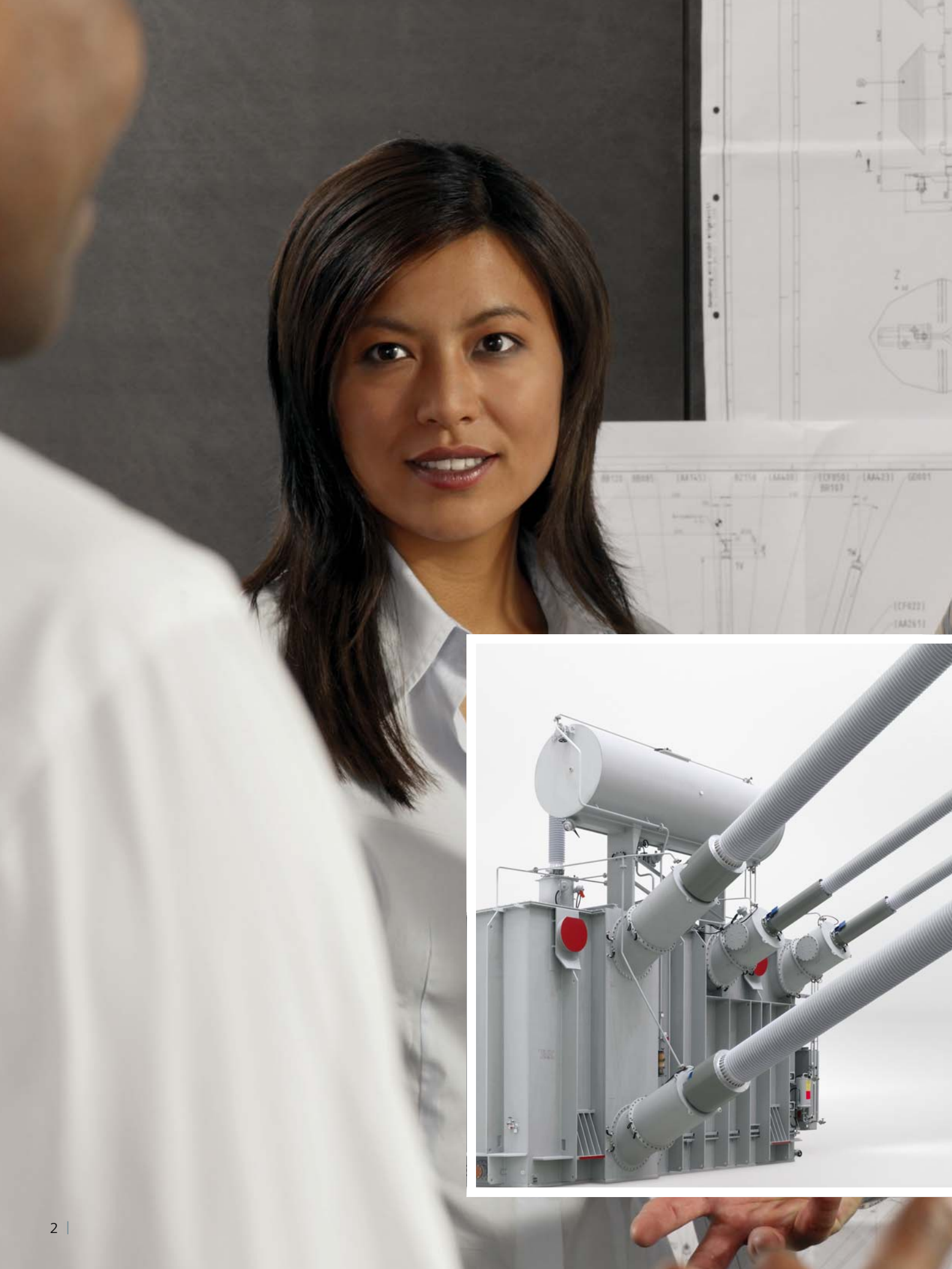




Transforming know-how into solutions.  
Siemens Transformers.

Answers for energy.

**SIEMENS**





## Transforming ideas into quality. Siemens Transformers.

Whether for infrastructure systems, industry or households – transformers play a key role for a reliable power supply. As a customer, you quite rightly place the highest demands on reliability, cost-effectiveness and operation time. In more than 100 countries and for more than 100 years, transformers made by Siemens are synonymous with top quality – as a result of ideas, know-how and unequaled experience.

