

**Francis turbines**



# Expertise in hydro

## with engineered reliability

**The future belongs to hydropower. It conserves our fossil fuel reserves, is in abundant, self-renewing supply, is non-polluting and produces no waste streams. The world's hydropower potential from rivers and reservoirs amounts to no less than 15 billion MWh per year – and only about 20 percent of this has been developed so far.**

Hydropower is not only environmentally friendly, but also cost-effective. Hydropower plants have the highest operating efficiency of all known generation systems. They are largely automated, and their operating costs are relatively low. Hydropower plants also play an important role in water resource management, in preventing flooding, making rivers navigable, solving irrigation problems and creating recreation areas.

Voith Siemens Hydro Power Generation is a leader today in hydropower equipment and services. As an experienced partner to power-plant operators, we provide fast, creative and cost-effective solutions. We offer everything from individual components to complete customized concepts, from turnkey delivery of new plants to the modernization of existing power stations, truly your best choice for one-stop shopping.



*Three Gorges, China*



### Competence and capabilities

- Consulting, engineering, erection and commissioning
- System/plant assessments
- Service, modernization and rehabilitation of existing hydropower plants
- Complete equipment, installation and services for hydropower plants
- Francis, Pelton, Kaplan, bulb turbines, pump-turbines, standard and custom
- Storage pumps, radial, semi-axial and axial-flow pumps
- Generators and motor-generators, excitation systems
- Frequency converters, protection systems, switchyards for all voltages, transformers
- Power plant automation, control centers for hydropower plants and cascades, including plant management and diagnostic systems
- Shut-off valves

As your complete hydroelectric partner, Voith Siemens Hydro Power Generation also covers your service needs. In keeping with our comprehensive hydropower expertise, we have a worldwide customer service network on which you can always depend for enhanced operating results.

With our Integrated Services (IS) concept, we provide you with customized support right down the line – from project planning through implementation to plant commissioning and service.

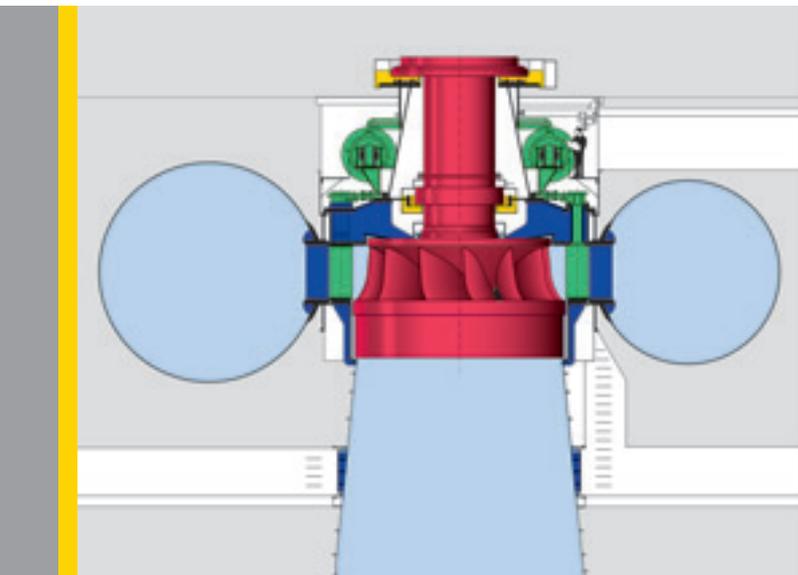
Why take chances? Profit from

***Engineered reliability.***

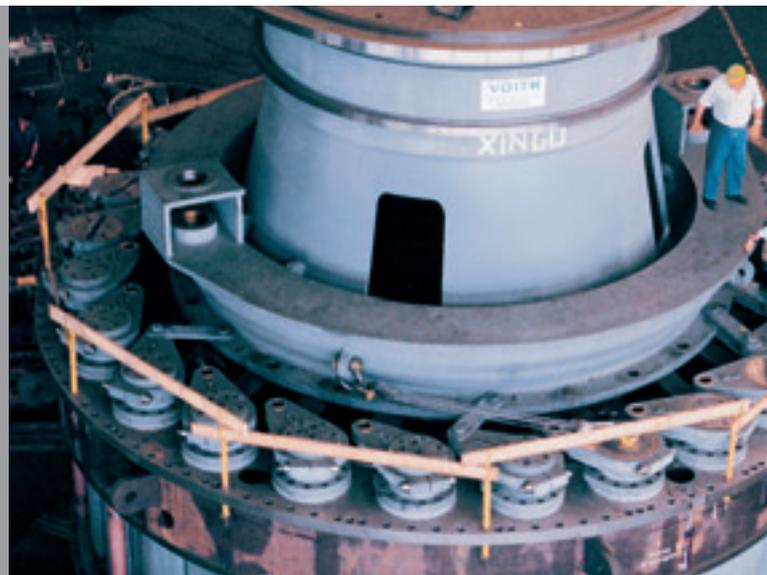


# Characteristics

**Right from the beginning, Francis turbine development has always been synonymous with Voith.**



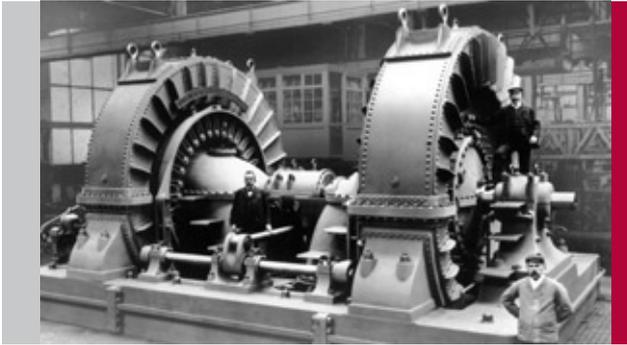
*Cross section of a Francis turbine for Xingó hydropower plant in Brazil*



