



Transforming know-how into success. Siemens **Transformers**.

GFAFOL cast resin transformers – in use around the world

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GEAFOL cast-resin transformers – all the benefits for power distribution

The closer the power distribution is to the consumer, with the transition from the medium-voltage to the low-voltage level, the lower the losses are, and the less complex the cable network is. Therefore, for economic reasons alone, transformers should be as close as possible to the consumer.

On the other hand, the available space is usually very limited – a real challenge with respect to the often considerable dimensions of transformers. Transformers must also be safe and reliable – otherwise they are a potential danger

to man and machine. Critical requirements must therefore be taken into consideration in order that transformers can be moved closer to buildings and industrial plants.

Siemens GEAFOL cast-resin transformers have fulfilled these high demands and proven themselves for over 40 years. Today, GEAFOL cast-resin transformers up to a rated power of approximately 40 MVA can be manufactured.

Power ratings up to 40 MVA can be achieved by GEAFOL transformers today without any problem.



GEAFOL cast resin transformers
Standard model with 1000 kVA



GEAFOL-Static Converter
3-tier design



7.5-MVA GEAFOL transformer for extremely
low ambient temperatures down to -55°C

Compact design

The compact design and the comprehensive safety certification enable the use of GEA FOL transformers in almost every environment. The broad range of applications is supplemented by the flexible connection system and the especially economic, almost maintenance-free operation. GEA FOL transformers still have benefits even at the end of their life cycle, as they practically can be completely recycled without danger to the environment.

Certified safety

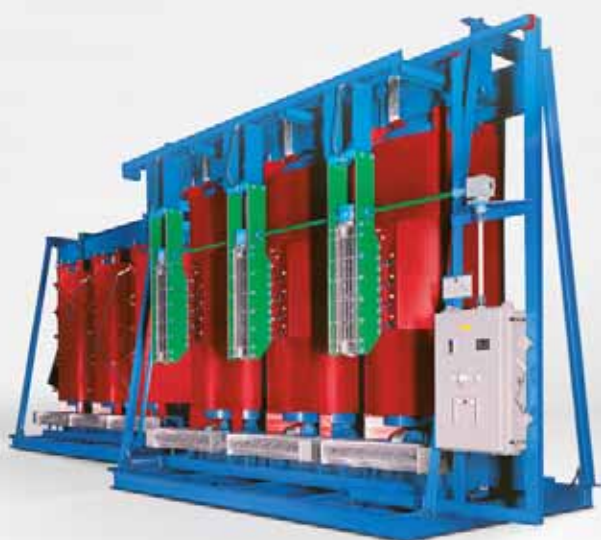
We produce cast-resin transformers in compliance with VDE 0532, IEC 60076, DIN EN 60726, ANSI and in compliance with special national regulations or customer wishes. The transformers satisfy the highest requirements for safe installation in residential and working environments with the climate category C2, the environmental category E2 and the fire resistance category F1.

Customized models

Individual problem solutions that satisfy all requirements with respect to operating mode, low noise level and power loss, connection system, cooling method as well as transport and installation are possible at all times. In addition, GEA FOL cast-resin transformers can also be modified for extreme conditions and made earthquake-proof.

Global use

At present, well over 80000 GEA FOL cast-resin transformers are in use throughout the world. This brochure provides an overview of their wide range of performance and application.



22-MVA GEA FOL transformer with oil-free on-load tap changer



40 MVA GEA FOL transformers built in 2007, most powerful cast resin transformers in the world

Transforming potential into power

Renewable energy

Whether wind, hydroelectric or solar – renewable energy is a substantial business throughout the world. GEAFOLE cast-resin transformers are a major part of this development. For example, wind. In the future, the Australian island of Tasmania will be able to significantly increase its share of renewable energy. A wind park is planned for the northwest

coast of the island with a total power output of 128 MW. Participating in this ambitious project are Tasmania's power supply company, Hydro Tasmania, the world's leading manufacturer of wind power stations, and Siemens Power Transmission and Distribution (PTD).

Mechanically strengthened GEAFOLE transformers ensure that the power produced by the wind power plant reaches the consumer.



