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DRY-TYPE DISTRIBUTION TRANSFORMERS FROM SIEMENS ENERGY

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Since the product launch in 1966, GEAFOL cast-resin transformers from Siemens Energy have been providing a wide range of customer benefits. Some benefits are exactly the same as 56 years ago: the reliability and quality of the transformers haven't changed. But the energy market is growing, changing, and evolving, just like Siemens Energy and other customer benefits of dry-type transformers. The newest GEAFOL dry-type transformer from Siemens Energy with a rating of 45 MVA offers the perfect answer for the challenges of our dynamic times.

Photo: Siemens Energy

Changing industrial landscape

In the last couple of years, an interesting change has happened in both the industrial and urban landscape. Many metropolitan areas of the world developed rapidly, which naturally has also led to an increasing demand for energy. This steadily growing energy demand is a worldwide phenomenon. For many people all around the world, having energy is something completely natural; for many others, it still seems to be an unattainable luxury. But there is no doubt that everybody needs energy. As metropolitan areas grow, the inclusion of industrial areas into very densely populated and frequented parts of the cities becomes more common. The explanation is simple: free space is becoming a scarce resource. High-rise buildings, hospitals, data centers, metro stations, oil rigs, paper mills, airports, and other infrastructure have high power requirements. Transformers often operate near residents, separated from their immediate surroundings only by a single wall. Accordingly, the safe and secure operation of transformers is simply a must.

Distribution transformers are particularly in focus as they bring the power to the final energy consumers – to factories, to large commercial buildings, to hospitals, or even to data centers. The reliable and safe operation of distribution transformers has become more important than ever.

Is it possible to react flexibly to the customer needs? To maintain safe and reliable grids? To produce transformers which are able to operate safely even in urban areas? To install large transformers near residential areas without any risk for the residents? Is it possible to achieve zero harm and, at the same time, offer a cost-efficient solution? And most important: is it possible to do it in an environmentally friendly way?

Complex questions, one simple answer: **GEAFOL from Siemens Energy**.

Fire- and explosion-proof, robust, reliable and green, GEAFOL and CARECO dry-type cast-resin transformers from Siemens Energy meet the highest safety requirements of the energy distribution infrastructure, especially in urban areas.

The safe, reliable, and green choice

The energy distribution infrastructure, especially in urban areas, must meet the highest possible safety criteria. It must be fire- and explosion-proof, robust, reliable, and green, as transformers and switchgears are often separated from their immediate surroundings only by the wall of the substation.

All these requirements can be met with GEAFOL[1)] and CARECO[2)] dry-type cast-resin transformers from Siemens Energy. Dry-type transformers do not contain any insulation oil and are therefore better suited for use in an urban environment than liquid-filled transformers. Dry-type cast-resin transformers operate with high-voltage windings, fully encapsulated in cast-resin insulation. This avoids the need for a tank with insulation and cooling liquid. Dry-type cast-resin transformers provide a particular degree of safety during operation, especially due to their electrical strength and excellent fire-related behavior. They are flame-resistant, self-extinguishing, and, at the same time, eco-friendly as well as nearly completely recyclable. GEAFOL and CARECO from Siemens Energy are insulated with an epoxy resin / quartz powder mixture instead of oil, which is a very environmentally friendly alternative. They can be used practically everywhere: there are no restrictions on the place of installation.

Cast-resin transformers are the safest choice for high-rise buildings, data centers, oil rigs, hospitals, airports, ships, metro stations, and other infrastructures with high power requirements. At the same time, GEAFOL and CARECO are eco-friendly and up to 99% recyclable.

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1) GEAFOL: Cast-resin transformer with aluminum windings
2) CARECO: Cast-resin transformer with copper windings

There is no risk of oil contamination, as these transformers do not contain any oil. For areas where the protection of flora and fauna is of extreme importance, cast-resin transformers are the perfect, green choice. Additionally, cast-resin transformers are practically maintenance-free and maintenance costs are therefore negligible. The lifetime of cast-resin transformers is 25+ years. These two facts, among others, make cast-resin transformers a cost-efficient solution.

As a result, it is no surprise that more than 150,000 GEAFOLs have been installed by Siemens Energy worldwide so far, and the percentage of cast-resin transformers, compared with oil-immersed distribution transformers, continues to grow.

High electrical strength and small size

Another advantage of cast-resin transformers, which often receives little attention, is the selection of materials and their precise processing in order to achieve high dielectric and mechanical strength.

GEAFOL cast-resin transformers are available in the rating range up to approximately 50 MVA and for operating voltages up to 72 kV. They operate reliably even at altitudes of -1,500 to +6,000 meters and ambient temperatures from -60 °C to +60 °C.

Distribution transformers are mainly used where electricity needs to be transformed from the medium voltage level down to low voltage, or to another incoming grid voltage level. Coming back to the issue of transmission systems in frequented and metropolitan areas, there is one more aspect to mention. Over the past five decades, the weight of GEAFOL has been reduced by more than one third, without any reduction in output range or adverse effects on operational safety and reliability. The available floor space for the necessary electrical equipment, like a transformer, is often limited. Therefore, the total power throughput has to be maximized and at the same time the necessary floor space for the transformer installation needs to be minimized. As a consequence, large distribution transformers are often more suitable than small power transformers.

