Tailor-made solutions for water applications

Pumps
Expertise in hydropower with technical reliability

Voith takes overall responsibility from planning to start of commercial operation for new pumping stations as well as the modernization of existing plants. As your reliable partner in hydropower, Voith also covers long-term service needs through its HyService.

Considering the growing world population and therewith the significantly increasing demand for drinking water, process water and agricultural products, an adequate and sustainable management of water resources seems to be indispensable. Also taking into account today’s adverse climatic conditions, such as frequent floods and long-lasting droughts due to observable climate change, suitable water treatment solutions are gaining even more importance.

Sustainable use, appropriate allocation, conservation and reuse of water is a must. Building pumps is part of the science and art of water conveyance, irrigation, drainage and flood control. In this way, high pump efficiency levels should be guaranteed in order to ensure low operating costs and counter the increasing global demand for electricity.

Due to our comprehensive experience in engineering, manufacturing and project management for hydropower plants and pumping stations, we are able to offer customized technical pumping solutions.

Voith offers customized pumps for the following applications:

• Drinking water
• Waste water
• Irrigation and drainage
• Flood control
• Desalination
• Cooling water for thermal power plants
• Storage
• Pumped storage applications: reversible machine sets, ternary systems and motor generators

Voith provides turnkey solutions:

• Consulting, engineering, erection, supervision, commissioning and service
• Radial-flow, mixed-flow and axial-flow pumps
• Motors
• Valves
• Electrical and mechanical balance of plant equipment
• Hydraulic steel structure
Our technology and product range

Pumps have been part of Voith’s product portfolio for decades. The diversity of pump sizes and types manufactured in the course of these years, in combination with high demands in our hydropower business, defines our efficiency and cost effectiveness in the field of pump construction.

Voith has earned a worldwide reputation as reliable pump manufacturer, evidenced by about 560 pump applications installed in 187 stations around the world with a total power consumption of about 7,200 MW.

With great commitment and dedication, we seek to offer best-fit solutions leading to high effectiveness and reliability of entire pumping stations.

Voith pump application range

<table>
<thead>
<tr>
<th>Standard pump application range</th>
<th>Advanced pump application range</th>
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<tbody>
<tr>
<td>Radial-flow pumps</td>
<td>On request</td>
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<tr>
<td>Mixed-flow pumps</td>
<td></td>
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<tr>
<td>Axial-flow pumps</td>
<td></td>
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</tbody>
</table>

Q [m³/s]  H [m]  0.1 MW  0.5 MW  1 MW  2 MW  5 MW  10 MW  20 MW  50 MW  100 MW  200 MW

0.5  1  2  5  10  20  50  0
Axial-flow pumps
Discharge: From about 5 m³/s (or less, if tailor-made design is requested)
Pump total head: Up to about 15 m

Type of construction
Propeller pumps with fixed impeller blades and fixed guide vanes. Kaplan pumps with adjustable impeller blades and fixed guide vanes.

Application:
Pumps for drainage and irrigation plants, flood control, storm water, (drinking) water supply, waste water pumps, storage pumps, cooling water pumps.

Mixed-flow pumps
Discharge: From about 5 m³/s (or less, if tailor-made design is requested)
Pump total head: Up to about 60 m

Type of construction
Fixed and movable impeller blades and guide vanes, single-flow, single-stage and multi-stage, guide wheel with discharge bend or spiral casing.

Application:
Pumps for drainage and irrigation, (drinking) water supply, storm water pumps, waste water pumps, storage pumps, cooling water pumps, pumps for desalination plants.

Radial-flow pumps
Discharge: From about 1 m³/s
Pump total head: Up to the order of magnitude of 500 m per stage and of 1 200 m and more in total head in the event of several stages.

Type of construction
Fixed impeller blades, fixed and movable guide vanes, single- and double-flow, single- and multi-stage.

Application:
Pumps for irrigation, (drinking) water supply, storage pumps, cooling water pumps, pumps for desalination plants.
The right solution for every application

Our pumps are characterized by compact arrangement and robust design. Due to sophisticated hydraulic shapes, our pumps reach high efficiency levels. They are easy to maintain, and standardized motors and gear units can be used as drives. By arranging pumps in different ways, we assure an optimum integration into new and existing buildings. We use different materials in order to ensure suitability for diverse water qualities. Thus, by using adequate materials and technologies, we produce highly qualitative pumps.

Our products and services are always designed to our customers’ specific needs proving technical reliability. As a result of decades of continuous optimization based on the latest hydro-dynamic research, we are ready to offer state-of-the-art technologies.