### **The right transformer for your task**

You need a product that exactly fits your task. We provide the right transformer for every requirement – from compact distribution transformers (DT) to large power transformers with ratings over 1,000 MVA.

### **Everything fits together – from the consultation to the service**

You expect a conclusive overall concept – one that's trouble-free, fast and offers

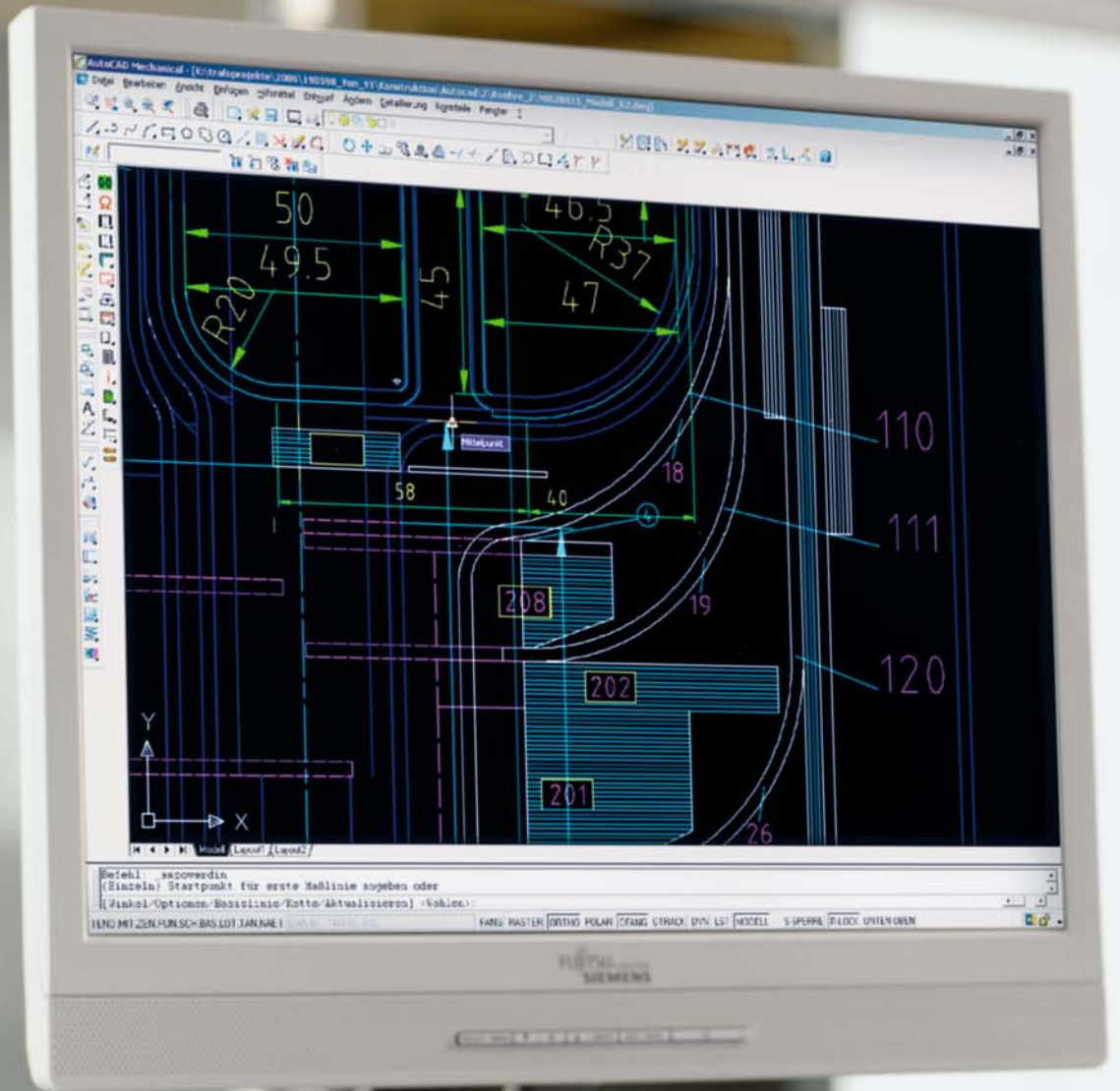
optimized interfaces. You can build consistently on our experience: from the initial advice, followed by the design, construction, manufacture, transport and commissioning, to Siemens TLM™ – Transformer Lifecycle Management™.

### **Reliability – born from experience**

You are looking for a solution provider with experience. Our background: 100 years of know-how and an installed base of several million MVA around the world.

