Local manufacture of cast resin transformers

by Mike Rycroft, features editor

Dry type cast resin transformers have been on the market for several years and have significant advantages over oil filled ones in many applications. A local company has set up plant to manufacture resin cast transformers and has produced the first batch for delivery to customers.

“Revive Electrical Transformers is the first company to produce cast resin transformers in South Africa. Our competitive edge is that we have the most advanced technology from Europe,” says Sumeshan Padayachee, the company’s general manager. Padayachee explained that the company had taken a decision to manufacture transformers of its own design rather than to manufacture under licence to another company. The company’s product range was designed by Dr. Franco Marini, a consulting engineer with 20 years experience. The factory can manufacture about 50 transformers per month with ratings of 100 – 3015 kVA and 3,3 – 22 kV. Production capacity is expected to double in 2014 with the purchase of a second machine.

Advantages of resin cast transformers (RCTs)

RCTs are considered to be more compact and safer than oil filled transformers. They offer up to 25% space savings and are safer – from a fire hazard perspective – as they use self-extinguishing material. They tend to have a high capacity and can support overloads and short circuit forces well. These units are maintenance free, with no oil leaking problems (since they contain no oil) and no special installation requirements. RCTs above 500 kVA are lighter and cheaper than oil filled equivalents, while at lower ratings it may be more convenient to use oil-filled or varnish impregnated dry-type transformers.

An RCT’s ability to handle short-circuit problems better than oil filled transformers is due to its construction. The winding is cast in resin which gives it mechanical support, whereas oil filled transformers do not have the same support for their windings. On overload the unit performs in the same way as an oil filled transformer. Should a coil fail it can be repaired on site, saving the cost and down time associated with returning a transformer to the factory. At end of its life, an RCT is easier to scrap because the resin is inert and there is no oil to dispose of.

Manufacture of RCTs

Padyachee said that although the manufacture of these transformers is a lot simpler than oil filled ones, the technology is complex and the machines to manufacture them are very complex and expensive. Describing the process, he said, “the three main steps are the high voltage winding, the low voltage winding and the casting, after which comes stacking and testing. This process uses eight or nine fewer steps compared to that of manufacturing an oil filled transformer.” Due to the complexity, specialist production people were brought in for several months to help in the setting up process, iron out difficulties and train staff in things like stacking cores etc. Dr. Marini’s experience proved invaluable to the company as he was able to resolve various stumbling blocks and problem areas in the manufacturing process. In all, it took about six months to get up to speed with production, from the arrival of the machines to the production of the first units.

High voltage windings

The high voltage (HV) winding uses aluminium strip foil containing 99% aluminium with zero silica. Insulation on
the windings is class-F insulation material consisting of 0.023 mm polyester film. A "pancake" winding configuration is used for the HV coils where strip foil is wound into disks which are connected in series. Resin forms the insulation between the disks and also provides a solid matrix between the disks, which assists with handling short circuits. The pancake configuration also makes the winding process faster – so that it is possible to produce two 1 MVA transformers a day compared to the three days it takes to produce two conventional oil filled transformers, saving two days.

Resin constitutes about 20% of the casting weight. Casting takes place under vacuum and is quite a complicated process. The length of the process depends on the number of windings but lasts between two and four hours. A maximum of six windings can be handled at a time depending on the size. The winding then goes through a heat cycle in a conventional oven for twelve hours of curing. Problems which could occur in the process include voids (bubbles) and cracks in the casting. Casting is a continuous process and any interruption will result in failure so the plant is equipped with a UPS to ensure a continuous power supply of the required quality. If anything goes wrong with the casting process or the heat cycle it is possible to lose the batch of coils.

Low voltage windings

The low voltage (LV) winding is similar to an oil filled transformer LV winding except for the insulation which is class-F epoxy impregnated DMD. The winding itself is aluminium foil. After winding, the coil gets heat treated in the oven for two hours to finish the resin curing process. This sets the winding in its shape. The LV winding is one continuous conductor and the foil windings reduce stress enormously.

Core

The core is obtained from a sub-supplier made to the company’s requirements. Reassembling the core after fitting the coils is a labour intensive process which requires special skills, but once the required skill level has been achieved the process runs smoothly. It is possible for one person to do three transformers a day once the skill level has been reached. It is still quicker to stack one of these transformers than to stack an oil filled transformer core, as three steps are saved in the process. A step-lapped core is used giving lower values of no-load loss, no load current and lower noise levels.

Accessories

A variety of accessories can be fitted. Fans are recommended for additional cooling if the transformer is to be loaded above its rating – up to 120% is possible.

Milestones

The first batch of 1050 kVA 22 kV/300V/300V transformers have been delivered to the solar farms at Lesedi and Lesatsi. The company is busy building prototypes for various customers at present.

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**Fig. 4:** The windings after casting.

**Fig. 5:** A completed low voltage winding.

**Fig. 6:** The core ready for mounting of the windings.

**Fig. 7:** A complete RCT ready for delivery.