Whether in rural or urban environments: GEAFOLE transformers ensure that power can be used.

Mechanically strengthened version for vibration-resistant installation

Siemens is providing its expertise in two ways for the wind park project in Tasmania: in the wind park itself, GEAFOL cast-resin transformers ensure that the voltage supplied by the generator is stepped up to the required power supply voltage on-site. Each of these GEAFOL cast-resin transformers is mechanically strengthened and can be installed vibration-resistant in the pod.

Power Transmission and Distribution – service from one source

Siemens is also head of the syndicate for the entire technology of the new high-voltage DC transmission (HVDC) line between the island of Tasmania and the Australian continent. The syndicate leadership comprises the delivery and installation of the entire HVDC line technology including converter transformers, smoothing reactors and high-voltage substations. The entire communication and control technology for the connection is also the responsibility of Siemens. The job is rounded off with the construction of the valve halls, the service buildings as well as the associated overhead lines and transfer points on both sides of the connection.

GEAFOL transformers also function without problems under extreme environmental conditions.





Twenty years of daily operation in an aggressive environment with low maintenance costs



Powerful and reliable: forced cooling ensures stable thermal conditions even under peak load

Transforming requirements into solutions

Industrial solutions

The numerous industrial requirements for transformers are enormous. However, although they seem so varied and comprehensive, they can be completely satisfied by GEAFOL cast-resin transformers in most cases. Standard requirements such as operating safety and optimum behavior with respect to fire safety are taken into consideration right from the start.

Economical in every respect

The cost-effectiveness of the GEAFOL transformers is one of their exceptional features. With these transformers it is possible to bring the medium voltage much closer to the consumer and then convert it to low voltage in the direct vicinity. In this way it is possible to greatly reduce the power losses that occur in the low-voltage system. In addition, the maintenance costs are kept low thanks to



the reliable technology, proven over many years. Our cast-resin transformers operate for decades almost maintenance-free – with minimum footprint. This saves valuable space which can then be used for the production. Cost-effectiveness also means the release of up to 50% power reserves by means of forced cooling.

Last but not least, the transformers must also be environmentally friendly for industry – a requirement which is increasing in importance. The following application scenarios show that these performance features can be achieved by the GEAFOLE transformers without problems, and still leave enough leeway for special versions.

20 years – and then only cleaned

Seven GEAFOLE transformers were in operation at an articulated-shaft manufacturer in Offenbach, Germany during two shifts per day, Monday to Friday, for 20 years – always at 90% load and subject to heat, oil containing chlorine, and grinding dust. They were then completely cleaned and ready for the next decade.

High power requirement at the Tüpras refinery in Izmir, Turkey

Twelve of the twenty transformers in operation have power ratings of 16–25 MVA. A reliable power supply is ensured for the sensitive chemical processes even under peak load through the use of fans.

Stable conditions in China: GEAFOLE cast-resin transformers with on-load tap changer satisfy all safety and environmental requirements in a Chinese semiconductor factory.



Safe:
the transformer is directly beside the assembly line.

Stable conditions in China

A rapidly growing infrastructure as in China can often lead to voltage problems. Medium-voltage systems can often not keep pace with the increasing power requirements and become unstable. Our GEAFOLE cast-resin transformers with on-load tap changer and a power rating up to 22 MVA are used in order to be able to supply the highly modern and sensitive plants with a stable voltage. These transformers with voltage control are connected on the load side of the medium-voltage system and supply the distribution transformers in the plant. This ensures a reliable supply in sensitive areas such as hospitals and industrial companies, but also in residential and business centers.

Safe: the transformer is directly beside the assembly line

High-quality automobiles leave the assembly line in southern Germany less than four meters from the GEAFOLE transformers – the transformers are on the same level as the assembly lines.

Outside or inside:
resistant to humidity

Three transformers in the crane:
6600 kVA, 37 m above the ground



630 kVA – in an area
of only 1.6 x 2.6 m

Even when space is limited: room can be found for
GEAFOL transformers – on the roof or in the cellar.

Outside or inside: resistant to humidity

52 GEAFOLE transformers in a paper production factory in South Africa, some of which are installed directly alongside the machines. And, as can be seen in the picture, 18 transformers for paper production machines were installed on the outside wall of a production shop in Schongau, Upper Bavaria, Germany.

