

HYDRONEWS

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MAGAZINE OF ANDRITZ HYDRO

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ANDRITZ
Hydro

Latest News

Key Figures 2014

Order Intake: 1,816.7 MEUR

Order Backlog*: 3,708.6 MEUR

Sales: 1,752.3 MEUR

Employees (without apprentices)*: 8,339

* as of end of period

Switzerland

ANDRITZ HYDRO has received a contract from Nant de Drance SA for the delivery of the electrical protection system for HPP Nant de Drance in Switzerland.

The 900 MW pumped storage power plant is located in the Swiss Alps and will deliver 2,500 GWh of electricity per year into the grid.

It is the first HIPASE P protection solution awarded into the Swiss market.

The new developed HIPASE P platform will be applied for the electrical protection of all six asynchronous motor generators (each rated at 174 MVA), all six block transformers, and all three station service transformers. The protection will be conducted redundant because of the high importance of this power plant.

Commissioning is expected stepwise from 2017 until 2018.

Türkei

Turkish utility company Kargi Enerji Üretim recently awarded a contract to ANDRITZ HYDRO for the supply of the electromechanical equipment for the Kargi hydropower plant, Turkey.

HPP Kargi is located on the Sakarya River, 100 km west of the Turkish capital Ankara.

ANDRITZ HYDRO will deliver three units, including two 48 MW turbines with 55.5 MVA generators, one 3.76 MW turbine with a 4.3 MVA generator and the complete electrical equipment. The units will supply 254 GWh of environmental friendly and renewable energy annually.

Commissioning is scheduled for 2017.

Hydro News Android app

The ANDRITZ HYDRO customer magazine Hydro News is now also available for Android devices. Since July 2013 it is accessible on iPads and online on our webpage.

The Android app can be downloaded from your Google Play store for free on tablet and smartphone or by following the QR-code below. The app runs on any device using Android 4.0.3 (Ice Cream Sandwich) or higher. Furthermore, the Hydro News can also be read online at www.andritz.com/hydronews.

iPad app:



Android app:



Web page:

www.andritz.com/hydronews

Mexiko

ANDRITZ HYDRO received a contract from Comisión Federal De Electricidad (CFE) for the rehabilitation of four units (1 – 4) corresponding to the first stage of the HPP Temascal, located on the Tonto River in Mexico.

All four units have been in operation for more than 50 years. The scope of supply includes engineering, procurement, manufacturing, site installation and commissioning of the four units (turbine and generator). An important project goal is to reduce water consumption in order to increase the availability of the units.

During the project, which shall be executed within 42 months, ANDRITZ HYDRO locations from Mexico, Austria and Switzerland will collaborate.

Philippines

Long-time customer Hedcor, a subsidiary of Aboitiz Power Philippines, awarded a contract to ANDRITZ HYDRO for the supply of the complete electromechanical equipment for the Manolo Fortich, two cascading hydropower plants located on the island of Mindanao, Philippines.

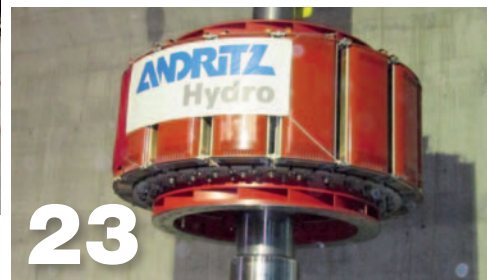
The scope of supply for HPP Manolo Fortich 1 (44.4 MW) and HPP Manolo Fortich 2 (26.1 MW) consists of six COMPACT Francis and two COMPACT Pelton turbines including hydraulic governors, synchronous generators, intake valves, and an extensive electrical package with the complete control systems and medium voltage switchgears.



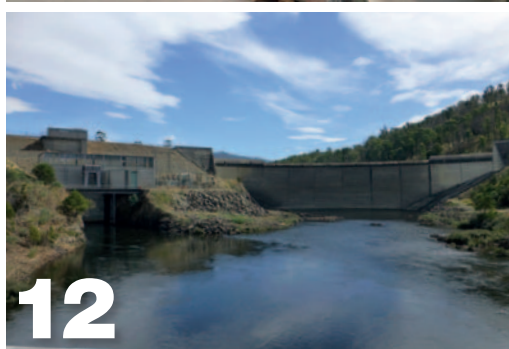
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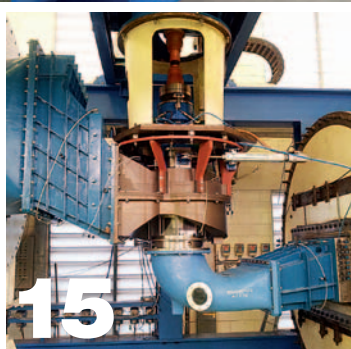
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Imprint

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Dear **business friend**

For ANDRITZ HYDRO the year 2014 presented a range of interesting challenges. Europe continued to show a trend toward declining energy consumption. Due to the infeed of volatile energy sources, such as wind and solar energy, which are subsidized and treated preferentially, major utilities struggled to cope with a massive decline in the profitability of their existing classic power plants. Investments were postponed, renewals cut down to the bare necessities, and pumped storage power plants – being vital to maintain security of supply – were put on hold.

The whole power industry is waiting for clear political decisions. At the same time, international investment activity is constrained on account of the financial crisis, which has not yet been overcome. Even major hydropower markets, such as the BRIC states (Brazil, Russia, India and China), only occasionally bring projects to final realization.

Nonetheless, in 2014 ANDRITZ HYDRO was again able to position itself quite well in such a difficult environment.

Overall, the projects gained as well as the results achieved present a successful picture similar to that of previous years. Once again, this can be attributed to the technical expertise and great commitment of our employees. The constant development of state-of-the-art know-how results in optimum technical design, making possible successful projects such as HPP Laúca in Angola, HPP Ñuble in Chile, HPP Xekaman 1 in Vietnam or HPP Lysebotn II in Norway. Order fulfillment and project management play important roles for ANDRITZ HYDRO. Timely completion of orders in accordance with the contract terms constitutes the foundation of trusting and reliable collaboration with our customers. That is being proved by such projects as HPP Angostura in Chile, HPP Paloona in Australia, HPP Akhmeta in Georgia and HPP Iovskaya in Russia.

The development of completely new technologies and their implementation in real projects have top priority for ANDRITZ HYDRO. We are convinced that a pivotal part of the future energy supply will come from the ocean. After successful fitting the world's largest tidal powerplant in South Korea's Sihwa

with electromechanical equipment and the current refurbishment of the oldest one at HPP La Rance, France, ANDRITZ HYDRO is also supplying the first commercial underwater park with tidal current turbines for MeyGen in Scotland.

The building of lagoons and the application of adapted bulb turbines in four-quadrant operation is our latest achievement in this field. As a member of a consortium, ANDRITZ HYDRO has been selected preferred supplier of electromechanical equipment for the world's first tidal lagoon project at Swansea Bay in Wales, UK, by Tidal Lagoon Swansea Bay plc.

On that basis we face this year's developments with great confidence and a positive attitude, even if the macro-economic conditions should stay the same.

We thank you for the trust you have shown and hopefully will continue to show us in the future.

Sincerely yours,

M. Komböck

H. Heber

W. Semper

Tidal energy

The future of ocean-based electrical energy production has begun

About 70% of our planet is covered with water, but only 3% of this is fresh water. The far larger amount of 97% of salt water possesses a huge potential of sustainable and clean energy. After a century of developing fresh water resources like rivers and lakes from the mountains to their deltas, now mankind is starting to produce electrical energy direct from the ocean. Amongst numerous technical approaches, today tidal power is considered to be one of the most promising additional future energy sources, with an estimated worldwide potential of more than 150,000 GWh.

Hydropower in transition – Very low head, barrages and lagoons

The history of hydropower technology development has followed the rivers – from high head solutions to very low head hydropower plants. As a leading global supplier in hydropower, today

ANDRITZ HYDRO is also a pioneer in providing commercial equipment for the ocean-based electrical energy future.

2012 – Very low head hydropower plant

ANDRITZ HYDRO has followed this development and realized several very low head examples like the world's largest HYDROMATRIX™ power plant Ashta, Albania, only 30 km from the coast.

2011/2014 – Tidal power plant

Tidal power plants are saltwater applications and typically use an existing natural bay blocked with a dam. In 2012 the world largest tidal power plant Sihwa (10 x 26 MW) was inaugurated in South Korea. ANDRITZ HYDRO delivered and installed the electromechanical equipment. In 2014, ANDRITZ HYDRO was awarded with the rehabilitation of the oldest commercial tidal power plant HPP La Rance in France.

2014 – Tidal current power plant

At the end of 2014, ANDRITZ HYDRO Hammerfest received an order from the UK-based tidal development company MeyGen Ltd. to supply three 1.5 MW tidal current turbines for an array under construction in the Inner Sound of the Pentland Firth, Scotland.

2015 – Tidal lagoon power plant

The latest tidal energy design is to build an artificial off-shore lagoon, mostly encompassed by a dam providing a head. In February 2015 ANDRITZ HYDRO, as a market leader in tidal energy technology, was appointed in a consortium with GE by Tidal Lagoon Swansea Bay plc. as preferred bidder for the supply of the electromechanical equipment for the world's first tidal lagoon hydropower project in Swansea Bay, Wales, UK. It will be located in the Severn Estuary and will be equipped with 16 bulb units, more than 20 MW each.

□ Ocean energy future: 1 – very low head, 2 – tidal, 3 – tidal current, 4 – tidal lagoon





□ ANDRITZ HYDRO Hammerfest tidal turbine

The future of ocean-based electrical energy production has begun

Tidal currents

To use the unexploited energy from tidal currents ANDRITZ HYDRO integrated one of the world's leading companies in the development and supply of tidal current turbines beneath the sea level – today known as ANDRITZ HYDRO Hammerfest. Established in 1997 by the local utility company Hammerfest Energi, ANDRITZ HYDRO Hammerfest has offices in Hammerfest, Norway and Glasgow, Scotland.

Tidal current turbines – technology and challenges

Tidal power is clean, renewable, reliable, and predictable. Any visual or audible impact above the surface is eliminated and normal shipping traffic will not be affected by the presence of fully submerged tidal arrays. It is based on experience of the technologies and solutions used in hydropower, marine propulsion, wind energy, offshore oil and gas industries, with focus on reliable and sustainable solutions.

