



Research and Development

Optimization of products and services

Always a flow ahead – ASTROE development and testing laboratory

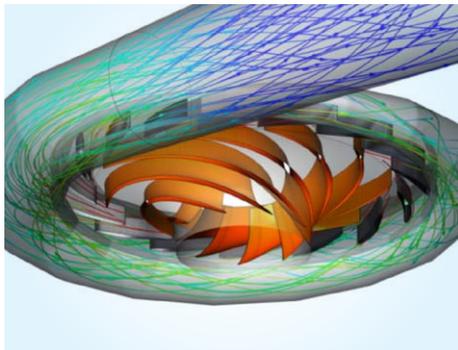
With ASTROE, center for hydraulic engineering and laboratory, we have an internationally renowned institute for hydraulic development work at our disposal. Optimization on the computer as well as numerous laboratory tests form the basis of the high technical quality of the pumps and turbines from ANDRITZ HYDRO.

Hydraulic design and CFD

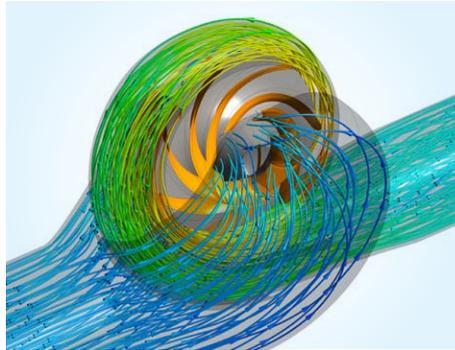
Hydraulic design requires an understanding of complex physical phenomena. Numerical flow simulations (Computational Fluid Dynamics – CFD) and mechanical calculations (Finite Element Analysis – FEA) provide

essential insights into the flow pattern and mechanical structure properties of essential components such as impellers or blades. The quality of the analysis methods and the underlying mathematical models are subject to continuous further development.

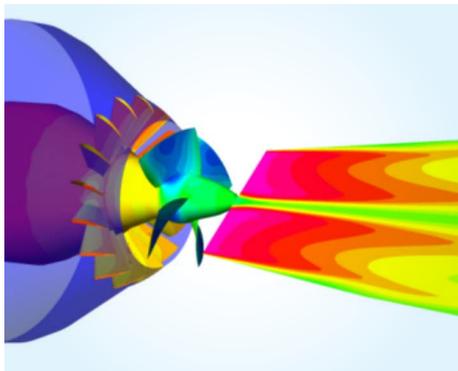
During the design process, the hydraulic components are optimized both in terms of hydraulic performance, efficiency, and safety margin to cavitation as well as in terms of mechanical lifetime. Detailed numerical analyses serve here to identify and prevent instability, vibration, and resonance in the early design phase.



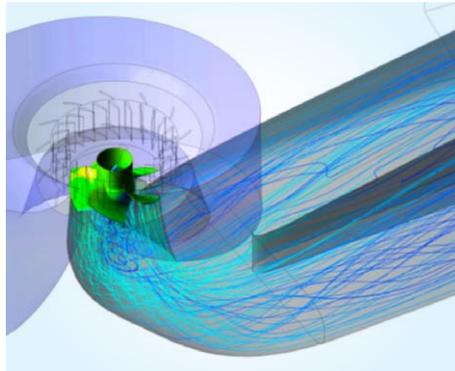
▲ Radial-flow pump



▲ Double-suction pump



▲ Bulb turbine



▲ Kaplan turbine

Range of services

- Numerical flow simulation (CFD)
- Program development for numerical analyses
- Hydraulic design and development of hydraulic components for
 - Engineered pumps and pumps produced in series
 - Pump turbines for pumped storage hydro power stations
 - Axial-flow turbines
- Optimization of efficiency
- Enhancement of safety margin to cavitation pitting
- Cost optimization while maintaining the hydraulic characteristics

Strategy

- Increased prediction accuracy of numerical methods through constant comparison of simulation and experiment

