

COMPACT HYDRO Program

The optimum solution of Small Hydro Power Stations

Romania Hydro Power Energy Summit, February 25th, 2016

Edwin Walch

The ANDRITZ GROUP

Overview

Profile: globally leading supplier of plants, equipment, and services for hydropower stations, the pulp and paper industry, the metal-working and steel industries, and solid/liquid separation in the municipal and industrial sectors

Headquarters: Graz, Austria

Global presence: over 250 production sites and service/sales companies worldwide

KEY FINANCIAL FIGURES 2014

	Unit	2014	2013
Order intake	MEUR*	6,101.0	5,611.0
Sales	MEUR	5,859.3	5,711.0
Net income (including non-controlling interests)	MEUR	210.0	53.0
Employees (as of end of period; without apprentices)	-	24,853	24,468

* MEUR = million euro



Worldwide leading position in four business areas

METALS and SEPARATION ...

ANDRITZ
Metals

Product offerings: presses for metal forming (Schuler); systems for production of stainless steel, carbon steel, and non-ferrous metal strip; industrial furnace plants

Order intake 2014: 1,693 MEUR

Sales 2014: 1,550 MEUR

Share of ANDRITZ GROUP's total order intake: 25%



ANDRITZ
Separation

Product offerings: equipment for solid/liquid separation for municipalities and various industries; equipment for production of animal feed and biomass pellets

Order intake 2014: 596 MEUR

Sales 2014: 587 MEUR

Share of ANDRITZ GROUP's total order intake: 10%



ANDRITZ
Hydro

Worldwide leading position in four business areas

... PULP & PAPER and HYDRO

ANDRITZ
Pulp & Paper

Product offerings: equipment for production of all types of pulp, paper, tissue and board; energy boilers

Order intake 2014: 1,996 MEUR

Sales 2014: 1,969 MEUR

Share of ANDRITZ GROUP's total order intake: 30-35%



ANDRITZ
Hydro

Product offerings: electromechanical equipment for hydropower plants (turbines, generators), pumps, turbo generators