The tidal turbines are designed to generate electrical energy from water currents with a speed above 1 m/s and at depths between 35 and 100 m. They are deployed on the seabed and kept in position by gravity, pins or pilings, depending on the seabed and tidal stream characteristics. Moreover, the horizontal axis turbines are equipped with a spe-

□ ANDRITZ HYDRO Hammerfest in Glasgow, Scotland



cially-designed variable-speed pitching mechanism and a nacelle yawing system, allowing the optimal harnessing of tidal currents in both ebb and flood directions. The whole substructure is designed to have a very small footprint, while the nacelle is optimized to minimize its drag profile.

Although ocean currents move slowly relative to typical wind speeds, they carry a great deal of energy.

Sea water has more than 800 times the density of air.

For the same rotor swept area, water moving at 2.5 m/s exerts about the equivalent amount of force as a constant wind speed of above 100 km/h (27.8 m/s). The tide level can be predicted well into the future, thus the speed of associated tidal currents can also be predicted with high accuracy.

Alongside the advantages of power generation from tidal flows, there are considerable technical challenges associated with this new technology. For example, a challenge is posed by the high turbulence levels and large waves associated with storms originating in the ocean. At a rotor hub height even 20 m below the surface, the effect of such large waves is to impose a sinusoidal velocity component with a magnitude of



Installation of HS1000 at EMEC, Scotland

around 4 m/s. Considering a normal cut-out water flow speed of 4.6 m/s, this wave results in a requirement for the turbine being designed to survive in flow speeds twice as high as the cut-out speed. Adding the requirement to consider fault conditions, which may result in pitch or yaw system misalignments, the thrust loading on the rotor hub can be up to 1,500 kN (150 tons), which is five times higher than the mean operating value of 340 kN (34 tons).

An 18 m rotor gives the turbine a swept area of 255 m². During extreme loading events the bending moment at the root of each of the three turbine blades can be up to 2,700 kNm. The peak rotational speed during normal operation is 14.5 rpm, giving a tip speed ratio of 4.8 – the ratio between the tangential speed of the tip of the rotor blade and the actual tidal current velocity. This high tip speed ratio is related to efficiency, with the optimum varying with the blade design. It results in a requirement for strong blades due to large centrifugal forces.

The MeyGen tidal current project

At the end of 2014, ANDRITZ HYDRO Hammerfest received an order from UK-based tidal development company MeyGen Ltd. to supply three 1.5 MW tidal current turbines for the array in the Inner Sound of the Pentland Firth, Scotland.

The Inner Sound of Pentland Firth is recognized as one of the most challenging and highly active sites of tidal flow with high wave frequency and requires careful engineering, manufacturing, and assembly to ensure that the technology deployed is able to operate and perform within its environs.

This order follows the successful completion of a series of tests with the pre-commercial prototype tidal current turbine HS1000 at the European Marine Energy Center (EMEC) in Orkney, Scotland. Furthermore, it is the first commercial order worldwide for the supply of large-scale tidal current turbines and forms part of the first phase of the project.

Offshore design codes state that any structure should be designed for storm conditions with a return period of at least twice the intended life of the structure. In the case of the MeyGen project, this means designing for a wave with a return period of 50 years, in theory a wave as high as 16 m.

MeyGen is the largest commercial tidal energy project under development in the world.

All major tidal turbine components are designed by ANDRITZ HYDRO Hammerfest in close cooperation with ANDRITZ HYDRO. The major components of the turbines like rotor blades, hub and front plate including the main bearing system, main-shaft, pitch and yaw system as well as assembling and test of the turbines prior to transportation to the site for deployment are supplied by ANDRITZ HYDRO Ravensburg, Germany. Engineering, design and delivery of electrical as well as control and instrumentation components are provided by ANDRITZ HYDRO Vienna, Austria.

In the long-term, MeyGen is planning to install 269 turbines with an overall capacity of 398 MW to provide predictable, renewable, and sustainable energy for about 175,000 Scottish households.



Installation of HS1000 at EMEC

The average generation per turbine is expected with 4.4 GWh per year.

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TECHNICAL DATA

MeyGen:

Type: Mk1

Output: 3 x 1.5 MW

Africa

Unexploited potential in a developing COMPACT HYDRO market

▣ Kashimbila, Nigeria, site panorama March 2013

Rapid growth of the African economy is creating a huge demand for electrical energy. However, although Africa is home to approx. 10% of the global hydropower potential, less than 7% of its potential has been developed so far. Furthermore, only 10% of Africa's population has access to electricity.

Several recent international reports have come to the conclusion that small-scale hydropower plants can be an adequate solution to cover the growing electricity demand in Africa. It will play a pivotal role in providing electrical energy to remote areas in connection with a proven technology either in stand-alone isolated mini-grids or as distributed generation in national grids.

ANDRITZ HYDRO in Africa

ANDRITZ HYDRO has a passion for Africa with a market presence for over 100 years. On the African continent,

▣ Compact Francis turbines as for HPP North Mathioya, Kenya



especially in central, east, and southern Africa, the COMPACT HYDRO business unit of ANDRITZ HYDRO has received several orders for the complete electro-mechanical scope of small-scale hydropower plants during the last few years.

Kashimbila, Nigeria

The Kashimbila multipurpose dam is located in southeastern Nigeria on the Katsina River close to the border with Cameroon.

Besides its original function as a buffer dam in case of the natural embankment failure in Lake Nyos, Cameroon, a total generation capacity of 40 MW was a substantial request by the Nigerian Government due to the current restricted generation capability.

Despite local restrictions such as transport limitations, the demand for a short installation time, and cost optimization, ANDRITZ HYDRO was awarded a con-



▣ Kaplan runners as for HPP Kashimbila, Nigeria, and HPP Stortemelk, South Africa

tract in 2012 to deliver four tubular type Kaplan turbines with a runner diameter of 2,850 mm.

The COMPACT AXIAL TURBINE (CAT) offers a smooth efficiency curve culminating in a high energy yield even at part load.

The final installation at HPP Kashimbila is planned for the second quarter of 2015.

Stortemelk, South Africa

NuPlanet, an established developer and independent power producer in South Africa, has awarded a contract to a consortium led by ANDRITZ HYDRO for the delivery of the complete electro-mechanical equipment at Stortemelk hydropower plant.

HPP Stortemelk is located at the existing Botterkloof Dam, near the town of Clarens in the province of Free State, South Africa. The dam has a gross head of approx. 15 m and was originally



constructed by the Department of Water Affairs as a buffer dam in order to minimize the erosion in the Ash River. It will be equipped with one 4.4 MW vertical COMPACT AXIAL TURBINE (CAT), with a runner diameter of 2,350 mm.

The handover of the turbine is planned for April 2016.

North Mathioya, Kenya

ANDRITZ HYDRO was awarded a contract from the general EPC-contractor JIANGXI Water and Hydropower Construction Kenya Ltd. for the delivery of the complete electromechanical equipment including three 1.9 MW COMPACT Francis turbines with a runner diameter of 568 mm on the North Mathioya River. The scheme is located near the town Kangema in Muranga District and will secure an independent electrical energy supply for local tea factories.

The Greening Tea Industry in East Africa (GTIEA) identified the North Mathioya River as one of the locations to develop

▣ Visit at North Mathioya



▣ North Mathioya River

a pilot project for the construction of a small hydropower plant to generate electrical energy for KTDA (Kenya Tea Development Agency). The growing of tea needs both, altitude and water, which are requirements for hydropower as well.

The delivery of the turbine and generator equipment to Kenya is scheduled for the end of 2015.

The interest in small hydropower in Africa is unbroken and will facilitate the advancement of this environmentally friendly form of energy. COMPACT HYDRO is looking forward to taking an active part in this development.

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TECHNICAL DATA

Kashimbila, Nigeria:

Output: 4 x 10 MW
Head: 19 m
Speed: 230.8 rpm
Runner diameter: 2,850 mm

Stortemelk, South Africa:

Output: 4.4 MW
Head: 14.8 m
Speed: 230.8 rpm
Runner diameter: 2,350 mm

North Mathioya, Kenya:

Output: 3 x 1.9 MW
Head: 120 m
Speed: 1,000 rpm
Runner diameter: 568 mm



Alto Anchicaya

New generator for a hydropower plant in Colombia

ANDRITZ HYDRO has been awarded a contract from Empresa de Energía del Pacífico (EPSA S.A. E.S.P.), part of CELSIA Group, for the design, supply, installation, and commissioning of a new 126 MVA generator for the Alto Anchicaya hydropower plant.

Colombia is a country with a huge hydropower potential to be developed in the upcoming years. HPP Alto Anchicaya is located in western Colombia, in the state of Valle del Cauca, about 85 km from Cali.

The generators were originally installed by General Electric in 1974 and the hydropower plant, with a total installed capacity

of 355 MW, consists of two 120 MW as well as one 115 MW Francis turbines and provides around 2,291 GWh of electrical energy annually. Its reservoir covers an area of 385 km².

The new generator for the Alto Anchicaya hydropower plant will be delivered from ANDRITZ HYDRO Inepar Brazil in June 2015. It will be the first generator from ANDRITZ HYDRO Inepar Brazil ever installed in Colombia. All local services and site works for the dismantling of the existing generator and for assembling of the new generator in the erection bay will be under the responsibility of ANDRITZ HYDRO Colombia. Commissioning is scheduled for November 2015.

In 2010 ANDRITZ HYDRO has received a contract for the supply of three Francis turbines for the 810 MW HPP Sogamoso. During the last few years ANDRITZ HYDRO won several new COMPACT installations and got a number of orders for the Service & Rehab business unit in Columbia. Earlier this year ANDRITZ HYDRO obtained an order for the refurbishment of a turbine at HPP Prado Tolima.

The Alto Anchicaya hydropower project will help ANDRITZ HYDRO to develop new opportunities in Colombia by showing our capabilities and know-how in the field of hydropower generators and confirms again the fruitful cooperation between ANDRITZ HYDRO and its clients in Colombia.

□ Rotor installation



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TECHNICAL DATA

Output: 1 x 126 MVA
Voltage: 13.8 kV
Frequency: 60 Hz
Speed: 450 rpm





Contract signing ceremony

Middle Bhotekoshi

Electromechanical equipment for a hydropower project in Nepal

In 2014, ANDRITZ HYDRO signed a contract with Madhya Bhotekoshi Jalavidhyut Company Limited to deliver electromechanical equipment for the 102 MW Middle Bhotekoshi hydropower plant in Nepal. MBJCL is a subsidiary company of Chilime Hydropower Company Limited, a branch of Nepal Electricity Authority (NEA).

