem at a very early stage, optimizing the maintenance and ultimately saving the transformer.

Figure 2. Bushing tap adaptor for partial discharge and bushing monitoring

Table 1. Offline DGA results for bushings H1 and H2

OFFLINE DGA results for H1 and H2 bushings		
	2012	2014
H_2	20	85
CH_4	8	167
C_2H_2	<2	21
C_2H4	<2	645
C_2H_6	14	65
CO	75	714
CO_2	1.460	2.790
N_2	51.800	84.300
O_2	7.490	29.600
TDCG	117	1697
TDG%	6,07	11,79

Table 1 reports the comparison between the DGA from bushing H2 and H1, showing the acetylene concentration exceeding 20 ppm in the bushing where the capacitance change and high energy events have been detected, confirming the online analysis and enabling the utility to immediately plan the bushing replacement. The correlation of partial discharges and bushing monitoring data, along with proper offline tests, was successful in identifying the problem at a very early stage, optimizing the maintenance (in this case truly condition-based) and ultimately saving the transformer.

Most important:

- The absolute intensity of the capacitance increases, and the partial discharges were so small that if they were only considered individually and separately they would cause little concern.
- The combination of the two small deviations/anomalies occurring at the same time, plus the experience from previous similar cases, suggested the choice of the DGA oil sampling as confirmation test.
- It must be noted that DGA on bushings is not a routine testfor the utility's policy and it is carried out only in very exceptional cases.

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