

HYDRO NEWS

No. 23 / 06-2013 • ENGLISH

MAGAZINE OF ANDRITZ HYDRO

PENSTOCK AND GATES

Top story (Page 05)

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Modernization of one of the largest hydropower plants in China (Page 16)

IOVSKAYA

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ANDRITZ
Hydro

Latest News

Key Figures 2012

Encouraging business development:

Order Intake: 2,008.4 MEUR

Order Backlog Dec. 31: 3,842.3 MEUR

Sales: 1,836.8 MEUR

Employees as of Dec. 31: 7,469

Laos



ANDRITZ HYDRO received an order from CH. Karnchang (Lao) Company Ltd. to supply the electromechanical equipment for the Xayaburi run-of-river hydropower station. ANDRITZ HYDRO will deliver seven 175 MW Kaplan turbines, an additional 68.8 MW Kaplan turbine, generators and governors, automation systems and additional equipment. Xayaburi will provide electricity for approximately one million households.

Laos has focused for years on expanding hydropower in order to improve the standard of living of its population (half of the population has no electricity supply), stimulate the country's economic growth, and reduce its dependence on fossil energy resources. Start-up is scheduled for the end of 2019.

Chile

Leading renewable energy company Pacific Hydro received the "Best Hydro Project of the Year" award for its Chacayes run-of-river hydro plant in Chile at the Renewable Energy Projects of the Year Awards in Orlando, USA. Pacific Hydro thanks ANDRITZ HYDRO for the effort made in the construction of the HPP.

The scope for ANDRITZ HYDRO included the delivery and installation



of the electromechanical equipment with two 59.9 MW Francis turbines, generators and auxiliary equipment.

El Salvador



A consortium of ANDRITZ HYDRO Inepar and Construtora Queiroz Galvão signed a contract with CEL (Comisión Ejecutiva Hidroeléctrica

do Río Lempa) in El Salvador for the expansion of HPP 5. de Noviembre. The scope includes the construction of a second power house and installation of two 40 MW Francis units. Originally, the power plant was inaugurated in 1954.

After modernization, HPP 5. de Noviembre will provide additional electrical energy for approximately others 110,000 households.

Austria

Grenzkraftwerke GmbH (Austria/Germany) signed a contract with ANDRITZ HYDRO for the rehabilitation of secondary equipment for 4 hydropower stations at river Inn and at HPP Jochenstein. The scope includes the renewal of the control and excitation system for 19 units as well as the replacement of electrical protection system for 3 hydropower plants. The project will be completed by the installation of 5 overall hydropower plant controller and a reservoir simulation system.

The hydropower plants have a total installed capacity of 476 MW and an annual energy production of 2,722 GWh. Project finish is planned for mid of 2017.

New Hydro News features

ANDRITZ HYDRO is launching some new features of the customer magazine "Hydro News". The new release is now available for iPads (see link). For additional content in this issue, like videos, please follow the QR-codes.

QR code to download the Hydro News mobile kiosk onto your iPad.





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Dear business friend

ANDRITZ HYDRO's advances in the global hydropower market continued uninterrupted in 2012 and are again reflected in the company's key performance indicators.

Over the last decade, ANDRITZ HYDRO has been able to more than double new orders, reaching levels that amounted to more than two years of revenue. The results were significantly improved through increasing efficiency and optimizing costs.

The continued expansion of volatile wind and solar energy, the need for energy storage, and the demand for use of locally available energy resources to generate power have all helped shift public opinion on sustainable and renewable electricity production using water. Hydropower is a stable and reliable component of the global energy market. This success is the result of competitive products and the use of the latest technology. ANDRITZ HYDRO is making a significant contribution on this front with its more than 7,000 highly qualified and motivated employees. All divisions within ANDRITZ HYDRO in all regions

of the world were able to report similar successes. Special highlights in 2012 included:

We won a number of project contracts in Europe, which is traditionally a fiercely contested market: Cliff & Ardncrusha in Ireland, Ybbs and Kaunertal in Austria, Vrutok in Macedonia, Çetin and Beyhan-1 in Turkey, as well as a number of smaller orders for modernization and renewal. The small-scale hydroelectric power division was also able to expand its market position, e.g. with eleven smaller hydropower orders in Turkey. The successful conclusion of the new power plant project in Gösendorf (Austria) and the opening of the world's largest matrix power plant in Ashta (Albania) were important milestones.

One of the most exciting markets with significant potential for the future is Africa. New projects, such as Assiut in Egypt, Inga 2 in the Democratic Republic of Congo, Palmiet in South Africa and various small-scale orders provide impressive proof of this potential. One important project milestone was the successful handover to customers of the first unit for Kindaruma

in Kenya. ANDRITZ HYDRO experienced positive growth in both new construction and modernization projects in the North and South American markets. New construction at Muskrat Falls in Canada and generator rehabilitation for the Lewiston power plant in the USA are the most important orders in North America. South American highlights include orders for Cerro del Aguila in Peru and Carlos Lleras in Colombia.

In the highly competitive Asian hydropower market, new orders for the Upper Tamakoshi in Nepal, Baglihar 2 in India, and Thuong Kon Tum in Vietnam demonstrate the advantages of a strong local presence. Larona in Indonesia was also successfully completed and handed over to customers.

Ongoing further development of our technologies, motivated employees, and local presence are important pillars at ANDRITZ HYDRO. We are confident that we are exceptionally well-prepared for the coming years thanks to the generous trust our customers continue to place in us.

Sincerely yours,

M. Komböck

W. Semper

H. Heber

Penstock and gates

Experience and spirit of innovation – a winning combination

ANDRITZ HYDRO's center of competence for penstocks and gates is located in Linz, Austria. ANDRITZ HYDRO has equipped over 800 hydropower plants in more than 79 countries with penstock and gates.

Our design for hydraulic steel structures combines state-of-the-art technology with top quality. Throughout the world, barrages, spillways, bottom outlets, intake structures and navigation locks are built with our know-how and guaranteed safe and reliable operation.

† Penstock HPP Tarbela Dam, Pakistan

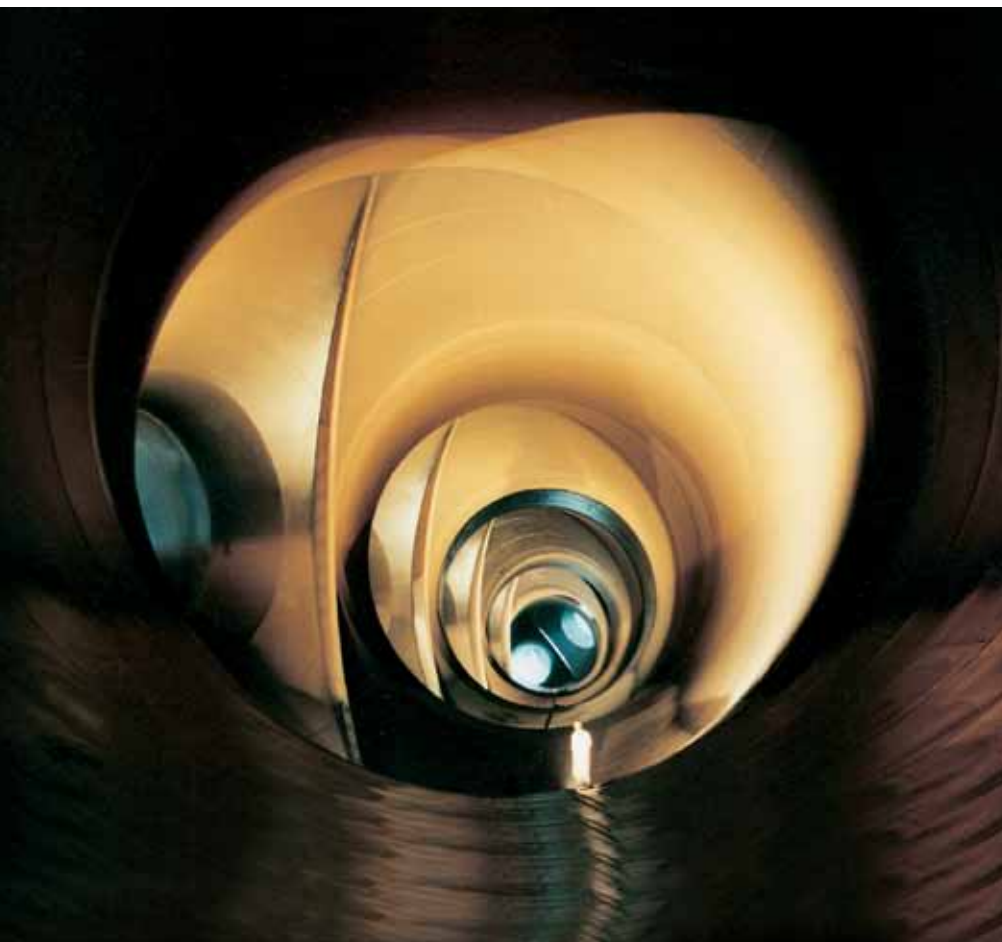
ANDRITZ HYDRO is the legal successor of VOEST ALPINE, VA TECH HYDRO, SULZER ESCHER WYSS / SULZER HYDRO and ACMV / HYDRO VEVEY for penstock and gates. Decades of knowledge and experience gained by these companies is now represented by ANDRITZ HYDRO. At present an increasing number of energy suppliers are requesting turnkey projects. ANDRITZ HYDRO's philosophy "From water to wire" shows that we provide the necessary competence over the entire product portfolio.