At present, Siemens produces worldwide around 200,000 MVA annually (including DT) – which means approximately 25,000 distribution transformers and up to 1,000 power transformers.

These are some of the reasons why your transformers should be “made by Siemens.” Let us sit down together and talk about your ideas – we will work out the solution most suitable for you.





## Transforming ideas into tomorrow's solutions. Siemens Transformers.

From the simple instrument transformer to today's high-tech product – the history of the transformer is full of trailblazing inventions and innovations. Always a leader in development: Siemens is a pioneer of the transformer technology.

### Origins

In 1890 Sigmund Schuckert built a factory in Nuremberg, Germany; one of the main products were transformers – the origin of the Siemens transformers. Only one year later, the company's products were used in the cross-country connection between the Neckar hydroelectric power station and the site of the International Technical Exhibition in Frankfurt.

### Internationalization

As early as 1903 Siemens and Schuckert joined forces and formed the Siemens-Schuckert-Werke. Their products set milestones on the international market for more than half a century. To be better able to meet the increasing global requirements, Siemens and AEG combined their transformer production in 1969. The Transformatoren Union AG (TU) was established, quickly becoming a world-renowned manufacturer. In 1987 TU was re-integrated into Siemens AG.

### Expansion into a unique network


The next milestone followed in 2005 with the integration of VA TECH – including the brand names ELIN, EBG, Peebles, Ferranti-Packard and STEM – into Siemens AG. This combined the strengths of two of the world's top transformer manufacturer groups.

Today, "Siemens transformers" represents a unique, worldwide sales, production and service network with offices, production centers and service facilities in more than 190 countries.



## Siemens Transformers – the milestones:

- 1912** A new standard is defined with the first transformers for 100-kV transmission.
- 1923** The first three-phase transformers in five-limb design are built in Nuremberg.
- 1932** Phase-shifting transformers are used for the supply of out-of-phase variable voltages in networks for the first time.
- 1965** The GEAFOL cast-resin transformer is introduced.
- 1968** The first single-phase transformers and reactors for 800-kV networks set new standards.
- 1969** Siemens supplies the first three-phase generator and network transformers for 400 kV.
- 1972** Transformers and reactors for high-voltage direct current (HVDC) transmission are tested successfully in a pilot project. Since then, more than 15 of such systems have been equipped throughout the world – making Siemens the leading manufacturer of this energy-saving future technology.
- 1974** Siemens supplies the first 1,020-MVA generator transformer 415/27 kV for the Philippsburg NPP, which will be the world's largest three-phase transformer for nearly twenty years.
- 1980** The first 10-MVA GEAFOL cast-resin transformer is delivered from Kirchheim.
- 1982** 250-MVA shunt reactors for 420 kV, the largest in the world at the time, are successfully put into operation.
- 1984** The first 850/1100-MVA generator transformer is built according to the DVG standard.
- 1995** The first 9.15-MVA GEAFOL cast-resin transformer mounted in protection housing IP44 with air/water-cooling system is installed on the Grand Princess cruise ship.

- 
- 1998** The first 22-MVA GEAFOLE cast-resin transformer with oil-free on-load tap changers is delivered.
- 1999** The first static frequency converter, 55.5 MVA (static shunt compensator) is installed for Flexible AC Transmission Systems (FACTS) in the USA.
- 2002** The first MIDEL®-insulated 230-kV transformer, 135 MVA, is built for Sweden. 300 MVA  $\pm$ 500-kV HVDC transformers and smoothing reactors are developed for various HVDC projects in China's Southern Grid.
- 2005** The "whispering transformer" – the first extremely quiet 420-MVA/345-kV autotransformer is built for the USA with a sound pressure level of only 57 dB (A).
- 2007** The first 40 MVA  $20 \pm 2 \times 2.5 \%$  / 12-kV GEAFOLE cast-resin transformer is produced. Siemens supplies the first single-phase step-up transformers with 701 MVA; 400/21 kV for a 2100-MVA transformer bank.
- 2008** Siemens receives the first two orders from China for  $\pm$ 800-kV UHVDC (ultra high voltage DC) transformers for the world's longest and most powerful UHVDC connections: Yunnan–Guangdong at 5,000 MW and a portion of Xiangjiaba–Shanghai at 6,400-MW.





# Transforming knowledge into first-class products. Siemens Transformers.

Why Siemens transformers are held in such high regard throughout the world can be explained very easily: because of the proven reliability in decades of continuous operation – often under the most demanding environmental conditions. The basis for this success is the acknowledged high quality of design and construction.

