



Power transformers

Generator step-up and system intertie power transformers Securing high-quality AC transmission

Generator step-up transformers

Built to withstand continuous full load

Generator step-up transformers (GSU) are the critical link between the power station and the transmission network, often operated day and night at full load. They must be built to withstand extreme thermal loading without ageing prematurely. Our track record of 1,400+ units delivered since 1995 is proof of the superior quality of ABB's GSU transformers.

Long-term resistance to ageing

A GSU transformer is loaded at 100 percent rating 24/7, throughout the year. It must be built to withstand the thermal load of high currents being fed into its windings from the generator without overheating, which would shorten its lifetime due to accelerated ageing. ABB designers must consider high currents, magnetic fields, high-stress areas, oil flow and heat exchange in every part of the windings in order to ensure maximum efficiency and reliability.

Truly mission-critical operation

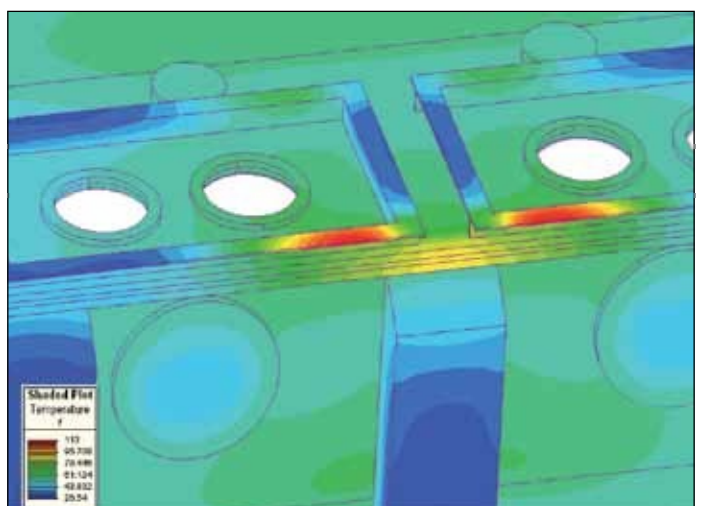
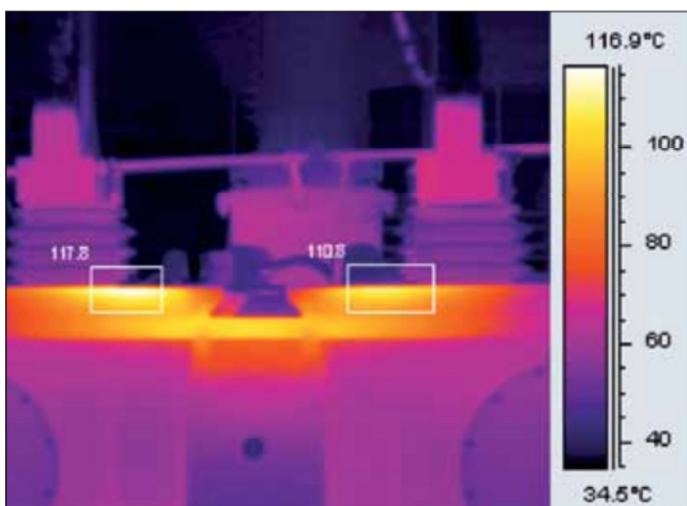
Whether your power station is nuclear, coal, oil, gas, hydro, wind or solar, ABB understands the criticality of GSU transformers. Any interruption of supply from these units may cause catastrophic loss of revenues for the owner. For example, standstill of one 500 MW unit for three months can result in loss of revenues equivalent to 20 times the purchase price of the power transformer.

Sophisticated thermal testing procedures

Standard factory heat run tests sometimes oversee thermal weaknesses, which will prove painfully obvious when they occur during operation. ABB's design software for thermal computation accurately calculates temperatures in every part of the windings. Fiber optics are used in the windings to verify that hotspot temperatures are kept within acceptable limits, while thermocameras are used to verify temperatures on all external parts. The software is continually updated and validated based on these accurate temperature measurements.

Strict design rules paired with in-depth knowledge

Delivering premium-quality GSU transformers requires precise design rules applied by experienced designers. Since every transformer is customer-specific, designers must also have a deep understanding of each customer's power system and operating practices. Paired with industry-leading expertise, ABB's industry-unique TrafoStar™ platform ensures that consistent design and manufacturing procedures are used in all 13 ABB power transformer factories worldwide.



Thermovision of the LV turrets of an ABB 500 MVA single-phase GSU transformer (left), and the corresponding temperature distribution calculated by ABB (right).

System intertie transformers

Sustaining electrical and mechanical stress over their lifetime

System intertie transformers are key elements in power networks, connecting AC networks of different voltage to each other. These power transformers must be built to withstand severe electrical stress from fault currents and transients. While seldom fully loaded, ABB system intertie transformers must stand ready at all times to handle any emergency case that may occur during their lifetime.