Our research laboratories are developing competitive hydraulic and electrical application layouts for new and existing pumps. We offer hydraulic model testing, customer acceptance tests and provide special engineering support, including, for example, materials and coating.
Typical design solutions

• Tailor-made design according to the specific application
• Horizontal-shaft, vertical-shaft or inclined-shaft design
• Single or double suction, single- or multi-stage
• Adjustable and fixed impeller blades for axial- and mixed-flow design
• Steel volute or concrete volute casings for mixed-flow and radial design
• Drives: electric motors, diesel engines or turbines; direct driven or by a gear unit
• Pump shaft:
  – supported by water-, grease- or oil-lubricated bearings (thrust bearings can be arranged directly at the pump, at the drive or at the gear unit)
  – rigidly coupled or flexibly coupled
  – sealed off by a stuffing box with a protective sleeve seated on the shaft or by mechanical seal
• Shut-off valves (e.g., non-return valves, butterfly valves or ball valves / spherical valves)
• Governing equipment and pump control systems

Materials
Steel, cast iron, cast steel, NIRESIST, stainless steel, bronze, Duplex, Super-Duplex.

Development / layout of hydraulic machines
Voith offers an extensive range of combined methods of simultaneous engineering, model tests and plant measurements for manifold applications like new hydraulics, improvements, modernization and assessment of specific phenomena under certain conditions.

Simultaneous engineering

• Hydraulic design based on a data bank of model-tested, proven hydraulic shapes that have been developed in our research department
• Computational fluid dynamics (CFD) analysis for highly sophisticated flow calculations
• Structural analysis: up-to-date finite elements (FE) analysis, Voith database / programs
• Cost analysis: design, manufacturing methods, materials

Witness test procedures

• Provision of reports describing pump characteristics based on pre-existing model tests.
• Model tests for new developments and model acceptance tests according to IEC: testing of complete performance characteristics inclusive dynamic behavior on the modern and efficient precision test rigs in our own hydraulic research laboratories in Germany and in the USA; since its establishment in 1908 the testing facilities have been continuously modernized and supplemented with additional equipment according to the demanding requirements imposed by the hydropower business. Voith has always aimed to provide state-of-the-art technologies, and therefore, we achieved in becoming one of the market leaders in the hydropower sector worldwide.
• Plant tests / measurements: at commissioning, for output- and efficiency evidence as well as for development of optimization possibilities in existing plants.
The benefits making the difference

• Long-term, proven, state-of-the-art technology
• Excellent quality through constant manufacturing process check-ups
• Optimum technical solutions for any kind of pump type in the medium and large size application range
• Flexible, customized, efficient and economic solutions
• High reliability as a sound basis for long-lasting business relationships
• Fast reaction times ensure optimized customer support
560 installed pump applications in 187 stations worldwide and a total power consumption of 7 200 MW
## Milestones and selected references

With production facilities for hydraulic and electrical machines in Europe, Asia, North and South America, we are close to our customers and active in all major hydropower markets worldwide.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Milestone</th>
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<tbody>
<tr>
<td>1912</td>
<td>Viverone, Italy</td>
<td>First pump, delivered to the Piedmont region of Italy.</td>
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<tr>
<td>1928</td>
<td>Niederwartha, Germany</td>
<td>First pump exceeding power of 20,000 kW.</td>
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<td>1938</td>
<td>Traição, Brazil</td>
<td>First Kaplan pump for pump turbine operation.</td>
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<tr>
<td>1954</td>
<td>Luenersee, Austria</td>
<td>First pump with a head exceeding 1,000 m.</td>
</tr>
<tr>
<td>1960</td>
<td>Taum Sauk, USA</td>
<td>First pump turbine with power exceeding 200,000 kW for pump turbine operation.</td>
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<tr>
<td>1962</td>
<td>Wagboden I, Austria</td>
<td>First inclined-shaft Kaplan pump not operating as a pump turbine.</td>
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<tr>
<td>1970</td>
<td>Hornbergstuf e-Wehr, Germany</td>
<td>Four horizontal two-stage double suction radial pumps for pumped storage.</td>
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<tr>
<td></td>
<td></td>
<td>P: 250,000 kW, H: 666 m, Q: 36 m³/s</td>
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<tr>
<td>1970</td>
<td>Süßenmühle, Germany</td>
<td>Four horizontal three-stage radial pumps for drinking water supply.</td>
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<tr>
<td></td>
<td></td>
<td>P: 7,320 kW, H: 330 m, Q: 2 m³/s</td>
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<tr>
<td>1973</td>
<td>Malta Hauptstufe, Austria</td>
<td>Two storage pumps equipped with synchronizing converters with gear coupling.</td>
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<tr>
<td></td>
<td></td>
<td>P: 140,700 kW, H: 1,100 m</td>
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<tr>
<td>1974</td>
<td>Cordoba, Argentina</td>
<td>Highest output from radial-flow cooling water pumps with 3,900 kW.</td>
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<tr>
<td>1975</td>
<td>Alhama, Spain</td>
<td>Six vertical radial pumps for irrigation.</td>
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<tr>
<td></td>
<td></td>
<td>P: 2,240 kW, H: 116 m, Q: 1.75 m³/s</td>
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<tr>
<td>1977</td>
<td>Embaba, Egypt</td>
<td>Eight raw water and six drinking water double suction radial pumps for drinking water supply.</td>
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<td>P: 284 kW, H: 16 m, Q: 1.6 m³/s</td>
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<td></td>
<td>P: 708 kW, H: 60 m, Q: 1 m³/s</td>
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<td></td>
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<td>P: 557 kW, H: 11.4 m, Q: 4.16 m³/s</td>
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<tr>
<td>1981</td>
<td>Häusling, Austria</td>
<td>Two storage pumps equipped with synchronizing converters with gear coupling.</td>
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<tr>
<td></td>
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<td>P: 178,500 kW, H: 726 m</td>
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<tr>
<td>1986</td>
<td>Mers El Hadjadj IV + V, Algeria</td>
<td>Four vertical mixed-flow pumps for cooling water, sea water application.</td>
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<td></td>
<td></td>
<td>P: 533 kW, H: 13.4 m, Q: 3.4 m³/s</td>
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<tr>
<td>1987</td>
<td>Large Cavitation Channel, USA</td>
<td>Largest axial-flow pump impeller with a diameter of 5.52 m.</td>
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<tr>
<td>1990</td>
<td>Säckingen, Germany</td>
<td>One horizontal radial storage pump.</td>
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<td></td>
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<td>P: 84,400 kW, H: 410.8 m</td>
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<td></td>
<td>Three single-flow two-stage storage pumps.</td>
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<td></td>
<td>P: 70,608 kW, H: 408 m</td>
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<tr>
<td>1992</td>
<td>Riva del Garda, Italy</td>
<td>One storage pump consisting of mixed-flow booster pump (H: 27 m) and radial-flow pump (H: 543 m, three stages) connected to the shaft line of a Pelton generator motor.</td>
</tr>
</tbody>
</table>
1992 Yang Zhuo Yong / Tibet, China
Four storage pumps with 19 100 kW each, six stages with gear coupling for connection in standstill.