630 kVA – in an area of only 1.6 x 2.6 m

Successfully implemented in a domestic appliance factory: a GEAFOLE in a very small area. It is on a platform directly above the switchgear and distribution cabinets. This 630 kVA transformer rating can be increased up to 900 kVA with cross-flow fans as part of a concept with decentralized stations not only for the general supply system, but also for the power-intensive production.

Three transformers in the crane: 6600 kVA, 37 m above the ground

In order that this 85-ton ship unloading crane can load a freight car every 45 seconds, three GEAFOLE converter transformers were mounted directly alongside the low-voltage switchgear – 37 m above the ground in limited space.

Even when space is limited: room can be found for GEAFOLE transformers

Limited space? A solution can also be found for this problem. The GEAFOLE transformer was installed on the roof at a well-known automobile manufacturer in Rüsselsheim, Germany. The housing for the medium- and low-voltage switchgear was also included. Additional fans on the roof increase the performance by 40%. A further transformer in the basement – directly below the motor testing bay – emphasizes the possibilities which result from the extremely compact construction: the transformer was assembled on-site and equipped with integrated switches.

Low and rugged:
GEAFOL in a potassium mine



In the rolling mill directly alongside the consumer: GEAFOl in converter operation

**Low and rugged:
GEAFOL in a potassium mine**

Underground use is very demanding and requires special features: the ability to resist heat and dust, and very high safety requirements with respect to the fire hazard – there was no alternative to a GEAFOl transformer. For this reason, the potassium mine in Wintershall, which produces more than 30000 tons of potassium salt each day at a depth of 600 m, was equipped with GEAFOl.

**In the rolling mill directly alongside the consumer:
GEAFOL in converter operation**

In Novolipetzk in Russia, GEAFOl transformers are working directly alongside the consumers in the cold rolling mill – in converter operation for mill stand and drive of a cold wide strip line. They are able to stand up to the strong dynamic and thermal loads caused by the quickly changing load cycle without problems.

1700 m below the surface:
safe power supply at 90% humidity



Underground:
on-site power supply in an ore mine

**1700 m below the surface:
safe power supply at 90% humidity**

In Doornfontein near Johannesburg gold is being mined at a depth of 3000 m. Four GEAFOL transformers provide a reliable energy supply at a depth of 1700 m at an ambient temperature of 40°C and 90% humidity.

**Underground:
on-site power supply in an ore mine**

The environmental conditions in the Swedish underground ore mining are extremely demanding, but the GEAFOL cast-resin transformers installed on-site are able to stand up to the demands. Even when they are completely fouled due to high humidity, diesel fumes and dust, they are simply switched off and the dirt is washed off with hot water.

Transforming isolation into independence

Solutions on the high sea

GEAFOL goes on board

In 1984 it was the largest drilling platform in the world with 835000 tons: the 110-m-high Norwegian drilling platform Statfjord C. Its power requirements correspond to that of a town with 30000 people. Obviously extremely high safety requirements apply on the Statfjord C. The drilling platform was therefore equipped with 17 GEAFOL resin-encapsulated transformers.

Because of the positive experience gained with these transformers, the Oseberg platform was also correspondingly equipped in 1988. It has 23 transformers on board, corresponding to the power requirements of a town with 40000 people. In the meantime, a large number of offshore platforms have been equipped with GEAFOL transformers and further platforms are being built.

On the high sea:
GEAFOL goes on board



With GEAFOL below deck:
the largest crane ship in the world



North of the Arctic Circle:
with GEAFOL on board the ice breaker



**North of the Arctic Circle:
safely underway with GEA FOL**

Canadian ice breakers and oil drilling ships of the CIS are operating in the Arctic Ocean with GEA FOL transformers on board; as these transformers are extremely resistant to vibrations and rolling, they can also stand up to extreme cold and are not susceptible to corrosion by salt water.

**With GEA FOL below deck:
the largest crane ship in the world**

The largest crane ship in the world, which sails under the Italian flag, also uses GEA FOL transformers exclusively. 36 of our transformers below deck supply the necessary power for the drives of the 7000-ton cranes – in addition to the other power supply for the giant, which displaces 700000 tons.