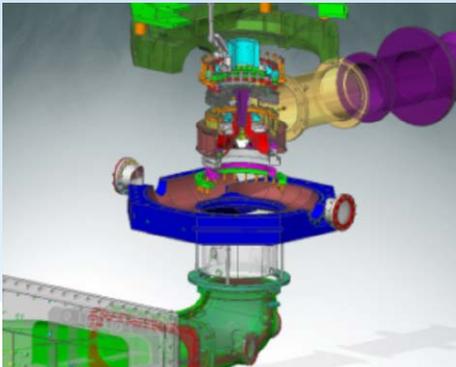




Model testing in the hydraulic laboratory

In the hydraulic laboratory, water turbines and pumps can be tested in model scale and customer acceptance tests are conducted. We attach great importance to achieving highest measuring accuracy using the latest measuring instruments,

which are calibrated and checked regularly. All test stands and models fulfill the requirements of the IEC 60193 test standard “Hydraulic turbines, storage pumps and pump turbines – Model-acceptance tests.”



▲ Model design and engineering - CAD



▲ Manufacturing in the machine shop



▲ Pump model of a multi-stage storage pump



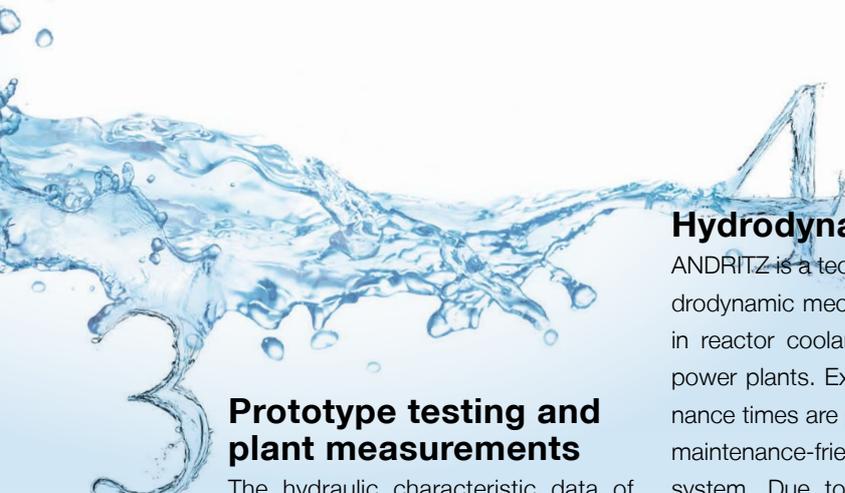
▲ Testing hall

Range of services

- Model design
- Development of special measuring technology (hydrostatic bearings)
- Development and acceptance tests for all pump and turbine types (except Pelton turbines)
- Two 4-quadrant-capable universal test stands
 - Measurement of hydraulic characteristics
 - Cavitation observations
 - Axial thrust and radial force measurements
 - Pressure pulsations

Strategy

- Highest quality and accuracy
- Reliable data basis for hydraulic design and mechanical construction of prototypes



Prototype testing and plant measurements

The hydraulic characteristic data of our series-production and prototype machines are validated on suitable test stands and within the scope of plant measurements. Pump test stands and a large pump test field are available for this purpose with individually configurable test options. Optimized and continuously developed measurement methods are used in large plants and various field tests. These procedures comply with approval standards ISO 9906 "Rotodynamic pumps – Hydraulic performance acceptance tests" and IEC 60041 "Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump turbines" and serve to ascertain and verify the hydraulic performance data.



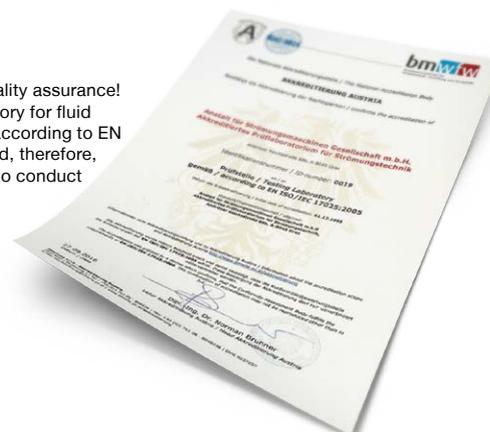
Hydrodynamic shaft seals

ANDRITZ is a technology leader for hydrodynamic mechanical seals installed in reactor coolant pumps for nuclear power plants. Extremely short maintenance times are possible thanks to the maintenance-friendly sealing cartridge system. Due to the special contour on the main sealing parts, a sealing gap of just a few micrometers forms when the pump shaft rotates, permitting consistent low leakage and a reduction of around 50 bar pressure per stage. Due to the three sealing stages that make up the sealing cartridge, the system pressure of 160 bar is reduced step-by-step until it reaches the ambi-