The Middle Bhotekoshi hydropower plant is located in the Central Development Region, Bagmati Zone, in Sindhupalchowk District, Nepal. The run-of-river power plant combines a capacity of 102 MW with a designed discharge of 50.8 m³/s and an available gross head of 235 m. At the moment HPP Middle Bhotekoshi is the third largest hydropower project under construction in Nepal.

Awarding of the contract for the prestigious Middle Bhotekoshi hydropower plant followed an international bidding

procedure, in which all major global manufacturers of electromechanical equipment took part. During bid evaluation ANDRITZ HYDRO convinced the customer of its techno-commercial solution and could sign the contract in July 2014.

ANDRITZ HYDRO will supply all the three vertical 35 MW Francis turbines with digital speed governors, three spherical inlet valves, three generators with static excitation systems, digital protection system, computerized supervisory and control (SCADA) system, single phase 220 kV power transformers, as well as the gas-insulated switchgear (GIS) and electrical and mechanical auxiliary systems.

After completion, the Middle Bhotekoshi hydropower plant will supply about 542.3 GWh of electricity into the national grid per year. The project is scheduled to be completed within two years and nine months.

The award of this contract reinforces ANDRITZ HYDRO's leading position in Nepal as a reliable partner in developing hydropower.

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TECHNICAL DATA

Output: 3 x 35 MW / 3 x 40.35 MVA

Voltage: 11 KV

Head: 222 m

Speed: 500 rpm

Runner diameter: 1,340 mm



Repulse

Ongoing refurbishment business in Australia

Hydropower plant and dam

In October 2014, Hydro Tasmania awarded a contract to ANDRITZ HYDRO for the design, manufacture and supply of turbine and governor equipment for the Repulse Kaplan upgrade project.

The Repulse hydropower plant is, together with HPP Cluny (Hydro News 26) and HPP Meadowbank, part of the Derwent scheme, located in southern Tasmania. HPP Paloona (Hydro News 25) is part of the Mersey Forth scheme located in northern Tasmania.

Hydro Tasmania has four Kaplan turbines at HPP Meadowbank, HPP Cluny, HPP Repulse and HPP Paloona installed during the period 1967–1972. ANDRITZ HYDRO is the OEM (Original Equipment Manufacturer) of the existing units. These turbines have been in service for over 40 years. The upgrade project objectives include addressing risk posed by age and deterioration of the Kaplan turbines after 40 years of operation. The existing runner blade operating mechanism consists of a lever arm from the guide vane servo, a pressure oil head and control valves (combinator), a runner servomotor, blade operating rods, cross head lever arms and trunnions inside the runner (hub). The Kaplan runner blade operating mechanism is oil operated and contained within the runner hub.

The scope of delivery includes a new 34 MW oil-free Kaplan runner, guide



Derwent River close to HPP Repulse

vanes, head cover, facing plates, shaft seal, servomotor for the runner blade, and guide vane regulating mechanism as well as the inner top cover, the hydraulic power unit, and the digital electronic turbine governor. The oil-free Kaplan runner provided Hydro Tasmania with a solution to the environmental and safety issues associated with the existing oil-filled Kaplan runner hub including eliminating the risk of oil leakage from the runner to the downstream waterway.

HPP Repulse represents the fourth and last upgrade project as part of the Kaplan works programme for Hydro Tasmania. ANDRITZ HYDRO has supplied turbine and governor equipment for the first three stations consisting of HPP Paloona which was commissioned and returned to service in August 2014 and HPP Meadowbank which is scheduled to be commissioned in August 2015. The components for HPP Cluny are in production. The equipment delivery is scheduled for October 2015.

Experience gained during these projects has been implemented into the design for HPP Repulse to improve the custom solution consistent with the high standards of Hydro Tasmania.

The delivery of major components for HPP Repulse is scheduled for May 2016. All installation works as well as the refurbishment of existing reused components will be completed by Hydro Tasmania.

The award of HPP Repulse project continues to underpin the strong developing relationship between ANDRITZ HYDRO and Hydro Tasmania in Australia.

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TECHNICAL DATA

Output: 34 MW / 35 MVA

Voltage: 11 kV

Head: 26.08 m

Speed: 136.4 rpm

Runner diameter: 4,500 mm



Ñuble

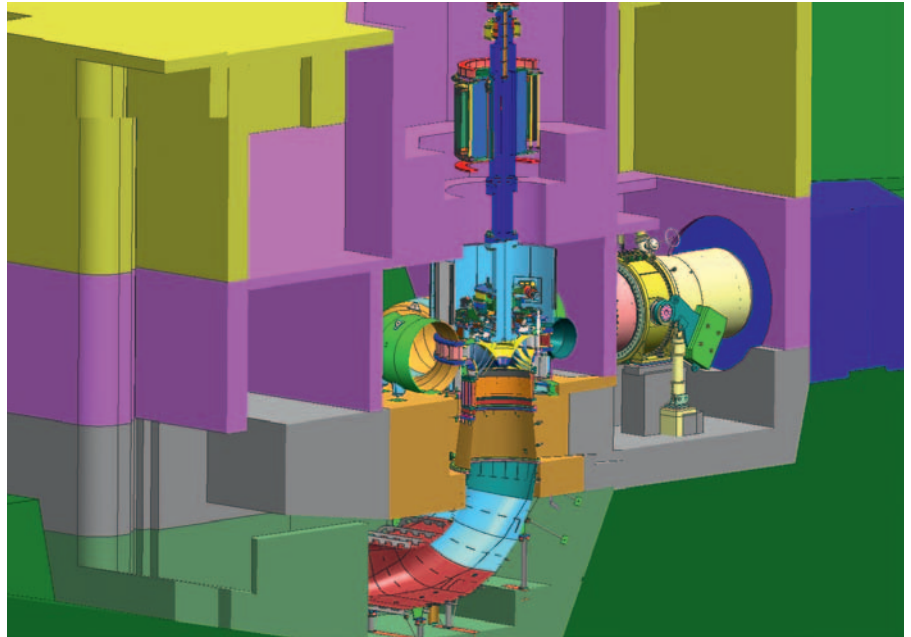
Electromechanical equipment for a new hydropower plant in Chile

ANDRITZ HYDRO has recently signed a contract with Hidroeléctrica Ñuble SpA for the complete electromechanical and hydromechanical equipment of the new Ñuble hydropower plant in Chile. Hidroeléctrica Ñuble SpA is a subsidiary of the Chilean power holding company Electrica Puntilla S.A.

The Ñuble run-of-river power plant is located about 4.8 km upstream of the town of San Fabian in the Bío Bío region and uses the water of the Ñuble River and its tributaries. The hydropower plant has a daily regulated area of 300,000 m², which was designed to regulate the outflow to the river in compliance with the environmental protection scheme.

An important aspect of the final decision to award ANDRITZ HYDRO with the contract was our strong and consolidated presence in Chile, our leading technical competence, as well as the high quality of equipment and services of all ANDRITZ HYDRO projects executed in Chile so far.

ANDRITZ HYDRO's scope includes supply, installation, supervision, commissioning, and on-site training for two vertical 71 MW Francis turbines and governors, two butterfly inlet valves including hydraulic control, two synchronous 75 MVA generators with static excitation systems, the electrical power systems, the mechanical auxiliaries systems, as well as the complete systems for Automation, Control and Protection (ACP), including communication from/to the national dispatch center. Furthermore, ANDRITZ HYDRO will deliver the penstock, six spillway radial gates (head: 22.4 m), two channel radial gates (head: 8.2 m), one intake wagon gate,

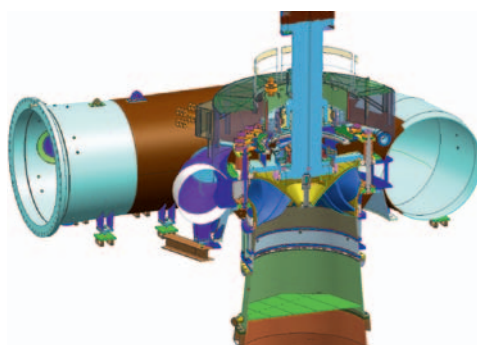


□ Schematic layout drawing of turbine and generator

two draft tube gates, and the complete architectural finishing of the power house.

The electricity generated by HPP Ñuble, will be supplied directly into the national grid (SIC) for domestic use. With an estimated annual energy production of 620 GWh, it will make an important contribution to meet the increasing energy demand of the country. The start of commercial operation is planned for May 2017.

□ Vertical Francis turbine section



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TECHNICAL DATA

Output: 2 x 71 MW / 2 x 75 MVA

Voltage: 13.8 kV / 230 kV

Head: 152.5 m

Speed: 333 rpm

Runner diameter: 2,230 mm



Kaunertal

Refurbishment of two synchronous generators in Austria

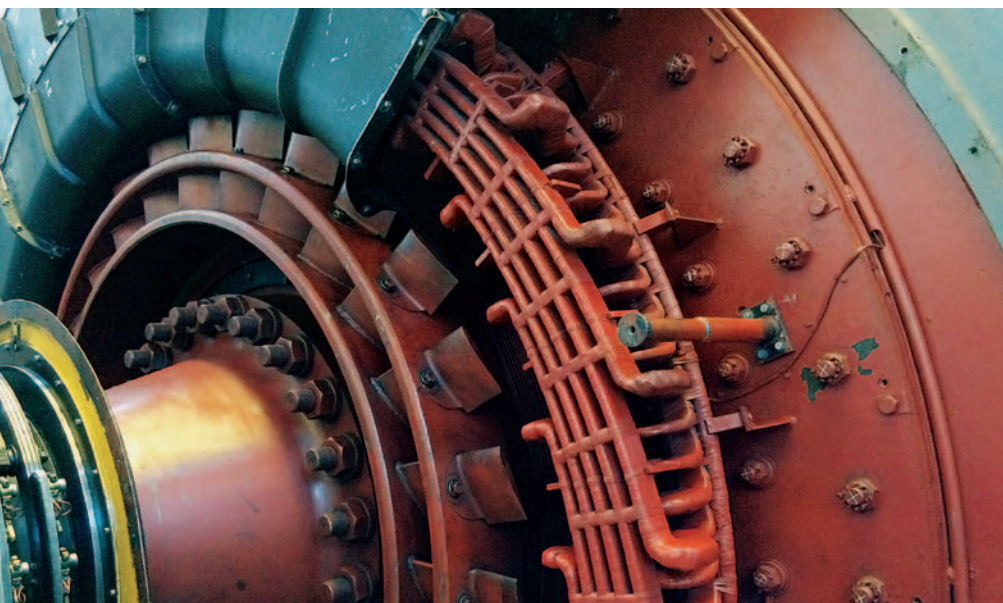
TIROLER WASSERKRAFT AG has awarded a contract to **ANDRITZ HYDRO** for the refurbishment of two synchronous generators for the Kaunertal hydropower plant.