Order intake 2014: 1,817 MEUR

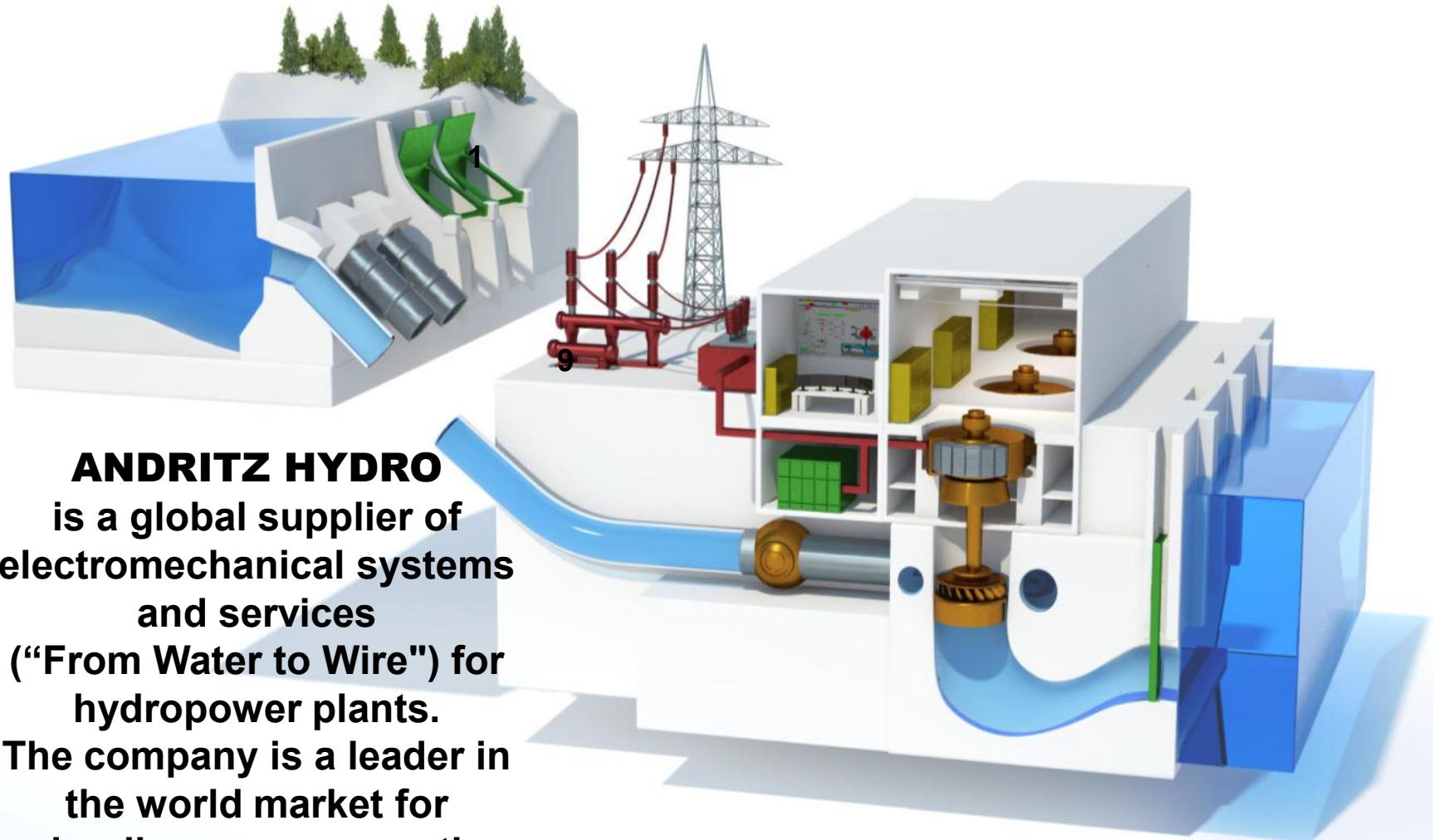
Sales 2014: 1,752 MEUR

Share of ANDRITZ GROUP's total order intake: 30-35%



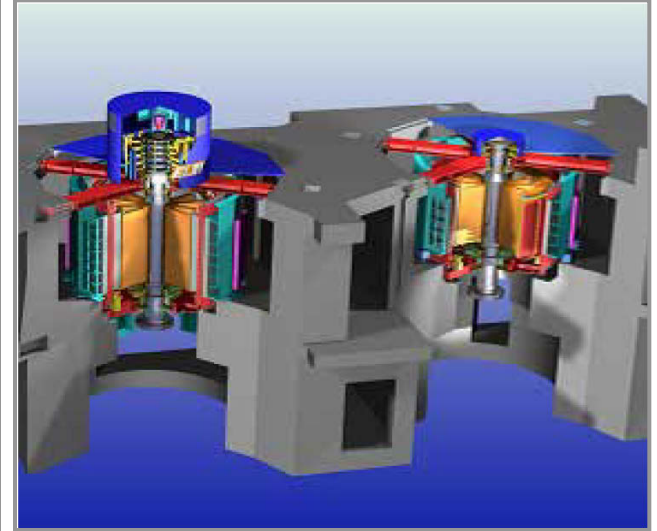
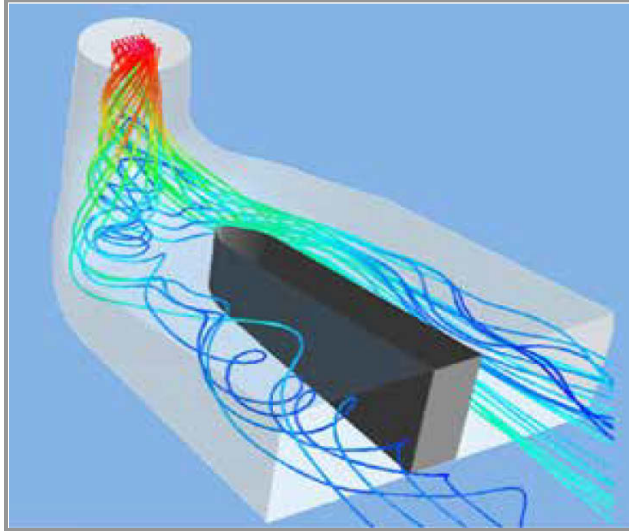
ANDRITZ
Hydro

ANDRITZ HYDRO



ANDRITZ HYDRO
is a global supplier of
electromechanical systems
and services
("From Water to Wire") for
hydropower plants.
The company is a leader in
the world market for
hydraulic power generation.

Our Experience



- More than 170 years of turbine experience
- Over 30,000 turbines (more than 420,000 MW) installed
- Over 120 years of experience in electrical equipment
- Complete range up to more than 800 MW
- Leading in service & rehabilitation
- World leader for Compact Hydro

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Organization

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Central Functions

Large Hydro



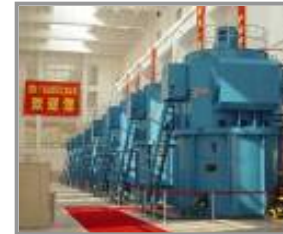
Compact Hydro



Service & Rehab



Pumps



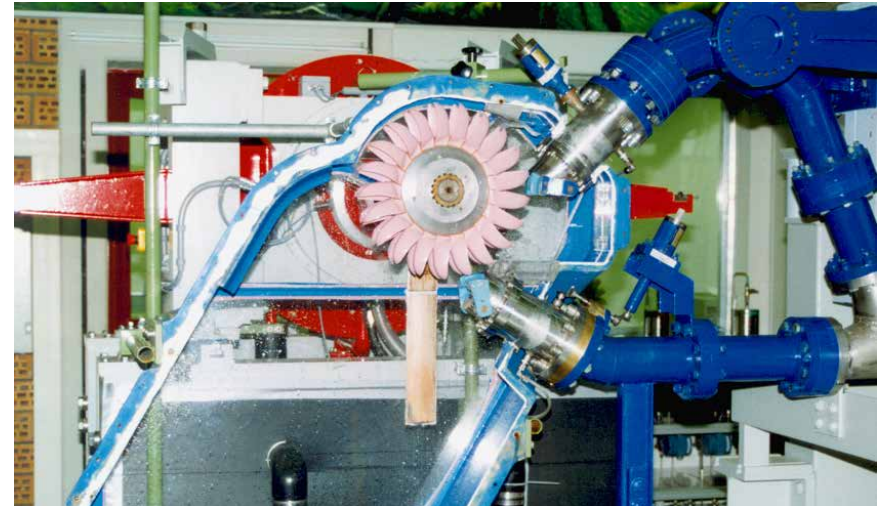
Generator Turbo



Research & Development

Model Testing

- **Main objectives of turbine model testing:**
 - Measurements of hydraulic data (efficiency, discharge, output, cavitation)
 - Determination of hydraulic torques and forces (runner blades and wicket gates, axial/radial thrust)
 - Investigation of performance (draft tube surges, aeration tests)
 - Feed back to flow analysis (Laser - Doppler anemometry)



COMPACT HYDRO

COMPACT HYDRO

is a global supplier of turnkey electromechanical equipment and services “Water to Wire” for hydropower plants of small and medium size with outputs up to 30 MW per unit.

