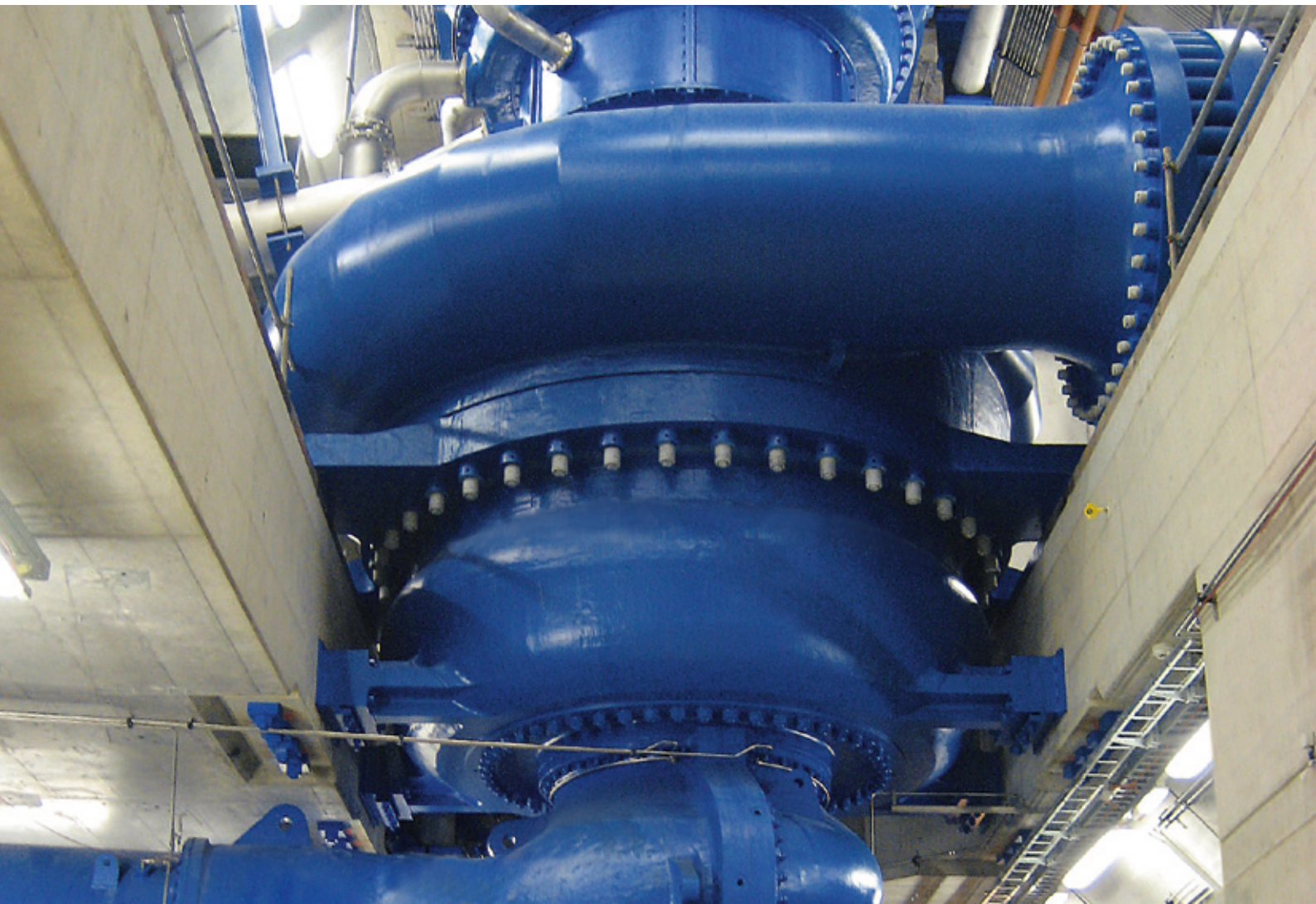
voith.com

VOITH

# Tailor-made solutions for water applications

## Pumps



Source: Forces Motrices Hongrin-Léman SA, Switzerland

# 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.

### Pumps – our competences and capabilities

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

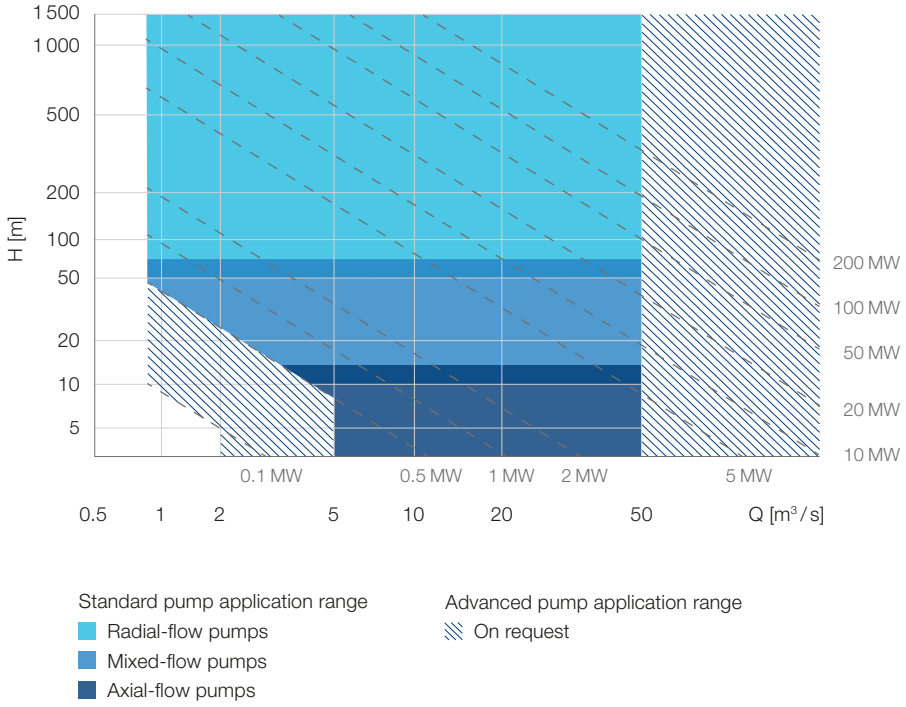
# Our technology and product range

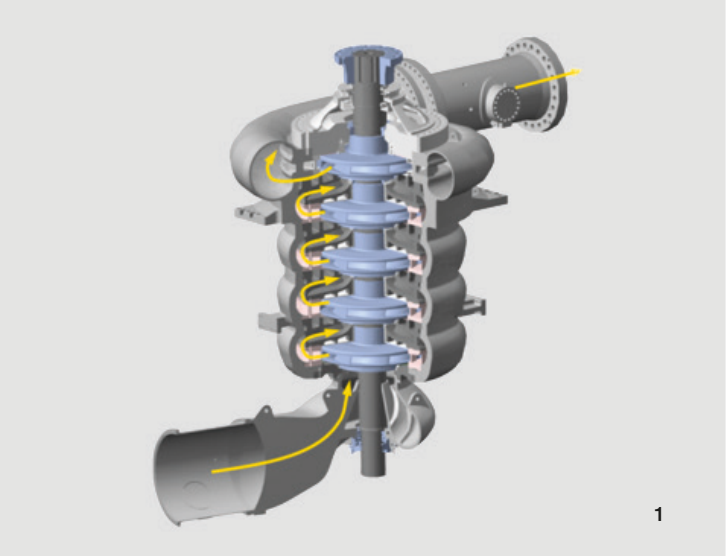
**Pumps have been part of Voith's product portfolio for decades. The diversity of pump sizes and types manufactured