HPP Kaunertal is located in western Austria in the state of Tyrol.

With a total of five units and an installed capacity of 500 MW, HPP Kaunertal produces an average of 664 GWh of electrical energy annually. The power plant uses a head of up to 895 m between the Inn River and the Gepatschspeicher, a dammed lake with 138 million m³ of impoundment volume collecting the water of several surrounding valleys in the Central Eastern Alps.

The existing horizontal synchronous generators with an output of 100 MVA each have been in operation for more than 50 years. ANDRITZ HYDRO will now provide two of them with new stators, new pole windings, new shafts with an in-depth assessment, as well as refurbishment of the remaining rotor-components. Before shutting down the first machine, a 3D-finite-element-analysis of the rotor and the shafts will be

▣ View of generator components



made to detect the areas most stressed. This method offers the opportunity to develop and prepare remedial actions in advance to ensure the shortest possible outage time. The analysis also allows a prediction of the remaining lifetime of the components analyzed and is therefore very helpful for the scheduling of future machine revisions.

The new generator components will be designed and manufactured by ANDRITZ HYDRO Weiz, Austria, where also the in-depth assessment, replacement of the rotor shafts and pole windings, as well as an overspeed-test of the existing rotor is carried out. The completely pre-assembled stator-halves will be delivered in November 2015 to keep the machine downtime as short as possible. All erection and assembly works will be carried out by an ANDRITZ HYDRO erection team in double-shifts.

Following the successful completion of the generator modernization projects HPP Kühtal and HPP Kirchbichl, as well as the new excitation systems and penstocks for the Kaunertal hydropower plant, this award confirms again the satisfaction and trust of TIROLER WASSERKRAFT AG in ANDRITZ HYDRO.



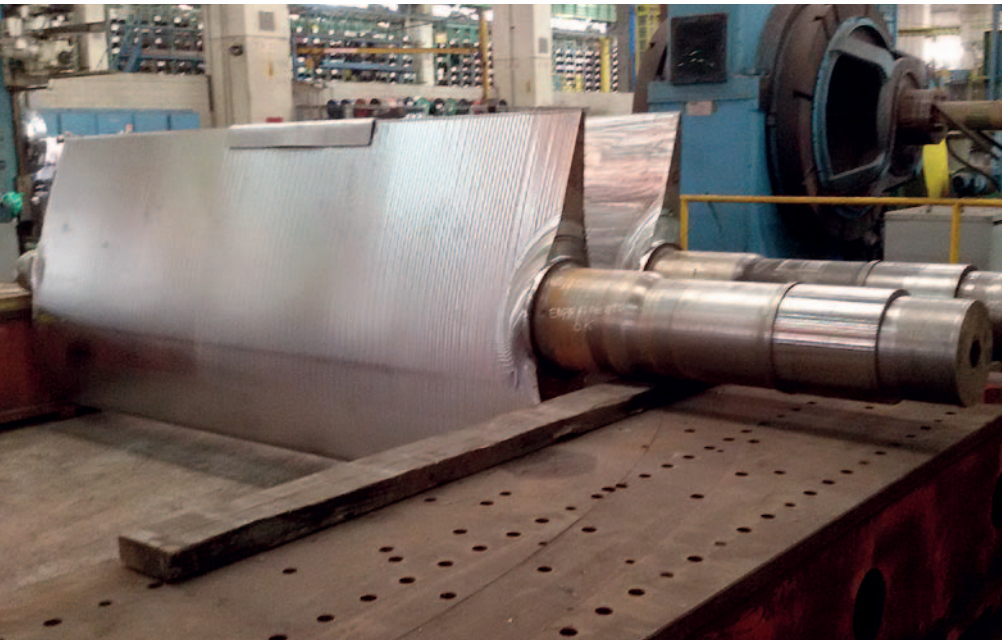
▣ Power house and switchyard

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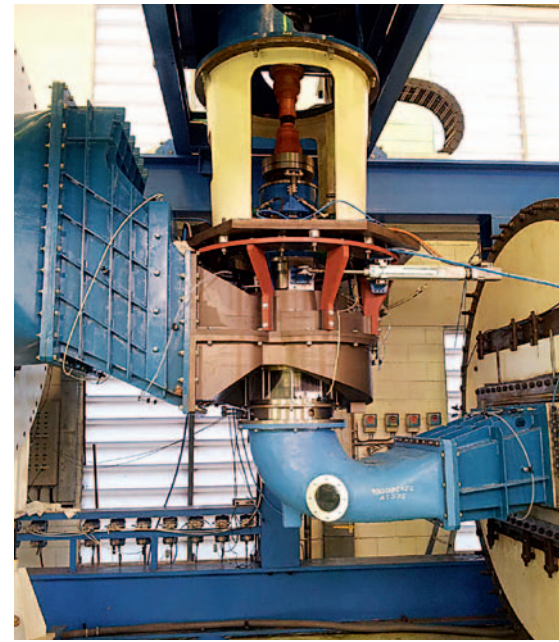
TECHNICAL DATA

Output: 5 x 100 MVA
Voltage: 10.5 kV
Head: 793–895 m
Speed: 500 rpm
Runner diameter: 2,858 mm





□ Wicket gates



□ Model testing

Sinop

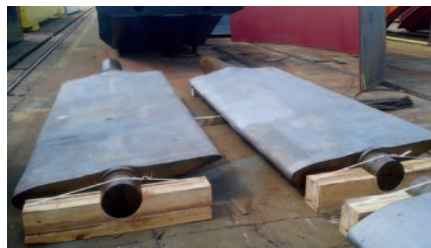
World's third largest Kaplan turbine to be installed at a Brazilian hydropower plant

In 2014, ANDRITZ HYDRO was sub-contracted by Construtora TRIUNFO SA, an experienced company in implementing power generation projects, to supply the electromechanical equipment for the Sinop hydropower plant in Brazil.

The final customer is a consortium composed of Eletronorte, Companhia Hidro-Elétrica do São Francisco S.A. (Chesf S.A.) and Électricité de France (EDF).

HPP Sinop is located on the Teles Pires River in the state of Mato Grosso, Central-West Brazil.

As a subcontractor, ANDRITZ HYDRO Brazil will supply the electromechanical equipment to Construtora TRIUNFO SA, including the hydraulic engineering, model testing, turbine and generator engineering, two vertical 204 MW Kaplan turbines, two synchronous 223.3 MVA generators, two excitation systems, and two governors, as well as the transpor-



□ Wicket gates

tation to the site, erection, and commissioning supervision. With 204 MW each, the units installed at HPP Sinop will not only be the largest Kaplan turbines in Brazil, but the third largest of such machines in the world.

After total installation, HPP Sinop will have a capacity of 408 MW. Furthermore, ANDRITZ HYDRO successfully concluded the first witness model test of a turbine at its laboratory in Araraquara, Brazil.

The Sinop hydropower plant is expected to start its commercial operation in Janu-

ary 2018. ANDRITZ HYDRO is proud to be part of such a large and challenging project in the Brazilian market.

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TECHNICAL DATA

Output: 2 x 204 MW / 223.2 MVA

Voltage: 13.8 kV

Head: 29 m

Speed: 97.74 rpm

Runner diameter: 8,850 mm





Rock Island

New electromechanical equipment for a run-of-river power plant in the USA

[View on Rock Island hydropower plant](#)

In December 2014, ANDRITZ HYDRO USA received a change order to the original contract dated August 2005 from Chelan County Public Utility District for four units (#B5 - #B8) at the Rock Island hydropower plant in Washington State.

Rock Island run-of-river power plant is located just outside the town of Wenatchee in Chelan County, Washington. It was the first dam to span the Columbia River.

Currently, HPP Rock Island consists of 19 units in two separate powerhouses with a combined installed capacity of 623.7 MW. The run-of-river power plant delivers about 2,600 GWh of electrical energy each year. The first of the two powerhouses on the dam was built in the early 1930s with the second powerhouse completing construction in the late 1970s.

For the HPP Rock Island change order, ANDRITZ HYDRO will be replacing four generator stators along with new rotor rims and rotor poles while overhauling three existing Kaplan runners to get them back into operating condition. This also includes typical rehabilitation of other turbine components. Furthermore, one of the units will receive the new ANDRITZ HYDRO designed stain-



[Machine hall](#)

less steel runner and wicket gates as provided for the already overhauled units #B9 and #B10. The complete scope will be delivered by the ANDRITZ HYDRO locations in Charlotte, USA and Weiz, Austria.

[Rotor assembly](#)



A key challenge of the project is working in the very narrow chambers of the powerhouse with virtually no lay-down area around the unit.

Building on its success at HPP Rock Island of the previously rehabilitated units, ANDRITZ HYDRO is fully confident that work on these next four units will also be very successful. The completion of the project is scheduled for the end of 2020.

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TECHNICAL DATA

Output: (#B5 - #B10): 22.5 MW / 25 MVA
Voltage: 13.8 kV
Head: 15.2 m
Speed: 100 rpm
Runner diameter: 5,710 mm



Dak Mi 2

Electromechanical equipment for a hydropower plant in Vietnam

In the middle of 2014, ANDRITZ HYDRO India signed a contract with AGRITA QUANG NAM Energy JS Company (AGRITAM) for the complete electromechanical works for Dak Mi 2 hydropower plant.

HPP Dak Mi 2 is located on the Dak Mi River, in Phuoc Son district in the province of Quang Nam in central Vietnam. It is a multipurpose scheme used for irrigation and hydropower generation.

ANDRITZ HYDRO's scope of supply includes design, manufacturing, and supply as well as supervision during erection and commissioning of the complete electromechanical equipment. The equipment supplies consists of two vertical 49 MW Francis turbines with electronic speed governors, two spherical inlet valves, two generators with static excitation system, protection system, computerized supervisory and control system (SCADA). Furthermore, 63 MVA power transformers (three-phase) and a 220 kV switchyard (AIS) along with the entire electrical and mechanical auxiliary systems will be delivered by ANDRITZ HYDRO. The transportation of



Mr. Nguyen Canh Huong (General Director of AGRITAM, Vietnam) and Mr. G Ravindra (ANDRITZ HYDRO, India) shaking hands during contract signing ceremony

the electromechanical equipment is scheduled for 2016.