COMPACT HYDRO

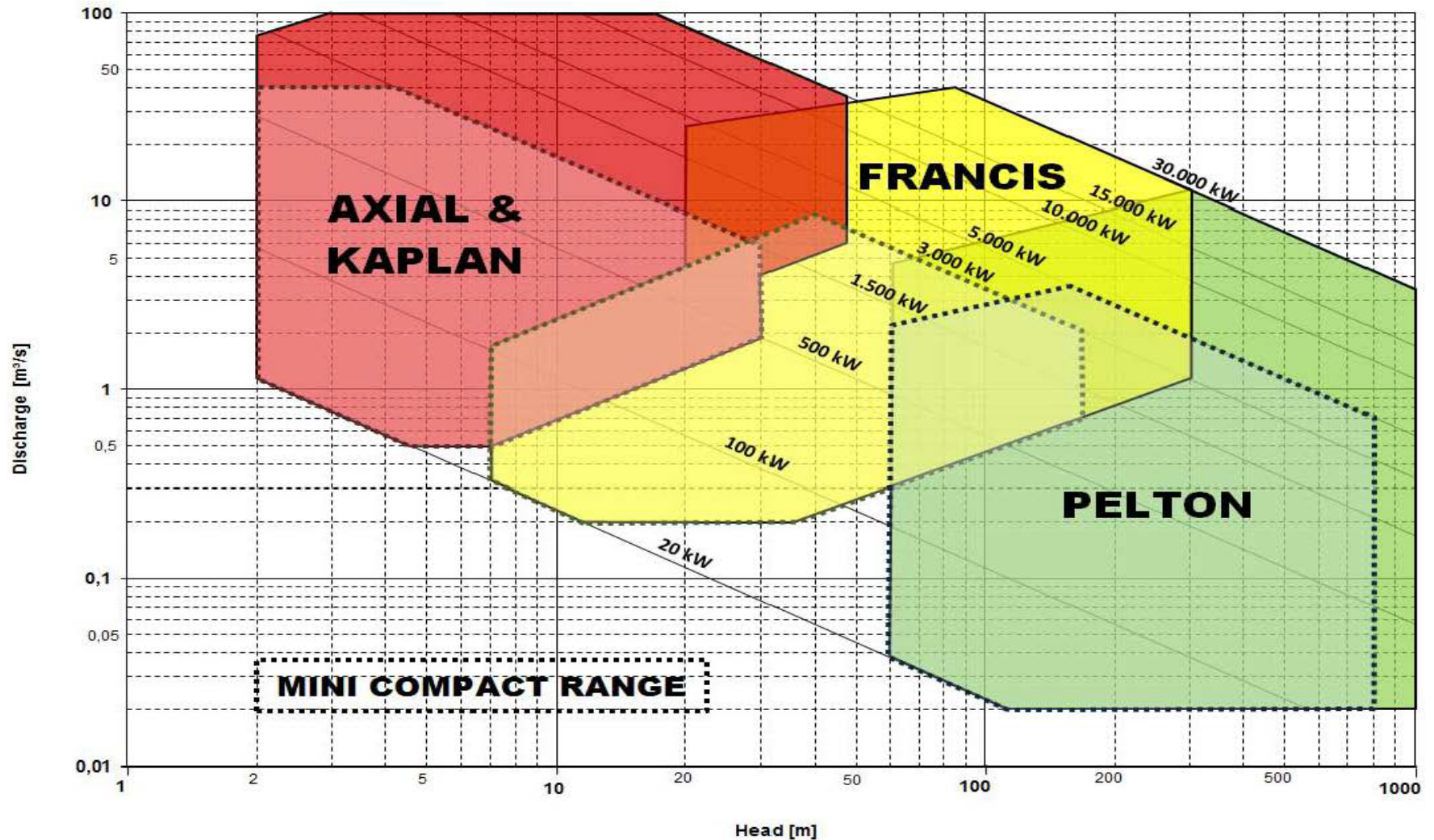
**More than 10,000 units of
Compact Hydro power plants supplied**



**Every week another three
Compact Hydro units start operation**

COMPACT HYDRO

Application Range



COMPACT HYDRO

Application range

- The range of products and services is developed from low to high head applications and covers a head ranging from 2 up to 1,000 meters with a unit output up to 15 MW for Axial and up to 30 MW for Francis and Pelton.
- The range of products includes in addition to the turbine itself, all or part of the electromechanical equipment within the powerhouse such as generator, inlet valve, governor, controls, switchgear, transformer.



