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Better Transformer Designs Improve Safety And Efficiency

As electricity utilities and users worldwide look to become more safety conscious and efficient in their use of electrical energy, it is important to leverage the improvements that have been made in the design of transformers.

According to Trafo Power Solutions managing director David Claassen, there have been considerable strides in technology, surpassing both the efficiency and the reliability of the traditional oil-filled transformers that are predominantly used in power grid systems.

These high efficiency solutions include open-wound transformers (OWTs), vacuum-pressured impregnated transformers (VPIs) and cast resin transformers (CRTs). Traditional oil-filled transformers use paper saturated in oil wrapped around the winding material as an insulation medium. If not maintained correctly, insulation degradation will occur, with the oil posing both a safety and environmental risk.

“OWTs are constructed by dipping preheated windings into a high temperature varnish bath and then baking the high temperature varnish,” says Claassen. “This replaces the need for oil and paper, so only a small amount of material is flammable.”

In VPI construction, layers of polyester resin are applied to the windings, which are subjected to interchanging cycles of pressure and vacuum that ensures deeper penetration. This reduces the chances of air voids.

“With CRTs, windings are placed in a mould which is filled under vacuum with resin epoxy,” he says. “Fibreglass reinforcing mesh is used to further strengthen the windings, which are cured in a heat-controlled oven. This process also prevents air voids, and the resin in CRTs is non-flammable.”

These designs have also made advances in reducing losses, and thereby improving efficiencies. Some 84% of a transformer’s losses at full load are copper losses – also known as load losses – and are due to current flowing through the winding conductor itself. The remainder are core losses, or ‘no load’ losses, pertaining to the core steel losses.

“The use of OWTs, VPIs and CRTs offer considerable savings in energy costs of their life-spans – which for CRTs, for instance, averages about 20 years,” he says. “Despite the slightly higher capital cost of around 20%, these technologies can repay the price differential in just four years.”

Claassen says that low loss cast resin transformers are being used exclusively in many parts of the world including Europe and North America, and this is because although there is a 12 to 15% premium on these the payback period is between two to four years. These are now available for the African market from Trafo Power Solutions.

PIC 01 : Cross-section of a medium voltage winding.

PIC 02 : Low voltage winding.

PIC 03 : Medium voltage cast resin winding.

PIC 04 : Medium voltage windings prior to casting.

PIC 05 : Transformer core.

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FROM : CORALYNNE & ASSOCIATES
TEL : +79 523 7422
EMAIL : communicate@coralynne.co.za
WEBSITE: www.coralynne.co.za

FOR : TRAF0 POWER SOLUTIONS
TEL : +27 (011) 325 4007
EMAIL : david@trafo.co.za
WEBSITE : www.trafo.co.za