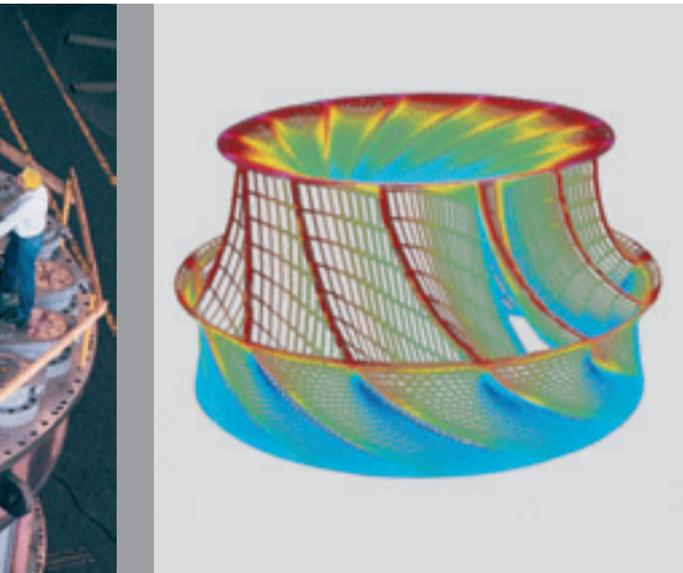
*Xingó during assembly*

With continuous optimization over the years based on the latest hydrodynamic research, well over half the turbines manufactured by Voith Siemens Hydro Power Generation are of the Francis type.

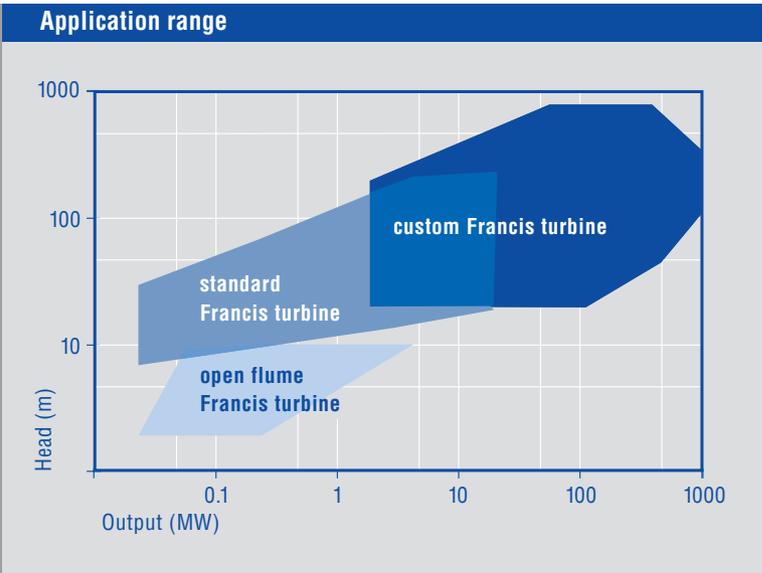
Our Francis turbines, including the world's largest and most powerful, are in service around the globe. What better testimony to our more than 135 years of hydro turbine experience?



Niagara Falls, Canada



*Numerical development methods linked to computer-aided manufacturing processes guarantee optimum hydraulic performance and reliability*



### Characteristics

Francis turbines are used primarily for medium heads and large flows. Their special hydraulic characteristics enable relatively high-speed compact units, right up to the largest capacities.

Voith Siemens Hydro Power Generation also supplies cost-effective Francis units in standardized designs and packages for small hydro plants.

# References and milestones



*Itaipu, Brazil/Paraguay*



*Itaipu, runner lowering*

- 1870** Beginning of hydro turbine production.
- 1873** First Francis turbine with a modern distributor.
- 1903** Niagara Falls, Canada:  
Double spiral turbine with  $P = 5.2$  MW and  $H = 79.5$  m. Most powerful turbines of their time.
- 1912** Niagara Falls, Canada:  
Double spiral turbine with  $P = 12$  MW and  $H = 54.9$  m. Most powerful turbines of their time.
- 1974** Grand Coulee III, USA:  
 $P = 820$  MW and  $H = 87$  m. Most powerful and largest Francis turbines in the world with 9.7 m runner diameter.
- 1974** Rovina-Piastra, Italy:  
 $P = 133$  MW at the high head of  $H = 554$  m.



*Wuqiangxi, China*



*Amlach, Austria*

**1978** Itaipu, Brazil/Paraguay:  
P = 800 MW and H = 118.4 m.  
Overall design and joint supply of turbines and generators for the world's most powerful hydro plant so far at 13,300 MW.

**1991** Norris Dam, USA:  
First aerating Francis turbine runner developed and tested in the industry, increasing dissolved oxygen content for enhanced aquatic life.

**1997** Three Gorges, China:  
Participation in the supply of turbines, generators and electrical equipment for the largest hydroelectric power plant in the world, currently under construction, with a total capacity of more than 18,000 MW.

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