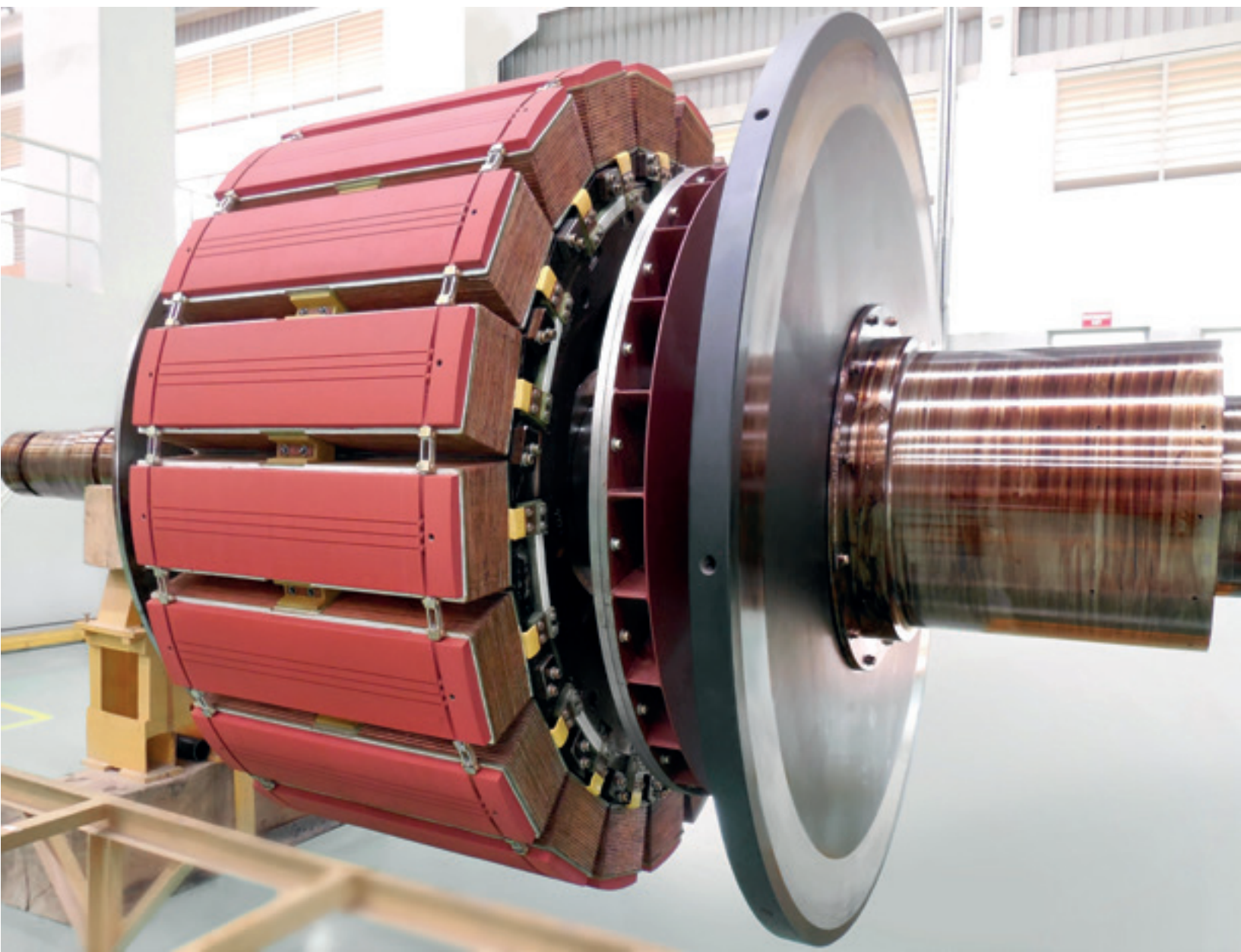
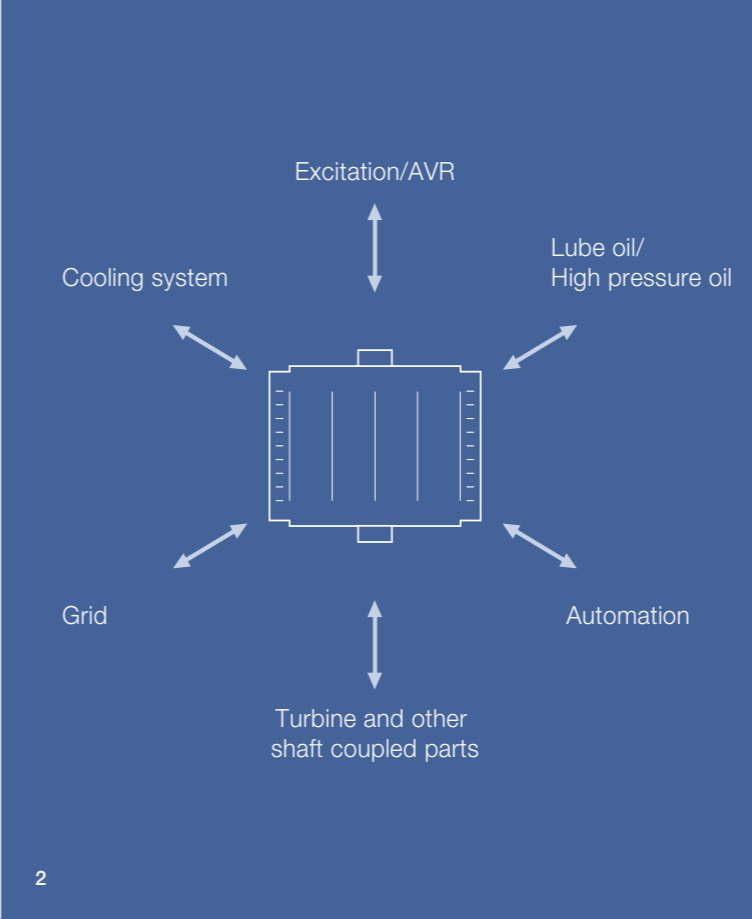


