

Keep hydropower technology running – with HyService from Voith Hydro



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A Voith and Siemens Company



Safe, reliable energy – with know-how from Voith

A safe and reliable energy supply requires power plant technology that is fully functioning and available at all times. To use hydropower in a way that is as cost-efficient and environmentally friendly as possible, the entire plant has to run flawlessly – 24 hours a day.

The basic prerequisite for trouble-free operation and preventing unscheduled downtimes is the ongoing technical maintenance of all hydropower plant components. Voith Hydro supports power plant operators with spare parts and repairs and by maintaining and upgrading existing facilities. We are renowned for our expertise and reliability that goes far beyond just the supply of generators, turbines, pumps and automation systems. We are an experienced partner for both new plants and comprehensive service.

Maintenance, repairs and upgrades

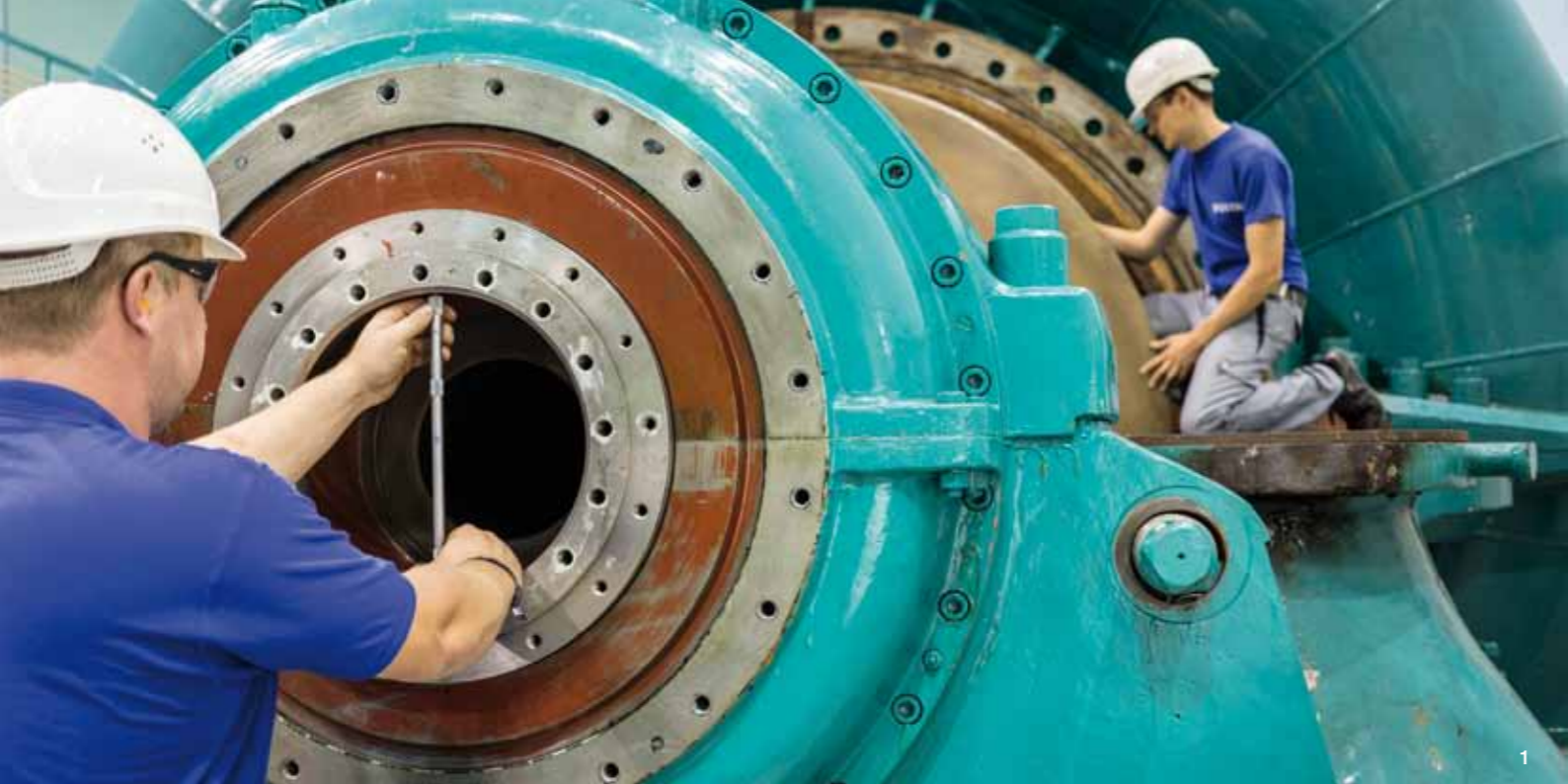
Voith Hydro offers products and services for all kinds and sizes of hydropower plants. Our engineers, designers and on-site fitters have in-depth knowledge that enables them to resolve any challenges that may occur in a power plant. When it comes to hydropower components we know what it takes. In the process, we see ourselves as your partner over the entire product life cycle, because the crucial factor for all support and service activities is quality that lasts.