Specified for maximum load for emergency purposes

Since system intertie transformers are rarely loaded near their maximum rating, they are often specified with a standard rating in order to be exchangeable with other transformers. Such transformers are expected to remain in the grid for decades, and in case of failure, power will normally flow in another grid branch. However, failures stress the network and increase the risk of cascading failures, which is why high reliability of system intertie transformers is crucial to ensure grid stability.

Low partial discharges at dielectric stress

Located at the intersection of high, medium and low voltage systems, system intertie transformers must be built to withstand severe electrical stress. They must cope with different kinds of fault currents and voltage transients during their lifetime. During factory-acceptance testing, each ABB unit is exposed to the most severe dielectric stress that it may come

to experience during its operational lifetime. In addition, every unit is verified to guarantee low partial discharge levels, thus ensuring strong long-term resistance to over-voltage.

Like a mechanical hammering

The frequency of fault currents and their peaks are like a mechanical hammering on a system intertie transformer. This will eventually stress the unit during its long service life. ABB has conducted a large number of short-circuit tests, and recommends that such testing is carried out on certain strategic system intertie transformers in the network. ABB also offers to demonstrate its premium design quality by conducting in-depth short circuit design reviews according to IEC standards.



Customer-specific transformers built on a controlled design process

Power transformers are highly complex, engineered products. Over their lifetime of up to 40 years, they are subjected to enormous electrical, magnetic and mechanical loads. This calls for design excellence and a controlled structured design and manufacturing process.



Structured design and manufacturing process

To ensure efficient and reliable long-term operation, ABB has implemented common design rules on a global basis. Its TrafoStar design and manufacturing platform is a structured methodology applicable in all phases of power transformer production – including quotation, electrical and mechanical design, manufacturing and testing.

Optimizing crucial operational parameters

Every ABB power transformer is produced according to customer specifications and international standards. Performance criteria such as short-circuit strength and overload capacity must be carefully balanced with plant space constraints, optimized use of materials and other physical and financial requirements. Design data is processed in ABB's extensive design programs to generate input for subsequent stages of the design process. This comprehensive design methodology is today unique to ABB.

Simulations verify performance criteria

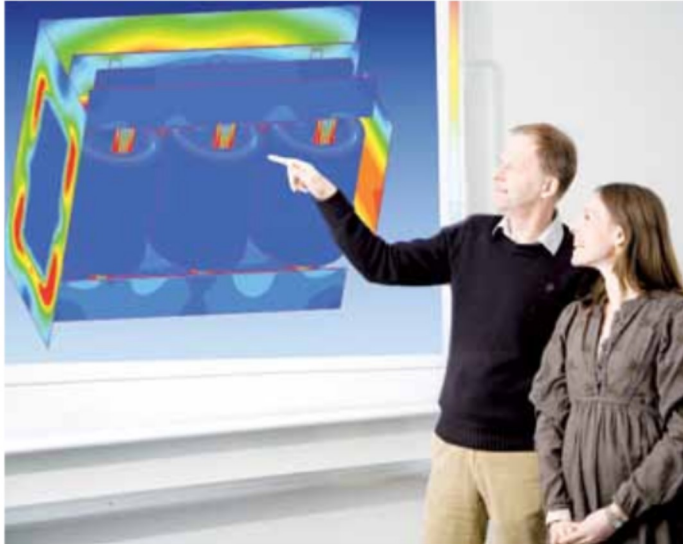
ABB design programs feature advanced simulation tools for key transformer components such as core, main insulation, winding insulation and windings. Transformer specifications are translated into ABB design rules and design modules stored in a global library. Each design is then checked by numerous verification programs.

Quality assurance in all business processes

ABB's quality management system addresses quality in every process and function of the value chain. The quality system is based on continuously measuring and comparing performance criteria such as test failures, customer complaints and cost of poor quality. With over 60,000 measurements conducted each year, ABB probably tests more operational parameters in all of our plants than any other supplier worldwide. Checklists, control points, design reviews and documentation ensure quality assurance in all business processes.

TrafoStar – key elements of ABB's common design and manufacturing platform:

- Design verification
- Creation of design elements
- Integration of modules
- Verification of CAD models
- Quality assurance
- Common manufacturing methods
- Common manufacturing equipment