Head:	$H \leq 45 \text{ m}$
Output:	$P \leq 15 \text{ MW}$



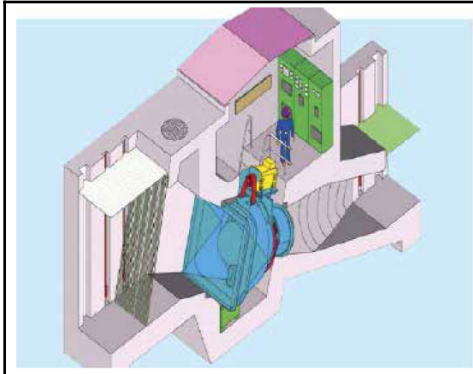
Head:	$H \leq 300 \text{ m}$
Output:	$P \leq 30 \text{ MW}$



Head:	$H \leq 1,000 \text{ m}$
Output:	$P \leq 30 \text{ MW}$

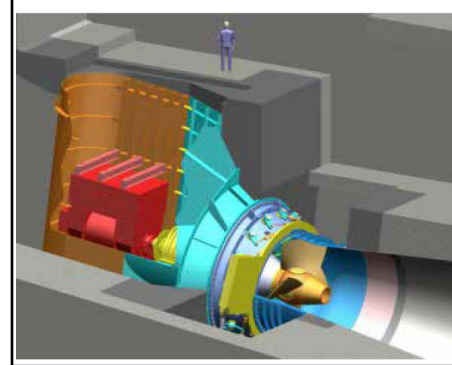
COMPACT HYDRO

Turbine Types for Low Head Applications



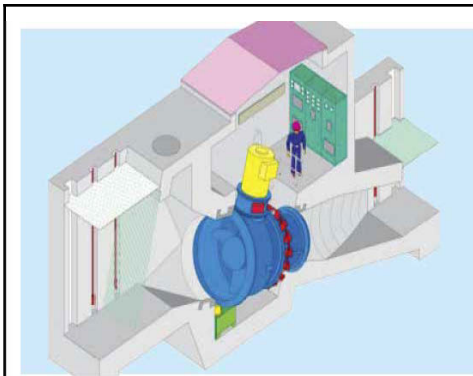
Head : up to **5 m**
Discharge : up to **25 m³/s**
Output: up to **0.6 MW**

BELT DRIVEN BULB TURBINE



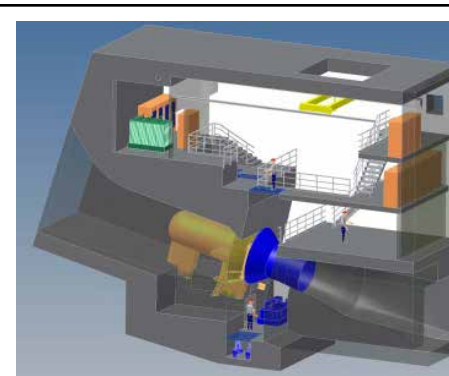
Head : up to **12 m**
Discharge: up to **100 m³/s**
Output: up to **10 MW**

COMPACT PIT



Head : up to **12 m**
Discharge: up to **45 m³/s**
Output: up to **2.6 MW**

BEVEL GEAR BULB TURBINE

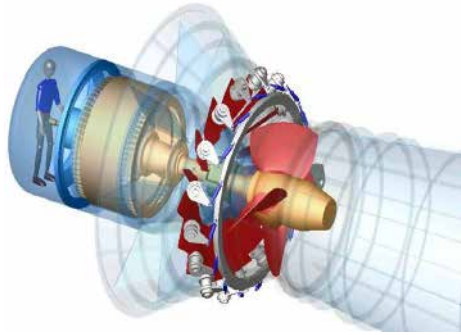


Head: up to **18 m**
Discharge: up to **100 m³/s**
Output: up to **10 MW**

COMPACT BULB

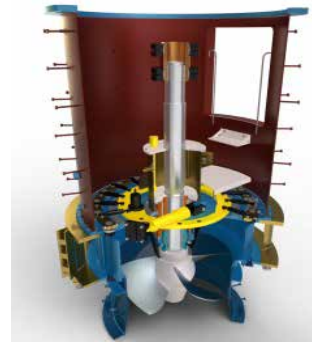
COMPACT HYDRO

Turbine Types for Low Head Applications



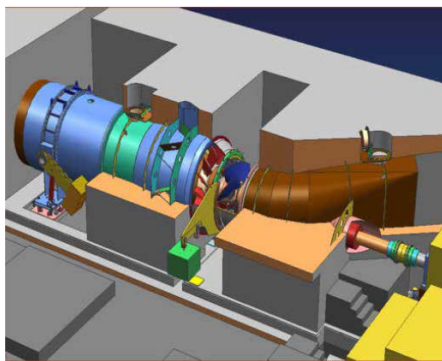
Head : up to **20 m**
Discharge : up to **100 m³/s**
Output: up to **5,0 MW**

ECO BULB TURBINE



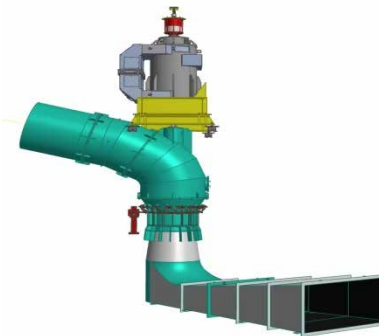
Head : up to **18 m**
Discharge: up to **80 m³/s**
Output: up to **10 MW**