Avoiding downtimes

Service, maintenance and modernization help preserve the condition and performance of a power plant and generally avoid downtimes. This ensures a high level of production reliability. If machine components need to be completely overhauled at the end of their service life it often makes sense to optimize the performance and efficiency of the machines at the same time.

As a manufacturer of hydropower components, Voith has the requisite design and manufacturing expertise in turbines, generators, controllers and shutoff valves. The wide-ranging know-how available at our Heidenheim site ensures flexible, expert and fast implementation, especially in the case of upgrades and overhaul projects, but also for repair jobs at short notice.

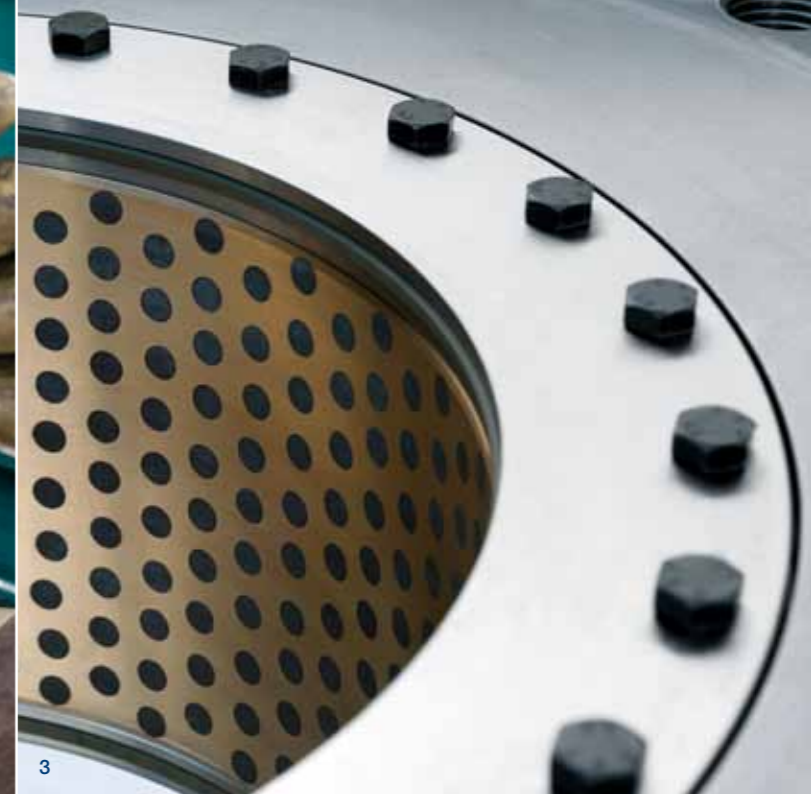
- 1 Efficient dismantling using modern equipment
- 2 Our high-tech horizontal boring mill allows simultaneous five-axis machining of components
- 3 Concentration and skill: a Voith worker producing pole windings



1



2



3

- 1 High-precision measurement
- 2 Mounting a measuring device to check the concentricity of a shaft
- 3 Voith minimizes the use of lubricants in the power plant by installing oil-free bearings and hubs

Spare parts and customer service – for efficient plant operation

For all systems in the power plant to work reliably and efficiently it is necessary to ensure regular maintenance and repairs as needed. As your service partner for reliable electricity generation from hydropower plants, Voith Hydro's mission is to safeguard the capacity and efficient operation of plants over their entire life cycle. We archive machine and equipment drawings, so that even after many years Voith customers are able to purchase spare parts from their original manufacturer. In addition, our experience from numerous projects allows us to quickly fabricate spare parts in the required quality for plants for which we were not the original supplier.