Penstock

ANDRITZ HYDRO is an industry leader in designing and constructing manifolds and bifurcations. Alongside optimization of hydraulic conditions, choosing suitable materials is of major importance in penstock construction. Our customers benefit from more than 60 years of expertise and know-how in the production and processing of high-strength steel, using state-of-the-art thermo-mechanically rolled, as well as quenched and tempered steels. We offer our customers tailor-made solutions for their construction purposes. ANDRITZ HYDRO's long-standing experience in the treatment of these materials, combined with continuous training for our welding staff, guarantee our customers' maximum safety in operating their facilities.

In penstock construction ANDRITZ HYDRO uses its strengths in engineering and project management to full effect. As more and more penstocks are manufactured directly on site, professional management under the supervision of ANDRITZ HYDRO's specialists is in ever-growing demand.

Over 315,000 tons of penstocks have been fabricated and installed by ANDRITZ HYDRO, and approximately 50% of them were fabricated directly on site. So far, 37 contracts have been successfully completed using this technology, all under challenging climate and terrain conditions. The largest project in terms of volume was the Mingtan Pumped Storage Power Station in



Taiwan, involving 26,000 tons of steel conduits and penstocks.

Actually in execution with on-site fabrication is HPP Ilisu in Turkey. It involves about 6,630 tons of penstocks with a diameter of 10 m and three bifurcations. The field workshop will also be used for the fabrication of draft tubes and spiral cases, as well as for draft tube and spiral case fabrication for other Turkish projects like HPP's Tatar, Pembelik and Beyhan-1.



s Field workshop at HPP Ilisu, Turkey

Gates

Dams for hydropower applications must meet extremely stringent safety requirements. ANDRITZ HYDRO supplies spillway gates, intake and outlet equipment, and bottom outlet and diversion gates, all fully conforming to these regulations.

ANDRITZ HYDRO's product range includes components for run-of-river plants, such as radial gates with and without flap, double hook gates, intake trash racks, trash rack cleaning machines, stop logs and draft tube gates as well as gates for the navigation locks.

ANDRITZ HYDRO's ability to execute even the most challenging and demanding orders is well known. Numerous international orders have cemented ANDRITZ HYDRO's reputation as a first-class manufacturer of high-head gates. Our references in this field include equipment designed for operating



s Spillway gates at HPP Caruachi, Venezuela

heads of more than 190 mWC (meter Water Colum). These gates are equipped with either hydraulic (servomotors) or mechanical hoisting devices. Automated circuits and remote-control systems ensure safe handling and cost efficient operation by keeping operational and personnel costs to a minimum.

In current execution are the Roller Gates of HPP Nant de Drance, Switzerland (Hydro News 20) with a width of 4,250 mm, height of 6,500 mm and design head of 154 mWC. Installation will start next year. For the gate housing we use thermo-mechanically rolled

steels with a yield strength of 700 N/mm² to reduce weight and installation time. Due to the material used, the huge dimensions and the load, these gates are located on the "high end side" of hydraulic steel structures.

In line with customer requirements, we are also designing and providing the cranes necessary to move our hydraulic steel structures. In execution are engineering, supply and installation of the hydro-mechanical equipment for the New Assiut Barrage, a run-of-river plant in Egypt, with a total weight of about 3,700 tons. Installation will commence in July of this year.

t Installation of double hook gate at HPP Wallsee Mitterkirchen, Austria





s Welding

R&D - the driving force

ANDRITZ HYDRO continuously invests in research and development, the essential ingredient for success in the competitive global marketplace and what makes our technology internationally renowned.

Hydraulic studies and model tests

The main criterion for bifurcations is optimum flow behavior. To achieve this, model tests are being performed in our own research labs as well as in co-operation with leading universities. The result is an optimum hydraulic shape. Numerous model studies on high-head and draft tube gates helped us gain new insights into their hydrodynamic behavior, enabling our designers to enhance their operational safety.

t Bifurcator model test at HPP Pirris, Costa Rica



Optimized manufacturing technologies

The highest-quality welding technique is essential in penstock construction. Welding of steels with a yield point of up to 700 MPa is not a problem for ANDRITZ HYDRO and can be achieved even under the most difficult tunnel and climatic conditions. The technology of WIG hot wire welding for large penstocks was developed in our own welding laboratories and was used for the first time in Goldisthal in 2000.

HPP Kaunertal, Austria (Hydro News 22), with an inclined pressure shaft of 1,460 m, is the next step in terms of highest welding quality.

ANDRITZ HYDRO will execute the field welds of the thermo-mechanically rolled steel grades S580/820M and S620 QL1, in total about 9,500 tons, with WIG-Hot Wire "Engspalt" (narrow-gap weld) technology. The installation of the pressure shaft will begin mid-year. Continuous development in order to lead the field has always been our top priority at ANDRITZ HYDRO. As expected, our products are subject to the most stringent international quality standards.

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t Intake gate model test at HPP Tsankov Kamak, Bulgaria



Muskrat Falls

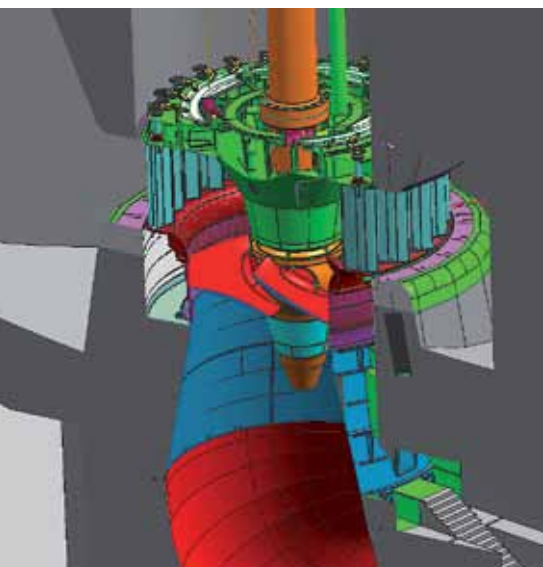
One of the world's largest Kaplan turbines is built in Canada

ⓘ Schematic drawing

On 2 January 2013, Nalcor Energy awarded a contract to ANDRITZ HYDRO for design, supply and installation of four Kaplan turbines and generators for the Muskrat Falls Project. Muskrat Falls is located on the lower Churchill River, approximately 35 km from Happy Valley-Goose Bay, Labrador in the Province of Newfoundland and Labrador, Canada.

Labrador's Churchill River is a significant source of renewable, clean electrical energy. There are three major sites identified for hydroelectric generating stations with the first, Churchill Falls (5,428 MW), in operation since 1971.

ⓘ Schematic drawing of turbine



Muskrat Falls will be the second site developed, adding 824 MW, and the third, Gull Island, is proposed for future development with an additional 2,250 MW of generating capacity. The power produced at the Muskrat Falls Hydroelectric Generating Facility will replace the production capacity of the Holyrood Thermal Generating Station on the island of Newfoundland, which will be shut down and eventually decommissioned. A good portion of the power will also be exported outside the province via subsea cables between Newfoundland and Nova Scotia. Power will also be on hand in Newfoundland and Labrador for industrial development.

SNC-Lavalin is the engineering, procurement and construction management (EPCM) consultant for the Muskrat Falls Hydroelectric Generating Facility and the Labrador-Island Transmission Link.

ANDRITZ HYDRO's scope of supply includes Kaplan turbines, generators, governors, static excitation systems and the complete monitoring, protection and control system. These turbines will be among the largest and most powerful Kaplan turbines in the world. ANDRITZ

HYDRO was awarded this contract after an extensive and detailed RFP process which included the complete hydraulic design and model testing (via our Lachine, Canada model test facility), including witnessing of the results.

All units are scheduled to be in service by 2017.

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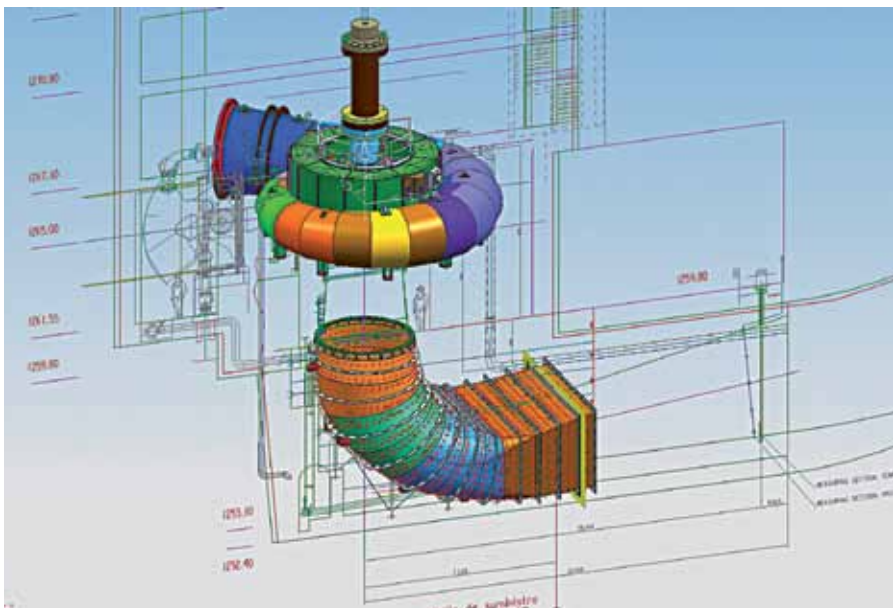
TECHNICAL DATA

Output: 209 MW / 229 MVA
Voltage: 15.0 kV
Head: 32.3 - 37.5 m
Speed: 85.7 rpm
Runner diameter: 8,800 mm



Cerro del Aguila

Largest HPP under construction in Peru



Schematic drawing

In February 2012, ANDRITZ HYDRO signed a contract with Consorcio Cerro del Aguila SA for the turn-key supply of engineering, manufacturing, delivery and erection of the complete electromechanical equipment for the new 514 MW HPP Cerro del Aguila in Peru.