**VOITH**

# Small Hydro Generators





**Cover picture** 15 MVA and 20 pole rotor component

1 Cambasi, Turkey, 27 MVA and 16 pole rotor

2 Hydro generator interfaces

## Know-how from a full line supplier

Within the heart of a hydropower plant, the generator turns torque into energy. We are experts for generators, intergrating them perfectly into your powerhouse.

Voith pays closest attention to water-to-wire solutions. Our focus: maximize the energy from your power unit and extend the lifetime of your equipment.

Therefore, Voith has developed a new Small Hydro generator product line which offers several advantages which conventional industry generators do not provide adequately.

Generators in hydropower applications are an integrated part of the drive train with interfaces to various power house components – the understanding of the complete power house system is essential in optimizing this product.

With more than 140 years of experience in manufacturing equipment for hydropower plants, Voith understands how to design and optimize each powerhouse component in relation to the generator. Voith orchestrates its best engineers in its R&D centers to produce vertical and horizontal generators with increased lifetime and solid quality. We offer proven solutions with no hidden expenses throughout the generator's lifetime.

Products from Voith are maximizing your return on energy production. We offer generators for Small Hydropower plants with a range from 690 V to 13,8 kV (frequency: 50 to 60 Hz) and full IEC tests including heat and speed test. And we stand behind our product with lifelong support and services.





Pole coil brazing and lamination

# Specific requirements for hydropower generators

Our contribution to making Small Hydropower attractive is to ensure that your Return on Energy Production is optimized.

## Your requirements

### Maximized Annual Energy Production

Voith generators offer high availability and great efficiency even at part load. They are robust and require low maintenance. To maximize your Annual Energy Production, Voith has designed generators for continuous reliable operation.

### Long generator lifetime

Voith has extensive experience in manufacturing generators and we pull from this long history to provide excellent solutions for Small Hydro. Our design concept considers fail synchronizations, short circuits and overspeed. Thus, Voith promises high level of safety and guarantees long lifespan.

### Stable generator operation at grid

Our product line demonstrates an excellent grid connection behavior. Moreover, our generators have the capability to go through grid faults in transient conditions. All requirements of the latest grid codes have been considered during design and testing phases.

### Minimized Total Lifecycle Cost

Voith's generators are engineered utilizing an efficient modular design concept thus reducing the upfront investment required by a Small Hydro developer. All designs consider the most extreme operating conditions possible which ensure minimum Total Lifecycle Costs for the equipment.

## Our generator product range

- + Voltage range of 690 V to 13,8 kV
- + Protection IP23 up to IP54 (IEC 60034-5)
- + Cooling IC 01 up to IC 81W (IEC 60034-7)
- + Frequency 50 and 60 Hz
- + for ambient temperature -10/+40 °C up to +60 °C on demand
- + Insulation class F, heating class B (best for cool vs. hot turbine-generator coupling)

# Our solution

With more than 140 years of experience in the field of hydropower, we are able to meet the hydro specific requirements for generators.

### Mechanical damping

For stable operation mechanical damping is of utmost importance. In contrary to conventional industry solutions, Voith considers damping already in the design phase instead of adding external components along the shaft line.

### Grid stability

Time to "connect to the grid" is essential in hydropower. Therefore, sufficient damping as well as grid stability capability is required to reduce standstill periods either from load rejections or grid failures.

### Long lifespan of components

Vibration levels of the generator highly impact lifetime of components. Therefore it is crucial to consider field coil design, rigidity of the rotor, bearing supports and generator housing in the design phase. Generator overheating is limited in design to cope with high temperature differences between cold hydro turbine and hot generator.

