



**SIEMENS**



# Efficient transformers for the grid integration of wind power

Mature and durable transformer technology for wind power units  
and wind farms

[www.siemens.com/energy](http://www.siemens.com/energy)

Answers for energy.



# Wind – a key to the future of energy





Renewable sources of energy are playing an increasingly important role due to growing energy consumption worldwide and the need for environmentally friendly solutions. Wind power is one of these solutions, with an enormous potential for the new energy age.

Trendsetting Siemens technology helps harvest this continuous source of clean, carbon-free energy in a highly efficient manner. Benefiting from 30 years of continuous presence in the wind power industry, Siemens supplies extremely reliable equipment for onshore and offshore wind power units of every size.

Meeting the challenges associated with harvesting wind power viably and sustainably, while securing a high return on investment, requires state-of-the-art technology and expertise.

As the only energy infrastructure supplier that provides products, services, and solutions along the entire energy conversion chain, Siemens is the ideal partner for meeting all manner of challenges specific to the wind power business in a secure, reliable, and profitable manner.



# Highly efficient Siemens transformer solutions: customized low-loss transmission





Technologically advanced transmission systems require top-quality transformers in order to generate and infeed wind power economically and reliably. Tailored to customers' precise needs, Siemens top-quality transformers guarantee low-loss transmission, optimal efficiency, and unmatched safety right from the very start of the energy conversion chain.

Siemens has been building distribution transformers for over one hundred years. Experience, ongoing research, and close cooperation with the world's leading wind power turbine manufacturers have seen Siemens develop various types of transformers and integrate them into all types of wind power turbines and wind farms all around the world, whatever the location.

#### **A convincing range of products and solutions**

Today's extensive Siemens product range comprises two main transformer types, GEAFOL cast-resin transformers and liquid-filled transformers. Both types can be customized in detail to meet individual customer requirements.

All Siemens transformers boast state-of-the-art efficiency levels thanks to their low no-load and load losses. Environmentally friendly, extremely safe, and highly reliable, they are available worldwide with attractive delivery times.

#### **Comprehensive experience and expert engineering in transformer technology**

Siemens' unparalleled experience, supreme technical know-how, and the enthusiasm of more than 8,000 employees make Siemens one of the world's leading and most reliable producers of technologically advanced transformers.

# Hitting the spot for every demand



## **GEAFOL transformers**

More than 100,000 GEAFOLE cast-resin transformers are currently in operation world-wide.

Siemens' electrical, technical, and thermal know-how,

based on decades of experience, have enabled the development of transformers that have been optimally adapted to both onshore and extreme offshore conditions.

Installed at the top of the wind turbine,

resin transformers require minimal installation effort and offer a range of various network concepts for optimal system efficiency. Various high-voltage and low-voltage connection options allow Siemens GEAFOLE transformers to be tailored to



## **Liquid-immersed distribution transformers**

Siemens' liquid-immersed transformers provide an innovative and highly reliable approach to transformer tech-

nology. Hermetically sealed, they can be installed outdoors without special housing and ensure minimal maintenance requirements.

The devices feature a range of standard connection sys-

tems for easy installation, ranging from normal porcelain to plug-in bushings.

Standby power losses are extremely low, which ensures maximum overall efficiency. The fire protection



## **Power transformers**

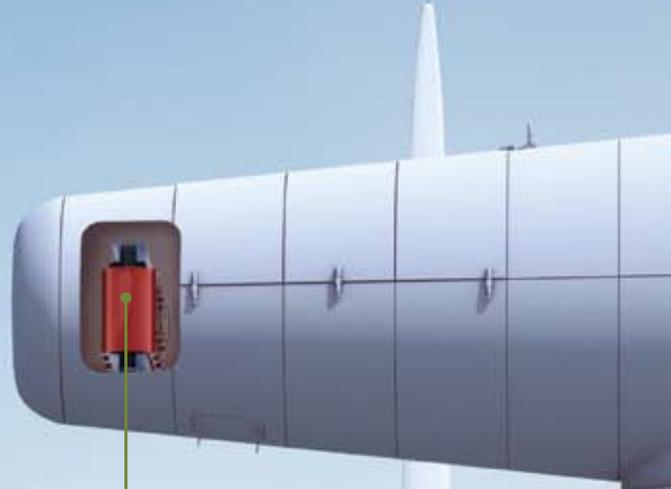
Offshore AC power transformers increase the voltage level of the electricity generated by the wind turbines to usually about 150 kV in

order to efficiently transmit the bundled energy from the platform to the coast.