The hydropower plant is located in the districts of Surcumbamba and Colcambamba, department of Huancavelica. It is owned by Kallpa Generacion SA (the majority shareholder of Kallpa Generacion is INKIA Energy, a company originating in Israel). Kallpa Generacion SA implemented a new strategy to increase its share in Peru's electricity generation by building hydropower plants. As a first project they are developing the potential presented by the Rio Mantaro, about

20 km downstream of the Restitucion power plant. HPP Cerro del Aguila will be equipped with three vertical Francis units. Consorcio Cerro del Aguila SA will design, manufacture, commission and test the hydropower plant.

ANDRITZ HYDRO won the contract over well-known international competitors, ranking highest on criteria including technical solutions, evaluated prices, time schedule, evaluation of suppliers and key persons. The project will be realized in close cooperation among several ANDRITZ HYDRO companies worldwide.

As a first contractual obligation, ANDRITZ HYDRO successfully performed the model test in July 2012 in Linz, Austria. The test was witnessed

by delegates from the Consortium Cerro del Aguila and Kallpa.

The largest developed hydropower potential in Peru is along Rio Mantaro with the HPPs Santiago Antunez de Mayolo (819 MW), Restitucion (223 MW), Malpaso (54 MW) and several additional small hydropower plants.

Downstream the HPP Santiago Antunez de Mayolo and HPP Restitucion, the new HPP Cerro del Aguila (also known as Mantaro 3) represents the third step of the Rio Mantaro major cascade development.

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TECHNICAL DATA

Output: 3 x 171.3 MW / 201.3 MVA

Voltage: 13.8 kV

Head: 265.1 m

Speed: 300 rpm

Runner diameter: 2,620 mm

Stator diameter: 7,800 mm

Butterfly valve diameter: 3 x 3.15 m





s Ardnacrusha during pre-design inspection



Intake HPP Cliff



s Contract signing of HPP Cliff & Ardnacrusha

Cliff & Ardnacrusha

Important refurbishment project in Ireland

In August 2012 ANDRITZ HYDRO signed its first contract with the Electricity Supply Board (ESB), Ireland's premier electrical utility, for modernization of the electro-mechanical equipment for the Ardnacrusha and Cliff hydropower plants.

HPP Cliff is the upper station of the Erne stations hydropower scheme, located in the northwest of Ireland near the town of Ballyshannon. It consists of two 10 MW Kaplan units. ESB brought it into service in the 1950s and today it supplies electrical energy for over 12,000 households. The scope of supply includes rehabilitation of both (unit 1 and 2) 10 MW Kaplan turbines and installing new turbine governors. For the two 12.5 MVA generators, ANDRITZ HYDRO will replace the stator core and stator winding, refurbish the generator poles and supply new excitation systems including the voltage regulators.

HPP Ardnacrusha is the largest run-of-river hydropower scheme in Ireland, located north of the well-known town Limerick. It was first commissioned in 1929/1934. In the early years its 85 MW

were adequate to meet the electricity demand of the entire country. Today, the plant's full output equates to about 332 GWh per year. The plant includes fish ladders so that fish such as salmon can climb the river and safely pass the power station. The scope of supply of unit 3 comprises rehabilitation of a 22 MW Francis turbine, new generator stator core, new generator winding, generator pole refurbishment and a new excitation system.

The mechanical scope will be jointly delivered together with our Alliance partner, Scotland's Weir Engineering Services. WEIR is responsible for refurbishment of the mechanical equipment, the Francis turbine refurbishments at HPP Ardnacrusha, general site management, site infrastructure, Health & Safety and installation works at both sides. This project is ANDRITZ HYDRO's first essential order for the refurbishment of hydropower plants in decades in Ireland. With this contract ANDRITZ HYDRO underlines its readiness to support Ireland in the modernization and extension of electricity generation from renewable sources. The overall program will be a challenge for the project team, with HPP

Cliff unit 2 and HPP Ardnacrusha unit 3 being refurbished in 2013/2014 at the same time, followed by HPP Cliff unit 1 in 2014/2015.

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TECHNICAL DATA

HPP Cliff:

Output: 2 x 12.5 MVA

Voltage: 10.5 kV

Speed: 115 rpm

HPP Ardnacrusha:

Output: 30 MVA

Head: 28.5 m

Speed: 150 rpm





Outside view of HPP Ybbs-Persenbeug

Following a successful project for Aschach power plant (2006 to 2010), ANDRITZ HYDRO Austria is now modernizing Ybbs-Persenbeug power station, providing additional hydroelectric power for 17,000 households.

Rising energy demand across the globe is also making itself felt in Austria. As a result, we must cover this demand and, at the same time, comply with climate and environmental protection requirements. Numerous Austrian hydropower plants in need of automation and modernization as a result of progressive aging and more dynamic operating conditions offer substantial potential. Efficiency and performance can be enhanced considerably through new methods in hydraulic and electrical engineering, improved materials and manufacturing techniques, and digital control systems.

The Ybbs-Persenbeug run-of-river power plant, the oldest power plant on the

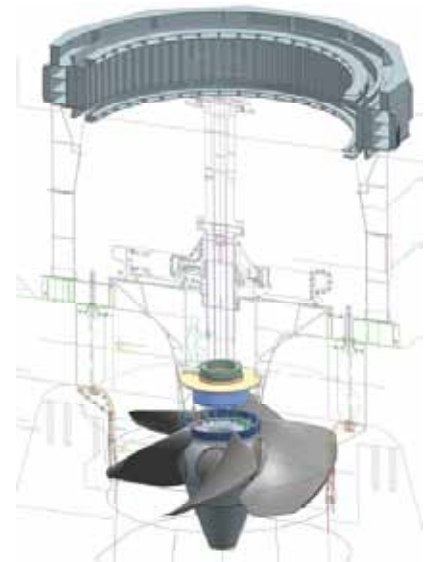
Plant modernization HPP Aschach, Austria



Austrian stretch of the Danube, was commissioned in 1959. The six units (three in the north and three in the south power plant) were extended in the 1990s by adding a seventh. ANDRITZ HYDRO modernized the Aschach power plant on the Danube between 2006 and 2010. With the Ybbs 2020 project, ANDRITZ HYDRO continues refurbishment of the Danube power plants in cooperation with VERBUND.

In an interview with the Austrian state broadcasting corporation, the project manager of VERBUND explains the details of "Ybbs 2020". Enhanced efficiency is still worthwhile, although the improvements may appear slight on paper. But they add up, from the winding of new generators to the use of harder-wearing steel alloys. An increase in efficiency of 4.5% means additional power for 17,000 households. This is equivalent to the annual requirement for the district capital, Amstetten, or the output of a power plant on the River Mur.

Important criteria in awarding the contract to ANDRITZ HYDRO were the excellent performance of the components offered, the highly successful Aschach power station revitalization project with a refurbishment time of only six months per unit, supply of the turbines and generators from a single supplier, and the extensive manufacturing facilities and engineering capacities available. These are what makes it possible to meet our customers' demanding requirements.



Design drawing of the Kaplan turbine



Machinehall HPP Ybbs-Persenbeug

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TECHNICAL DATA

Output: 5 x 35.4 MW; 1 x 36.7 MW

Head: 10.6 m

Speed: 68.2 rpm

Runner diameter: 7,400 mm



Thuong Kon Tum



Reinforcing our leading position in Vietnam

In 2012 ANDRITZ HYDRO signed a contract for the electromechanical works for one of the most prestigious hydropower projects in Vietnam, the 220 MW HPP Thuong Kon Tum. The project is being developed by Vinh Son – Song Hinh Power Joint Stock Company (VSSH), Quy Nhon, an affiliate of the largest Vietnamese electrical utility, Vietnam Electricity (EVN).

HPP Thuong Kon Tum is located at the border between Laos and Vietnam, near the city of Kon Tum. After completion this hydropower plant will generate about 998 million KWh per year. The project is scheduled for 28 months and the schedule for completion is 34 months.

Contract signing ceremony

The scope of supply for this project includes:

- 2 high head Pelton turbines (879 m) including electronic speed governors
- 2 spherical inlet valves
- 2 generators with static excitation systems
- digital protection systems for the plant, computerized supervisory and control (SCADA) systems, single-phase 220kV power transformers, 220 kV XLPE power cable and other electrical power system equipment and mechanical auxiliary systems.

VSSH is responsible for local transport via the Quy Nhon harbor, and for installation of the equipment. ANDRITZ HYDRO will supervise the installation

and provide commissioning services. The project followed international tender procedures, and all major global electromechanical equipment manufacturers participated. VSSH evaluated ANDRITZ HYDRO's bid as technologically best.

ANDRITZ HYDRO has been very successful in Vietnam's renewable energy business for many years. For HPP Xekaman 3 at the Laos-Vietnamese border region and HPP Song Hinh, ANDRITZ HYDRO delivered the complete electromechanical equipment.

HPP Song Hinh is running to the client's utmost satisfaction, and that trust has led to the new order. ANDRITZ HYDRO received the Letter of Acceptance on 7 August 2012. VSSH signed the contract with ANDRITZ HYDRO on 15 August 2012.

This contract once again reinforces ANDRITZ HYDRO's leading position in high head Pelton turbine technology.

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TECHNICAL DATA

Output: 2 x 112 MW / 2 x 129.41 MVA
Voltage: 13.8 KV
Head: 879 m
Speed: 600 rpm
Runner diameter: 2,060 mm



Komani

Success in Albanian rehabilitation project



◦ Komani lake

On 3 July 2012 Albanian utility **KESH** signed a contract with **ANDRITZ HYDRO** for the rehabilitation of HPP Komani.