HPP Dak Mi 2 will supply an output of 415 GWh sustainable and clean electrical energy per year into the central power grid of Vietnam.

This is the second large hydropower contract for ANDRITZ HYDRO from AGRIMECO group after HPP Chi Khe (2 x 20.5 MW; in 2014).

The award of this contract reinforces ANDRITZ HYDRO's position as a reliable partner in developing hydropower plants in Vietnam and Laos.

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Contract signing ceremony



TECHNICAL DATA

Output: 2 x 49 MW
Voltage: 13.8 kV
Head: 252.4 m
Speed: 428.57 rpm
Runner diameter: 1,530 mm



Pathri

Handing over of three units in India

Powerhouse building

A contract for the modernization of Pathri hydropower project was awarded to ANDRITZ HYDRO by Uttranchal Ltd in 2010. In August 2014 the project was successfully completed and all three generating units were handed over to the customer for commercial operation.

HPP Pathri is situated on the upper Ganges, 10 km west of the city of Haridwar. It is the first hydropower plant on the canal, fed by glaciers of the mighty Himalayas. The barrage was built mainly for flood control, irrigation and power generation.

Commissioned in 1955, HPP Pathri was originally equipped with three Kaplan turbines generating less than 50% of their capacity with considerable noise and vibration. By offering its successful environmentally-friendly oil-free Kaplan runner, ANDRITZ HYDRO was able to win the contract. The new units were manufactured in India.

ANDRITZ HYDRO provided the complete electromechanical solution, including three 6.8 MW Kaplan runners, guide vanes, regulating mechanism, shafts, bearings, seals, servo motors for the runner and guide vane mechanism, generator stator refurbishment, new rotor poles, refurbishment of rotor spi-



Turbine pit after renovation

ders, digital turbine governors, and the oil lubricating systems for the generator. Furthermore, ANDRITZ HYDRO supplied the SCADA-system, plant control, protection and excitation systems as well as mechanical and electrical balance of plant equipment. In addition, the scope included the renovation of hydromechanical equipment like the intake gate, draft tube gate, stop log gate and bypass gate system.

In August 2014, the installation and commissioning of all components were completed. A very challenging task was the integration of existing old and outdated components into new elements at optimum performance. The installation

works and the refurbishment of reused components was carried out during ongoing operation of the hydropower plant.

With HPP Pathri ANDRITZ HYDRO has gained an important Indian reference project and embraced an excellent opportunity to demonstrate its leading technology to this market. ANDRITZ HYDRO is looking forward to more challenges from India, since the majority of the existing Indian hydropower stations are beyond their planned life span.

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TECHNICAL DATA

Output: 3 x 6.8 MW / 8 MVA
Voltage: 11 kV
Head: 9.88 m
Speed: 125 rpm
Runner diameter: 3,890 mm



Rheinkraftwerk Iffezheim

Commissioning of fifth turbine at Germany's largest run-of-river power station



□ Kaplan runner during manufacturing



□ Inauguration ceremony

With the implementation of an additional fifth unit, HPP Iffezheim has become the largest run-of-river power station in Germany over the last four years.

The contract to deliver a fifth unit for HPP Iffezheim was signed between Rheinkraftwerk Iffezheim (RKI) and ANDRITZ HYDRO in October 2008.

With a maximum output of 38 MW the turbine-generator unit represents the core of this order. The horizontal bulb turbine has a remarkable runner diameter of 6,800 mm.

The scope of supply also included auxiliary systems, like drainage and dewatering, dual-circuit cooling water system, oil-hydraulic governor, as well as excitation, automation, control and protection system.

After the erection of the draft tube (diameter: 9.8 m, height: 5.5 m) with more than 30 tons in April 2011, the suction tube liner was installed at the end of

2011. The main installation was completed at the end of 2012. Due to high floodwaters the commissioning of the unit was delayed until mid-May 2013.

The official inauguration of the fifth unit took place in October 2013. As part of the formal speeches, EU Commissioner Günther Öttinger and the Secretary of State of Baden-Württemberg, Silke Krebs, have put significant emphasis on the achievements of the engineering work associated with the extension, as well as hydropower's environmental contribution. Due to the installation of the fifth turbine, 122 GWh of electrical energy will

be generated annually, thus saving about 11.000 tons of CO₂ emissions a year.

The completion of the expansion works at HPP Iffezheim proved to be a total success for RKI and ANDRITZ HYDRO.

Rita Hütter

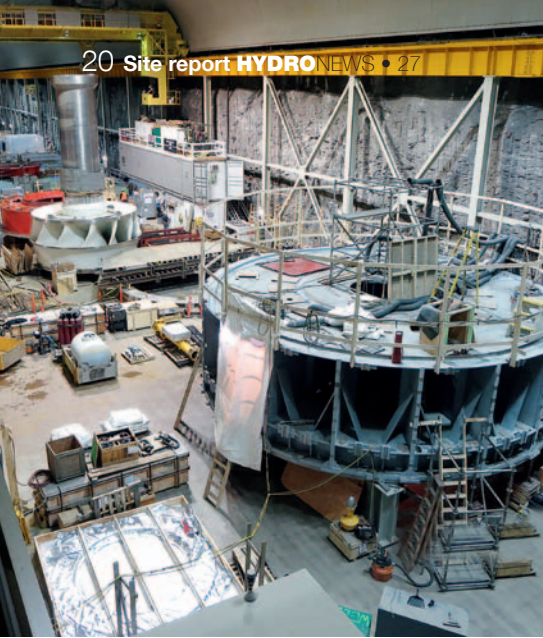
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TECHNICAL DATA

Output: 38 MW
Head: 9.5 m
Speed: 83.3 rpm
Runner diameter: 6,800 m

□ Bird's eye view of the hydropower plant





□ Powerhouse



□ Mica runner on barge

Mica Dam

New unit of a hydropower plant in Canada commissioned

ANDRITZ HYDRO's first unit for the Mica Dam expansion project of units #5 and #6 began commercial operations in early 2015.

Mica Dam is located in British Columbia, Canada, some 145 km from the city of Revelstoke. It has a height of 240 m and was originally built in 1973 under the terms of 1964 Columbia River Treaty between the USA and Canada to jointly control the Columbia River.

The first four generating units with a total capacity of 1,800 MW started commercial operation between 1976 and 1977, with two additional units to be installed in existing bays at a later date.

ANDRITZ HYDRO Canada entered a contract with British Columbia Hydro in July 2009 for the design, supply, installation, and commissioning of units #5 and #6. After successful completion of the model test, the execution of the project started in November 2010.

Major components for HPP Mica Dam were supplied by several ANDRITZ HYDRO manufacturing facilities with the turbine runners provided by ANDRITZ



□ Stator assembly

HYDRO Germany. The rotor structures and lower brackets were delivered by ANDRITZ HYDRO China, the head covers, bottom rings, wicket gates and operating mechanisms were shop assembled by ANDRITZ HYDRO Mexico.

Limited-capacity roads and multiple bridges in the area created a transportation challenge when the heavy, 137 ton Francis runner had to be brought over forest roads, changing trailers to adapt to the different conditions and finally being conveyed by barge across Mica Dam reservoir.

The execution of the project's aggressive schedule for the first unit was not easy due to HPP Mica Dam's remote location and being an underground powerhouse. In consideration of these

circumstances, the work was executed under very high safety standards for the workers and with special care for the environment to protect the pristine region from any contamination by the works.

Unit #5 started commercial operation in early 2015 and unit #6 will follow by end of 2015, adding a total of 1,040 MW of capacity to the HPP Mica Dam project.

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TECHNICAL DATA

Output: 2 x 520 MW / 2 x 570 MVA
Head: 170 m
Runner diameter: 6,300 mm
Speed: 133.33 rpm



Iovskaya

Successful inauguration in Russia

In November 2014, the second unit of the Iovskaya hydropower plant was inaugurated, following the successful handing over of unit #1 in January 2014 (Hydro News 25).

HPP Iovskaya is owned by the Kolsky Branch of JSC TGK-1 (Territorialnaya Generiruyushchaya Kompaniya No 1 – a regional utility) and was originally commissioned in 1960. It is part of the Nivskiy Cascade in the Murmansk oblast, located close to the northern polar circle.

Mr. Komböck receives inauguration certificate from Mr. Barvinok (General Director of TGK-1)



TGK-1 and ANDRITZ HYDRO at inauguration ceremony



ANDRITZ HYDRO's scope included the supply of two new double-regulated Kaplan turbines with seven runner blades, automation (control, protection, excitation, governor and vibration monitoring), a new generator winding as well as the balance of plant equipment.

The second, now modernized, unit was successfully synchronized and load tests were performed by end of 2014. After finishing the 82-hour test run, the Taking Over Certificate (TOC) was signed by representatives of TGK-1 and ANDRITZ HYDRO in an on-site ceremony. The customer was absolutely satisfied with the absence of vibration during the operation of both units, which had been a significant problem for decades. ANDRITZ HYDRO proved all guaranteed performance values to the customer during the first two months of operation of the second unit and nearly one year of operation of the first unit.

The rehabilitation project was completed one week prior to the contractual date, representing an example of good cooperation between TGK-1 and ANDRITZ



Unit #1 and unit #2 after modernization

HYDRO. HPP Iovskaya was the first manifold rehabilitation of ANDRITZ HYDRO in Russia. Together with HPP Tsimlyanskaya, the Iovskaya hydropower plant delivers significant experience for further hydropower projects in Russia.

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TECHNICAL DATA

Output: 2 x 50 MW
Head: 32 m
Speed: 136.36 rpm
Runner diameter: 4,600 mm



Angostura

Commissioning of hydromechanical equipment in Chile

Angostura dam, spillway and view on the Bío Bío River

In March 2010, ANDRITZ HYDRO signed a contract with Colbún S.A. for supply, design and installation of hydromechanical equipment for the Angostura hydropower plant in Chile.

HPP Angostura is situated around 600 km south of the Chilean capital Santiago de Chile at the Bío Bío River. After HPP Ralco and HPP Pangue, it is the third hydropower plant in a cascade at this river, which makes it a hydropower plant with rather stable water level. HPP Angostura is the major hydroelectric plant under construction in Chile and has been in development since 2004. It has the largest power house in the country, equipped with three units representing a total installed capacity of 316 MW.

The scope of ANDRITZ HYDRO includes the design, manufacturing, supply, and installation of the complete hydromechanical equipment of the plant, which consists of six spillway radial gates, three intake roller gates, two draft tube roller gates, one bottom outlet gate, two diversion gates and six sets of stop logs, as well as hydraulic equipment and electrical equipment for two control buildings.

