

High Voltage coils – making quality cost effective

For industries operating and maintaining high voltage (HV) motors and generators, a cost effective, timely and planned repair schedule is crucial to maintaining productivity. Central to this regime is the use of high quality, precision manufactured stator coils, available through a local and trusted partner that can deliver long term reliability, improved performance and minimal downtime.

Danny Fox, Coil Shop Manager at Sulzer's Birmingham Service Center, looks at the key aspects of replacing coils in HV equipment.

In an ideal scenario, every repair would be carefully planned and scheduled to minimize the effects of any downtime on the business. Unfortunately, in a less than perfect world, it is sometimes necessary to react swiftly to unexpected events. The key to better uptime and improved efficiency, however, is to minimize the likelihood of such an event occurring and to reduce the effects it can have on the business when it does – it is at this point that a 'cost versus quality' decision can have far reaching implications...

Fast delivery is crucial in coil manufacture

The manufacture of high voltage coils is a very precise science and the design and construction methods will vary between suppliers, as will materials and testing procedures. For large rotating machines such as HV and MV motors and generators, testing the replacement coils and balancing the rotor is key data that evidences to the client the quality of the finished and repaired product. Obviously, when repairs are unplanned, speed is crucial in returning the equipment to a running state, but this cannot be achieved to the detriment of quality, which has much longer lasting implications.

The efficiency of high voltage equipment can be considered in a number of ways; cost efficiency is influenced by reliability, service

lifetime and maintenance costs, while power efficiency depends on the intrinsic design as well as component reliability. Maintaining high efficiency levels depends on consistent quality assurance in both the product and process aspects of production.

The product level requires precision engineering in the design of any new coils, high standards of quality control in selecting and processing the raw materials as well as consistent verification of the quality of insulation being installed. The process aspect concentrates on the continuous design improvement and rigorous quality control with thorough component testing completed throughout the production processes.

Production to exact design specifications

Quality assurance is crucial and there are several standards which must be met, especially for the testing of HV coils, which is carried out both in-house and by external, independent, laboratories. Starting with the basic raw materials and throughout the manufacturing process, a series of continuous checks should be in place to ensure every coil is produced to the exact design specification.

Sulzer's Birmingham Service Center has a long and distinguished history of producing high quality, high voltage coils for use in motors and generators across the world. This reputation has been earned through its ability to meet and surpass the latest build quality standards including those used in the hydro-electric and nuclear industries.

The Service Center, a hub for the wider service center network in supplying coils across Europe, the Middle East and the Americas, focuses on B-stage resin rich coils which are typically used on larger multi-megawatt machines. Resin rich coils are manufactured using a hot pressed slot section and an uncured end-winding section which requires coating and curing after the stator rewind has been completed. This produces a very tough coil which retains some flexibility at the ends that allows it to be transported safely and

installed into the stator of a machine much more easily.

Maintaining the quality of every coil is a continuous process that is applied to all aspects of the production process, including checks on all of the raw materials used in the manufacturing process. If there are any perceived changes in the materials used in the insulation system, then a sample coil can be subjected, by customer request only, to voltage endurance testing in order to prove the insulation properties and reliability are unchanged. Suppliers have been known to change specifications of their materials without providing such information to the end users and so periodic sampling is also conducted to ensure the overall quality of the finished product is maintained.

Precision and accuracy improve performance

The use of B-stage resin rich coils is predominant in the rewinding of larger machines but this method also delivers benefits for smaller machines. The construction of the B-stage coils allows the resin to flow in the end of the winding and bond the layers of insulating tape to produce a more homogenous insulation and sealing of the winding. In most cases, the use of modern insulating materials will improve both the dielectric and thermal performance when compared to those used by the OEM during original manufacture.

The process begins with an initial assessment of the components due for repair and is followed by the design stage, which involves using the latest 3D CAD packages to produce a series of manufacturing drawings for the coil shop. Precision and accuracy of the drawings, coupled with the latest insulation technology allows for improvements in coil design to be achieved.

Quality starts with the raw materials and Sulzer purchases continuously cast copper rod and uses its own in-house rolling and annealing process, combined with automatic shaping machines and computer controlled heated presses. The entire process can operate 24 hours per day to deliver consistently high quality coils with very

short delivery times. The coils can then be dispatched from its high-voltage coil shop, via freight service, to any location worldwide for delivery to site, ready for installation.

By using the latest CAD software, the bars or coils can be precisely designed to ensure an exact fit in the stator slot, making the installation process more efficient. Comprehensive testing techniques guarantee the reliability of the new coils, which is especially important for coils being used in marine, nuclear and hydro generators, where the coils can be required to pass a 400 hour voltage endurance test to provide evidence to support their build quality.

Modern insulation technology allows for thinner layers that can withstand greater dielectric stress and higher temperatures, also allowing more space for copper within the same slot area. This reduces the resistance of the replacement stator winding, which can then run cooler, allowing a small but significant increase in output.

Local approach for clients ensures cost-effective results

In some cases the full extent of a repair does not become apparent until the generator is removed and examined closely. While the stator coils will usually be replaced, there can often also be an issue with the laminated core and the rotor assembly. It is essential that the same level of skill and expertise is employed in the repair of these components as well, in order to complete an effective, long-term repair.

It is important that any service provider has the scope and ability to adapt to any change in circumstances that may be experienced during the project. This requires skilled and experienced engineers as well as the technical resources to resolve any situation and ultimately to complete the repair efficiently whilst keeping the client fully appraised of progress.

Access to such expertise can often involve a long search and complicated communications; this can be greatly simplified when

dealing with a multinational repair specialist that maintains a local approach for every client. Sulzer ensures that customers can use their local service center to tap into years of expertise and engineering skill within the network in order to deliver the most cost-effective results.

Many clients require potential suppliers to demonstrate their professional credentials and standards, often in the form of compliance with various international standards. The Birmingham Service Center has invested considerably in improving both its production equipment as well as its management systems. As a result it now holds certifications for compliance with ISO 9001, ISO 14001, and BS OHSAS 18001.

The last, and maybe least well-known, is the Health and Safety Management system that benefits the entire business by introducing an improved health and safety framework. This helps to minimize operational risks and hazards which ensures that not only the skilled staff have a safe environment to work in but also that the client has complete peace of mind, as well as improved productivity.

For those involved in the operation and maintenance of large MV and HV rotating machines, there are many choices when seeking a repair or rewind of such equipment. The key to a successful project is ensuring that those involved deliver a high quality product, precisely, quickly and with the necessary support to ensure a timely and cost effective solution.