Additional onshore AC power transformers transmit the power to the areas of consumption.

Offshore demands on transformers are much more challenging as compared to average onshore equipment. Siemens transformers are comprehensively optimized to meet these challenges with regard to:





meet customer's needs at all times.

GEAFOL transformers are flame-retardant and self-extinguishing. They meet the highest fire protection and environmental requirements and ensure maximum operating

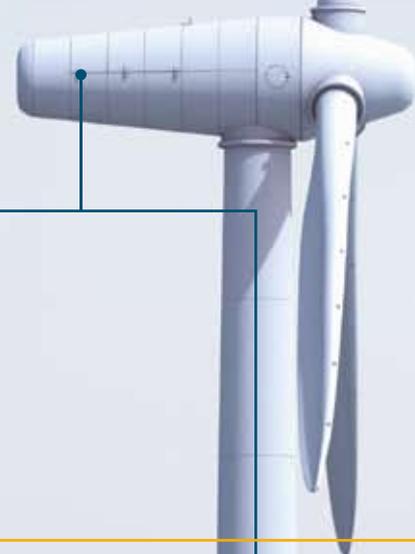
safety. In addition, minimum maintenance is required on these devices and they are extremely easy to repair. That is why GEAFOL transformers installed in wind turbines can truly play to their strengths.

capability of these transformers has been optimized using low-inflammability dielectric insulation liquid synthetic ester, which complies with IEC61099.

In terms of environmental considerations, the insulating liquids are biodegradable and the transformers can be recycled, which means that waste is kept to a minimum.

- weight and size
- freedom from maintenance
- corrosion protection
- forces during the movement of the platform to its final offshore position

- fully encapsulated connection technology
- platform vibrations





## **HVDC transformers**

Generally, areas of high energy consumption are not close to areas of generation.

Connecting offshore wind farms to the grid, increasing

the availability of electric power supply on offshore platforms, or transmitting power via submarine cables across the sea are perfect examples of where HVDC is the preferred solution for providing efficient and

## **Shunt reactors**

In DC networks, shunt reactors are widely used in the system to limit overvoltages and short-circuit currents. In view of the growing number of high-voltage overhead lines and high-voltage sub-

sea cables, growing transmission distances, and increasing network capacities, these reactors play an increasingly important role in the modern network system.

## **Service**

Transformers of any type are a huge investment. And they are key to the flawless operation of entire networks. No doubt they are designed to last for decades, but since

they are in use day and night for decades, wear and tear inevitably takes its toll. This is why Siemens has developed a comprehensive service concept for transformers that not only

reliable power transmission over long distances.

HVDC systems offer a number of technical advantages, most notably the nearly ideal sinusoidal-shape waveform, the independent control of active and reactive power,

and the ability to stabilize interconnected AC networks.

Siemens' specially designed, IGBT-powered HVDC PLUS system provides even more advantages:

- compact and adaptable station layout, lower space requirements
- reduced losses thanks to low switching frequencies
- lower time and cost demands from planning all the way to commissioning



### Made for every requirement

Siemens shunt reactors meet all specified requirements in terms of voltage, rating, type of operation, noise emission and loss levels, type of cooling, transportation, and

installation. Due to the distance bridged, any subsea cable is a natural capacitor running in parallel with the transmission line. It causes a considerable voltage increase.

Depending on the transmission distance, the profile

of the line, and its transmission capacity, a shunt reactor is required at the line terminals. A liquid-immersed shunt reactor is the solution of choice here. Its advanced design and production technology ensure low loss and noise emissions levels.



extends their life, but also reduces their impact on the environment, minimizes planned and unplanned downtime, and preserves the value of transformers in the most effective way, lowering operating costs.

Siemens experts worldwide perform services such as condition assessment and monitoring, early fault detection, or lifetime extension through targeted measures.

It goes without saying that Siemens also offers spare parts service, repairs and retrofits, and extensive consulting services that provide value added right from the earliest planning stage of a project.