Teams from ANDRITZ HYDRO locations in Austria and Chile were involved in the HPP Angostura project. The design was



Spillway

provided by ANDRITZ HYDRO Austria (Linz and Vienna), the installation supervision was done by all parties involved. Site management was carried out by ANDRITZ HYDRO Linz, local and staff matters were handled by ANDRITZ HYDRO Chile. During the peak of the installation phase, works at all five points installation points took place simultaneously.

In September 2013, a big contractual milestone was achieved with the filling of the reservoir. The Partial Acceptance Certificates (PAC) for the spillway and the intake were signed in January 2014, the certificates for the draft tube and the bottom outlet followed in February 2014. In May 2014 ANDRITZ HYDRO successfully finished all remaining installation and commissioning works, including demobilization of the site.

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TECHNICAL DATA

Radial Gate:	13.20 m x 17.04 m
Intake Gate:	4.75 m x 7.50 m
Bottom Outlet Gate:	6 x 8 m
Diversion Gate:	8.10 m x 16.60 m
Draft Tube Gate:	4.50 m x 9.03 m



Ayvali

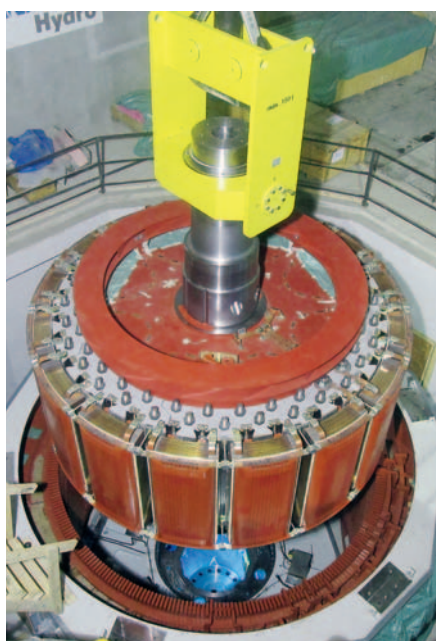
Four new units for a hydropower plant in Turkey

In May 2012, Özdoğan Enerji A.Ş. signed a contract with ANDRITZ HYDRO for the supply of an electromechanical Water-to-wire solution for the new Ayvali hydropower plant in Turkey. In August 2013, this contract was extended to include two COMPACT units using the obligatory residual water flow.

HPP Ayvali is located on the Oltu branch of the Çoruh River, in the province of Erzurum in northeastern Turkey, close to the border with Georgia. It features a roller compacted concrete (RCC) dam with a height of 177 m, a maximum dam reservoir of 308 million m³ and an installed capacity of 130 MW.

For the impoundment facility ANDRITZ HYDRO's scope comprises the complete electromechanical Water-to-wire solution, including two Francis turbines, generators, transformers, main inlet valves, the complete electrical equipment, all auxiliary systems, and two

□ Rotor lifting into the pit



□ Client's representative in front of an ANDRITZ HYDRO COMPACT Francis turbine

COMPACT HYDRO units. Furthermore, a 154 kV switchyard to connect the hydropower plant to the national electrical grid was delivered.

The project was executed by ANDRITZ HYDRO Austria in cooperation with ANDRITZ HYDRO Ankara, Turkey, which providing competence for the generator, turbine, and electrical power systems, as well as all installation activities on-site.

After the delivery of the components, which have been manufactured in Europe and Turkey, the installation of the electromechanical equipment started in 2014 in close cooperation with Özkar İnşaat ve Tic. A.Ş., the customer's sister civil company. The impounding of the reservoir started by mid January 2015.

Depending on the water level, the commissioning and commercial operation of both Francis turbines are scheduled for mid 2015. The completion and commercial operation of the compact units will follow afterward.

This contract underlines again ANDRITZ HYDRO's leading position in the Turkish public and private hydropower market.

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TECHNICAL DATA

Francis units:

Output: 2 x 65 MW / 2 x 76.5 MVA

Voltage: 13.8 kV

Head: 190 m

Speed: 375 rpm

Runner diameter: 1,950 mm

Compact units:

Output: 2 x 2.6 MW / 2 x 3 MVA

Voltage: 6.3 kV

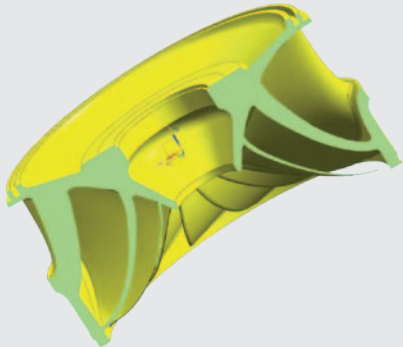
Head: 115 m

Speed: 1,000 rpm

Runner diameter: 625 mm



Guatemala Renace III



In 2014, ANDRITZ HYDRO received an order from Cobra Infraestructuras Hidráulicas S.A. for the supply of three Francis turbines for the new Renace III hydropower plant, which will be located on the Cahabón River, near the town of San Pedro Carchá in Guatemala.

ANDRITZ HYDRO Spain is responsible for the supply of turbines, main inlet valves, generators, and associated equipment, including detailed engineering, manufacturing, transportation to the site, erection, and commissioning.

Manufacturing and preassembly of the main turbine components will be carried out at the ANDRITZ HYDRO workshop in Spain. The generator will be supplied by the Spanish company Gamesa.

Currently, the manufacturing of the main components is in progress. HPP Renace III will be handed over to the customer in March 2016.

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TECHNICAL DATA

Output: 3 x 22 MW
Head: 153.4 m
Speed: 600 rpm
Runner diameter: 1,293 mm

Vietnam Sap Viet

In October 2014, ANDRITZ HYDRO India signed a contract with Sap Viet JSC for the delivery of a complete COMPACT HYDRO Water-to-wire package, including two 10.5 MW horizontal Francis units for the HPP Sap Viet.

The Sap Viet hydropower plant is located in the province of Son La, some 200 km north of the Vietnamese capital Hanoi.

During negotiations in September 2014 ANDRITZ HYDRO convinced the customer to use horizontal turbine arrangements, which will bring a significant benefit regarding costs

and installation time and will also be of great advantage for subsequent maintenance.

This order shows again the strong presence of ANDRITZ HYDRO in Vietnam.

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TECHNICAL DATA

Output: 2 x 10.5 MW
Voltage: 6.6 kV
Head: 74 m
Speed: 478 rpm
Runner diameter: 1,600 mm

Italy Ponte Fiume

In November 2014, ANDRITZ HYDRO received an order from ENEL S.p.A. for the supply, erection, and commissioning of two vertical turbines substituting two old open flume Francis turbines for the Ponte Fiume hydropower plant.

The contract foresees the delivery of two double-regulated ECOBulb™ units with a runner diameter of 2,600 mm and a speed of 176 rpm.

Since it will be the first ECOBulb™ installation in Europe with permanent magnet generator and power factor compensation through power converters (Active Front End), this project represents a "new milestone" in our cooperation with this worldwide acting utility.

ANDRITZ HYDRO France will deliver the bulbs and stators while ANDRITZ HYDRO Italy will supply the distributor, draft tube, EPS, power converters, auxiliaries, erection, and project management.



The inauguration of unit #1 is scheduled for April 2016, unit #2 will follow one month later.

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TECHNICAL DATA

Output: 2 x 5 MVA
Voltage: 3.3 kV
Head: 15 m
Speed: 176.5 rpm
Runner diameter: 2,600 mm

Canada Chaudière Falls



ANDRITZ HYDRO was awarded a contract by Chaudière Hydro LP. (owned by Hydro Ottawa) for supplying the complete Water-to-wire equipment for one hydropower plant at Chaudière Falls in August 2014.

The Ottawa River has always played a key role in the development of Canada. Since the commissioning of the first

generating station at Chaudière Falls in 1891, the Ottawa River has become a major source of renewable electrical energy production with some 2,300 MW of hydropower capacity installed at 12 hydropower plants along its length.

Over the years, seven generating stations at the Chaudière Falls location have been built by different companies. Hydro Ottawa owned two of these hydropower stations. In 2012 the company acquired three more stations as well as the remaining undeveloped water rights.

Hydro Ottawa will now redevelop the site by decommissioning two of the three acquired hydropower stations and building a new low-profile, run-of-river power plant. The four turbines with a nominal capacity of 8 MW will be the most powerful ECOBulb™ turbines delivered to date by ANDRITZ HYDRO.

HPP Chaudière Falls is located within the city limits of Ottawa, the capital of Canada. The site itself presents many challenges. Construction must take place without disturbing power generation or traffic circulation in the vicinity. The new facility must also be aesthetically pleasing, complimenting the urban and historical nature of the site and be welcoming to the public.

Once complete, the 29 MW facility will produce enough clean energy to power 20,000 homes.

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TECHNICAL DATA

Output: 4 x 8 MW
Head: 10.1 m
Speed: 163.6 rpm
Runner diameter: 3,350 mm

Germany Illerstufen V–VII

ANDRITZ HYDRO Germany has received an order from Bayrische Elektrizitätswerke GmbH (BEW) for the electromechanical equipment for three hydropower stations on the Iller River.

The scope of supply consists of three Bevel Gear Bulb turbines, each with a runner diameter of 1,600 mm, synchronous generators and a large electrical package, including erection and commissioning.



BEW owns five run-of-river power stations along the Iller River, among these are the Illerstufe V (Fluhmühle), the Illerstufe VI (Legau) and the Illerstufe VII (Maria Steinbach). All these hydropower stations were built between 1938 and 1944 and are equipped with Straflo turbines – single regulated axial turbines with a fixed runner position and integrated generator pole shoes located on the outer rim of the runner blades.

Due to a change in the operation license, the decision was made to replace one of the existing Straflo turbines at each location with a double-regulated Bevel Gear Bulb turbine. The new turbines are able to work continuously under part-load conditions with good efficiency values.

The handover of the turbine equipment for the three locations is planned to take place in three stages, at the end of the years 2016, 2017 and 2018.

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TECHNICAL DATA

Illerstufe V – Fluhmühle:

Output: 1.07 MW
Voltage: 3.1 KV
Head: 8 m
Speed: 300 rpm
Runner diameter: 1,600 mm

Illerstufe VI – Legau:

Output: 1.17 MW
Voltage: 3.1 KV
Head: 8.65 m
Speed: 300 rpm
Runner diameter: 1,600 mm

Illerstufe VII – Maria Steinbach:

Output: 1.11 MW
Voltage: 3.1 KV
Head: 8.85 m
Speed: 300 rpm
Runner diameter: 1,600 mm

Peru 8 de Agosto and El Carmen

In 2014, ANDRITZ HYDRO France signed two contracts for COMPACT HYDRO projects in Peru.