ent pressure. In an emergency, each individual stage can also absorb the entire pressure of 160 bar. This has proved to be one of the most efficient and safest solutions for seals in reactor coolant pumps – some sealing stages have been in use now for more than 20 years. Station blackout tests have shown that the mechanical seal can even withstand a worst-case scenario.



ASTROE believes in quality assurance! We are a testing laboratory for fluid mechanics accredited according to EN ISO/IEC 17025:2005 and, therefore, we are also authorized to conduct independent tests. ▶



ANDRITZ HYDRO

Technology leader for generations

ANDRITZ HYDRO is a global supplier of electromechanical equipment and services for hydropower plants and one of the leading suppliers worldwide in the market for hydraulic power generation.

The company's long history contains many famous company names as well as those of outstanding researchers and developers in the hydropower sector (Escher-Wyss, Kaplan, Bouvier, Pelton, ELIN, GE, etc.).

ANDRITZ HYDRO develops custom-tailored designs as well as standardized, cost-efficient solutions for most diverse requirements in large new plants (e.g. Rio Madeira, Brazil – 90 bulb turbines) or small hydropower plants. For the replacement, modern-

ization, and extension of existing large-scale plants (e.g. Simon Bolivar II, Venezuela – 770 MW) as well as for small plants, ANDRITZ HYDRO supplies special solutions optimized according to the 3-phase concept (Diagnosis – Analysis – Therapy). In mainly smaller modernization projects, a large number of these turbine designs are created exclusively on a computer without any model testing.

Every location has a clearly defined research and development focus. Direct integration of R&D staff in project development, proposal management, and project execution is an essential factor in achieving commercial success. Customers and consulting engineers can access the R&D know-how directly and, at the same time, current

market feedback is incorporated right away into future developments.

Project highlights

Bieudron, Switzerland
(H = 1.869 m, P = 423 MW):
World record-holding Pelton turbine

Goldisthal, Germany
(P = 380 MVA): Large pump turbines; first large, variable-speed motor generators outside Japan

Häusling, Austria
(H= 734 m, P = 180 MW):
World record-holding Francis turbine

Aschach: Largest Kaplan plant in Austria

ANDRITZ HYDRO – Research & Development

HYDRAULIC DESIGN & CFD	MODEL TESTING IN THE HYDRAULIC LABORATORY	PROTOTYPE TESTS AND PLANT MEASUREMENTS	HYDRODYNAMIC SHAFT SEALS
 <p>1 Numerical simulations provide essential insights into the physical phenomena of fluid mechanics.</p>	 <p>2 Measurement of hydraulic characteristics by means of precision models on 4-quadrant test stands, customer acceptance tests.</p>	 <p>3 Validation of hydraulic performance data in test runs on the test stand and/or measurements in the plant.</p>	 <p>4 Development and testing of hydrodynamic shaft seals with proven record lifetime.</p>



Water



Pulp and paper



Food



Mining and minerals



Power



Other industries

ANDRITZ



ANDRITZ AG

Stattegger Strasse 18
8045 Graz, Austria
Phone: +43 (316) 6902 0
Fax: +43 (316) 6902 413
pumps@andritz.com



www.andritz.com/pumps

All data, information, statements, photographs and graphic illustrations in this leaflet are without any obligation and raise no liabilities to or form part of any sales contracts of ANDRITZ AG or its affiliates for equipment and/or systems referred to herein. © ANDRITZ AG 2017. All rights reserved. No part of this copyrighted work may be reproduced, modified or distributed in any form or by any means, or stored in any database or retrieval system, without the prior written permission of ANDRITZ AG or its affiliates. Any such unauthorized use for any purpose is a violation of the relevant copyright laws. ANDRITZ AG, Stattegger Strasse 18, 8045 Graz, Austria.