From preventive maintenance to troubleshooting
 Voith Hydro offers a reliable service for all types of generators and hydraulic machinery and for automation technology and all sub-systems. Our services range from simple repairs to complex emergency servicing.

| Range of services | |
|---|----------------------------|
| <ul style="list-style-type: none"> • Spare parts deliveries • Spare parts installation service • Minor repairs, servicing and maintenance • Troubleshooting | Basic Service |
| <ul style="list-style-type: none"> • Inspection/Health Check • Mobile emergency service | Solution Service |
| <ul style="list-style-type: none"> • Service contract • Service hotline • Servicing and maintenance concept • Updates/Upgrades | Added Value Service |

Fast response and lead times

Repairs and spare parts safeguard plant availability
 Our services are tailored to the needs of every customer. We aim to find the right technical and plant-specific solution in the shortest possible time. We quickly and reliably fabricate the appropriate spare parts that you require. Thanks to our ultra-modern pool of machinery and extensive experience, we are also able to fabricate and machine large, complex parts at Heidenheim. Our installation service then installs it all on site. We are also happy to carry out minor repairs, servicing and maintenance on your behalf.

Problem solved by remote diagnosis – hydropower plant operates reliably again

Project example: Waldshut power plant, Germany

Schluchseewerk AG's Waldshut power plant produces up to 170 million kW hours of electricity per year. It is one of three hydropower plants in the Waldshut district of the Hochrhein-Bodensee region. The machine hall of the more than 60-year-old pumped storage power plant with a head of 160 m lies directly on the banks of the Rhine. Driven by a Voith turbine, the mean generator output of the power plant is 150 MW and the pump output 80 MW.

To prevent downtimes, turbines and generators must always be in perfect condition and any malfunctions rectified quickly and accurately. In the case of the Waldshut plant, Voith Hydro managed to do this via remote diagnosis. Again and again, at irregular intervals, there was an unforeseen error in the position control circuit on a turbine controller that caused it to be switched off. But because the fault was only occurring rarely

and was not reproducible, the system was put back into operation, even though there was a risk of further downtimes. The operator's defect causal analysis on site did not produce a definitive result, so in the end Schluchseewerk AG asked Voith Hydro for support.

Replacement of bearings prevents further shutdowns

To get the power plant ready to operate again in the shortest time possible we carried out an analysis. Using remote diagnostics after the problem occurred again we obtained measured values that were sorted, filtered and analyzed within four hours. The cause of the fault was determined: sluggishness of the distributor caused by slightly higher friction in the non-wearing bearings. The plant operator then changed the bearings and therefore prevented further downtimes and impending penalties from the grid operator.

Special seal will last another 20 years – fabricated and installed during scheduled overhaul

Project example: Walchensee power plant, Germany

The Walchensee power plant in Bavaria is one of the largest and most efficient high-pressure storage power plants in Germany. Operating since 1924 in Kochel am See, it now has an installed capacity of 124 megawatts and is owned by E.ON Kraftwerke GmbH. The peak load power plant draws its energy from the natural slope of around 200 m between the Walchensee upper basin and the Kochelsee lower basin. The water from the Walchensee flows through pipes, which are an average of two meters thick, onto the turbines in the valley, driving the power plant's four Pelton and four Francis turbines.

During a routine inspection in June 2009 the plant's maintenance team noticed a badly damaged sealing ring on a spherical valve. The wear was so advanced that the seal had to be replaced. Due to technical requirements a repair was not possible, so Voith Hydro got the order to supply a new seal.

