

Transformer oil reclamation service prolongs active life for Deeside Power Station's GSU transformers

ABB's state-of-the-art on-line oil reclamation service has helped Deeside Power Station to ensure the reliability and long service life of its three vital GSU (generator step-up) transformers by reducing acidity levels and eliminating potentially troublesome corrosive sulphur from their insulating oil.

The need

Deeside Power Station is a 515 MW CCGT (combined cycle gas turbine) power station owned by International Power GDF Suez. It has three GSU transformers (two for each of the gas turbines and one for the steam turbine) that step-up the voltage produced by the generator units to the 400 kV required by the UK transmission system.

Oil tests carried out as part of a general maintenance programme had indicated increasing levels of acidity and the presence of corrosive sulphur. The oil in each of the three transformers had previously been passivated using 7 litres (100 ppm) of Irgamet 39. Subsequent tests showed an unexpectedly high consumption of the passivator so Deeside Power asked ABB's specialist UK transformer repair and maintenance team to take further samples and recommend remedial measures. These new tests confirmed that the oil was in a condition where it needed reconditioning or replacement. The main aim was to remove the acidity and sulphur that were reducing the DP (Degree of Polymerization) value of the paper insulation, which is an important indicator of its remaining service life.



Mobile oil reclamation rig.

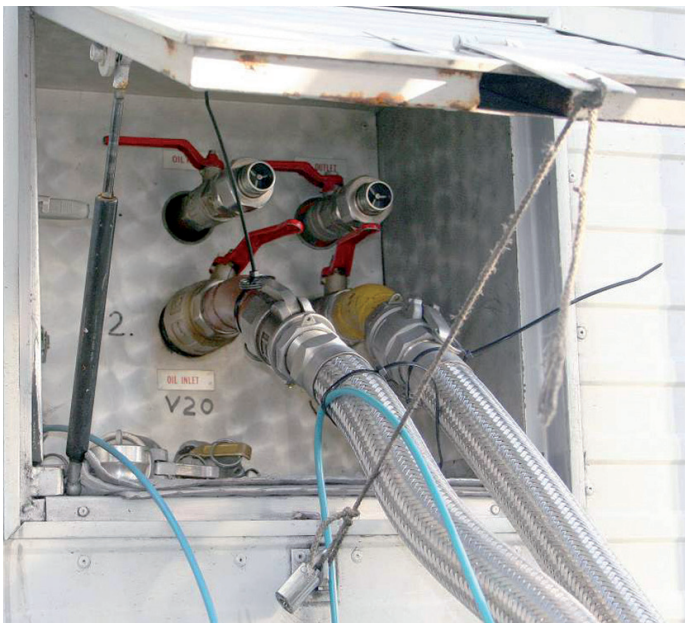
Why are acids a problem for transformers?

Acids form as a result of oil degradation due to oxidation, indicating that the transformer oil is ageing. Corrosive sulphur is also well known as a significant cause of premature transformer failure as it reacts with copper components to form highly conductive copper sulphide that deposits on windings and the paper insulation, causing a breakdown of insulating properties and resulting in shorting, arcing and even fires.

The solution – ABB's mobile oil reclamation rig

ABB's unique on-line oil reclamation service was used to reclaim the oil rather than replacing it with new. This process enabled the acidity and sulphur to be removed over a period of time with the transformers remaining energized, so the power station could continue to operate at full capacity without the need for an outage.

The mobile oil reclamation rig is housed in a 40 foot trailer. At the site it was connected to the drain valve at the bottom of each GSU transformer and the warm oil circulated through columns of fullers earth to remove the acids, sludge and other degrading products, including corrosive sulphur. Periodically, the fullers earth column was bypassed so that the waste products could be burned off to regenerate it. While this was happening, the oil was passed through a de-gassing plant.



Connections to rig.

The reclamation process, in which the oil is circulated continuously through the rig, took around 10 weeks for each transformer due to the large volume of oil to be processed – a 190 MVA GSU transformer, such as the units at Deeside Power, holds 70,000 litres. The progress of the reclamation process was monitored by checking the colour of the oil as it changed from a dark brown to a light straw colour. At this point the oil was sampled for laboratory testing to confirm the successful removal of acids and corrosive sulphur.

Reclamation is superior to an oil change

Initially, it might appear that carrying out a complete change of the transformer oil would be a faster and more efficient method of eliminating the by-products of oil degradation. However, extensive laboratory and field tests carried out by ABB have shown this offers only a short term benefit as the new oil soon becomes contaminated by the residual oil in the tank and the insulation. So, while the reclamation process is longer and slower, it provides a permanent long-term solution that restores the properties of the oil to very near those of new oil by removing acids, sludge and other degrading products like corrosive sulphur. This also has a beneficial effect on the ageing of the paper insulation. In fact, in the 15 years since ABB first introduced the on-line reclamation technique it has never had to retreat a transformer.

A further advantage of the oil reclamation process is that it is a more environmentally friendly solution. It eliminates the need to use large quantities of new oil and to dispose of the spent oil with the associated transportation risks. These are important issues for environmentally responsible sites such as Deeside Power Station.

Where does corrosive sulphur come from?

Crude oil contains a number of naturally existing sulphur compounds, and even when it is refined to produce transformer oil a low level of sulphur may remain in the form of compounds such as organic mercaptans and disulphides (e.g. dibenzyl disulphide DBDS). These natural sulphur compounds can serve a useful purpose by acting as natural oxidation inhibitors that improve the stability of the oil. Indeed, in the early 1990s some refiners even added back sulphur in the form of synthetic DBDS.

Under certain conditions in the transformer these sulphur compounds can degrade to form corrosive sulphur, which in turn reacts with copper to form copper sulphide. A number of power transformers that were commissioned in the late 1980s to early 1990s have suffered an increased risk of failure as a consequence of copper sulphide deposits forming in their windings and insulation paper. Hence the presence of elevated levels of corrosive sulphur in an oil sample is now regarded as indicative of a transformer that requires suitable preventative treatment.

Excellent results

Liam Warren of ABB's UK power service operation said: "On-line oil reclamation is a powerful technique that enables the oil to be restored to virtually as-new condition without taking the transformer out of service. It has provided excellent results so far in reducing acid levels and removing corrosive sulphur from Deeside Power Station's GSU transformers, without any safety or environmental issues on this particularly sensitive site. Our main aim is of course to deliver a long-term benefit. So the key measure of the success of this project will be in future oil acidity levels continuing to meet the contract guarantee, and the copper sulphide levels passing future IEC 62535 tests."

For more information please contact:

ABB Limited
Power Service
Oulton Road, Stone
Staffordshire, ST15 0RS

Tel: +44 (0)1785 825050
Email: service@gb.abb.com

www.abb.com/service