VERTIKAL KAPLAN TURBINE



Head : up to **45 m**
Discharge: up to **80 m³/s**
Output: up to **15 MW**

S-TYPE TURBINE



Head: up to **45 m**
Discharge: up to **80 m³/s**
Output: up to **15 MW**

COMPACT AXIAL TURBINE

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Project – Talmühle / Germany

**1 Compact Bevel Gear
Bulb Turbines**

Runner diameter: 1,200 mm

Head: 4,42 m

Output: 334 kW



COMPACT HYDRO

Project – Kadievo / Bulgaria

**1 Compact Bevel Gear
Bulb Turbines**

Runner diameter: 1,950 mm

Head: 5.72 m

Output: 1,330 kW



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Project – Rothleiten/ Austria

2 Compact Bulb Turbines

Runner diameter: 3,650 mm

Head: 5.71 m

Output: 5,100 kW



COMPACT HYDRO

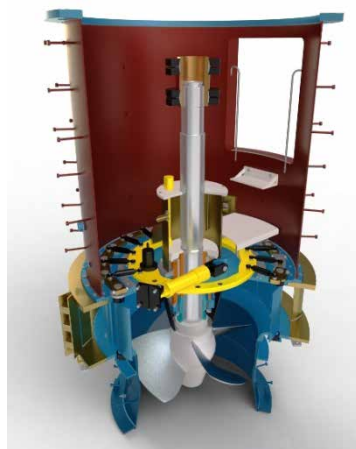
Project – Budjovice / Czech Republic

**3 Compact vertical Kaplan
Turbines**

Runner diameter: 1,450 mm

Head: 5.00 m

Output: 440 kW



COMPACT HYDRO

Project – Dafnosonara / Greece

2 Compact S-Type Turbines

Runner diameter: 2,600 mm

Head: 15.60 m

Output: 5,600 kW



COMPACT HYDRO

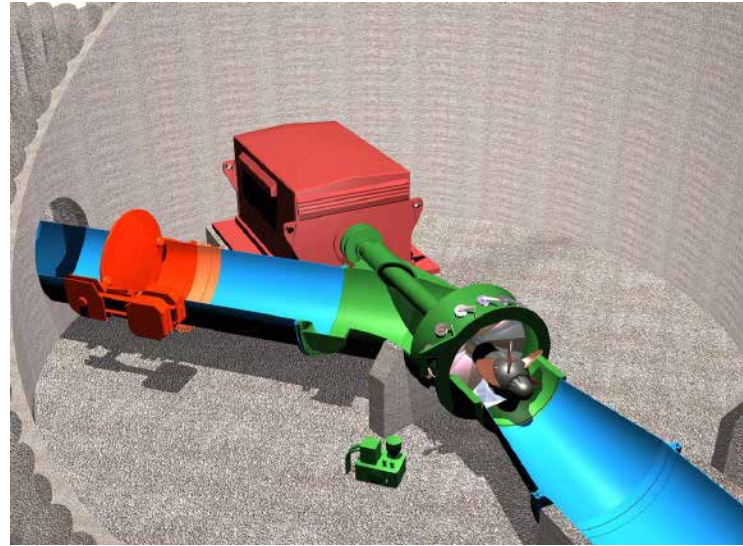
Project – Linthal / Switzerland

1 Compact horizontal Axial Turbines

Runner diameter: 1,450 mm

Head: 21.1 m

Output: 1,550 kW



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Francis Turbines



Head: $H \leq 300$ m

Output: $P \leq 30$ MW

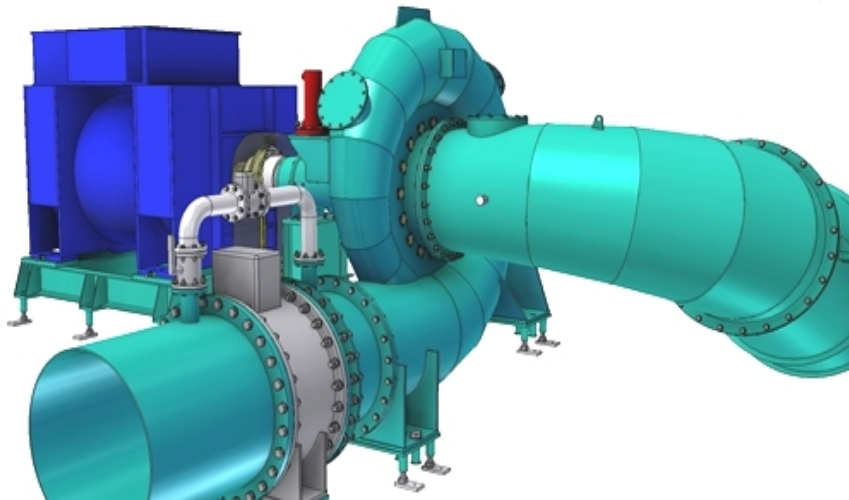
- **Horizontal shaft**
- **Vertical shaft**
- **Model tested runners in ANDRITZ laboratories**
- **Compact power house arrangement**
- **Short installation time**