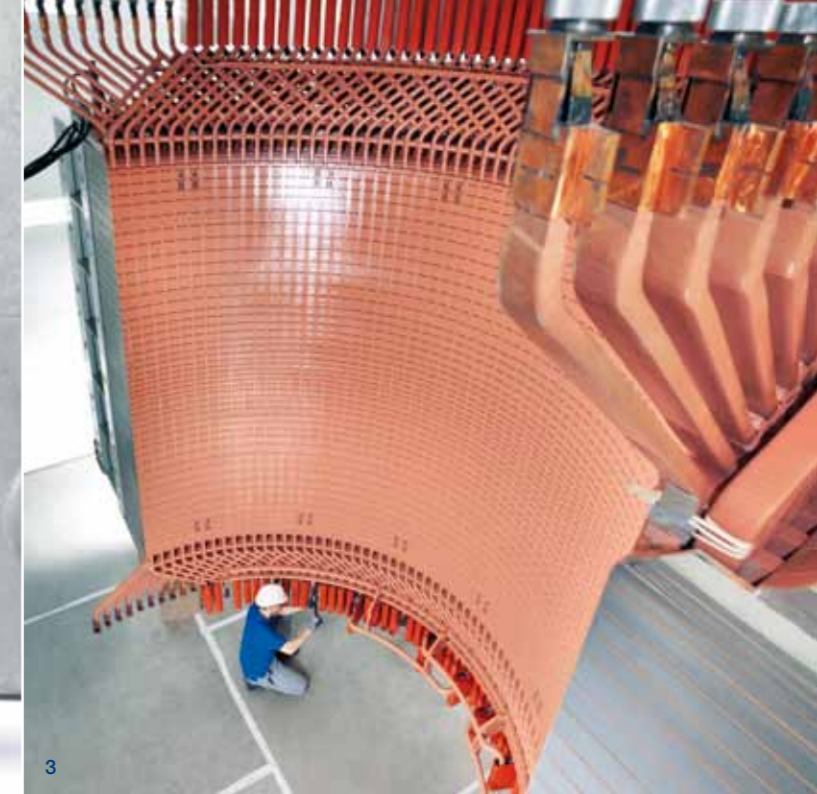
The challenge was to replace the sealing ring during a scheduled machine maintenance shutdown in just six weeks. Due to the extensive dismantling and reassembly work involved, replacing the sealing ring at a later date would have led to a machine downtime of several days. No easy task, as the new sealing ring had to be made from a centrifugal casting ring as blank, which is not in stock in this size and so has to be specially fabricated. The functioning of the ring calls for precise machining and special gaskets that are also made to specification.

Spare part cast and mounted on schedule

The complex fabrication order was completed in a very short period of time. Within the very narrow deadline of six weeks, Voith supplied the bronze sealing ring and associated gaskets including machining and quality control. The scheduled downtime for the overhaul could therefore be maintained despite the damage to the sealing ring.

Project examples in Germany





- 1 In the Heidenheim production facility our lathes can machine workpieces up to 14 m in diameter
- 2 State-of-the-art 3D-CAM software ensures accurate machining
- 3 In our windings cubicle we investigate and assess the condition of the windings of the generators needing overhaul

Refurbishment and modernization – for greater efficiency and profitability

Hydropower plants are designed to last for generations. Many have been operating reliably for decades, but may not now be running as efficiently as they could. Voith specializes in modernizing and overhauling the components and machines in such plants to make them state-of-the-art. As a result, efficiency and reliability are often substantially improved. Moreover, plant operators can provide much more environmentally friendly electricity as a result of extensive upgrades. Making hydropower systems fit for the 21st century is therefore one of the best options for increasing the supply of clean energy.

Repairing and modernizing a plant is often a complicated task, because replacing certain components can affect operation of the entire plant. Voith Hydro is aware of the detailed interaction between various machine components. This is what makes us an experienced partner.

Overhauls to maintain your plant's performance

The objective of many overhaul projects is to maintain the performance of existing power plants. To achieve this we provide plant overhauls for small and large power plants. Using precise fault diagnosis we identify weak points and problematic components and rectify them.