**New type of cooling system for the transformers of
the “Grand Princess”**

The “Grand Princess” is one of the world’s largest cruise ships. With 15 decks, 100000 gross registered tonnage and a length of 285 m, it has room for 2600 guests and a crew of 1100. Maximum comfort for the passengers is of great importance. One of the technical highlights is the new type of cooling for the GEA FOL cast-resin transformers. They are in an enclosed housing with IP 44 degree of protection, which contains two air-water coolers and four fans. The air heated up by the transformers is blown through the coolers within the housing and cooled down there by the water. This ensures that only the radiant heat and not the total heat loss of the transformers is dissipated to the machine room. The climate control can therefore be kept much smaller and more cost-effective – with significantly reduced weight.

New type of cooling system for the transformers of the “Grand Princess”: eight GEA FOL converter transformers supply the diesel-electric drive system of the “Grand Princess” with a rating of 9150 kVA each.



Transforming energy into speed

Solutions for transportation and traffic systems

Whether large airports, road tunnels or subway stations – the electrical supply and therefore the availability of the safety and control systems must be guaranteed at traffic intersections. Almost everything depends on the power supply, and without current the traffic quickly collapses. The requirements are therefore correspondingly high:

Functional reliability with low maintenance costs

- Fail-safe and fire-resistant devices for safety systems
- Easy to maintain and rugged – the smaller the dimensions, the easier it is to find installation space

An above average range of requirements can be satisfied by the GEA FOL transformers in close cooperation with the responsible planners.

Power supply for the Transrapid line between Shanghai and the Pudong international airport

Within the framework of the Transrapid project, Siemens is providing the following converter transformers for the supply of the linear motors and the reactive-power compensation systems:

- 36 single-phase transformers, 3290 kVA for 300 Hz, connected as three-phase bank for the supply of the linear motors
- 30 two-tier converter transformers, 4000 kVA for the supply of the inverters
- 8 converter transformers, 3150 kVA for the reactive-power compensation systems

Special attention had to be paid to the important linear motor parameters, e.g. operating frequency, harmonics and inverter-dependent DC current components. Because of the high reliability of the GEA FOL transformers, operation under these stringent conditions is not a problem.



Problem-free traffic:
GEA FOL in the subway in Munich

With 430 km/h
to the airport in Shanghai



Problem-free subway traffic

Several GEA FOL transformers provide a reliable power supply in the subway in Munich. The subway in Caracas also uses GEA FOL transformers for the lighting, air-conditioning and signal systems. The criteria are always the same: a high degree of reliability, reserve power for peak loads and a safe response to secondary fires without development of dangerous gases.

Power for the airport infrastructure in Amsterdam

With more than 40 million passengers a year, Schiphol airport in Amsterdam is one of the largest airports in Europe. Seven GEA FOL transformers provide the power for a newer section of the arrivals building. GEA FOL transformers are used in many airports throughout the world.

Street lighting in Saudi Arabia

The highway between Jeddah airport and the oasis town of Medina in Hejaz is one of the many roads in the world whose lighting is based on GEA FOL. Seven compact stations with 400-kVA or 500-kVA transformers ensure a reliable power supply even at very high temperatures.

GEA FOL in the Arlberg tunnel

With a length of almost 14 km, the Arlberg tunnel is the second longest tunnel in Europe. 18 GEA FOL transformers have been installed to ensure that the traffic flows without problems – distributed for the ventilation, lighting, safety and traffic control systems.

GEA FOL on the roof of the world

Even where the air is too thin for others, GEA FOL transformers are providing a problem-free service. For example, in several railway stations in Tibet at an altitude of 5000 m. A separate insulation system was specially developed for the 33-kV transformers so that they are able to work reliably under these extreme conditions.

GEA FOL on the Zugspitze

Also on the highest mountain in Germany, the Zugspitze railway, the weather and the radio station have to be reliably supplied with power.