# Experience and expertise you can rely on

## Our services begin at your starting point

Large-scale wind farms, as well as single wind power turbines, require professional project management and partners who are able to supply both expert knowledge and a position to see the big picture at every stage of the project – partners like Siemens who supply a comprehensive range of targeted products, solutions, and services that provide real value added.

From the very first stages of planning and the outline of adequate financing solutions through the construction of new plants and consultancy on upgrade projects to life-long service and maintenance, Siemens offers everything you need. That's why Siemens' customized transformers are an indispensable part of today's wind energy solutions, and they do their bit in shaping the new energy age around the world.

## 1 Robin Rigg, UK

The transformer plant in Kirchheim (Germany) furnishes several wind farms all around the world. For the Robin Rigg offshore wind farm in the UK with a total power of 180 MW generated by 60 turbines, GEAFOL transformers were delivered that were installed in the nacelles.

## 2 La Fatarella, Spain

The La Fatarella wind farm in Spain has 21 turbines generating 50 MW. The 54.6 MVA transformers installed in the wind farm are liquid-immersed distribution transformers from the transformer plant in Weiz, Austria.

## 3 Gardunha, Portugal

The Gardunha wind farm comprises 57 turbines generating 114 MW. More than 2,000 special transformers (SILFO) for wind turbines have been supplied by the Sabugo transformer plant in Portugal.



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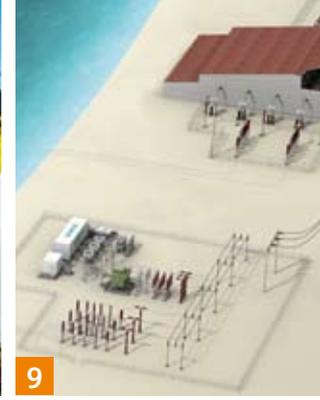
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**4 Sicily, Italy**

The Siemens transformer plant in Trento produced 220 KV 50 MVA transformers for the Lago Arancio wind farm in Italy. These transformers ensure grid access for the wind farm, which has a total of 137 turbines and generates 46 MW of power. With its associated wind farms Rocca Ficuzza, Nebrodi, and Alcantara, the overall production exceeds 200 MW of installed power.

**5 Monte Grighine, Italy**

The Monte Grighine wind farm in Italy uses GEAFOL transformers from Kirchheim, Germany. 43 turbines generate nearly 100 MW of power.

**6 Jiangsu, China**

Asia also uses Siemens transformers from Europe for their wind farms: 21 liquid-filled distribution transformers from Weiz (Austria) with a rating of 54.6 MVA were installed in a wind farm equipped by Siemens Wind Power, generating 50 MW off the eastern coast of China.

**7 Greenwich, Canada**

The transformer plant in Bogotá is the supplier for wind farms in America. For the Greenwich wind farm with 43 turbines generating nearly 100 MW, the plant delivered 46 liquid-immersed, pad-mounted distribution transformers with a power rating of 2.6 MVA each. The plant also manufactures medium-power transformers for the connection of wind farms to the grid.

**8 Lillgrund, Sweden**

Power transformers for wind farms can also be installed on offshore platforms. The 120 MVA medium-power transformer for the Lillgrund wind farm in Sweden was manufactured in Dresden (Germany), and has a corrosion protection for maritime climate conditions.

**9 BorWin2, Germany**

The transformers for the BorWin2 wind farm in Germany came from Nuremberg. Two HVDC transformers (one onshore 585 MVA, one offshore 590 MVA) and two reactors (19 MVA and 8 MVA) were ordered to transmit the total wind farm power of 800 MW.

**State-of-the-art production facilities for cutting-edge product quality**

Thanks to large investments in production sites and a professional team of developers fully engaged in wind power projects, Siemens is able to offer cutting-edge transformer technology tailored to the demands of wind power units.

Excellent logistics and manufacturing sites at selected locations worldwide ensure the secure supply of Siemens products at all times. In addition, a tight and powerful network of lead and back-up manufacturing facilities ensures extremely fast delivery. Siemens has proven itself to be a first-class supplier of state-of-the-art solutions through timely completion of hundreds of wind power transformers in recent years.

Siemens transformer factories are located in the Americas, Europe, Asia, and Russia to serve the rising global demand of transformers for wind power generation now and in the future.

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