Our plant overhaul packages include:

- Partial and full overhauls
- Corrosion protection and weld repairs
- Minor rebuilds
- Milling and turning work
- Converting to maintenance-free bearings
- Installation, commissioning and re-commissioning

Modernization to increase your plant's performance

In most cases, the objective of upgrades is to improve the efficiency, capacity and overall performance of existing power plants through redesigned components. This also includes replacing and optimizing components that have caused considerable maintenance and repair work to date or whose age means that they are likely to fail soon.

Some of the key tasks of a successful modernization include:

- Replacing or modernizing turbine and generator components
- Design modifications for the latest turbine technology (e. g. water-lubricated bearings) as well as re-engineering
- Using advanced materials and components
- The latest technology for controller and automation applications
- Optimization of the power plant's own energy consumption
- Major rebuilds and assembly



- 1 The old runner had to be replaced
- 2 A Voith worker prepares the new runner for transport
- 3 Shop assembly of the modernized distributor
- 4 Reassembling the machine

Replacing the runner – reduced repair effort and higher efficiency

Project example: Neuhausen hydropower plant, Switzerland

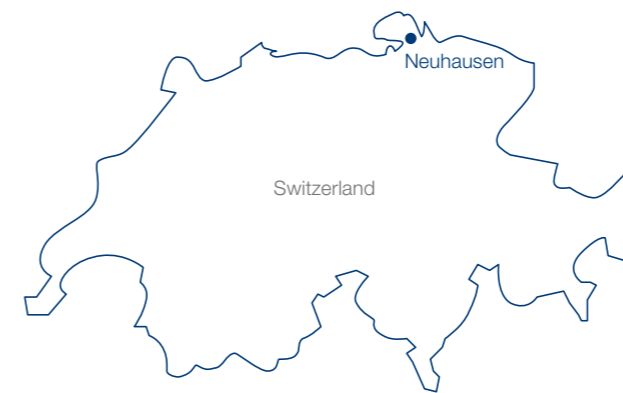
Right next to the biggest waterfall in Europe, the Rheinfall (Rhine Falls) in Neuhausen in the Swiss canton of Schaffhausen, the Neuhausen hydropower plant was built between 1948 and 1951. The plant uses the 23-meter incline of the Rhine Falls to produce around 40 gigawatt hours of energy annually.

As part of a plant upgrade, Rheinkraftwerke Neuhausen AG – an amalgamation of EnAlpin, Axpo and the municipality of Neuhausen – commissioned Voith Hydro at the end of 2009 to overhaul and optimize the Francis turbine and mechanical components installed in the plant. The objective of the rebuild was to improve efficiency and ensure freedom from cavitation of the Francis turbine using a new five-metric-ton runner with a diameter of around 2.5 m. In addition, the associated turbine components were to be upgraded and the digital and mechanical turbine controller replaced. The modernization led to a reduced maintenance requirement and higher efficiency. The installed capacity of the hydropower plant was 4.7 megawatts before the overhaul. It is now 5.6 megawatts.

Dismantling and reassembly in just four months

The plant was shut down for just four months while we carried out the dismantling and reassembly. The actual overhaul time was seven weeks. The hydraulic design of the new runner was formulated by the R&D team of Voith Hydro in York (USA), which specializes in upgrades. Within just a few months the runner was fabricated and accepted. The factory acceptance of the distributor followed quickly, so that the turbine could be supplied promptly for reinstallation at the Neuhausen hydropower plant. The refurbishment of the third party machine went very well, and by the end of July 2011 the power plant was already synchronized with the grid and in operation.

Neuhausen, Switzerland



“We are very satisfied with the rebuild. Voith did a great job with the project within the time frame. And the machine efficiency is better than expected.”

Urban Meier, Project Manager Overhaul Neuhausen, Axpo AG

- 1 One of the spherical valves en route to Loch Ness in Scotland
- 2 During the pressure test for the new spherical valves for Foyers



Source: Ian Lawson



New spherical valve for Foyers – reliably back on the grid after modernization

Project example: Foyers hydropower plant, Scotland

The Scottish power utility Scottish and Southern Energy (SSE) produces, stores and transfers electricity and therefore offers millions of people in the UK a basic supply. SSE was formed in 1998 following the merger of Scottish Hydro-Electric plc and Southern Electric plc. It plays a major role in the Scottish energy market.