Across the desert:
GEA FOL in Saudi Arabia

Power for the infrastructure:
GEA FOL at Amsterdam airport ...

and Istanbul airport



Very high up: GEA FOL in Tibet at an altitude of 5000 m above sea level

Distributed for safety:
GEA FOL in the Arlberg tunnel

At the top:
GEA FOL on the Zugspitze

Veltins-Arena, Germany –
powered by GEAFOLE



Power supply for Europe's
tallest office building with GEAFOLE

Transforming voltage into safety

Solutions for administration and culture

Similar criteria for the transformer installation apply to the administration and cultural sectors, i.e. office buildings, banks, hospitals, stadiums, theaters etc., as to the industrial sector: proximity to the consumer, small space requirement and above all, safety. Safe transformers must be self-extinguishing and may not develop any dangerous gases during secondary fires. There is also the demand for low maintenance. External service providers are often employed in the administration and cultural sectors – and every service call is a cost factor.

If the transformers also have to be quiet and disposed of, or recycled without any danger to the environment after decades of operation, then the decision has usually already been made – for GEAFOLE cast-resin transformers.

GEAFOLE powers one of the tallest office buildings in Europe

At 298 meters, the Commerzbank headquarters in Frankfurt am Main is one of the biggest office buildings in Europe. The requirements on a reliable power supply were also very high. Siemens was successful against its competitors and received the order to supply the entire electrical equipment. In addition to low-voltage and medium-voltage switchgears, this also included the proven GEAFOLE distribution transformers.

Reliable:
GEAFOL in the Gulf



Power supply around the clock:
GEAFOL in the hospital

Power supply around the clock: GEAFOL in the hospital

One of the many hospitals whose power is supplied via distributed GEAFOL cast-resin transformers is the SÖS hospital in Stockholm, Sweden – a hospital in which more than 1000 in-patients and 1500 out-patients are treated each day. A special point about this hospital is that the 50000 m³ underground supply network was installed later. 12000 truck loads of earth and stone had to be removed. Today, GEAFOL transformers above and below ground provide a problem-free power supply.

Also the largest hospital in Hamburg, the University Clinic, has been retrofitted with GEAFOL transformers. One of the major reasons for the changeover to GEAFOL trans-

formers is that special fire protection measures are eliminated. Special installations, such as oil collecting basins for normal transformers are no longer required. The comparatively short conversion times also made the decision easier.

Reliable: GEAFOL in the Gulf

The Trade Centre in Dubai in the Persian Gulf is one of the largest buildings in the region. GEAFOL transformers are distributed throughout the 33 floors and are responsible for the majority of the power distribution.

Culture in magnificent style –
and with eight GEAFOLE transformers



Embedded in the dome:
GEAFOLE in St. Peter's Cathedral



Ultramodern –
with GEAFOLE

Ultramodern – with GEAFOLE

The nine GEAFOLE transformers in the futuristic building of a large bank in Munich are located on the fourth, eleventh and twenty-fourth floor and supply all floors with power. The cast-resin transformers are supplied via a 10-kV medium-voltage cable.

Embedded in the dome: GEAFOLE in St. Peter's Cathedral

This is one of the last places one would expect them to be, but nevertheless they are there: several GEAFOLE cast-resin transformers are installed below the dome in St. Peter's Cathedral in the Vatican. An optimal solution for this world-renowned magnificent building.

Culture in magnificent style – and with eight GEAFOLE transformers

The National Concert Hall and the National Theater are located in Taipei in the heart of the island republic of Taiwan in the Far East. They were built in traditional Chinese style and each have a capacity of approximately 2000 seats. They also have the benefits of GEAFOLE technology.

Transforming sources into streams

Solutions for power plants and power transmission

GEAFOL for power plant construction

Naturally, GEAFOL transformers are also used where power is generated: in high-capacity decentralized cogeneration plants and as excitation transformers for turbo generators in large power plants – including the Olkiluoto 3 power plant in Finland.