The total EPC lot (Engineering, Procurement and Construction) is led by Sacyr, a collaboration between the Spanish companies Sacyr and Monte Alto. The contract was signed on the basis of a turbine equipment supply in consortium with the generator manufacturer.

Both hydropower plants are owned by the local company Generación Andina S.A.C, founded by Energie Baden-



Württemberg AG and Peruvian developer Andes Generating Corporation S.A.C. – and currently owned by Union Group.

HPP 8 de Agosto and HPP El Carmen are located in the district of Monzon, in the province of Huanuco, around 640 km north of the Peruvian capital Lima.

For HPP 8 de Agosto ANDRITZ HYDRO will deliver two generating units, including two 10.6 MW horizontal Francis turbines, main inlet butterfly valves (DN1400), hydraulic pressure units, and the cooling system. The scope of supply for HPP El Carmen consists of two generating units, including two 4.4 MW six-jet vertical Pelton turbines, main inlet butterfly valves (DN800), and hydraulic pressure units.

Both projects are expected to be in operation by the end of 2015.

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TECHNICAL DATA

El Carmen:

Output: 2 x 4.47 MW
Head: 228 m
Speed: 720 rpm
Runner diameter: 820 mm

8 de Agosto:

Output: 2 x 10.62 MW
Head: 128 m
Speed: 720 rpm
Runner diameter: 1,006 mm

Italy Groppello

ANDRITZ HYDRO has received a contract from ENECO for the supply, erection and commissioning of the complete Water-to-wire package for HPP Groppello in Italy.

The new Groppello hydropower plant is located in the province of Lombardia in northern Italy.

ANDRITZ HYDRO Grenoble, France is responsible for the turbine, the speed increaser, and the mechanical balance of plant.

ANDRITZ HYDRO Schio, Italy will supply the generator, the electrical power systems (EPS), and automation, as well as the SCADA system.



The realization of small hydropower projects in Italy is being enabled by renewable energy incentives supporting the mini-hydro market.

The commissioning of the complete electromechanical equipment at the Groppello small hydropower plant is scheduled for November 2015.

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TECHNICAL DATA

Output: 833 kW
Head: 4.35 m
Speed: 156 rpm
Runner diameter: 2,200 mm

Norway Døvikfoss

Toward the end of 2014, ANDRITZ HYDRO was awarded a contract by EB kraftproduksjon for the supply of a new Kaplan runner for the bulb turbine at HPP Døvikfoss.

HPP Døvikfoss is located in Buskerud County in southern Norway. It was originally commissioned in 1975. Initially no major rehabilitation work was planned, but due to a generator breakdown in February 2014 with an estimated outage time of about 1.5 years, the customer decided to upgrade the turbine in parallel with the generator repair work.

ANDRITZ HYDRO will supply rehabilitation work, reconstruction of the guide vane apparatus connection, the delivery of a new High Pressure Unit (HPU) for runner and guide vane control and a new cooling system, as well

as a high pressure water unit for gate control. The new runner will be water filled (glycol), reducing the risk of emission of oil into the river.

Manufacturing and assembly of the runner, the works on-site, and commissioning will be executed by ANDRITZ HYDRO Norway. ANDRITZ HYDRO Finland will perform the drawings and the calculations.

The HPP Døvikfoss project emphasizes the good relationship between ANDRITZ HYDRO and EB kraftproduksjon.

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TECHNICAL DATA

Output: 15 MW
Voltage: 4.8 kV
Head: 5.85 m
Speed: 75 rpm
Runner diameter: 6,400 mm

Austria Schönau

Following commissioning of unit #1 in March 2013, ANDRITZ HYDRO has now successfully put unit #2 at Schönau hydropower plant into commercial operation.

HPP Schönau is located on the Enns River on the border between the Austrian states of Styria and Upper Austria.

The contract for refurbishment of two generators was awarded to ANDRITZ HYDRO in December 2011 by Ennskraftwerke AG Austria. ANDRITZ HYDRO impressed the customer by offering the best technical and economic solution, especially regarding increasing generator efficiency.

The scope of supply included two complete new generator stators, complete new poles for the rotors, new axial rotor fans, new control equipment for the generator and powerhouse ventilation,

as well as air temperature regulation, erection, and commissioning.

The completion of HPP Schönau marks a further important milestone for ANDRITZ HYDRO in the Austrian hydropower market.

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TECHNICAL DATA

Output: 2 x 16.5 MVA
Voltage: 6.3 kV
Speed: 115.4 rpm



Canada Calabogie



ANDRITZ HYDRO won a contract for the supply of new equipment and the refurbishment of three sluiceway units at Calabogie hydropower plant in Canada.

HPP Calabogie, first put into service in 1917, is located 22 km south of Refrew, Ontario, on the Madawaska River. Currently the facility is operated by the Ottawa/St. Lawrence Plant Group within Ontario Power Generation (OPG).

The hydropower plant consists of two generating units. The sluiceway contains two different types of water control units – three units controlled with sluiceways and five units controlled by stop-logs.

ANDRITZ HYDRO will supply one set of sectional service gates, follower and storage rack for three sluiceway units, heated sluiceways, stair tower and electrical controls, as well as wiring (including a new 600 V supply and duct bank from the powerhouse to the dam). Furthermore, the scope comprises the blasting and painting of the hoist towers and the existing embedded parts and rebuilding of the hoists.

The 600 V supply duct bank was installed 2014. The remaining units will be delivered one each year between 2015 and 2017.

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TECHNICAL DATA

Scroll Case: Open Pit
Output: 2 x 2.2 MW / 2 x 2.5 MVA

Brazil Assis Chateaubriand (Mimoso)

ANDRITZ HYDRO signed a contract with Energy Pantanal Ltda., a subsidiary of EDP Energias Do Brazil S.A., to provide equipment and services for the maintenance and modernization of the Brazilian Assis Chateaubriand hydropower plant and its respective systems.

HPP Assis Chateaubriand, better known as Mimoso hydropower sta-



tion, is located on the Pardo River in the state of Mato Grosso do Sul, about 150 km from the state capital, Campo Grande.

The two existing Kaplan turbines were originally supplied by different manufacturers and work side by side at different heights, an unusual arrangement.

ANDRITZ HYDRO's scope of supply combines a new automation system, including voltage and speed regulation, and the spillway automation systems, as well as the auxiliary electrical system.

The first unit will be taken off the grid in June 2015 while the second unit is due to go back online in November 2016. During this period at least one machine will remain connected to the grid in order to maintain power generation. The project is planned to be completed in 2017.



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TECHNICAL DATA

Output: 20 MW / 23.5 MVA – 7 MW / 8.8 MVA
Voltage: 6.6 kV – 6.6 kV
Head: 23.5 m – 15.5 m
Speed: 163.6 rpm – 200 rpm
Runner diameter: 3,890 mm – 2,950 mm

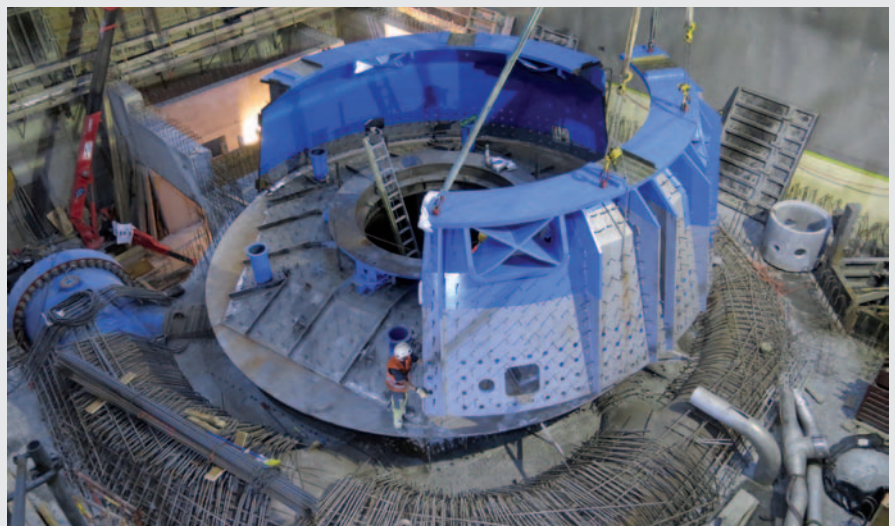
Switzerland Innertkirchen 1

In October 2014, the first project milestone at the Innertkirchen 1 hydropower plant was completed on schedule by concreting the turbine housing and the distributor pipe.

This follows an April 2013 order from KWO, Kraftwerke Oberhasli AG, for ANDRITZ HYDRO to install a six-jet Pelton turbine within the newly established underground cavern of HPP Innertkirchen 1.

ANDRITZ HYDRO Switzerland and Austria (Weiz and Vienna) are in charge of design, manufacturing, transport, installation and commissioning of the turbine, the generator, the brushless excitation system, the voltage regulator as well as the generator leads.

The generator will be pre-assembled at ANDRITZ HYDRO Weiz, Austria, by



May 2015. Until then, ANDRITZ HYDRO Switzerland will manufacture the turbine governor (hydraulic and electronic), the control system, the runner, and the intakes as well as some auxiliary components before the main installation starts in May 2015. After completion of the penstock by KWO, the Innertkirchen 1 hydropower plant will be fed by water from the Grimsel catchment area.