The World Bank financed and regulated the procurement procedure initiated in August 2011. The full-scale rehabilitation ranges from the turbines to transformers. The tender requirements were open to worldwide sourcing, and contained many critical technical requirements and a challenging schedule.

Powerhouse



HPP Komani has an installed capacity of 624 MW. It is the largest hydropower plant in Albania, followed by HPP Fierza with 500 MW. Its annual energy production of approximately 1,700 GWh delivers 20% of Albania's total electricity consumption. Therefore the timing of the project and the reliability of the potential supplier were some of the most important criteria in the competitive bidding process for the rehabilitation of HPP Komani.

ANDRITZ HYDRO has proven its abilities to handle such critical requirements before, as in the rehabilitation of HPP's Fierza, Vau I Dejes, Ulzah and Shkopeti. These local references, which list nearly all of KESH's assets, and a detailed and competitive bid convinced the customer and the World Bank to sign the contract with ANDRITZ HYDRO.

The project management team from ANDRITZ HYDRO Vienna, Austria, will coordinate and handle deliveries and engineering services supplied from various ANDRITZ HYDRO locations, such as turbines and auxiliaries from Vevey, Switzerland; generators from Weiz, Austria and a complete new system from Vienna, Austria. The project is scheduled to be finished in 42 months, starting with commencement

on 17 December 2013. This is a giant step which will strengthen our market position in Albania.



◦ Contract signing

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TECHNICAL DATA

Output: 4 x 156 MW
Head: 96 m
Speed: 158 rpm
Runner diameter: 4,300 mm



Cachoeira Dourada

A South American cooperation project

5 Outside view of HPP Cachoeira Dourada

In January 2012 ANDRITZ HYDRO Inepar, Brazil, led by Austria and in cooperation with Chile, Colombia and Peru, was awarded the modernization of HPP Cachoeira Dourada by ENDESA. These 3 Brazilian units are only a part of the successful interaction between different units within ANDRITZ HYDRO.

The name Cachoeira Dourada (Gold Waterfall) represents the fog which covers the waterfalls at sunset and turns the water to gold. The plant is located in the heart of Brazil, on the Paraíba River between the states of Minas Gerais and Goiás.

HPP Cachoeira Dourada was built from 1958 until 1994 in 4 different steps, including 10 units in total. The project started with two 17 MW vertical Kaplan turbines, which were enough in those times. In 1964 it was expanded by 3 more 54 MW vertical Kaplan turbines.

After the construction of another hydropower plant downstream, it was possible to install three more 84 MW Francis turbines and two more 105 MW vertical Kaplan turbines. HPP Cachoeira Dourada is equipped with units from different suppliers, power and type, with a total installed capacity of 658 MW, and still has space for further extension.

In order to mitigate low reliability of the main isolation, units 6, 7 and 8 will be equipped with new windings and cores. In unit 1 a new stator is initially planned to be refurbished and used for other units. The generator, with a stator diameter of 10,700 mm, will receive 504 new coils between 2012 and 2014. The project is scheduled to be finalized in 2015. 22 units will be modernized by Endesa over the next 5 years.

This long-term project will strengthen the relationship between ANDRITZ

HYDRO and the South American market.

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TECHNICAL DATA

Unit 6, 7 and 8:

Output: 3 x 93 MVA

Voltage: 13.8 kV

Speed: 81.81 rpm

Stator diameter: 10,700 mm



Tinizong

Important rehabilitation in Switzerland

ANDRITZ HYDRO received an order from Elektrizitätswerk der Stadt Zürich (ewz) for the modernization of three machine groups in HPP Tinizong. Ewz is one of the largest energy service companies in Switzerland. Since 1892 it supplies the city of Zurich and parts of the Canton Graubünden with electricity.

The Tinizong hydropower plant was built about 60 years ago and is ewz's most powerful and important hydropower plant in Mittelbuenden, Switzerland. A large part of the electromechanical equipment has been operating since the power plant's commissioning. Now the time for modernization has come, and the project is planned to be finished in late 2014.

HPP Tinizong is filled with three horizontal machine groups. Machine groups 1 & 2 are identical and consist of two flying-mounted, single-Jet Pelton turbines with centrally located synchronous generators. In connection with the construction of the Nandro supply and of HPP Tiefencastel East, the Tinizong powerhouse was extend-

ed between 1968 and 1971 with an additional horizontal machine group. Unit 3 consists of a synchronous generator with one Pelton turbine. ANDRITZ HYDRO was contracted to evaluate all turbines with respect to their potential for optimization. The study is based on a proven 3-phase approach: Analysis - Diagnosis - Therapy. It was essential that ewz was deeply involved in all respects in order to capture the operating conditions as far as possible and to develop specific customer-related solutions. The more detailed the analysis of the operating conditions, the more effective plant-specific improvements will be.

Within this potential study, various methods for optimization with regards to efficiency and performance increases were worked out by ANDRITZ HYDRO.

The customer decided to replace the inlets with deflectors, the digital and hydraulic turbine governors, to modify the turbine housing and to replace the spherical valve control system. This option fully addresses the main goal of the renewal, which is to reduce operat-

ing costs at maximum availability of the machine groups and to ensure safe operation of the turbines at all times. With this solution, a further performance increase will result in heightened efficiency of approximately 1%. The runners, including coupling elements and their drainage, were already replaced for all turbines.

Refurbishment work on the first two units is scheduled to start at the end of August 2013 and will be finished in March 2014. The whole modernization work is planned for completion in September 2014.

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TECHNICAL DATA

Unit 1 and 2:

Output: 2 x 28.50 MW

Head: 472 m

Speed: 333.3 rpm

Runner diameter: 2,450 mm

Unit 3:

Output: 17,50 MW

Head: 472 m

Speed: 333.3 rpm

Runner diameter: 2,380 mm

Machine hall



Er Tan

Modernization of one of China's largest hydropower plants

s Downstream dam view

In November 2012, ANDRITZ HYDRO received an order from YALONG RIVER HYDROPOWER DEVELOPMENT COMPANY LTD. for the upgrade of the computer supervisory & control system of HPP Er Tan in Sichuan province, China.

HPP Er Tan is located at the lower stream of the Yalong River, one of the main branches of the YangTse, China's largest river and the third largest river in the world.

As the biggest hydropower plant in China before 3-Gorges, HPP Er Tan is equipped with 6 units (550 MW turbine/generator set each), and has been in operation since the year 2000. The old control system processes huge amounts of hardwired IO's (8,000 digital

inputs, 2,000 digital outputs, 2,500 analog inputs and 250 analog outputs). Due to a shortage of spare parts, as well as the outdated technology, the customer decided to upgrade the old system with the most advanced automation system. After a serious bidding process and market investigation by the customer, ANDRITZ HYDRO China convinced the customer in the end with the best technical proposal and the excellent reputation of our products and services.

The contract's scope includes dismantling of the old system, design/engineering, installation and commissioning of the new system. The solution consists of a redundant SCADA system at two geographic locations and 13 distributed local control units (6 x unit control, 2 common auxiliaries control, 1 x 500 kV switchyard control,

1 x dam control, 1 x mimic board control, 1 x second power house common auxiliaries control and 1 x intake gate control). The HPP Er Tan order is important for ANDRITZ HYDRO in order to secure our future market position, both domestic and international.

Chen Zang

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TECHNICAL DATA

| |
|-------------------------------|
| SCADA: 1 (redundant) |
| Output: 6 x 550 MW |
| Common auxiliaries control: 2 |
| Switchyard control: 500 kV |

t Powerhouse



Ruacana

New hydraulic design for units 1, 2 and 3 in Namibia

ANDRITZ HYDRO was recently awarded a refurbishment contract for model testing, supply of three Francis runners and installation supervision at HPP Ruacana, Namibia.

HPP Ruacana is situated in the North-Western part of Namibia on the Kunene River, which represents the border between Angola and Namibia. The underground power station is equipped with three 82 MW and one 92 MW Francis turbines. This is the second major order NamPower has awarded to ANDRITZ HYDRO in the recent past. Contributing factors were the successful installation of unit 4 in HPP Ruacana (2011/2012) and the fact that ANDRITZ HYDRO is the OEM (original equipment manufacturer) of unit 1–3, commissioned in 1977. ANDRITZ HYDRO will also be in charge of the supply of three Francis runner prototypes including supervision of the installation works. Unit 1–3 had a historical vibration problem during part load. The source of the problem was the whirl motion of the vortex and draft tube pressure pulsation. It was also asked during tendering whether the replaced runner would be exposed to a vibration problem without a forced aeration system. Therefore it was decided to perform a fully homologous model test using original model parts from the first tests before



Ruacana Falls, Namibia

commencing with the manufacturing of the prototype runners. Model tests were carried out on the existing and new hydraulic designs at the hydraulic laboratory in Linz, Austria.

Another reason for conducting model tests was to ensure that the new design would improve the hydraulic behavior and increase efficiency across the entire operating range, as well as to confirm the potential to increase the power output from 82 MW to 87 MW per unit. Several different design options were developed together with the client to achieve their best investment returns. In the end, the most attractive option was the new hydraulic profile

with a reduced runner outlet diameter. The award of this contract is a success for ANDRITZ HYDRO and will support Namibia in its endeavor to meet its energy goals.

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TECHNICAL DATA

| |
|---------------------------|
| Output: 87 MW |
| Head: 134 m |
| Speed: 230.8 rpm |
| Runner diameter: 2,840 mm |

t Underground powerhouse



t Hydraulic laboratory in Linz, Austria





Iovskaya

Successful rehabilitation project in Russia

Old machinehall

On 26 July 2011 ANDRITZ HYDRO Russia signed a contract with Kolsky Branch of JSC TGK1 (Territorial'naya generiruyushchaya kompaniya No 1) for supply, installation and commissioning of two Kaplan turbine runners, double regulated with seven runner blades.