In December 2011, Voith Hydro started on an extensive and complex modernization program at the Foyers hydropower plant. It included, for example, replacing the two existing spherical valves, which had reached their life span of 40 years and needed to be replaced. Initially, our greatest challenge was to safely close the valves at full flow to stop the machines.

Restore availability

The modernization of the plant with a throughput volume of 100 cubic meters of water per second and a maximum turbine output of 150 megawatts per unit went according to plan. The spherical valves had already been delivered to the plant in October 2013. Following a final check Voith was due to install the valves in the summer of 2014. This means that the machine groups will be completely available again in the foreseeable future and are designed for a long service life with a large number of operating mode changes for components. The housing and rotor assembly are welded. A cast spherical valve was not possible due to the limited crane capacity in the powerhouse.

To avoid higher foundation forces, the spherical valves were designed such that the servo-motors are mounted directly on the housing. The upgrade was due to be completed in October 2014 – when the power plant can then work efficiently again in the future with the new spherical valves.

Foyers, Scotland



“I am delighted that valves of such a substantial size were designed and produced by Voith and installed by their highly skilled assembly team.”

Ivor MacSorley, Project Manager Modernization Foyers, SSE Generation Ltd.

The latest technology for resources and energy efficiency

R&D at Voith is targeting solutions to meet future challenges. Our company's R&D strategy is focused on global trends, including, above all, resources and energy efficiency and environmental compatibility. Voith Hydro Brunnenmühle is the global R&D center for generator and turbine technology at headquarters in Heidenheim.

This is where for more than 140 years hydropower plants have been designed and tested in model tests. Even now, turbines are being calculated individually, designed and tested using models before the facility is built. Modern simulation processes occasionally complement or replace model construction.

Important tools for R&D in modernization are various simulation methods and measurements in test rigs and on site.

Voith Hydro uses high-quality measuring technology and hardware as well as the latest simulation techniques and software.

For upgrading hydropower plants our facility in York, Pennsylvania, USA is another Voith Hydro technology center that plays an important role. Worldwide we are pursuing the goal of achieving low overall costs for a plant over its entire service life. Voith Hydro is the only manufacturer in the USA that has a hydraulic laboratory.

The combination of our experience and technology as well as the know-how of the operators facilitates successful modernization projects. We are happy to work out customized solutions for your plant.

Full-line supplier for hydropower plants

A quarter of the electricity from hydropower worldwide is produced using technologies and services from Voith. Voith is one of the world's leading providers of systems, technologies and services in the area of hydropower. In power plants all over the world, components and services from Voith ensure a reliable energy supply. International power plant builders and operators rely on the experience and expertise of Voith engineers.

As a full-line supplier we develop innovative turbines, generators and automation technology for large and small hydropower plants. In addition, components and service over the entire life cycle of a plant ensure a reliable and secure energy supply to people and industries.

Voith Hydro in Heidenheim – the ideal partner for hydropower

In the energy segment, Voith can look back over a long history: The first Voith turbine was built in 1873 for Heidenheim textile manufacturer Plouquet. Then came the first large-scale international project: 12 turbines for the hydropower plant at the Niagara Falls (1903–1910).

Since 1908 Heidenheim has not just been home to Brunnenmühle, the international R&D Center of Voith Hydro. To this day it also houses the construction and design department and the production and service facilities for automation, welding, grinding and factory assembly. Around 150 engineers are working in Heidenheim on the optimization of water turbines. This is where for the planned power plants, Pelton, Francis and Kaplan turbines are fine-tuned to achieve the best possible efficiency and performance.

As a service facility, Heidenheim guarantees the best products and services thanks to the highest standards of quality. The quality management system meets all the requirements of ISO 9001. In addition, Voith Hydro has implemented environmental management according to ISO 14001 and OHSAS-compliant health protection and occupational safety, both in its own production facilities and at its various construction sites.

If you would like a consultation or further information please contact us on:

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View of the modernized service and production facility for hydropower plant components of Voith Hydro in Heidenheim