COMPACT HYDRO

Turbine Types for High Head Applications

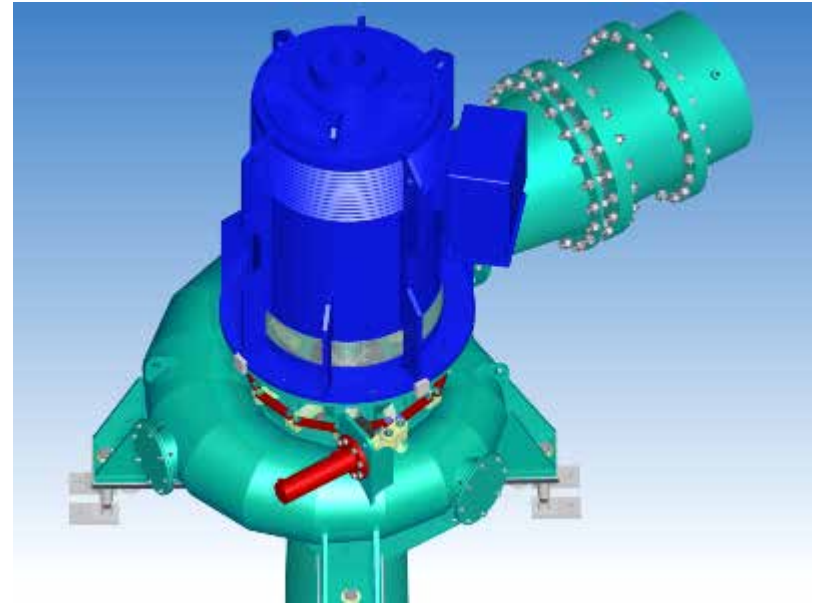
HORIZONTAL FRANCIS TURBINES

Head : up to **300 m**
Output: up to **30 MW**



VERTICAL FRANCIS TURBINES

Head : up to **300 m**
Output: up to **30 MW**



COMPACT HYDRO

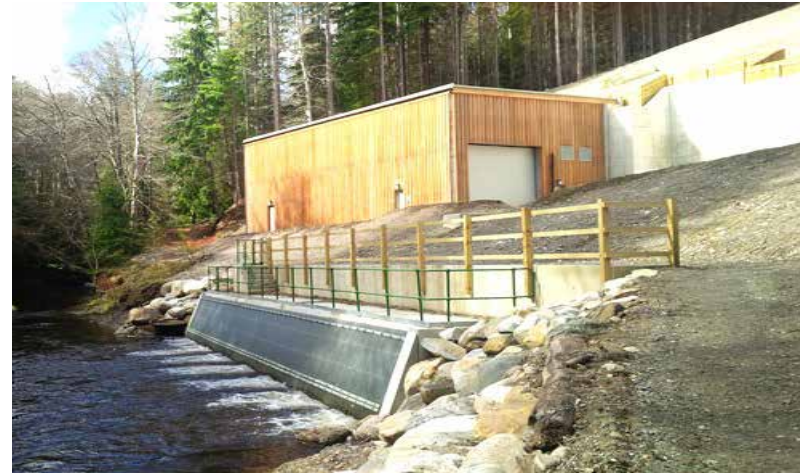
Project – Blackrock / Scotland

**2 Compact horizontal
Francis Turbines**

Runner diameter: 663 mm

Head: 94,0 m

Output: 3,800 kW



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Project – Stave / Canada

**4 Compact horizontal
Francis Turbines**

Runner diameter: 1,250 mm

Head: 95.1 m

Output: 10,400 kW



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Project – Pennarossa / Italy

