

# Case study into tap changer faults indicated via DGA analysis

## Foreword

Eden was formed by Alan Denbow and Eddie Gregory in August 1985. Former employees of Burmah Castrol, they realised that the vast majority of electrical engineers were simply replacing expensive transformer oil without fully appreciating the additional technical benefits of purification to the electrical equipment, and that Eden could achieve a more convenient solution at a significantly lower cost.

The treatment of transformer oil is the first choice for a cost effective and efficient maintenance program: the increasing cost of new oil, the importance of production and minimising generation downtime, coupled with the environmental benefits of avoiding the transportation of hazardous waste and use of virgin products, are all part of the equation. In May 2016 Eden branched out to include in-house maintenance and testing of electrical equipment.

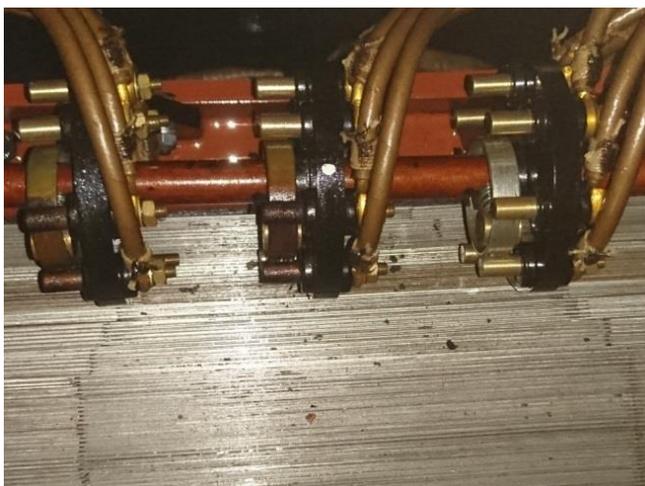
The following case study details the benefits of having a preventative programme of testing on high voltage apparatus and how when a fault occurs a fast acting solution prevents long term disruption and loss of production.

## Background

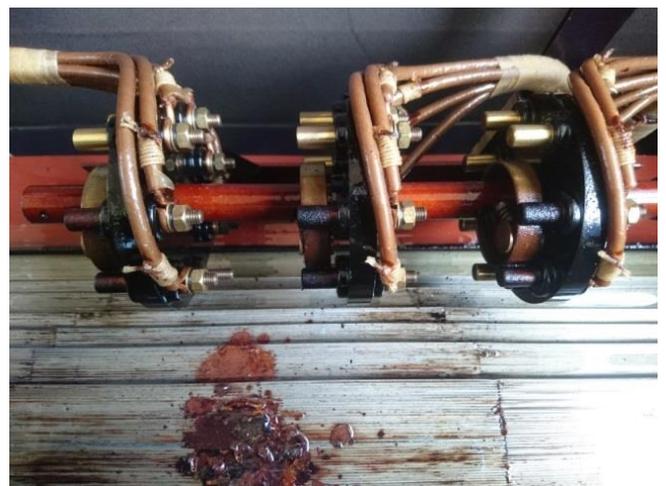
Our client contracted Eden to sample their oil filled transformers and perform routine and dissolved gas analysis as part of their preventative maintenance program.

The transformers were manufactured in 1985 and consisted of a 2000 KVA and a 1600 KVA transformer with conservator tanks and Buckholz relay. Both transformers were filled with mineral oil insulation of 1,275 and 1,110 litres respectively.

Samples were taken on the 7<sup>th</sup> July 2016 and the DGA test completed on the 12<sup>th</sup> July. Both sets of results showed an increase in the dissolved gas levels. The gas levels indicate X8T01 had a high range thermal fault above 700°C and or overheating of a conductor. The gas levels in X8T015 indicated a thermal fault in the range of 300-700°C. Upon inspection it was discovered that both transformers had developed a fault on the off load tap changers, X8T01 had two phases with bad connection and X8T015 on all three phase