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TECHNICAL DATA

Output: 150 MW / 165 MVA
Voltage: 13 kV
Head: 664 m
Speed: 375 rpm
Runner diameter: 2,770 mm

DIA TECH

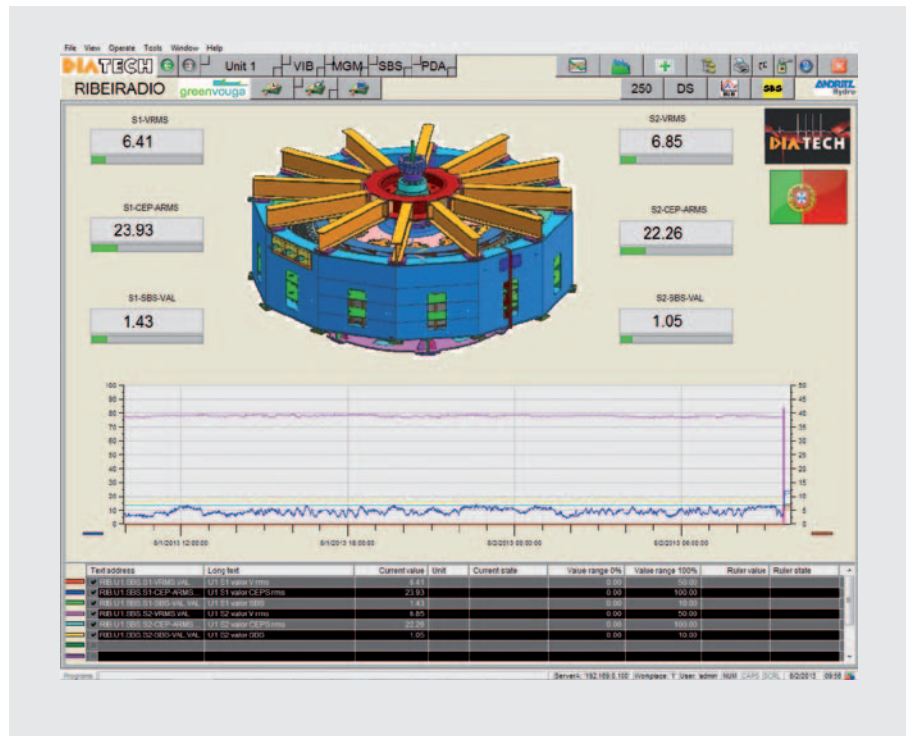
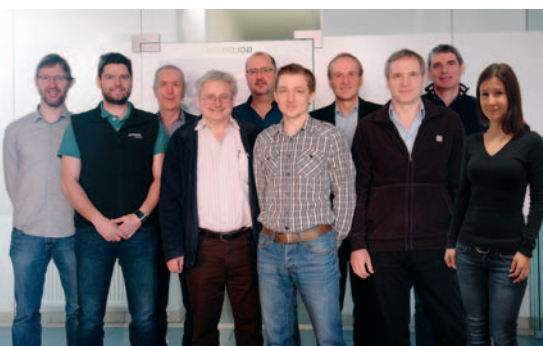
25 years of monitoring and diagnosis

The year 1990 marked the kick-off of the implementation of a globally unique idea: utilising software and computing power for the early diagnosis of possible problems in hydropower equipment.

Creating a proper diagnostic system required fast, freely programmable data collecting and processing systems, which were written and performance optimised by ANDRITZ HYDRO's software development specialists. Under the name "GEMO" was a state-of-the-art monitoring system built, which already included the initial stages of a smart "Vibration Diagnosis Module", a "Structure-Borne Sound Diagnosis Module", and a "Torsional Vibration Diagnosis Module". As the system turned out to be rather costly, the development of a new, Windows PC-based monitoring system under the name "DIA TECH" began.

The Data Management program is an essential component within the ANDRITZ HYDRO monitoring concept. It allows managing incoming (measured) and outgoing (calculated) data and distributing them to knowledge modules, database and visualisation software. The ability to integrate third-party systems and their measured data for central

Monitoring and diagnosis team in Weiz, Austria



□ New DIA TECH GUI based on SCALA 250 allows indication of a diversity of diagnosis information

data administration makes ANDRITZ HYDRO a global pioneer in this area.

Overall, the DIA TECH portfolio comprises an extensive range of products but ANDRITZ HYDRO has also the capacity to develop any required additional functions in-house as the need arises. For example, for HPP Goldisthal in Germany a completely new module for the air gap monitoring called "DIA TECH MGM" was developed, becoming a favourite to ANDRITZ HYDRO's customers. The monitoring product philosophy of ANDRITZ HYDRO allows to meet virtually any customer requirement.

The DIA TECH monitoring and diagnosis solution has been on the market for more than 15 years and is continuously being further developed. For instance, the popular DIA TECH SBS-Module (Structure-Borne Sound) was enhanced by in-

corporating the "CEPSTRUM" method. Three years ago, ANDRITZ HYDRO also initiated a complete reorganization of the data management program and the switchover to the in-house software product 250 SCALA has been completed.

Being able to diagnose emerging problems early, allows plant operators to take appropriate countermeasures, avoid severe damage, schedule repair downtimes for periods of 'low loss' and reduce waiting times for spare parts. All this translates into a considerable savings potential.

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NUMBER OF REFERENCES SINCE 1994:

Hydropower plants: 91

Units: 253

New generator activities

Successful integration of new employees in ANDRITZ HYDRO

In July 2014 the ANDRITZ HYDRO generator team was enhanced by 27 qualified employees – 25 in Switzerland and two in Austria.

Extending ANDRITZ HYDRO capabilities

In July 2014, the former hydro generator activities of ABB Switzerland were integrated into ANDRITZ HYDRO.

The new team within ANDRITZ HYDRO in Switzerland consists of experienced employees in the field of engineering, design, project management, quality, and sales. It supplies all kinds of service activities, including cleaning and inspections, repair, and the refurbishment and optimization of existing units up to new generating units. The big strength of the team is based on its engineering and design capabilities in reverse engineering, analysis and assessments, field measurements, and lifetime studies of hydropower plants. These engineering capabilities are set up so that no Original



□ Assessment of the unit

Equipment Manufacturer (OEM) drawing is required, which means absolute independency of the generator OEM.

With this approach, the Swiss team has successfully commissioned four large units in Switzerland and four units in Austria over the last two years. During these successful refurbishment projects the ambitious guaranteed values could be reached on all units.

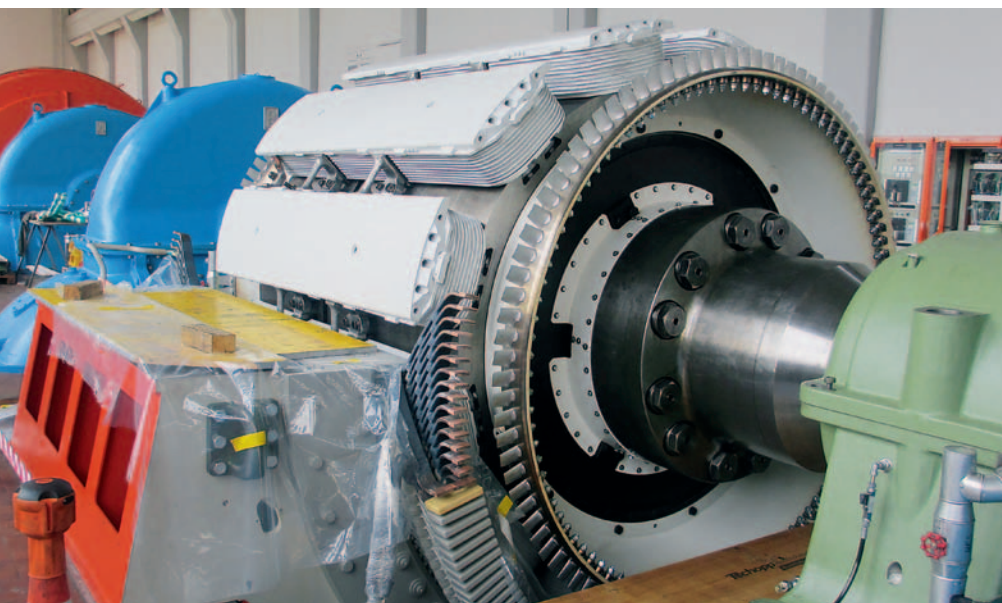
New development in refurbishment concepts

The new team within ANDRITZ HYDRO Switzerland supports customers to prepare refurbishment concepts based on their actual needs.

Today, with the hydropower market getting more and more competitive, it is essential to analyze units in detail to detect all components in need of refurbishment and thus be able to give profound support to the customer. For example, a stator can be refurbished by rewinding instead of replacing the complete stator, or the ventilation can be improved to achieve reduced losses and to supply more reactive power without the need of a large refurbishment job.

ANDRITZ HYDRO is investing in a challenging market environment to be able to supply the best possible services to our customers.

□ Installation of a renewed rotor



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□ Stator inspection



Customer Day

Hanoi, Vietnam

For many years ANDRITZ HYDRO has been very successful in Vietnam's renewable energy business. In October 2014, ANDRITZ HYDRO organized a Customer Day Vietnam in the capital city Hanoi for the second time.

More than 100 representatives from the hydropower industry, banks, and financial institutions as well as consulting firms participated. The Customer Day

was opened with a keynote speech from the Austrian Ambassador to Vietnam, H.E. Dr. Thomas Loidl. Dedicated paper presentations also underlined the wide range of the ANDRITZ HYDRO product and service portfolio.

Based on the very good experiences and feedback of the last two Customer Days in Vietnam, ANDRITZ HYDRO is eager to remain a leading supplier in Vietnam and the whole Indochina region.



Hydro 2014

Cernobbio, Italy

The HYDRO 2014 took place in Cernobbio, Italy, from October 13 – 15.

ANDRITZ HYDRO emphasized its position as a leading global supplier of electromechanical systems and services for hydropower plants with several technical presentations and a well visited booth.



Vienna Hydro

Vienna, Austria

In November 2014, the Austrian University of Technology organized the "International Seminar on Hydropower Plants" for the 18th time.

Under the general slogan of "Innovations and Development needs for sustainable Growth of Hydropower" ANDRITZ HYDRO participated with several technical presentations and a booth for the active exchange of experience and discussions between all participants.



REWA 2014

Kuala Lumpur, Malaysia

In September 2014, the Renewable Energy World Asia conference and exhibition took place in Kuala Lumpur, Malaysia and attracted more than 900 delegates and over 200 exhibitors.

ANDRITZ HYDRO participated with three technical paper presentations and an attractive booth.

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EVENTS:

HydroVision International
Booth 5041
14 – 17 July 2015
Portland, USA,
www.hydroevent.com

REWA 2015
Booth D50
01 – 03 September 2015
Bangkok, Thailand,
www.renewableenergyworld-asia.com

HYDRO 2015
Booth 58
26 – 28 October 2015
Bordeaux, France,
www.hydropower-dams.com

Renewable energy from tidal currents



ANDRITZ HYDRO Hammerfest develops the most energy-efficient, modular tidal turbine solutions capable of harnessing the energy in tidal currents. ANDRITZ HYDRO Hammerfest has successfully installed its self-developed HS1000 tidal current turbine in the waters of the European Marine Energy

Centre, Scotland. The HS1000 is based on the technology of the HS300, the world's first tidal current turbine connected to the grid. This plant provides the core technology for installation of the first commercial underwater energy arrays. **We focus on the best solution – from water to wire.**



HP:HN27.7.300.en.06.15