in the course of these years, in combination with high demands in our hydropower business, defines our efficiency and cost effectiveness in the field of pump construction.**

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





1

2

**1+2** Hongrin-Léman, Switzerland
Multi-stage radial-flow pump

### 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.

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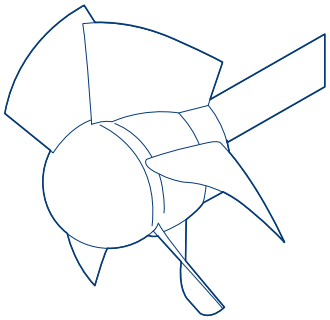
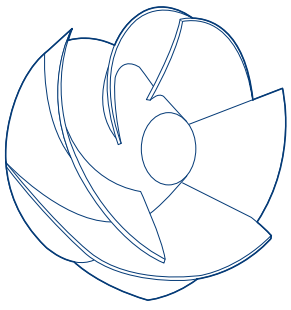
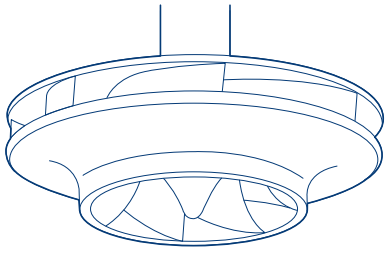
Axial-flow pumps

