James B. Shimwell / Director of Operations / TRANSEC UK Ltd. / Dorking, Surrey, UK
Senja Paasimaa / Regional Market Manager / Vaisala / Helsinki, Finland

Moisture Management in Power Transformers

Moisture management is one of the greatest challenges today in the maintenance of oil insulated high voltage transformers. TRANSEC UK Ltd. provides first-rate on-line moisture management for oil-filled power transformers – with a little help from Vaisala's online moisture and temperature monitoring.

Generator, transmission and distribution transformers are some of the most critical and expensive assets in a power network. They are very reliable and require very little maintenance in general since they have no continuously moving parts. However, the insulating materials degrade with time, and ultimately determine the end of the transformer's life.

Excessive moisture will accumulate in the transformer's insulation, where more than 95 percent of water is retained, thus increasing conductivity and accelerating ageing. As higher levels of moisture saturation are reached, it is possible that on a sudden temperature fall, e.g. from load shedding, free moisture can develop, increasing the risk of internal 'tracking' and eventually, short-circuit.

TRANSEC Units – Technology for Transformer Moisture Management

TRANSEC UK Ltd. is a UK-based company whose business is

moisture management of power transformers, primarily for power generator and transmission grid companies and power utilities. Founded in 2004, the company is a wholly owned subsidiary of the well established UK company Bowden Bros Ltd., which has been manufacturing instruments for high voltage networks since 1930.

The company's offering consists of on-line transformer drying units – the TRANSEC Units – and related services such as cylinder exchange service, full installation, and commissioning. Their main market areas are Asia, Middle-East and Europe; 80 percent of production is exported.

The main application is moisture management of oil filled power transformers in service. However, it is becoming obvious that new power transformers can also greatly benefit from factory-fitted Units, when the target is to maintain the transformer's insulation dryness at the factory level, thus improving its service life.

On-line Molecular Sieve to Dry Out Power Transformers

A TRANSEC Unit is an on-line zeolite molecular sieve. It continuously removes water from the oil, which also acts as the transfer medium to extract water from the paper insulation in a power transformer. When retro-installed on an existing transformer, the on-line unit reduces the moisture level of insulation and maintains the reduced level thereafter.

The process not only reduces the rate of ageing, but will improve the dielectric strength of the insulation and increase reliability, especially against external effects, e.g. through faults, by maintaining the strength of the solid insulation.

The idea of a molecular sieve using zeolite as a drying medium is well known since the 1960's. However, only recently – with synthetic beads – it has become possible to control the pore size closely enough during manufacturing to allow for the adsorption characteristics that a modern molecular sieve requires, while at the same time not invalidating historical DGA (Dissolved Gas Analysis) data.

The TRANSEC Units, equipped with an oil circulation pump and in-line particulate filters, consist of either one or three series-connected cylinders. Each cylinder contains a one meter high 'bed length' column of synthetic zeolite. The units can be installed, commissioned, maintained

A TRANSEC Unit consists of one or three series-connected cylinders. Each on-line transformer drying unit continuously removes water from oil in generator, transmission and distribution transformers.

and their active material replaced off site without the transformer to which they are connected requiring to be off-load, which is a great cost benefit for asset operators.

The three cylinder unit has the capacity to remove up to 10 liters of water from a transformer, before it becomes saturated. Depending on the transformer's moisture level, the operating time of a TRANSEC Unit before saturation varies from one to several years. After saturation, the cylinder(s) can easily be changed. Each cylinder has a serial number, and its 'as supplied' weight is recorded on a database. A direct comparison after saturation shows the quantity of water adsorbed by the cylinder, making it possible to manage the moisture removal process.

Units also have sampling points for the site operator to take an oil sample for further analysis in a laboratory.

The TRANSEC Units are available with moisture and temperature monitoring in both inlet and outlet oil pipes. The reliable and stable measurement provided by the Vaisala MMT162 is not just a means to monitor moisture in oil, but also a measure for the performance of the moisture management system.

The compact sized MMT162 is easy to install to a T-piece of oil piping in a TRANSEC Unit.

Continuous Moisture Monitoring with Vaisala MMT162

The TRANSEC Units are available with moisture and temperature monitoring in both inlet and outlet oil pipes. When the input and output ppm levels of a Unit converge, the grid company or power utility knows that the molecular sieve material is saturated and the cylinders need to be changed. To minimize environmental impacts, TRANSEC cylinders are recyclable and the company offers a replacement program.

Vaisala's moisture and temperature transmitters for oil can be used to monitor the saturation level of a dryer online and in real-time. Vaisala has worked with TRANSEC UK Ltd. and previously Bowden Bros Ltd. since 2000.

Earlier TRANSEC Units offered the Vaisala HMP228 Moisture and Temperature Transmitter for Oil for moisture monitoring. Since Vaisala introduced the Vaisala HUMICAP® Moisture and Temperature Transmitter for Oil MMT162 – the development of which utilized TRANSEC UK Ltd.'s earlier request on features as well – it became obvious that it was a more suitable solution for this particular application, both technically and cost-wise.

The compact sized MMT162 is easy to install to a T-piece of oil piping in a TRANSEC Unit. Power supply and signal wiring can be connected by using standard cabling, and retrofitting of older Units is also straightforward with standard connections. The MMT162 offers moisture and temperature measurement with two simultaneous output options: analog and digital RS485.

Reliable and stable measurement is crucial since the measurement is not just a means to monitor moisture in oil, but also a measure for the performance of the moisture management system. Due to the nature of the main application area of the TRANSEC Units, i.e. high voltage and extra high voltage compounds, having someone go frequently onsite to calibrate the sensors is not a viable option, which means being able to trust the sensors to work is essential.

Customer in Focus

TRANSEC UK Ltd. has placed strong focus on assisting their customers to manage the moisture issues of their power transformers. TRANSEC Units equipped with the Vaisala MMT162 moisture monitoring not only show the readings on a local display, but can also send the on-line measurement signal to customers' own data collection system at their sub-stations.

Also, calculations to define the moisture of solid insulation based on measured oil moisture level and temperature can be done. When the units are equipped with monitoring, they offer the user indication on cylinder saturation, thus optimizing the use of the Unit. TRANSEC UK Ltd. continues to improve their offering and follows closely new trends and knowledge in the HV industry to serve their customers also in the future.

Further information:
www.vaisala.com/en/products/moistureinoil

"The biggest challenge in our business is to convince users and operators of the value of on-line drying systems as a preventative measure. As with insurance, it is only when you do not have it that you realize its value. With an installed capital cost of probably less than 0.5 percent of the total cost of a medium power transmission transformer and with a very small on-going operating cost, the likelihood of doubling the service life of the transformer ought to be attractive, even to the Company Accountant!"

– James B. Shimwell, TRANSEC UK Ltd.