## **Systematic quality**

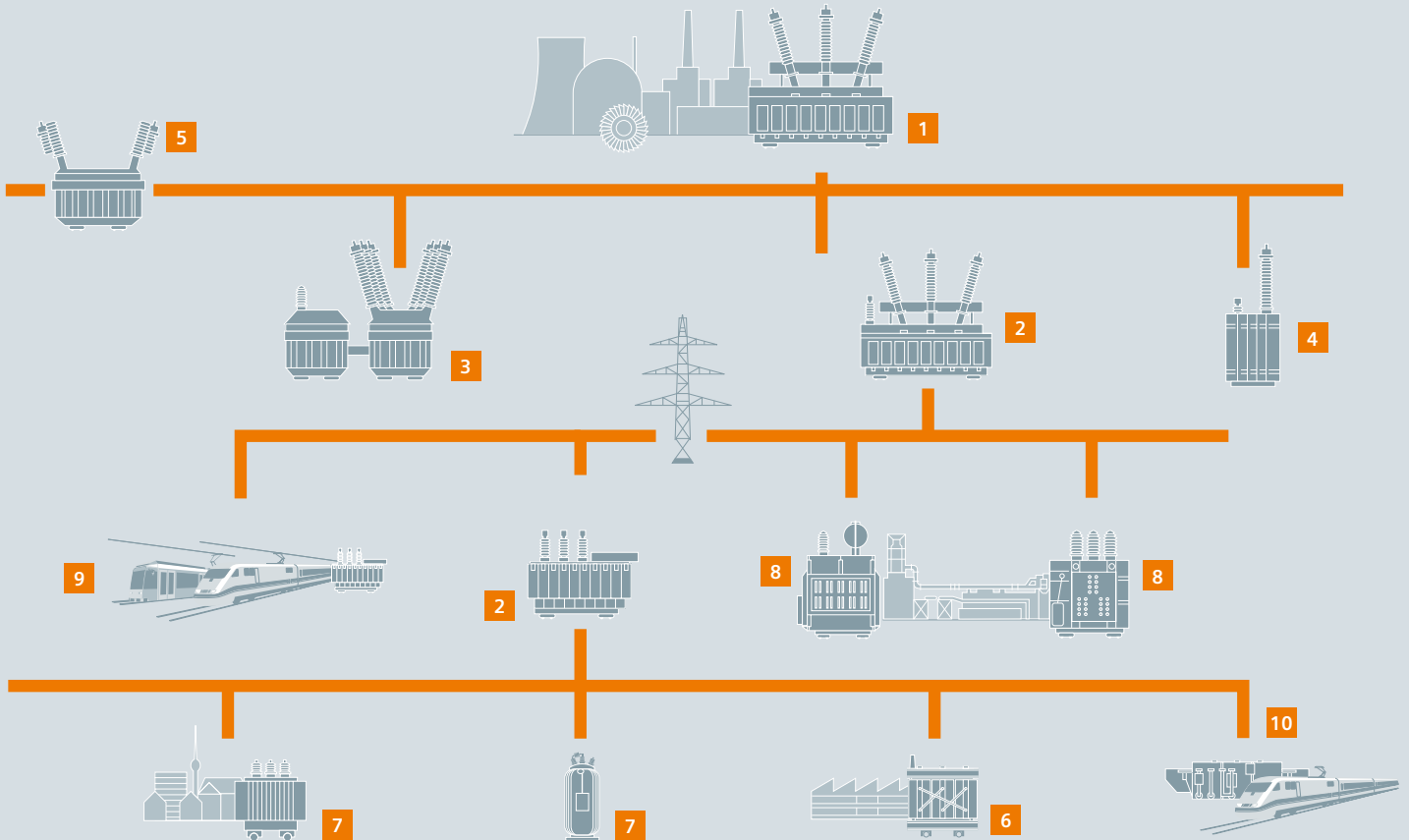
Our quality management system certified according to DIN ISO 9001 is in effect in all factories where Siemens transformers are manufactured. It is organized in the same way everywhere, so quality is the logical result of a uniform philosophy.

## **Reliability right from the start**

Siemens transformers are subject to very stringent final approval tests performed at the place of manufacture. Highly specialized test laboratories are available for this purpose in all factories. The result: maximum availability and reliability in field use.

## **Extremely low failure rate**

In technical publications, a failure rate of 0.5 percent is considered as “excellent”. A value lower than this is achieved in all our factories. This is the result of high quality standards which, of course, also apply to our subcontractors. A further reason is the comprehensive feedback of experience from operations, which we use to optimize our products.