More than 150,000 GEAFOLs have been installed by Siemens Energy worldwide.

The largest dry-type transformer of Siemens Energy with a special cooling technique

The world's largest and most complex cast-resin transformers come from the transformer plant in Kirchheim, which is product lead center for development and production of cast-resin transformers at Siemens Energy. The largest GEAFOL produced in Kirchheim so far was quite unique.

With a rating of 45 MVA, Siemens Energy offered a safe, powerful, and environmentally friendly alternative to liquid-filled transformers. The transformer, which weighs 58 tons, has some special features. Thanks to the modern test laboratory in Kirchheim, it was possible to test the transformer – even at such a high rating – directly in the factory. This helped to avoid the time-consuming and work-intensive transport to another location and the related costs. The freedom from partial discharges of this special GEAFOL was tested up to twice the rated voltage, in other words, far beyond the specified standard. This ensures high reliability of the transformer during operation.

The thermal load of the transformer represents a particular challenge in the power range from 20 MVA and above. For GEAFOLs in this rating class, Siemens Energy has developed a highly efficient cooling method which operates by using cooling ducts. Why are cooling ducts special? Because they are used in the higher voltage winding and in the core to dissipate heat losses. In addition, the GEAFOLs from Siemens Energy absorb the high axial forces that occur in the event of a short circuit thanks to a special coil support system. To achieve such a high output, the high-voltage coils consist of six partial coils that are interconnected to create one winding. Excess heat is dissipated via special patented cooling channels in the windings. In this special system developed by Siemens Energy, the smaller coils are spring-loaded to compensate for the thermal expansion of the larger coils. Potential harmful overheating of the core and clamping parts is detected by monitoring the temperature of the tie bolt (connecting the top and bottom clamps) at the core circuit. Converters have higher electrical loads due to steep voltage peaks. These loads and corresponding heat increases are dealt with by providing appropriate insulation for the windings.

Photo: Siemens Energy

GEAFOL 45 MVA

The increased dimensions of dry-type transformers resulting from the increase in voltage are becoming more and more important for many customers. Siemens Energy has developed a particularly compact GEAFOL, primarily for size-critical applications. Due to the special insulation, higher operating voltages can be safely controlled without the disproportionately large increase in insulation distances that has previously been necessary. This development also leads to reduced dimensions and weight.

Another innovation of Siemens Energy is the new, award-winning housing for GEAFOL which has many customer benefits. To mention just one, the transformer and its housing can be supplied as a fully mounted unit on a common base frame. Besides the freedom from partial discharges (which far exceeds existing standards), the particularly high reliability of the transformer is ensured by the proven GEAFOL technology.

It is important to note that that all these innovations were incorporated in the 45 MVA GEAFOL, the largest cast-resin transformer ever produced in Kirchheim. Of course, this was not a prototype, but it was a customer order for a data center.

In general, GEAFOL is available for power ratings up to 50 MVA. Different electrical and mechanical setups, like double-tier transformers, help to increase the power rating per square meter. Adapted to the circuit of the static converter, these special transformers are manufactured primarily with a Dy5 circuit, or Dy5Dd0 for two-tier design. Any required phase shifts are also possible with GEAFOL technology by installing shift-tip windings. Three-tier GEAFOLs are mainly used in modern direct converter installations. Even four-tier designs are possible with GEAFOL.

The world's largest and most complex cast-resin transformers come from the transformer plant in Kirchheim, a product lead center for development and production of cast-resin transformers at Siemens Energy.

Shaping the future's energy landscape

Siemens Energy, as the inventor of dry-type transformers, has a worldwide network of factories, providing customized GEAFOLs and CARECOs. The factory in Kirchheim, Germany plays a lead role in building big dry-type distribution transformers. Besides Kirchheim, the new and modern Siemens Energy factory in Guangzhou (China) is also capable of designing, building, and testing dry-type distribution transformers of this size. Having this capability on different continents enables Siemens Energy to supply GEAFOLs as well as the copper-based CARECOs to every corner of the world within the shortest possible time. Besides Kirchheim and Guangzhou there are Siemens Energy dry-type transformer factories in Budapest (Hungary), Jundiai (Brazil), and Guanajuato (Mexico).

Cast-resin transformers of Siemens Energy are practically maintenance-free and their high overload capacity ensures maximum reliability. Due to high quality standards in development, design, engineering, and production, GEAFOL and CARECO are reliable in operation, environmentally compatible, flame-retardant, self-extinguishing, and non-toxic.

GEAFOL and CARECO make energy transmission more environmentally friendly, safe, and efficient. Covering an output range from 100 kVA to 50 MVA, with operating voltages up to 72 kV, dry-type transformers from Siemens Energy offer numerous benefits, such as high efficiency, safety, quality, and reliability to customers worldwide. Independent of the customer's core focus, e.g. decarbonization, efficiency, or digitalization, the goal of Siemens Energy is to satisfy customers and make a positive contribution to the future.