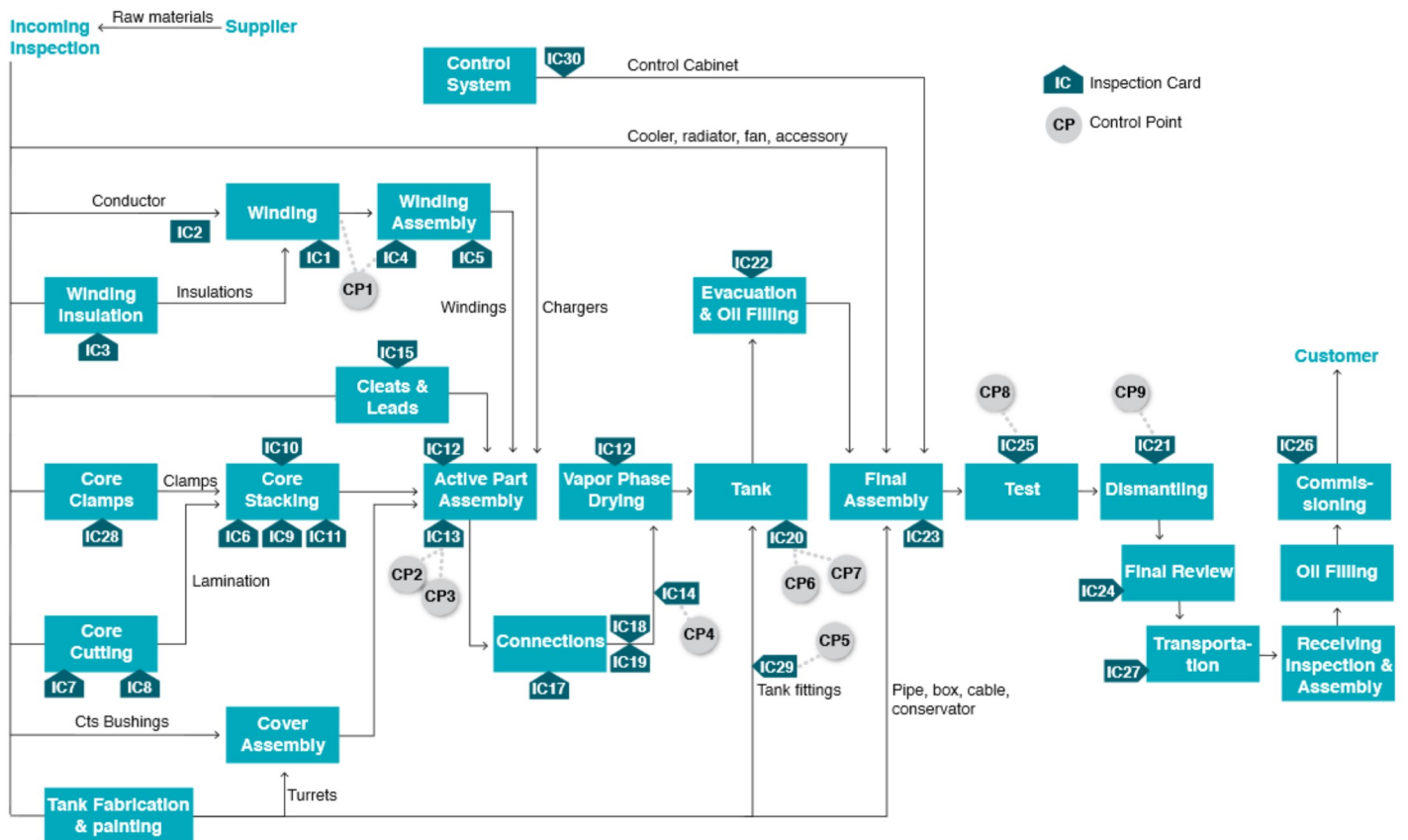


Tank loss and temperature verification.



Core loss and winding temperature verification.

Production quality control system – inspection by certified engineers and supervisors



Checklists, control points, design reviews and documentation ensure high quality in every process and function of the value chain.

A complete range of GSU and system intertie transformers

Since 1995, ABB has delivered more than 14,500 power transformers for some of the world's largest projects. These include over 500 units in the 735–765 kV range to all major geographical markets. ABB is renowned for its high quality in high-voltage applications.



Generator step-up transformers

Unit ratings	1,500 MVA
System voltages	up to 1,000 kV



System intertie transformers

Unit ratings	up to 2,000 MVA
System voltages	up to 1,000 kV

Full support from transport to training

ABB services ensure that your power transformers are operating at optimal performance throughout their lifetime. Our services range from transportation and basic maintenance to advanced diagnostic assessments and onsite repairs.



Service

Each ABB power transformer comes with a technical guarantee and full backup, including field support and global after-sales services delivered by local branch offices, agencies and representatives throughout the world. Diagnostic assessment, onsite repairs, upgrades and spare parts deliveries are available to customers worldwide.

Transportation

Reliable transportation is key to successful power transformer installation. Moving an object the size and weight of a large power transformer requires planning, know-how and a global network of contacts. ABB has long experience in delivering transformers by rail, road, sea and even air – worldwide. Our skilled staff will ensure a fast and efficient transport process.

Installation

ABB engineers will be on site to supervise installation and start-up. They will prepare the transformer by reassembling all parts dismantled for transit, refill it with oil and run the necessary tests to ensure trouble-free operation. Customers can choose between a supervisory or full-installation agreement. As far as possible, the engineers assigned will have local language skills.

Training

The customer's local operations and service personnel will be trained during installation and commissioning on site. Comprehensive training programs are available – contact your local ABB representative for more information.