HPP Iovskaya is located on the Iova reservoir. It is the first hydropower plant of the Kovdinsky Cascade and was commissioned in 1960. The reservoir

covers an area of 5,240 km². It is being fed by the Kowda, a river in the south of the Kola Peninsula in Murmansk Oblast, Russia, close to the border with Finland.

The runner diameter of the new turbine was increased (from 4,500 mm to 4,600 mm) to improve cavitation behavior and turbine output. Furthermore, the contract included modernization of the turbine governors, a new generator stator winding, excitation, protection and a complete automation system.

This successful project strengthens ANDRITZ HYDRO's position in Russia.

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TECHNICAL DATA

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

Assembly of turbine blade



The challenge of this project may be seen in the complexity of the rehabilitation works, wherein ANDRITZ HYDRO executed the responsibility of a general contractor on a "turn-key" basis. It required a lot of coordination work between the customer, the design institute, the installation company and all involved ANDRITZ HYDRO locations. The remote location of this power station in a yearlong harsh and biting climate is also a very special task.



La Yesca

Two large fixed cone valves for Mexico

La Yesca, the new hydropower plant on the Santiago River in the state of Nayarit, Mexico, was inaugurated in November 2012.

ANDRITZ HYDRO Mexico designed, manufactured and installed the new equipment in close cooperation with the Mexican customer Comision Federal de Electricidad (CFE). These valves represent an ANDRITZ HYDRO record in size (DN = 2,500 mm).

In June 2010 the contract was awarded to ANDRITZ HYDRO Mexico including upstream bifurcation, two shut-off valves and two fixed cone valves, for maintenance purposes. The contract included control of the complete system. A typical fixed cone valve is used to discharge water at high pressure from the reservoir into the atmosphere. In this specific case the valves were installed in a tunnel, which required an additional dissipation chamber to avoid damage to the tunnel walls from the impact of the water. The valves were designed to dissipate huge amounts of energy without cavitation and vibration.

† Successful manual operation of the valves



‡ Divergent flow valve



‡ Bifurcation site supervision erection

Through flow simulations and with the contribution of the customer's hydraulic laboratory, a hydraulically optimized profile of the dissipation chamber was developed, also taking into account the forces transferred to the foundation and the aeration requirements at opening. The valve body is a tube with a centric cone and welded in the end with five vanes. Another tube slides over the body to regulate the water flow until it contacts the seat of the cone, when the valve is fully closed. Close cooperation between ANDRITZ HYDRO and CFE made this project another success story.

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TECHNICAL DATA

Bifurcation

Pieces: 1

Inlet diameter: 5,000 mm

Outlet diameter: 2,500 mm

Max design flow: 360 m³/s

Shut-off Valve: Butterfly valve (biplane disc)

Units: 2

Seals: 2 (1 operation, 1 maintenance seal)

Diameter: 2,500 mm

Design Head: 146.6 m

Bottom-Outlet Valve: Fixed cone valve

Units: 2

Diameter: 2,500 mm

Design head: 146.6 m



Wuskwatim

Manitoba Hydro's newest hydropower station in Canada

The Wuskwatim project is the first new hydro-electric project to be built in the province of Manitoba in 20 years.

The project was awarded to GE Hydro (now ANDRITZ HYDRO) in two parts: the equipment order was signed in 2004 and the installation contract in 2006. The model test was performed at the ANDRITZ HYDRO hydraulic laboratory in Lachine, Canada. This project was managed by three ANDRITZ HYDRO locations. ANDRITZ HYDRO Canada provided the overall project leadership, turbine design/supply and field installation of the complete scope. ANDRITZ HYDRO Inepar, Brazil, was responsible for the design/supply of the generators and ANDRITZ HYDRO Germany delivered the high pressure governor design. The three units were commissioned back-to-back, from April to October 2012. The units are notably quiet compared to other hydraulic units in the customer's fleet and have

achieved high availability scores in the Manitoba hydro system since being put into commercial operation.

ANDRITZ HYDRO's most important achievements were:

On-time Installation:

As the project progressed, many factors intensified the pressure to stay on schedule. In order to maintain our completion targets, ANDRITZ HYDRO developed a compressed installation program modifying the installation sequence, working parallel shifts on all three units and fabricating an elevated structural platform which sat above one of the units under construction and provided a second assembly and fabrication area. The site fabrication of lower brackets, rotors and upper brackets was continuous and intense. Completed components were stacked on top of each other and also temporarily moved into place in adjacent units until needed to free up laydown areas. All targets were met.

First Nations:

ANDRITZ HYDRO worked with the local First Nations community and was praised for our on-the-job training program which provided employment and training for 4 aboriginal apprentices. ANDRITZ HYDRO also sponsored a multi-year scholarship at the northern college and upgraded 2 community buildings at the First Nations site. ANDRITZ HYDRO once again demonstrated its strength and flexibility in focusing on our customers' needs.

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TECHNICAL DATA

| |
|------------------------------|
| Output: 3 x 70 MW / 86.1 MVA |
| Voltage: 13.8 kV |
| Head: 21 m |
| Speed: 96.7 rpm |
| Runner diameter: 6,700 mm |

† Efficient use of assembly area by stacking of lower bracket on top of completed rotor



† Installation of discharge ring





s Contract signing ceremony

Ramu 1

Contract signing in Papua New Guinea

After years of developing a rehabilitation project for the existing HPP Ramu 1 together with the customer, PNG Power, and an external consultant, financing was achieved and ANDRITZ HYDRO was invited to sign the corresponding contract in Papua New Guinea.

The signing of a contract between the state-owned utility PNG and a European Company – a contract that secures a reliable power supply for the cities and villages in the eastern highlands – is an event of considerable importance for the local population. Hundreds of guests attended the open-air ceremony, where different tribes performed dances in traditional costumes and body paint. A chorus sang the specially composed “Ramu 1 Rehab Song”.

t Machine hall



HPP Ramu1 is located in the eastern highlands of Papua New Guinea and consists of five units with a total capacity of 81.6 MW. The first 3 units had been delivered in 1976, and 2 more units were supplied by ANDRITZ HYDRO in 1989. At that time, the project was known as Yonki Dam. Due to economic and political circumstances, no maintenance has been carried out on the installed equipment for decades, resulting in significantly decreased production, heavily damaged components and unavailable, obsolete spare parts. Unit 5 is out of service with heavy cavitation and pressure pulsations, and vibrations caused a limitation in the load. The existing units can only be operated in Manual mode.

In recent years PNG Power ordered several spare runners and modernization of the governors for 2 units. With the participation of specialists from Jakarta, Indonesia and Linz and Vienna, Austria, ANDRITZ HYDRO undertook several condition assessments and elaborated proposals for the global plant modernization. The focus was mainly on own cost as this proactive pre-investment and thus expecting an invitation for direct negotiation. At the same time ANDRITZ HYDRO could finalize the effective rehabilitation of Rouna 2, the plant close to Port Moresby.

This successful reference supported the PNG Power Management team’s wish and need to obtain the financing required for Papua New Guinea.

Contract Scope:

- Turbine Governor upgrade
- Cooling water system, shaft seal for turbine
- Servomotor replacement
- Control System, Generator Protection
- Unit auxiliary board, common control cubicle, SCADA cubicle, dam control, switchyard control
- 110V DC-system
- Drainage & dewatering system.

The project, an important achievement for ANDRITZ HYDRO, is scheduled to be finalized in 27 months.

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TECHNICAL DATA

Output: 3 x 17.2 MW / 2 x 15 MW

Speed: 750 rpm



Bajina Basta

Takeover of third unit in Serbia

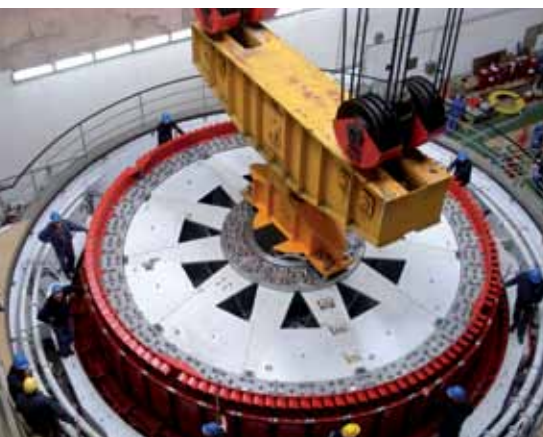
In November 2007 the state-owned hydropower provider Electric Power Industry of Serbia (EPS) awarded a contract to ANDRITZ HYDRO for the rehabilitation of the run-of-river HPP Bajina Basta. The investment is made by Drinsko Limske power plants Bajina Basta (DLBB), the owner of the hydropower plant, in cooperation with the German-based KfW Bank.

HPP Bajina Basta is located on the river Drina and on the border between Bosnia and Serbia. The plant, with a total installed capacity of 420 MVA, was originally commissioned in 1966. It consists of four 105.6 MW Francis turbines / generator sets. A pumped storage plant on the same location increases the total output to approximately 1,000 MW. Bajina Basta is the second largest plant in Serbia, providing 8% of the total country's electricity.

The refurbishment project consists of design, uprating, manufacturing, transport, installation and commissioning of four Francis turbines, generators, control and excitation systems, main transformers, medium voltage and outdoor high voltage switchgear.