# Transforming concepts into variety. Siemens Transformers.

Only a company that offers a complete product range can really cover all of your requirements. Siemens has put this fact into practice.

Whether the task is to transform the generated power at the power plant, to bridge seas and continents or to provide a stable power supply directly at the consumer – we will work out and implement the correct solution for you. For every required power, every voltage, every cooling method and every operating mode.

## Setting the course for success

The parameters must already be correct during the specification so that the transformer solution meets your requirements. We provide qualified advice for the decisive questions – from dimensioning through budgeting and configuration to network planning.

## Safely and punctually at the site

The transport of transformers is precision work. We ensure that your product arrives safely and punctually at the location of installation – whether by rail, ship, road or air. In every country in the world, irrespective of the size of the transformer – and including all the formalities from customs to transport insurance.

1

### Generator step-up transformers – customized advanced technology for high- and very-high-voltage systems

Generator step-up transformers enable an individual adaptation to the voltage levels of the power plant and transmission conditions. Siemens step-up transformers have set examples throughout the world – up to the power limit range.

5

### Transformers for HVDC – for especially efficient power transport under difficult conditions

Whether over long distances or between systems with different frequencies – the relatively new technology of high-voltage direct current (HVDC) transmission ensures the economical transport of power. However, its implementation requires very special knowledge during the conception, manufacture and installation of the transformers and smoothing reactors. There are very few companies only that can provide this technology, and Siemens is the worldwide number one.

9

### Special-purpose transformers for applications in power transmission

Siemens provides a complete range of transformers that perform special tasks. These range from short-circuit testing transformers to infeed transformers for traction systems or experimental physical systems.

2

### System and system-interconnecting transformers

High voltage networks use different voltages (e.g. 500, 400, 230 kV). To enable the power flow of electrical energy between these networks for the cross-point system, interconnecting transformers are used. System transformers manage the connection of high voltage and medium voltage networks.

6

### GEAFOL cast-resin transformers – for economical power supply directly at the consumer

The name GEAFOL stands for features that have proven themselves for over four decades in various applications, from the wind power station to the cathedral: the cast-resin transformers are flame-retardant, flame-extinguishing, and even with arcs do not ignite or develop poisonous gases – thanks to the environmentally friendly quartz-powder-filled epoxy resin insulation. The practically maintenance-free operation reduces the life-cycle costs, and the version with reduced no-load and short-circuit losses provides even greater efficiency. The very high freedom of partial discharges up to twice the rated voltage ensures best reliability.

10

### Traction transformers – for a mobile society and fast transport of goods

Compact, economical and above all safe, Siemens traction transformers have accompanied – and in some cases enabled – the development of transportation systems for more than 90 years. Today they are used in locomotives, urban railways and high-speed trains – day in and day out.

3

### Phase shifters for optimized control of power flow in electrical networks

Highly specialized phase shifters from Siemens offer network operators the possibility of optimizing their transmission capacity in existing networks economically. They significantly increase flexibility and speed in controlling the power flow between existing networks of different voltage and phase conditions.

7

### Oil distribution transformers and voltage regulators – for reliable supply through to the final consumer

The smallest links in the chain of transformers are in operation at the end of the transmission and distribution of the electrical power. Hundreds of thousands of Siemens transformers are being used for this around the world – of optimizing to provide power inconspicuously, but efficiently and reliably to the consumer.

4

### Shunt reactors – for better power systems

As one of just a few internationally experienced specialists, Siemens manufactures reactors for all fields of application – and makes a significant contribution to the stabilization and improvement in efficiency of the power systems through reactive-power compensation and reduction of overvoltage. Siemens products have also proven themselves at the highest of voltages and extreme powers.

8

### Special-purpose transformers for industrial applications

Everywhere raw materials are industrially produced and processed, extreme currents and power are needed. Siemens provides the technologies even for the most demanding applications – such as rolling mill drives, melting furnaces or electro-chemical plants.





# Transforming commitment into comprehensive service. Siemens Transformers.

With your investment in a Siemens transformer, you expect maximum consideration over the entire operation time. You can rely on this: we are always there to assist you with our experience and technical competence.

## **Longer operation time, optimized utilization with TLM™ – Transformer Lifecycle Management™**

As with every other technical system, transformers are subject to a certain amount of wear during operation. The decisive factor is knowing the duration of trouble-free operation and implementing countermeasures in good time. The solution: Siemens TLM™ – Transformer Lifecycle Management™.