1992 El Salam 1–3, Egypt
Inclined axial Kaplan pumps with electro-mechanical drives for adjustable impeller blades for irrigation.

1992 Süßenmühle, Germany
Two horizontal three-stage radial pumps for drinking water supply.
P: 10 030 kW, H: 325.5 m, Q: 2.78 m³/s

1993 Altenheim, Germany
Three vertical axial Kaplan pumps with adjustable impeller blades for flood control.
P: 516 kW, H: 6.4 m, Q: 6 m³/s

1994 El Tabia, Egypt
Six vertical axial pumps for drainage of waste water.
P: 479 kW, H: 6.3 m, Q: 7 m³/s.

1994 Niederaussem, Germany
Two vertical mixed-flow pumps for cooling water purpose for a thermal power plant.
P: 3 770 kW, H: 26.5 m, Q: 12.1 m³/s

1996 El Max, Egypt
Modernization of six inclined axial pumps for drainage of waste water.
P: 700 kW, H: 4.6 m, Q: 14 m³/s.

1996 Altenheim, Germany
Three vertical axial Kaplan pumps with adjustable impeller blades for flood control.
P: 516 kW, H: 6.4 m, Q: 6 m³/s

1996 Rurberg, Germany
Modernization of three vertical mixed-flow booster pumps combined with three vertical radial pumps for drinking water supply.
P: 74 kW, H: 12.6 m, Q: 0.52 m³/s
P: 917 kW, H: 145.7 m, Q: 0.52 m³/s

1996 Kassaby, Egypt
Modernization of four inclined axial pumps for drainage.
P: 302 kW, H: 3.6 m, Q: 7.5 m³/s

1997 Linker Donausammler, Austria
Two vertical axial pumps for storm water.
P: 1 540 kW, H: 13.9 m, Q: 10 m³/s

1997 Pont Ventoux, Italy
One storage pump connected to the shaft of a splitter type Francis turbine with gear coupling.
P: 73 400 kW, H: 519 m

2000 Alamos, Portugal
Two vertical radial pumps for multi-purpose irrigation.
P: 6 244 kW, H: 85.5 m, Q: 6.88 m³/s

2003 Kassaby, Egypt
Modernization of four inclined axial pumps for drainage.
P: 302 kW, H: 3.6 m, Q: 7.5 m³/s

2003 Koralpe, Austria
One vertical three-stage radial pump for pumped storage.
P: 38 000 kW, H: 740 m

2004 Kops II, Austria
Three vertical three-stage radial pumps for pumped storage.
P: 152 000 kW, H: 784 m

2008 Koralpe, Austria
One vertical three-stage radial pump for pumped storage.
P: 38 000 kW, H: 740 m

2008 Hongrin Léman, Switzerland
Two vertical five-stage radial pumps for pumped storage.
P: 117 700 kW, H: 865 m

2011 Obervermunt II, Austria
Two of the world’s largest horizontal single-stage radial pumps including torque converters for pumped storage.
P: 170 000 kW, H: 251.2 m, Q: 64.6 m³/s
Nominal pump impeller diameter: 3.49 m