# SGB-Cast Resin Transformers
# leading in on- and off-shore solutions

**⇨ High reliability**
**⇨ Low fire load**

### Technical requirements :

- Wide load variations
- Harmonics cause additional losses
- Repeated switching operations
- Over voltage
- Grid connected requirements
- Mechanical stress at transport and during service

### SGB's solutions:

- High voltage winding glass fibre reinforced. Even most extreme and rapid load fluctuation will not induce cracing of insulation
- Calculation of harmonic losses. Reducing the losses by using the right shape of conductors
- Layer winding with linear voltage distribution, reducing the stress caused by transit oscillation
- Magnetic core suitable for overexcitations up to 10% over voltage

### Characteristics
### tested by independent test labs:

| | |
|---|---|
| Vibration proof | IABG |
| Climate Class C2 | KEMA |
| Environmental Class | E2 KEMA |

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**SGB STARKSTROM**

# SGB Jet-System
# New cooling for on-shore transformers

**Dipl.-Ing. Arnold Schwaiger**

**With its Jet System, SGB offers an optimized solution for wind energy plants for on-shore installation.**

**It is produced for the power range from 1.6 MVA to 4 MVA and for a maximum operating voltage of Um 36 kV.**

**The design can be adapted for installation in the tower as well as in the nacelle.**

**In addition to life-cycle costs, the following factors were given especial consideration in the course of development:**

**a) optimized cooling**

**b) personal protection**

**c) fire protection**

**d) conditions for connection to the grid**

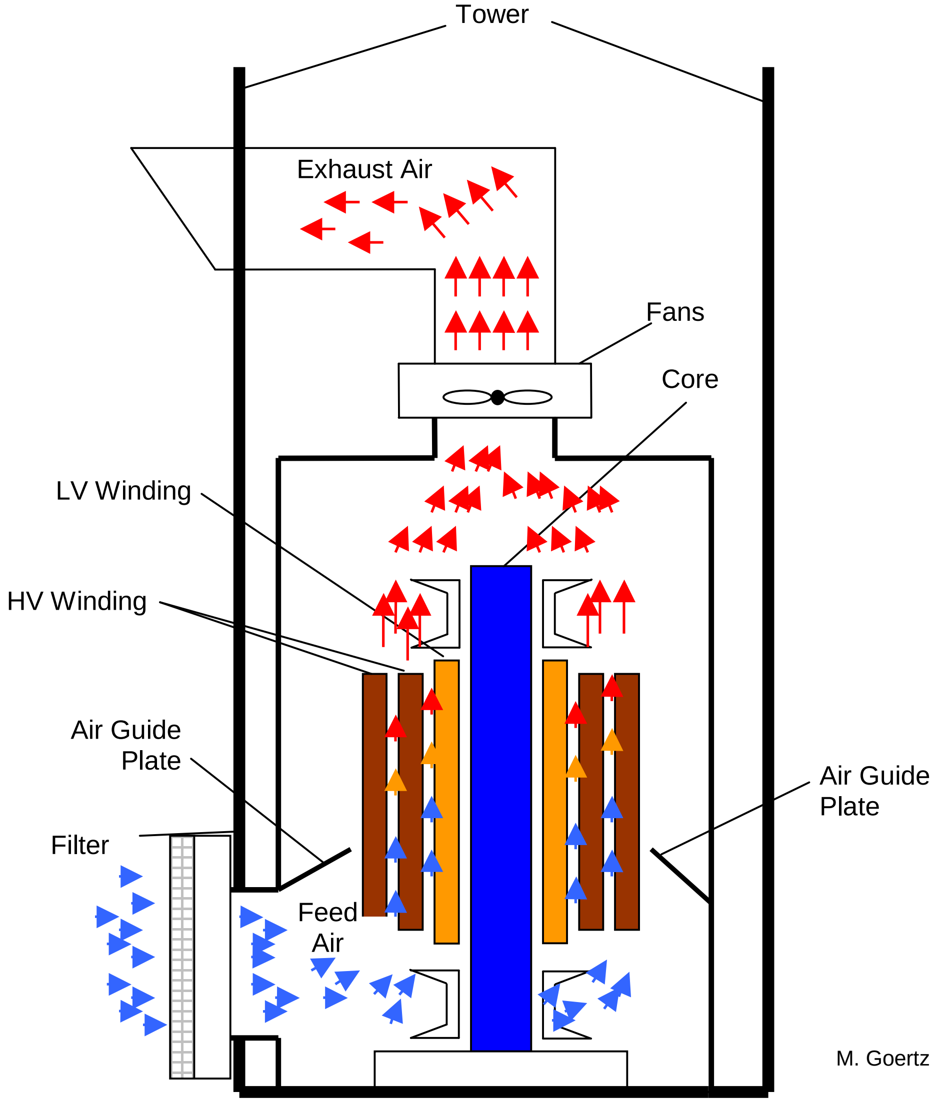
**e) transport conditions and vibrations**