1 Compact vertical Francis Turbine

Runner diameter: 942 mm

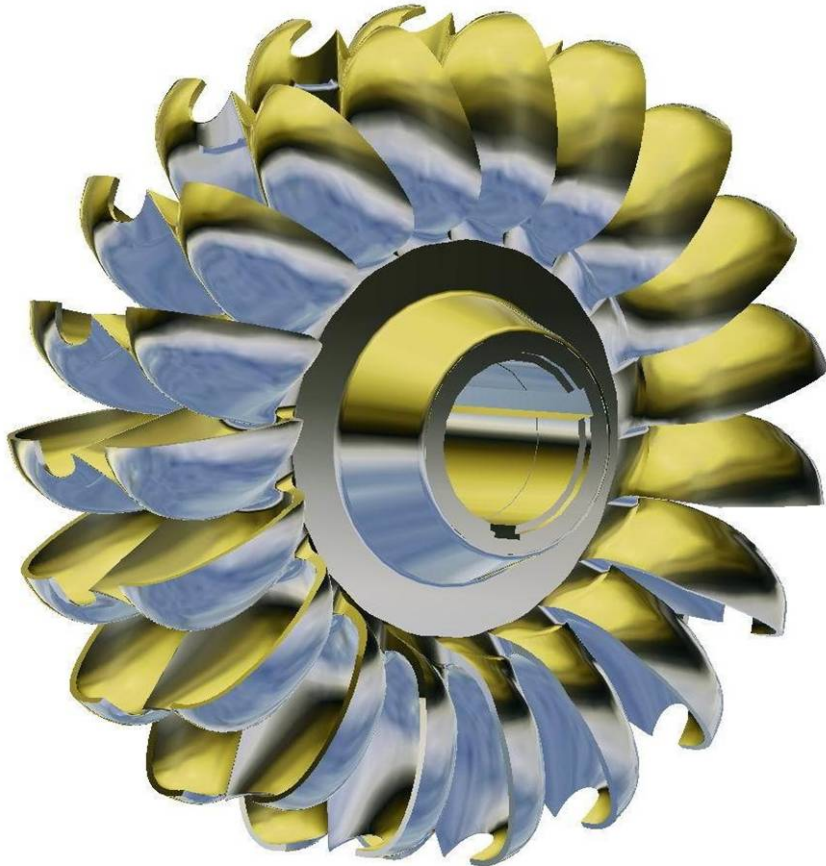
Head: 37.7 m

Output: 2,000 kW



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Pelton Turbines



Head: $H \leq 1,000$ m

Output: $P \leq 30$ MW

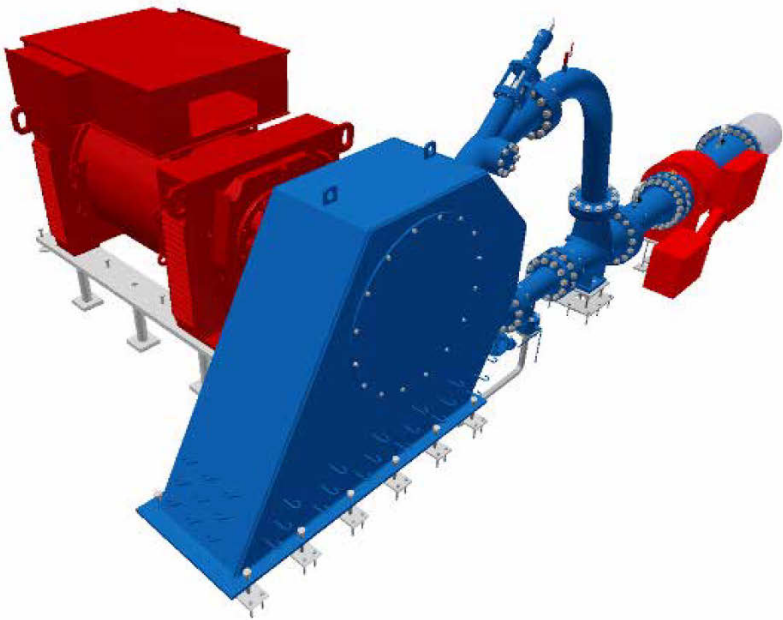
- **Horizontal shaft: 1 - 3 jets**
- **Vertical shaft: 2 - 6 jets**
- **Model tested runners in ANDRITZ laboratories**
- **High efficiencies at part load**
- **Low overpressure in the penstock**
- **Compact power house arrangement**
- **Short installation time**

COMPACT HYDRO

Turbine Types for High Head Applications

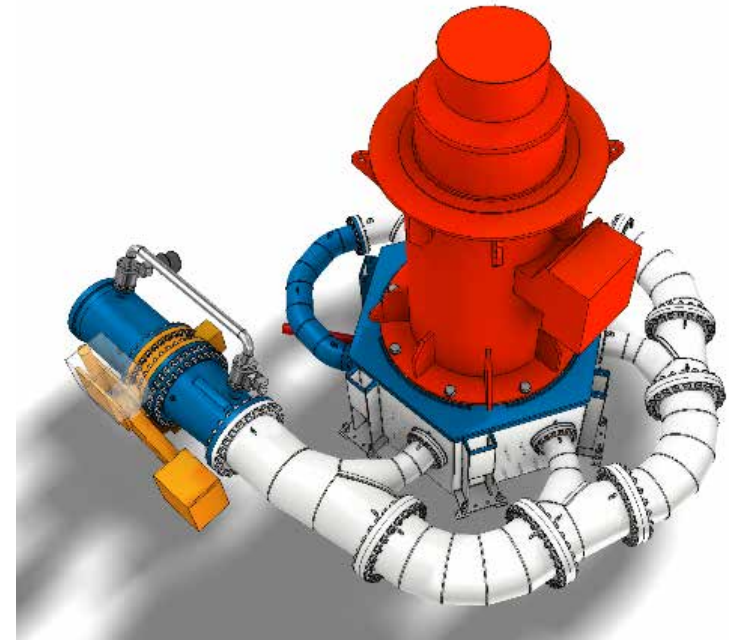
HORIZONTAL PELTON TURBINES

Head : up to **1000 m**
Output: up to **30 MW**



VERTICAL PELTON TURBINES

Head : up to **1000 m**
Output: up to **30 MW**



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Project – Val Mila / Switzerland

**2 Compact 1 nozzles horizontal
Pelton Turbine for Drinking Water**

Runner diameter: 510 / 390 mm

▪ **Head: 344 / 198 m**

▪ **Output: 180 / 42 kW**



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Project – Las Truchas / Mexico

**2 Compact 2 nozzles
horizontal Pelton Turbine**

Runner diameter: 1,260 mm

▪ **Head: 768.0 m**

▪ **Output: 7,200 kW**



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Project – Wöllbach/ Austria

**1 Compact 3 nozzles
horizontal Pelton Turbine**

Runner diameter: 590 mm

Head: 219,5 m

Output: 280 kW



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Project – Paraul Bailor / Romania

**2 Compact vertical 6 nozzles
Pelton Turbines**

Runner diameter: 800 mm

Head: 77.0 m

Output: 780 kW



Compact Hydro stands for:

- Complete line of turbine and electrical equipment up to 30 MW unit output
- Modular equipment design
- Low environmental impact
- Short period of project implementation
- Low investment cost and risk due to proven design concept

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Standard pumps as turbines



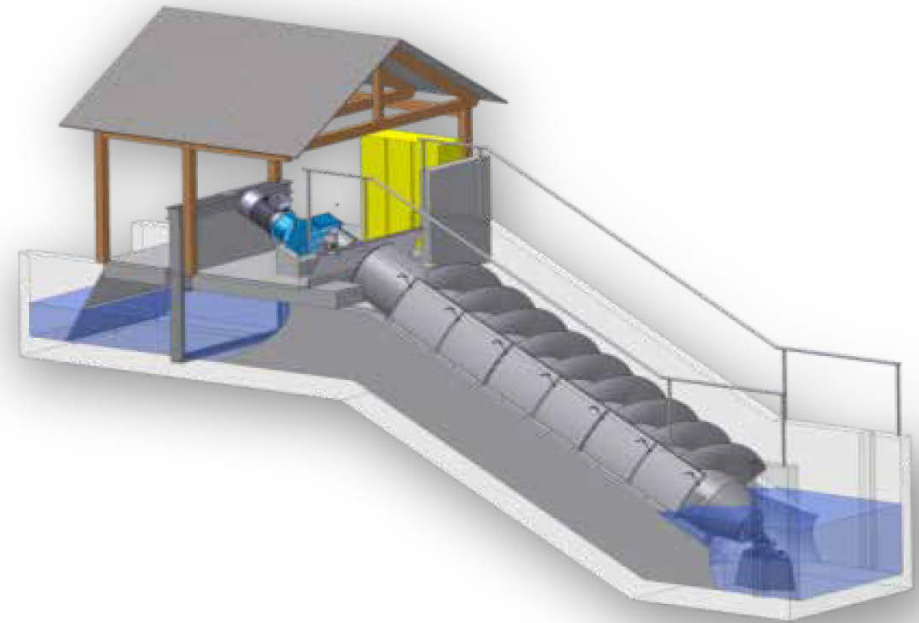
Pumps running as turbines

Types:	single- or multistage
Head:	up 80 m, multistage up to 350 m
Output:	bis zu 2 MW



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Hydrodynamic screws turbines



Hydrodynamic screw turbines

Flow:	Up to 10 m ³ /s
Head:	Up to 10 m
Output:	Up to 500 kW

Tidal current energy

ANDRITZ HYDRO Hammerfest

▪ ANDRITZ HYDRO Hammerfest

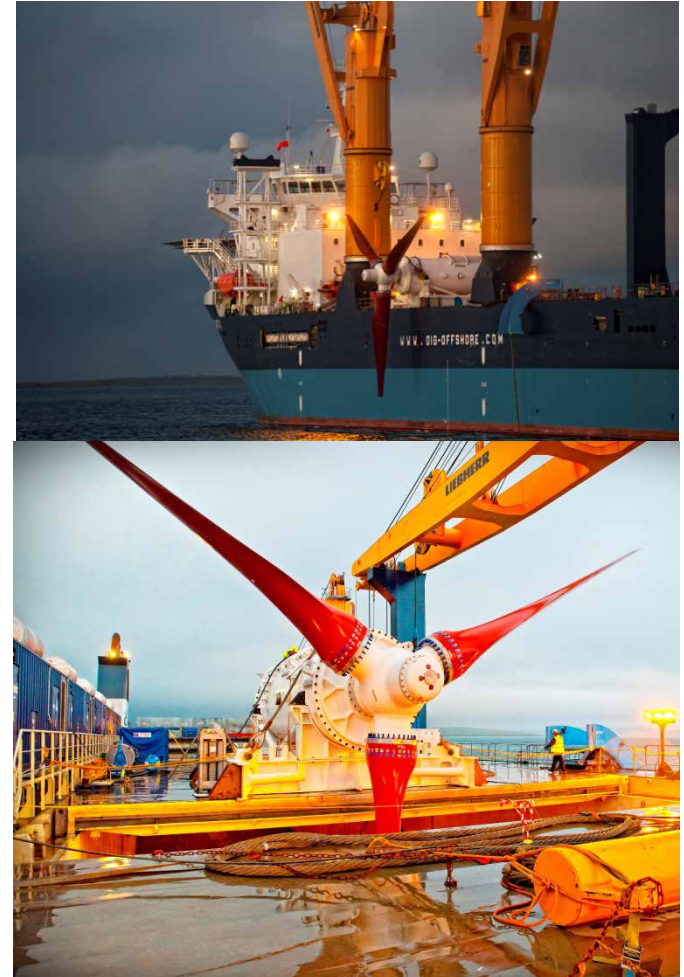
- One of the world's leading companies in development of technology for power generation from tidal currents occurring in coastal waters.

▪ History

- 1996 – founding in Hammerfest
- 2003 – world's first tidal current HS300 (300kW turbine) in Kvalsundet (near Hammerfest)
- 2011 – successful installation of HS1000 (1000kW turbine) at EMEC/UK

▪ Shareholders

- ANDRITZ HYDRO
- Hammerfest Energi
- Iberdrola (ScottishPower Renewables)
- other North Norwegian shareholders





ANDRITZ HYDRO
Your partner for renewable and clean energy