X8T01

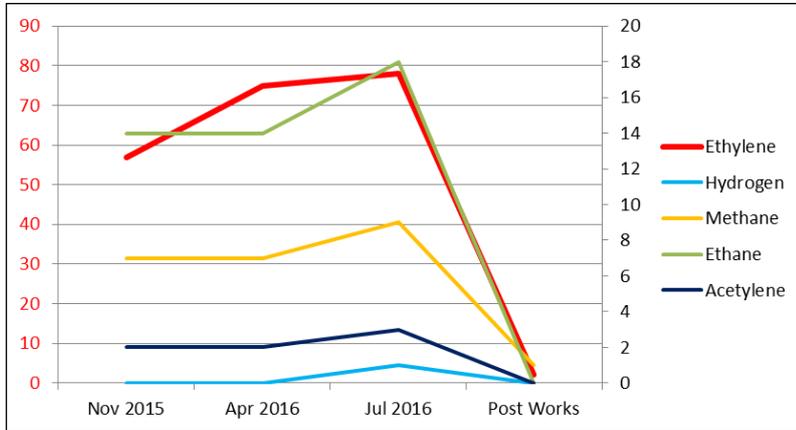


X8T015

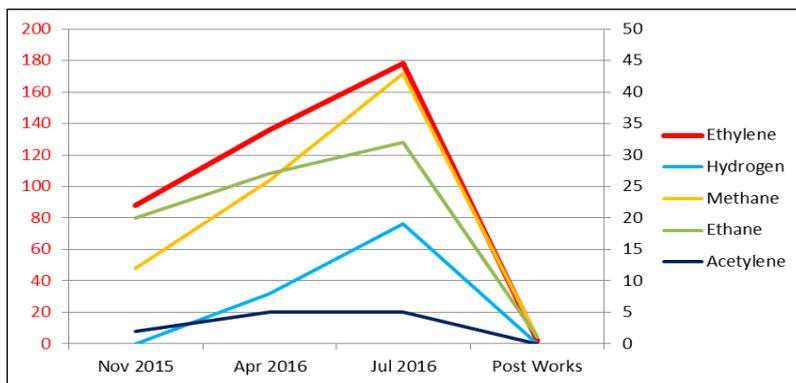
The root cause of the problem was the contact point of the selector ring of the tap changers, the spring pressure when pressed is significantly weaker on the old units due to age and the temperatures generated by the fault. There also appears to be little sign of usage, a problem common to offload changers that are not used after commissioning. New tap changer units were installed.

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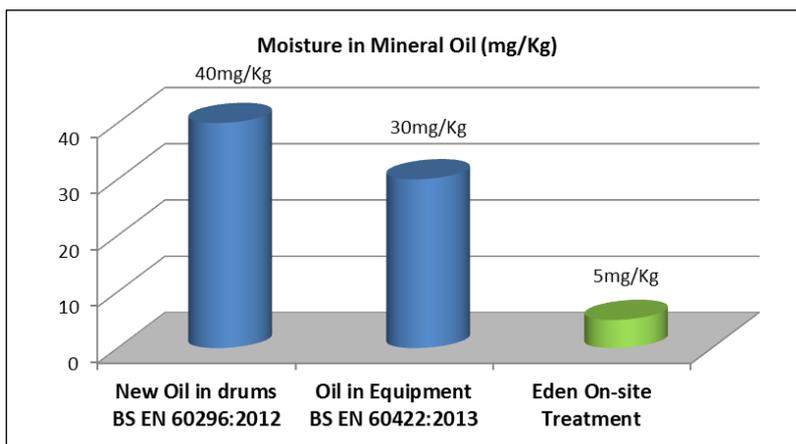
Eden's vacuum filter plant was used to recondition the insulating oil, this removed the dissolved gasses and a new datum sample was taken. The purification of the oil via the plant saved on the cost of replacing the oil with new and the disposal costs of the old oil. New gaskets were fabricated and installed and the transformer returned to service.



X8T01



X8T015



These graphs demonstrate the elevated dissolved gasses present in the insulating oil from X8T01 and clearly shows the benefits of the vacuum filtration. Simply removing the oil to perform such works as a tap changer replacement does not remove the by products of internal heating caused by an internal fault.

The vacuum filtration plant reduces the moisture content of the oil in the transformer also and purifies the oil far exceeding BS EN 60422:2013.

Research by Stanley Myers, Joseph Kelly and Robert Parrish demonstrates that the working life of the insulation paper is halved by the doubling of moisture.

Regenerating the insulating medium in a transformer is one of the few environmentally beneficial alternatives that is both cost and productivity effective at point of delivery and over the lifespan of the equipment.

As no new virgin products are used there is an instant benefit to the environment before considerations such as the impact of transportation and refinement are taken into account. And, with no oil being replaced, there is no hazardous waste oil to transport.

	New Oil, BS EN 60296:2012 (drums)	Specification after passing through Eden's plant
Dielectric Strength	30 kV	>60 kV
Moisture Content	40 mg/Kg	<5 mg/Kg