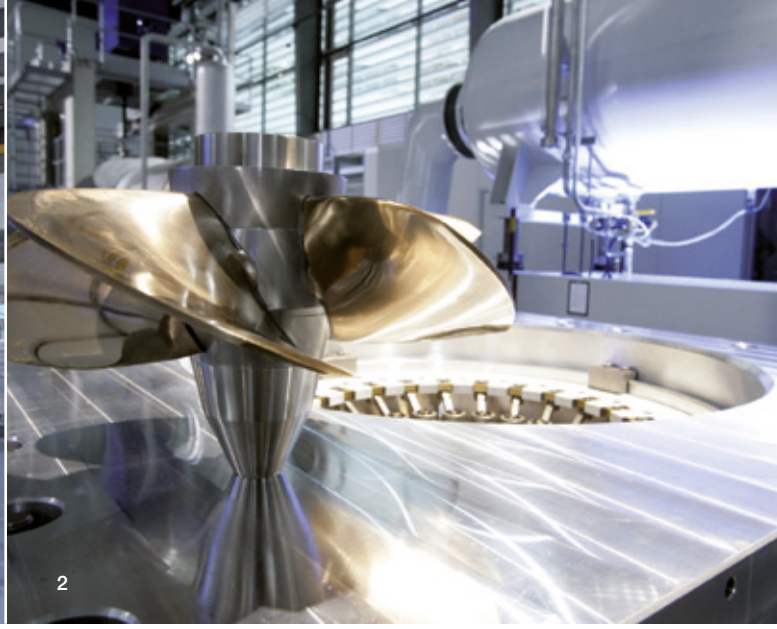


Mixed-flow pumps



Radial-flow pumps





**1 + 2 Brunnenmühle**
Our hydraulic research and development laboratory in Germany

# 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.


**3 Süßenmühle**
Customized multi-stage pumps for drinking water, for example

## 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

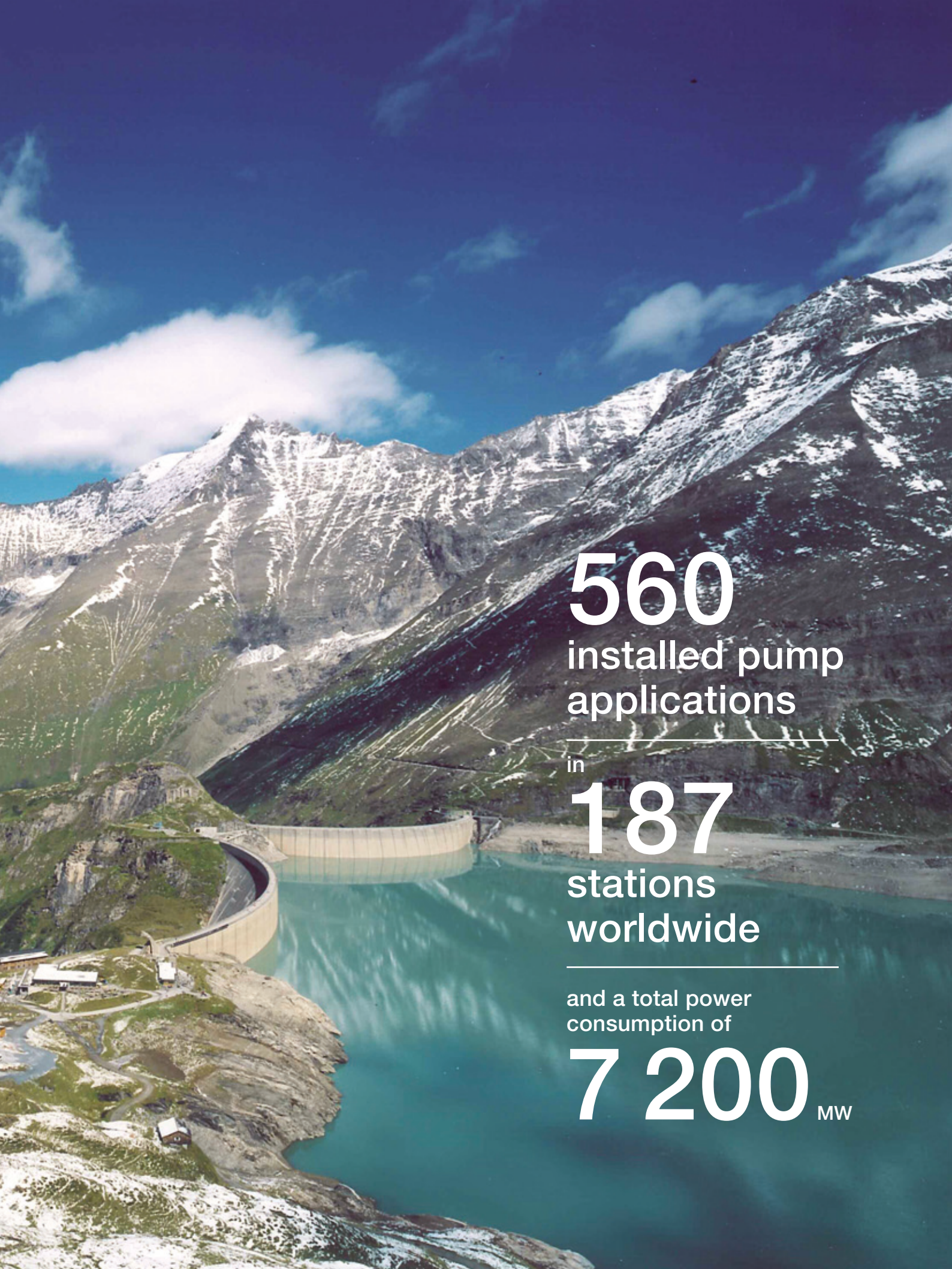
- Hydraulic design based on a data bank of model-tested, proven hydraulic shapes that have been developed in our research department
- Computational fluid dynamics (CFD) analysis for highly sophisticated flow calculations
- Structural analysis: up-to-date finite elements (FE) analysis, Voith database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