Three units, one for each year, have been successfully commissioned and

Generator rotor lowering into final position



Bird view

handed over to the owner on time. The third unit is also operating for back-to-back start of the two 315 MVA pump storage units. As a result of refurbishment works, the vibration of the turbine-generator units was significantly reduced within the contractual limits. During the official celebration of handing over of the third unit to the owner, Mr. Citakovic, General Manager of DLBB, expressed his satisfaction and positive experience with ANDRITZ HYDRO and its Serbian sub-suppliers. The importance of the Bajina Basta rehabilitation project was demonstrated by the fact that the Serbian Prime Minister, Mr. Ivica Dacic, as well as the Minister of Energy, Development and Environmental Protection of the Serbian Republic attended the inauguration ceremony. After commissioning, the plant's output will increase by 13% and its annual energy generation will rise by 40 GWh. This project illustrates ANDRITZ HYDRO's exemplary teamwork and our strength in satisfying individual customer requirements.

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TECHNICAL DATA

Output: 4 x 105.6 MW / 109.5 MVA

Voltage: 15.56 kV / 50 Hz

Head: 66.5 m

Speed: 136.4 rpm

Runner diameter: 4,336 mm

Stator outside diameter: 10,470 mm

Step-up transformers:

Output: 4 x 112 MVA OFWF

Voltage: 15.56 kV / 242 kV





s Transportation of one of the four valves

Kvilldal

Modernization of Norway's heaviest valves

In autumn 2012, ANDRITZ HYDRO Norway conducted a complete rehabilitation of 4 inlet valves for HPP Kvilldal, Norway, owned by Statkraft.

HPP Kvilldal is the largest hydropower plant in Norway and was once the largest hydropower development in Northern Europe. The power plant began operation in 1981 and has an annual output of 3 TWH (4 Francis turbines with total 1,240 MW / 1,480 MVA).

The waterways were last inspected in 1995. Now, HPP Kvilldal needed rehabilitation and was closed for 6 months. Much of the outage time was due to drainage and the filling of the compli-

t Spherical valves after refurbishment



cated waterway system with an air cushion chamber. The rehabilitation of the four inlet spherical valves, each with a total weight of 115 tons, was performed in 10 weeks. The short time period for rehabilitation work was a challenge for our workshop and the workers at site in the hydropower plant. ANDRITZ HYDRO Norway had 21 people on site to do this rehabilitation job, in addition to hired personnel who took care of the surface treatment.

The modernization process included installation of a new main seal and new major bolts, replacement of all lubrication pipes and overlay welding of the expansion box with stainless steel, which provided a corrosion-resistant sealing surface. Several rings in the revision seal were also replaced. Statkraft has a high focus on HSE. All personnel must undergo mandatory safety training before entering the site and working on the power plant. HPP Kvilldal is an important factor in the supply of electricity to the Norwegian grid. The project was managed with close customer expedition and weekly status reports to

Statkraft's top management. ANDRITZ HYDRO acted in good cooperation with Statkraft and project manager Doinita Overskeidhad throughout the project's execution.

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TECHNICAL DATA

Shut-off valve: Spherical valve

Units: 4
Seals: 2 (1 operation, 1 maintenance seal)
Diameter: 2,200 mm
Design Head: 625 m





Company executives and political dignitaries of Albania and Austria at inauguration ceremony



Turbine-generator units in maintenance position

Ashta 1 & 2

Albania opens the world's largest HYDROMATRIX® plant

After winning concession rights to build and operate the Ashta 1 & 2 project in northern Albania in 2008, Energji Ashta, a joint venture of VERBUND AG and EVN AG, inaugurated the Ashta 1 plant on 18 September 2012. Ashta 2, the second stage of the 2-stage cascade, started commercial operation in December 2012.

ANDRITZ HYDRO's innovative HYDROMATRIX® technology allows efficient use of the hydropower potential at the Drin River site and helps to reduce Albania's dependence on energy imports. What began in March 2010 as a fast-track site construction and installation venture was successfully completed in 2012. ANDRITZ HYDRO's engineering and site teams made it possible to keep the scheduled dates for mechanical completion and commissioning. They were proud to present their achievements during the inauguration of Ashta 1. Project team members and executives from Energji Ashta and its project partners ANDRITZ HYDRO, POYRY and PORR, as well as politicians from Albania and Austria, gathered at the site on a sunny

September day to celebrate the official inauguration. Attendees witnessed the results of a joint development effort, which defines a milestone for this innovative and emission-free hydropower technology. The following months of operation of HPP Ashta 1 showed that the performance of the turbine-generator units surpasses our guaranteed values. During this period, ANDRITZ HYDRO also conducted electrical tests to simulate real-life grid operating conditions, which proved that the plants can cope with all expected grid faults. Numerous design improvements were made for this project and had the expected positive effect on equipment performance. ANDRITZ HYDRO also implemented a joint plant control system, which will be further tested and optimized in the following months. After completion of the remaining commissioning works at the Ashta 2 plant, full operation is expected to start in early 2013.

State-of-the-art technology by ANDRITZ HYDRO, as well as professional project development and site management, meet the highest environmental standards and make the Ashta plants a showcase for a suc-

cessful hydropower project. Once completed, the two plants will deliver 240 Mio KWh of electricity, sufficient for 100,000 Albanian households.

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TECHNICAL DATA

| |
|-----------------------------|
| Head Ashta 1: 4.98 m |
| Head Ashta 2: 7.53 m |
| Output total: (max.) 53 MW |
| Number of TG-Units: 45 + 45 |



Market news

ANDRITZ HYDRO opens new locations

For us, growth also means being closer to our customers with a local presence. That's why **ANDRITZ HYDRO** has further expanded our global structure.

ANDRITZ HYDRO is further increasing our local proximity to customers, building on the foundation of our longstanding global network of locations. The most recent highlights are the founding of a new location in the growth market of Portugal, and in Myanmar, an Asian market of the future.

Portugal

Portugal has a high number of projects (pump storage power plants, small hydropower plants and renovation projects), making it a very interesting hydropower market in Europe. Well-qualified and highly motivated employees are an important prerequisite for the successful and optimal execution of current ANDRITZ HYDRO projects, such as Bemposta, Baixo Sabor and Foz Tua. The new location in Porto, Portugal, was founded for two reasons: to provide the best possible local service for the Portuguese market, and to safeguard and expand installation know-how at ANDRITZ HYDRO.

In parallel with technological advancement, we focus on training our specialists intragroup to become foremen and supervisors to supply well-trained skilled workers around the world for the installation of international ANDRITZ HYDRO projects, and our staff development program concentrates on motivated next-generation staff to provide professional installation and construction site management. The first employees are already involved in the Baixo Sabor project. They are also scheduled to work on projects in Kaunertal, Austria, and Nant de Drance, Switzerland.

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† Location in Porto, Portugal



Myanmar

Southeast Asia has been an important hydropower market for ANDRITZ HYDRO for decades. We have now opened a branch in Yangon, Myanmar, in addition to our other long-established branches in Indonesia, Vietnam, Malaysia and the Philippines. Two-thirds of Myanmar's energy production is based on hydroelectric power. The country has about 735 MW of installed capacity, with a total hydropower potential of more than 100,000 MW. Current per capita power consumption stands at 1/50th of the value for Austria. This makes Myanmar an interesting future market for ANDRITZ HYDRO, and the new branch office will ensure the best possible customer support.

ANDRITZ HYDRO has been completing projects in Myanmar since the 1980s, always to the customer's fullest satisfaction (1983 – Kon Nyaung, 1984 – Tatkyi Falls, 2004 – Mone, Paung Laung). Our new branch office is located in the country's business center in Yangon, enabling a more precise analysis of market needs and opportunities.

ANDRITZ HYDRO is working on educational programs in partnership with the Ministry of Electric Power, and is taking part in technical inspections of decommissioned hydropower plants. The goal is to work together with state officials to identify modernization projects that can be completed in the short term, in order to cover Myanmar's rising energy demand.

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Sweden Midskog

ANDRITZ HYDRO is currently working on a rehabilitation project for Vattenfall at the Midskog hydropower plant. The HPP is located near Stugun, Jämtland in Sweden and consists of three Kaplan turbines. The plant was commissioned in 1944 with an average head of 27 m. At present HPP Midskog proudly delivers electricity to 145,000 households.

ANDRITZ HYDRO's scope of work includes the rehabilitation of turbines number 2, part of Vattenfall's large rehabilitation program, and of number 1, which was carried out between 2010 and 2013. This rehabilitation will increase the output of HPP Midskog by 72 Gwh/year.

The scope of work includes a model test, one new oil free self-lubricated runner, a new high pressure unit and refurbishment of old components. The turbine is manufactured by ANDRITZ HYDRO Nalden in Sweden.



The model test was performed by ANDRITZ HYDRO OY in Tampere, Finland.

Commissioning of the refurbished turbine is scheduled for autumn 2013. This project is very important for ANDRITZ HYDRO in the Scandinavian market.

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TECHNICAL DATA

| |
|---------------------------|
| Output: 54 MW |
| Head: 27 m |
| Speed: 136.4 rpm |
| Runner diameter: 5,300 mm |

Brazil Paracambi

HPP Paracambi is located in Paracambi city, 75 km from the famous Rio de Janeiro in the southeast of Brazil. Its reservoir extends over an area of 2.37 km² and passes through Pirai and Itaguaí city, by the Ribeirão das Lajes river, which stays full all year long.

The project is owned by Lightger Ltda. which is a partnership between Light and CEMIG GERACAO S.

These two companies have long histories in the Brazilian hydro business, and awarded a contract for the supply of turbines, generators and associated equipment to Orteng Equipamentos e Sistemas Ltda. ANDRITZ HYDRO Inepar do Brasil,



our joint venture, was subcontracted from Orteng to supply the two 12.85 MW Kaplan turbines and 14.28 MVA generators, as well as site supervision and commissioning of the equipment. On 16 May 2012, the first unit was successfully put into commercial operation, and unit 2 followed on 13 July. HPP Paracambi is hugely important for the state of Rio de Janeiro in order to minimize its need for imported energy from external resources.