This term covers a wide range of services, with the goal to significantly lengthen the operation time of your transformers and therefore to optimize utilization over the entire operation time. In this way, you receive the optimum benefit from your investment.

## **Overview of the TLM™ – Transformer Lifecycle Management™ services:**

- Condition Assessment and Diagnostics
- Online Monitoring
- Consulting & Expertise
- Maintenance & Lifecycle Extension
- Spare Parts & Accessories
- Repair & Retrofit
- Transport, Installation & Commissioning

China



15 generator transformers Three Gorges, the world's largest hydroelectric power plant

**Technical data:**

Power: 840/1092 MVA  
Voltage: 550 ±2 x 2.5 %/20 kV  
Cooling method: ODWF with river water

USA

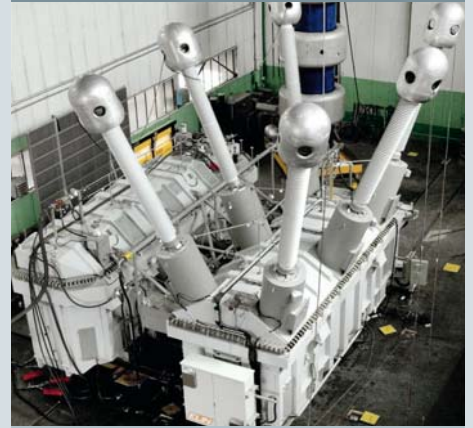


Four autotransformers with extremely low noise for a US power supply company

**Technical data:**

Power: 420 MVA  
Voltage: 345 kV  
Sound pressure level: 57 dB (A)

USA



Two phase shifters for a supply system station in Nevada

**Technical data:**

Power: 309/520/650 MVA, three-phase  
Voltage: 525/525 kV  
Load operation: ± 24°

# Transforming local requirements into global options. Siemens Transformers.

Size and proximity – you profit from both aspects during your cooperation with Siemens. As one of the world's largest manufacturers of transformers, we provide a tight network of competence; at the same time, we are your regional contact, who understands and implements your requirements.

Our manufacturing competence is concentrated at 20 locations throughout the world. We can guarantee a high local added-value share at all these locations. These production sites are linked through the exchange of experience, which results from the numerous practical field jobs and through worldwide uniform

quality management standards. This network is also supported by the global Siemens presence in over 190 countries.

The following examples provide an overview of the solutions resulting from this cooperation. Whether hundreds of meters below the ground or on top of

the world, whether on land, water or at extreme elevations – Siemens transformers are at home in every environment. What does your environment look like? Get in touch with us. We will be pleased to advise you and develop the transformer solution that perfectly meets your requirements.

China



800-kV UHVDC transformers for the world's longest and most powerful transmission links

Technical data:

Power single-phase: 400 MVA  
Power three-phase: 300 MVA  
Voltage: ±800 kV UHVDC

Rated power: >5,000 MW  
Transmission distance: >1,400 km

USA



Reactor for a power supply company

Technical data:

Power: 150 MVA, three-phase  
Voltage: 525 kV  
Cooling: ONAN separate cooling unit

Germany



Transmission transformer for the Bürgerwindpark Lübke-Koog

Technical data:

Power: 40 (50) MVA  
Voltage: 110 kV/60 kV

Vector groups changeable

On HV side: to YN  
On LV side: reconnectable  
From yn6(d) to d5, 21 kV

Germany



Industrial transformer for a high-grade steel mill

Technical data:

Isolating transformer including furnace transformer and series reactor in one tank  
Power: 100 MVA  
Voltage: 110/0.950–0.525 kV

Germany



Two of the most powerful GEAFOL cast-resin transformers in the world are used on the experimental and test line for high voltage direct current transmission systems at Siemens Energy in Erlangen

Technical data:

Rated power: 40 MVA  
Voltage: 20/12.2 kV  
Cooling method: AN/AF

Europe



163 locomotive transformers BR 189 Eurolok for 15 countries

Technical data:

Rated power: 7980 kVA  
Voltage: 15/25 kV  
Traction: 4 x 1.6 kV (1650 kVA)  
Cooling method: KDAF, 580 kW

Published by and copyright © 2009:  
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Power Transmission Division  
Order No. E50001-G640-A127-X-4A00  
Printed in Germany  
Dispo 19201, c4bs No. 7480  
TH 101-090574 470902 WS 11093.0

Printed on elementary chlorine-free bleached paper.

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