Big transformer for the Big Apple: record Siemens transformer for New York

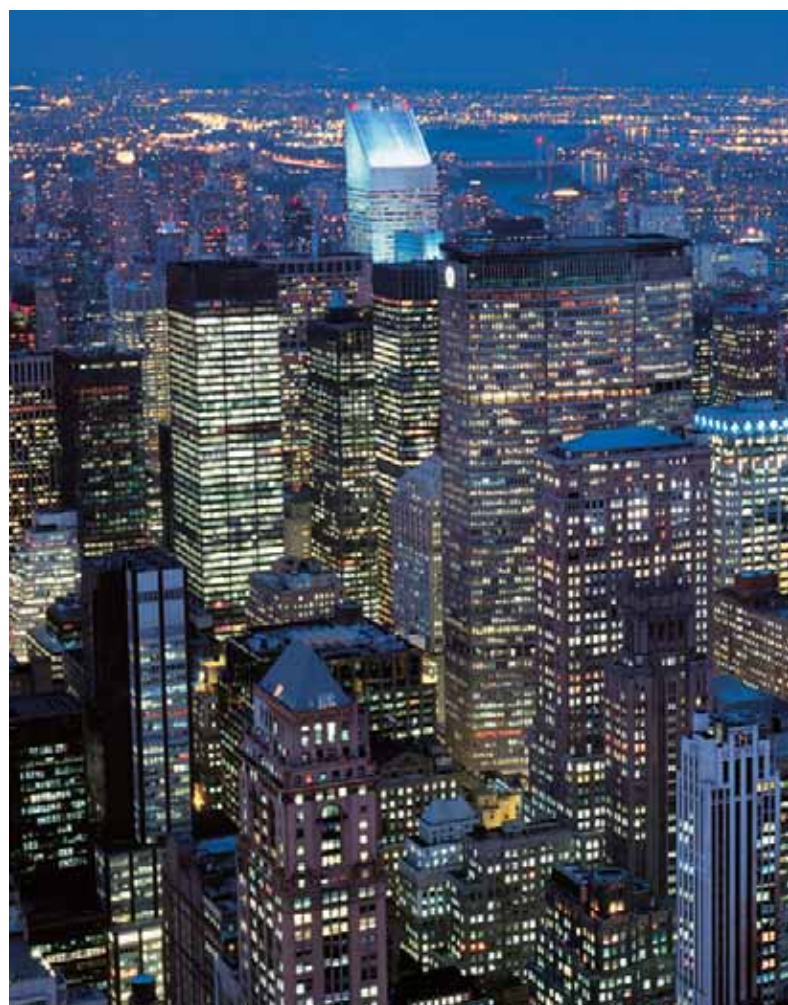
Siemens Power Transmission and Distribution has supplied one of the world's largest GEAFOL cast-resin transformers to the USA. The record transformer with a rated power of 25 MVA weighs 45 tons and was ordered by the New York Consolidated Edison Company, one of New York's largest power suppliers. The metropolis is following the trend: cast-resin transformers of up to 40 MVA are being increasingly requested.

Pioneering power transmission:

most powerful cast resin transformer in the world

A reliable power supply requires a well-developed power infrastructure with high-output transformers – whether it's in power plants, substations, HVDC lines or industry and transport. HVDC systems in particular can transport power very economically across long distances, thus playing a major role in reducing CO₂ emissions. Two 40 MVA GEAFOL cast resin transformers – the most powerful cast resin transformers in the world – are being used at a new Siemens AG test facility for HVDC systems.

Wherever power is produced, cast-resin transformers are never far away:
GEAFOL in the power plant operation



Reliable power supply for millions:
GEAFOL in New York

Siemens AG
Energy Sector

Transformatorenwerk Kirchheim/Teck
Hegelstr. 20
73230 Kirchheim/Teck
Germany
Tel.: +49 (0) 7021 508-0
Fax: +49 (0) 7021 508-495

Siemens Transzformátor Kft.
1214 Budapest
II. Rákóczi Ferenc u.189.
Hungary
Tel.: +36 (1) 278 5300
Fax: +36 (1) 278 5335

www.siemens.com/energy

For more information, contact our
Customer Support Center.
Tel.: +49 180/524 70 00
Fax: +49 180/524 24 71
(Charges depending on provider)
E-mail: support.energy@siemens.com
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Order No. E50001-U413-A23-V5-7600
Printed in Germany
Dispo 19201
TH 101-071109 101893 RS 01083.0