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TECHNICAL DATA

Kaplan Turbines / Generators

| |
|--------------------------------------|
| Output: 2 x 12.85 MW / 2 x 14.28 MVA |
| Voltage: 13.8 kV |
| Head: 13.7 m |
| Speed: 163.64 rpm |
| Runner diameter: 3,500 mm |
| Frequency: 60 Hz |

Canada Wells

ANDRITZ HYDRO was awarded a contract for refurbishment of the U2 generator at Wells Electricity Generation Station by Mississagi Power Trust, which is an affiliate of Brookfield Renewable Energy Group. The project includes supply and installation of a replacement winding, rotor field winding refurbishment and accessories.

Located 86 km downstream of Aubrey Falls, this is the second of three stations along the Mississagi River in North West Ontario, Canada. The scope includes design improvements which will increase generator's efficiency and power output rating, and extend the ser-



vice life of the replaced components. This order followed the successful execution of the Aubrey Falls project.

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TECHNICAL DATA

Output: 2 x 239 MW

Head: 65 m

Colombia Sogamoso

On 7 November 2012 ISAGEN, the customer for the Sogamoso project, celebrated the successful pre-assembly of the third and last spiral case.



Pre-assembly was celebrated by re-enacting an almost 75-year-old photo, which shows a truck parked inside the inlet cone of a spiral case. The original picture from 1938 was taken in the former Escher-Wyss workshop in Zurich, Switzerland, for a project in Manchuria, northeast Asia.

With the successful finalization of the last spiral case pre-installation, the milestone for successful installation of all embedded turbine components is within reach, and will allow the turbine main turbine installation to begin very soon. With the planned commissioning of the three units, starting at the end of 2013, Sogamoso will enrich ISAGEN's Power plant Portfolio by another 840 MW of renewable and clean energy.

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TECHNICAL DATA

Output: 3 x 280 MW

Head: 146 m



USA Hoover Dam

In April 2010, ANDRITZ HYDRO USA was awarded a contract from the US Bureau of Reclamation (USBR) for the Hoover Dam N8 turbine replacement runner and model test.

The Hoover Dam is located in the Black Canyon of the Colorado River, between Arizona and Nevada.

ANDRITZ HYDRO Canada (HCM), in collaboration with ANDRITZ HYDRO USA, completed the runner design and model tests in the Montreal Laboratory in November 2010. The hydraulic design successfully met the most challenging requirement: that the new runner operates smoothly without restrictions for a very wide operating zone, from 5% to 100% of rated flow. ANDRITZ HYDRO USA supplied the prototype runner, with manufacturing from ANDRITZ HYDRO Mexico's workshop. The new runner was installed during the summer of 2012, and was followed by field testing which confirmed that the prototype turbine's efficiency was met and even exceeded. The tests also demonstrated that the new runner could operate from no-load to 100% full rated output without limitations. Consequently the customer exercised its option to purchase three additional runners for units A1, N5 and N6. HPP Hoover Dam was a successful cooperation project between ANDRITZ HYDRO and the US Bureau of Reclamation.

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TECHNICAL DATA

Output: 107 MW

Head: 136 m

Speed: 180 rpm

Runner diameter: 3,320 mm

Colombia Providencia I & III

Mineros is a successful Colombian gold mining company. Because power consumption is important for its production process, HPP Providencia I was built some decades ago. The hydropower plant consists of 4 Pelton turbines with a total installed capacity of 7.3 MW.

Due to the growth of the mining sector, the company plans to increase its hydropower production by 10.9 MW. For that purpose they planned to expand Providencia I by installing a new Pelton unit of 1.7 MW, and also decided to build a new hydropower plant, Providencia III, consisting of 2 x 4.6 MW Francis turbines. Both contracts were awarded to ANDRITZ HYDRO, based on a consortium with ANDRITZ HYDRO France (leader), responsible for the turbines; Indar Spain for the generators, and ANDRITZ HYDRO Colombia for control, protection and erection. Technical challenges include the installation of a 5th unit at the existing powerhouse of HPP Providencia I and pressure relief valves at HPP Providencia III, which required controlling the pressure along the 3.5 km tunnel. Additionally, both hydropower plants are supposed to work from time to time under an isolated network. The final technical solution was agreed with the support of our specialists in that field, the hydraulic laboratories in Zurich, Switzerland. Commercial operation of the plants will start by the end of 2013.

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TECHNICAL DATA

Providencia I / Providencia III

Output: 1.7 MW / 2 x 4.6 MW
Head: 195.05 m / 82.20 m
Speed: 600 rpm / 600 rpm
Runner diameter: 940 mm / 600 mm

Austria Bolgenach

In April 2012 ANDRITZ HYDRO received an order from VORALBERGER KRAFTWERKE AG for supply, erection and commissioning of a 4-nozzle vertical Pelton turbine with an inlet pipe, a synchronous generator and electrical equipment for HPP Bolgenach.

The power house is located on the dam side (Bolgenach reservoir) of 74 MW HPP Langenegg (head of



275 m), which was commissioned in 1979. It utilizes the eco-flow as mandated by the authorities for energy production. After a construction period of 5 months, erection had taken place in November 2012 to everyone's satisfaction. Only two weeks later the first connection to the grid was conducted in the presence of the customer's board of directors. The turbine-generator unit will produce approximately 1.2 GWh/year.

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TECHNICAL DATA

Output: (max.) 161 kW
Eco flow: 200 l/s
Head: 66 to 93 m
Speed: 750 rpm
Runner diameter: 460 mm

Jamaica Maggotty

The original HPP Maggotty consists of one 6 MW Francis turbine. It was built in 1957 and refurbished by ANDRITZ HYDRO in 2002. Now the owner, Jamaica Power Services Co Ltd (JPS), is expanding the existing hydropower plant.

The modernization process includes a new powerhouse with 2 x 3.7 MW Compact Francis turbines. It will increase energy production from renewable sources in the country, thus helping to reduce Jamaica's dependence on fossil fuels. Construction



works have been awarded to the British EPC contractor Kier Infrastructure and Overseas Ltd. Included in the offer was E&M equipment supply from the consortium led by ANDRITZ HYDRO in France.

The E&M scope of supply consists of a water to wire solution where ANDRITZ HYDRO France is in charge of 2 x 3.7 MW horizontal Francis turbines and butterfly valves (DN1000). ANDRITZ HYDRO Mexico supplies the governor, control and protection systems. Indar, Spain will provide the generator. Commercial operation of the plant is expected by the end of 2013.

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TECHNICAL DATA

Output: 3.7 MW
Head: 92.85 m
Speed: 750 rpm
Runner diameter: 800 mm

Spain Belesar II & Peares II



HPPs Belesar II & Peares II (ecologic flow) are located in the Miño River town of Saz Fiz de Asma, in the province Lugo in Galicia, Spain.

ANDRITZ HYDRO Spain was awarded a contract from Gas Natural Fenosa for engineering, procurement, manufacturing, transport, erection and commissioning of two vertical Francis turbines, butterfly valves, generators and Dissolved Oxygen System (DO) for both projects. Engineering of the DO-System has been carried out by ANDRITZ HYDRO Canada. Manufacturing and preassembly of the main turbine components was executed in our Algete factory in Madrid, Spain. The supplier for the generator is Alconza Berango, located in Vizcaya, Spain. At HPP Belesar II, manufacturing is already finished and erection will be taking place between February and June 2013. The provisional acceptance date is planned for August 2013. The HPP Peares II, which is at an advanced erection phase, is planned to be finished at the end of January 2013. The plan is to go for provisional acceptance in April 2013.

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TECHNICAL DATA

Belesar II / Peares II

Output: 10.5 MW / 9.4 MW

Head: 118.5 m / 90.5 m

Speed: 600 rpm

Runner diameter: 1,050 mm / 960 mm

Georgia Akhmeta

In May 2012, ANDRITZ HYDRO received an order from GEOENERGY LLC for electromechanical Equipment supply for HPP Akhmeta in Kakhetie, located in Georgia.

GEOENERGY LLC is a subsidiary of PRIME ENERGY LLC, a private energy company, engaged in electricity trading and power generation from renewable energy sources. Thanks to the trust of this major hydropower developer, ANDRITZ HYDRO signed its first contract in the potential market of Georgia, confirming our intention to take an active part in the HPP's development. ANDRITZ HYDRO France will provide 2 x 4.5 MW Francis tur-

bines, operating under a net head of 90 m and coupled to synchronous generators.

ANDRITZ HYDRO Turkey will provide the full EPS scope including automation, protection and SCADA as well as transformers and the medium voltage equipment. The plant is expected to start its commercial operation in July 2013.

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TECHNICAL DATA

Output: 2 x 4.5 MW

Head: 90 m

Speed: 750 rpm

Runner diameter: 850 mm

Romania Cobasel

In October 2012 S.C Silvania International Prod S.R.L. awarded a contract to ANDRITZ HYDRO for delivering one 4-nozzle vertical Pelton turbine, an air-cooled generator (615 kVA & 400 V), a penstock connection pipe, an inlet valve (DN600/PN16), a hydraulic oil pressure unit, control-measuring-protection equipment for the turbine-generator-set, AC-DC distribution, LV-circuit breaker and control equipment for the intake (Tyrolean type weir).

Installation and commissioning is part of the contract. HPP Cobasel is located in Bistrița-Năsăud country, approximately 50 km north-east of the city of Bistrița, Romania.

The hydropower plant consists of a Tyrolean type intake at the weir, a single chamber desilter, a 2,242 m long penstock made of GRP (DN800), and a turbine-generator unit with water to wire equipment.



Trial operation is scheduled for the end of June 2013.

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TECHNICAL DATA

Output: 553 kW

Head: 88 m

Speed: 500 rpm

Runner diameter: 760 mm

Philippines Tudaya 1 & 2

ANDRITZ HYDRO Germany received two orders from Hedcor Inc., the largest developer of run-of-river plants in the Philippines, in 2012.