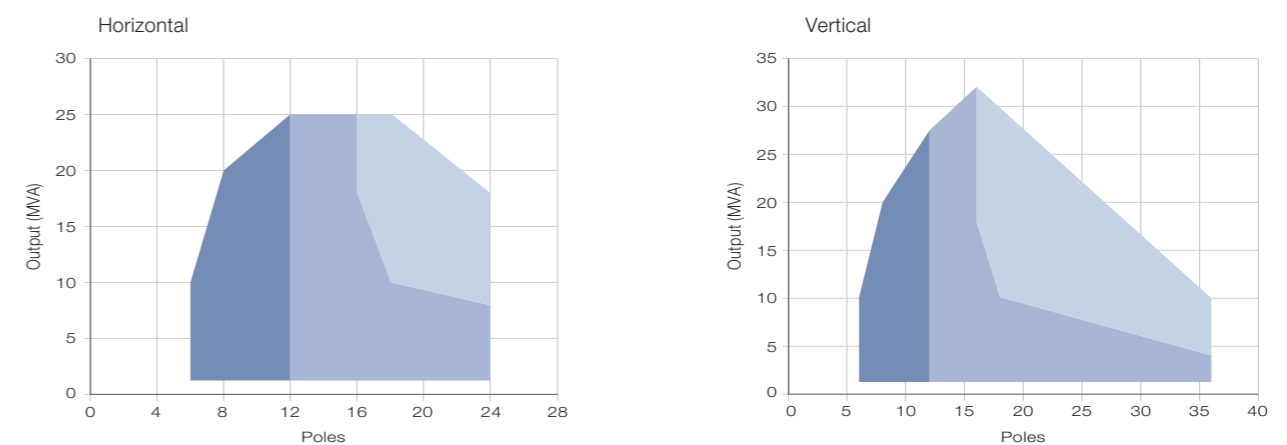
### Hydro specific design

The level of electrical, mechanical and thermal stresses in hydropower industry exceeds the typical levels of other industries. This requires a rigid generator design and an adapted production process of the stator and rotor, its windings and the winding insulation.

## Synchronous speed overview

No. of poles	RpM	
	50 Hz	60 Hz
6	1000	1200
8	750	900
10	600	720
12	500	600
14	429	514
16	375	450
18	333	400
20	300	360
22	273	327
24	250	300
26	231	277
28	214	257
30	200	240
32	188	225
34	176	212
36	167	200

## Generator standard application range\*



\* Others are available on demand

# Technical features

## Stator

- Solid reinforced winding overhung, withstands short circuits and fault synchronizations
- Rigid consolidated magnetic core with radial cooling ducts for extended lifetime and reduced losses
- Solid connections and epoxy 2 component resin with VPI-Process guarantee perfect performance under electrical and thermal stress
- High quality 100% tested coils ensure lifelong durability of the stator

## Rotor

- Single layer rotor coil for best cooling, insulation and mechanical rigidity
- Sufficient electrical damping ensures a smooth operation on grid. Laminated massive rim and pole rotor constructions cover the range from low to high speed solutions
- A massive salient pole rotor for a long and trouble free operation running with minimal vibration; alternative designs are also available

## Bearings

- Selection of best fitting bearing for your application
- Equipped with flange sleeve, pedestal sleeve and optionally antifriction bearings
- All bearings are from Voith qualified suppliers

## Accessories

- Brushless exciter with single layer field coil for high over voltage durability
- Fits with Voith excitation system as well as commercially available equipment
- Static excitation is also available with very durable slipping equipment
- Various terminal box concepts depending on voltage level with optional star point separated are available



Eidisverkid, Faroer Island, 9,6 MVA, 8 pole generator



## High quality and lifelong support

In addition to standardized testing, all horizontal and vertical generators are fully IEC (IEC 60034-1 and IEC 60034-2) tested, including heat run tests in open and short circuit condition. All generators are tested in full over speed on vertical respectively horizontal test fields.

For our Small Hydro generators a standard document submittal list with all necessary technical documentation is available at project start.

### Lifelong product support

From engineering and electromechanical calculations to quality assurance, production, erection and commissioning our Voith in-house competence is always at your fingertips. We are ready to support you during the project development and stay with you the entire product life cycle, not only on Small Hydro generators but on the entire Small Hydro plant.



Rotor with exciter



Rotor pole body

Voith Hydro Holding GmbH & Co. KG  
Alexanderstrasse 11  
89522 Heidenheim, Germany  
Tel. +49 7321 37 0  
Fax +49 7321 37 7828

[www.voith.com](http://www.voith.com)

A Voith and Siemens Company

**VOITH**  
Engineered Reliability