# Description of the Jet-Systems

In this context, the SGB resin-encapsulated transformer is accommodated in a proven protective housing IP44. The cold supply air is routed directly to the housing from outside via a supply air box and a piping system. The cooling air is routed directly into the transformer winding ducts via an air guide plate.
The exhaust air heated by the transformer losses is blown directly into the open air via a piping system which also accommodates a low-noise fan and an exhaust air box.
This makes up a defined cooling system which can be tested in the scope of a factory test and ensures that the measured values are also reached after installation within the wind energy plant.
No-load losses and the low load losses up to 30% nominal power can be dissipated without switching the fan ON. In case of a higher load, the fan is activated via temperature sensors in the windings.
The optimized design of the cooling system makes for considerable material and space savings. The targeted air supply keeps the heating of the windings low.

The transformer has been designed for climate class C2 and for a temperature range from + 40 to –25℃. Temperatures between –50℃ and + 50℃ can be covered in exceptional cases.

In accordance with the environmental class E2, the transformer was tested successfully at KEMA in a climatic chamber with moisture precipitation and a conductivity of the water of 0.5 to 1.5 S/m. If the environmental conditions exceed these requirements, the feed air box can be equipped with appropriate filters.




# Personal and fire protection

Thanks to the high reliability of SGB resin-encapsulated transformers, the risk involved is very low. Due to the low fire load and the fact that no coolant is used, the transformer does not contribute essentially to fire incidents.
The dismountable housing of galvanized sheet steel protects the staff against touching live parts. All components are connected to the plant's grounding system. In case of faults, the hot gases can escape via the ventilation and deaeration lines. Arc monitoring sensors signal malfunctions occurring, thus allowing the plant to be switched off extremely quickly. This reduces possible risks and damage considerably. Fire gases are also routed out of the plant via the supply and exhaust air lines, thus satisfying the requirements of EN 50308.
The temperatures of the windings are integrated within the plant control system and, on being exceeded, cause the plant to be deactivated.

# Conditions for connection to the grid

Wind energy plants are often built and operated on spurs remote from the large consumption and conventional power generation centers. Due to the continuously rising proportion of wind energy in consumption networks, the demands on grid operators as regards the electrical properties are also on the increase.
Depending on the prevailing conditions in the countries concerned, voltage fluctuations resulting from the power characteristics of wind parks and the behaviour in case of fault have to satisfy different requirements. A certain amount of inductive and capacitive reactive power must be provided.
As transformers are the link connecting the grid to the wind generator, the conditions for connection to the power system have a considerable effect on the transformer's design and thus the costs of manufacturing.
Overvoltages on the transformer due to higher mains voltage or capacitive loads, result in over-excitation and thus cause the core to heat up to inadmissibly high temperatures.
This can be compensated by a reduction of induction, i.e. the enhanced use of magnetic sheet metal.
It should also be possible to provide the rated power of the wind energy plant at undervoltage.
Thus, the transformer must be operated continuously at approx. 10% higher current. This also means extra material outlay.
By optimizing the cooling of the transformer, through ducts in the windings and the design of the magnetic core, we have managed to reduce this additional extra expense considerably.

# Transport conditions and vibrations

As wind energy plants are exported in high quantities, the stress imposed by transport, especially over the last few meters, must be considered. We know from experience that the risks are higher than those caused by vibration in the wind energy plant and can realistically be compared to those caused by serious earthquakes.
Thus, the cores of SGB transformers used for wind energy plants are not only secured by gluing the core plates and bandages, but also by pins passed through the core yokes.
Moreover, clamping of the glass-fibre reinforced HV winding and the LV winding glued with Prepreg is effected by a support system with cup springs.

# Summary

The targeted cooling within the Jet System permits material savings and provides a proven, reliable and low-cost version of safe interfacing of wind energy plants to supply grids.


SGB