**1912** **Viverone, Italy**
First pump, delivered to the Piedmont region of Italy.

**1928** **Niederwartha, Germany**
First pump exceeding power of 20 000 kW.

**1938** **Traição, Brazil**
First Kaplan pump for pump turbine operation.

**1954** **Luenersee, Austria**
First pump with a head exceeding 1 000 m.

**1960** **Taum Sauk, USA**
First pump turbine with power exceeding 200 000 kW for pump turbine operation.

**1962** **Wagboden I, Austria**
First inclined-shaft Kaplan pump not operating as a pump turbine.

**1970** **Hornbergstufe-Wehr, Germany**
Four horizontal two-stage double suction radial pumps for pumped storage.
P: 250 000 kW, H: 666 m, Q: 36 $m^3/s$

**1970** **Süßenmühle, Germany**
Four horizontal three-stage radial pumps for drinking water supply.
P: 7 320 kW, H: 330 m, Q: 2 $m^3/s$

**1973** **Malta Hauptstufe, Austria**
Two storage pumps equipped with synchronizing converters with gear coupling.
P: 140 700 kW, H: 1 100 m

**1974** **Cordoba, Argentina**
Highest output from radial-flow cooling water pumps with 3 900 kW.

**1975** **Alhama, Spain**
Six vertical radial pumps for irrigation.
P: 2 240 kW, H: 116 m, Q: 1.75 $m^3/s$

**1977** **Embaba, Egypt**
Eight raw water and six drinking water double suction radial pumps for drinking water supply.
P: 284 kW, H: 16 m, Q: 1.6 $m^3/s$
P: 708 kW, H: 60 m, Q: 1 $m^3/s$

**1978** **Al Jobail I – IV, Saudi Arabia**
Eight vertical mixed-flow pumps for cooling water, sea water application.
P: 557 kW, H: 11.4 m, Q: 4.16 $m^3/s$

**1981** **Häusling, Austria**
Two storage pumps equipped with synchronizing converters with gear coupling.
P: 178 500 kW, H: 726 m

**1986** **Mers El Hadjadj IV + V, Algeria**
Four vertical mixed-flow pumps for cooling water, sea water application.
P: 533 kW, H: 13.4 m, Q: 3.4 $m^3/s$

**1987** **Large Cavitation Channel, USA**
Largest axial-flow pump impeller with a diameter of 5.52 m.

**1990** **Säckingen, Germany**
One horizontal radial storage pump.
P: 84 400 kW, H: 410.8 m
Three single-flow two-stage storage pumps.
P: 70 608 kW, H: 408 m

**1992** **Riva del Garda, Italy**
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.

**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.

**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** **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

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

**1997** **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

**1999** **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

**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

**2011** **Hongrin Léman, Switzerland**
Two vertical five-stage radial pumps for pumped storage.
P: 117 700 kW, H: 865 m

**2014** **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

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