The first order, HPP Tudaya 2, was signed in June 2012 and consists of a water to wire package including two Compact Francis turbines of different sizes. The purpose is to maximize the annual power output.

In September 2012 ANDRITZ HYDRO was awarded the second project, HPP Tudaya 1. The scope consists of one Compact Pelton turbine, the hydraulic governor and the main inlet valve as well as turbine and generator control cabinets.

Indar, the Spanish consorcial partner, will deliver synchronous generators for both contracts. The projects will be installed and commissioned near the city of Davao, on the island of Mindanao, in the first quarter of 2014.



The consortium, under the guidance of ANDRITZ HYDRO Germany, won the contract against international competition.

Positive experience with the previous order, HPP Irisan, in 2011 and the long-term relationship between our representatives in the Philippines and Hedcor Inc. clears the way to secure these orders.

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TECHNICAL DATA

Tudaya 1 / Tudaya 2

Output: 6.7 MW / 5.15 + 2.55 MW

Head: 227.7 m / 82,8 m

Speed: 514.3 rpm / 600 + 900 rpm

Runner diameter: 1,160 mm / 978 + 672 mm

Panama Barro Blanco

HPP Barro Blanco is located on the Tabasará River in Panamá, in the province of Chiriquí and the district of Tolé.

ANDRITZ HYDRO Spain is responsible for engineering, procurement and manufacturing, and transportation,



erection and commissioning of two vertical Kaplan turbines and generators. One horizontal Francis turbine for ecological flow, a butterfly valve and the generator are also part of the project.

The contract was awarded to ANDRITZ HYDRO in January 2012 from UTE Tabasará, a subsidiary company based in Cobra, Spain. The owner is Generadora del Istmo, S.A. (GENISA).

The main turbine components will be manufactured at the ANDRITZ HYDRO workshop in Algete, Spain. The generator subcontractor is Indar Electric, based in Beasain-Guipúzcoa.

Cobra Infraestructuras is responsible for construction of the dam and power house and for supply of the mechanical balance of this plant. Cobra Instalacio-

nes y Servicios is responsible for supplying the switchyard, transmission line, SCADA and electrical balancing for the plant.

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TECHNICAL DATA

Kaplan turbines

Output: 2 x 13.3 MW

Head: 41.34 m

Speed: 360 rpm

Runner diameter: 2,200 mm

Francis turbine Ecological Flow

Output: 1.9 MW

Head: 41.4 m

Speed: 600 rpm

Runner diameter: 910 mm

Compact Hydro

Projects for AltaGas in British Columbia

Assembly of the first generator of Forrest Kerr before shop tests

ANDRITZ HYDRO, with 29 Compact units delivered and installed in British Columbia (BC) by the end of 2012, and 19 additional units for projects currently under execution, installed a total capacity of nearly 500 MW. This activity shows ANDRITZ HYDRO as a clear market leader in this segment for BC as well as for North America in general.

Among the latest contracts awarded to ANDRITZ HYDRO, 3 orders were received from AltaGas, all requiring flow ramping (slow variation of the plant flow under normal or exceptional circumstances) and energy dissipation. These include HPP Forrest Kerr (9 Francis turbines totaling 200 MW), HPP McLymont and HPP Volcano. Each plant represents a different state-of-the-art approach designed to address energy dissipation.

Forrest Kerr is currently in the delivery Stage, with all nine butterfly inlet valves and Francis units on their way to the site or running through final factory acceptance checks. Several of the generators have already been tested, approved and shipped. Site erection began in early 2013 in accordance with the planned schedule. Energy dissipa-

tion at Forrest Kerr will be achieved through running the Francis units at over speed, which has previously been successfully implemented in BC.

AltaGas' Volcano project, awarded to ANDRITZ HYDRO at the end of 2012, will be equipped with two vertical 6-jet Pelton units. These are nearly identical to the Kwalsa units, which use specially modified deflectors to dissipate all the energy within the turbine housing for extended periods of time.

The McLymont project was awarded to ANDRITZ HYDRO in 2012 and is located in the same region as HPP Forrest Kerr and HPP Volcano, in the north of BC, close to the Alaskan border. This project, equipped with three 24.3 MW horizontal Francis units and a full flow external dissipation system, will be very close, in terms of concept and design, to the Ashlu Creek project, which was delivered in 2008 to Inn-nergex. HPP Ashlu Creek was the first plant in the world to use a full by-pass and dissipation system for 60 MW under 215 m of net head.

The dissipation concept used for HPP Ashlu and planned for HPP McLymont was developed by ANDRITZ HYDRO in partnership with French valve



HPP Forrest Kerr cavern with ANDRITZ HYDRO site TA, Project Manager and the author

experts from D2FC Energy Valves, and proved to be an extremely reliable and smooth-running system.

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TECHNICAL DATA

HPP Volcano:

Output: 2 x 8.5 MW

Head: 212 m

Speed: 514 rpm

Runner diameter: 1,115 mm

HPP McLymont:

Output: 3 x 24.3 MW / 26 MVA

Voltage: 13.6 kV

Head: 264 m

Speed: 720 rpm

Runner diameter: 1,062 mm

Test field generator

Most powerful test field generator delivered

Rotor insertion into the generator stator

ANDRITZ HYDRO delivered a synchronous generator for the world's most powerful transformer test field within the SIEMENS Group. The converter set at Weiz, Austria consists of a 72-MVA synchronous generator, a 12.5-MVA synchronous motor and a direct-current motor with 1,100 kW. The core of the plant is the synchronous generator, delivered by ANDRITZ HYDRO, with a total weight of 180 t.

The highlight of this special synchronous generator is its exceptional versatility. It can be operated in three-phase mode (50/60 Hz; 60/72 MVA) as well as single-phase mode (50/60 Hz; 40/45 MVA). The machine is even designed for operation at 16 2/3 Hz. This "all-in-one" requirement for the generator posed three significant challenges for ANDRITZ HYDRO:

† Generator transport to the converter-house



180 t heavy generator moved into machine-building using mobile rail track

Mechanically

The relatively high operating speed of 1,200 rpm was the biggest challenge, as it required special shape forming of the pole components as well as a thorough selection of materials.

Operation under single-phase load

This operation mode required special construction of the damper winding. Reduction of detrimental effects to the foundation from the pulsing torque was achieved by a specially designed stator-core cage, which decouples the casing from the stator core through customized flat springs. This special construction allowed the generator-stator to be fixed directly to the foundation, without the typical spring elements in between, which are usual for single-phase machines.

Total weight of 180 t

The biggest challenge during erection was to bring the 180 t heavy generator into the newly erected converter house, and to lower it into the generator pit. The generator, with rotor in place, was transported into the new machine building using mobile rail tracks, and was lowered with a special lifting frame.

Complete engineering manufacturing and erection were carried out by ANDRITZ HYDRO Weiz, Austria.

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TECHNICAL DATA

Output:

60 Hz, 3-phase, 72 MVA

50 Hz, 3-phase, 60 MVA

60 Hz, 1-phase, 45 MVA

50 Hz, 1-phase, 40 MVA

Speed:

1,200 rpm (60 Hz)

1,000 rpm (50 Hz)

Weight: 180 tons

Designed also for operation at 16.7 Hz

Successful training

on the Hydropower Sustainability Assessment Protocol



s Sustainability Trainees and Trainers



**Hydropower
Sustainability
Assessment Protocol**

As part of its “Sustainability Partnership” with the International Hydropower Association (IHA), representatives from ANDRITZ HYDRO completed their training on the Hydropower Sustainability Assessment Protocol during sessions organized by IHA in Vienna, Austria in early September 2012.

IHA was formed in 1995 under the auspices of UNESCO as a forum to promote and share good practice and further knowledge about hydropower. With members active in more than 80 countries, IHA is a non-governmental, mutual association of organizations and individuals.

Immediately upon the official release of the Protocol in June 2011, the Hydro Equipment Association (HEA), with its

member ANDRITZ HYDRO, became a “sustainability partner” of the IHA. For the two-day course last September, ANDRITZ HYDRO staff joined representatives from HEA, Oesterreichische Kontrollbank AG (OeKB), Poyry Energy GmbH and the University of Vienna. The training was facilitated by IHA Sustainability Specialists.

The Protocol, a comprehensive tool to assess the sustainability of hydropower projects globally, provides a rigorous, evidence-based assessment of relevant sustainability topics, depending on the development stage of the project. These topics include issues such as downstream flow regimes, indigenous peoples, biodiversity, infrastructure safety, resettlement, water quality, and erosion and sedimentation.

It is the product of a rigorous multi-stakeholder development process involving representatives from social and environmental NGOs, governments, commercial and development banks and the hydropower sector, represented by IHA. The process involved field trials in 16 countries, across 6 continents, and stakeholder engagement with 1,933 individuals in 28 countries.

Now, the Protocol is overseen by the Hydropower Sustainability Assessment Council, a global membership-based organization that ensures credibility in assessment results. The more private and governmental investors become active users and act upon what they discover, the better the industry can overcome problems and secure hydropower’s place in the future global energy mix. ANDRITZ HYDRO is ready to proactively support and contribute.

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Renewable Energy World Africa

Johannesburg, South Africa

Africa is currently one of the most interesting hydropower markets. This was the first Renewable Energy World Africa conference, and ANDRITZ HYDRO took the opportunity to make a comprehensive showing.

The coordinated concept including panel discussions, specialist presentations

and a trade show stand offered a solid basis for interesting discussions and strengthening existing contacts. Visitors used the time to find out more about ANDRITZ HYDRO and our latest developments in technology and project solutions. Renewable Energy World Africa was an important event for ANDRITZ HYDRO and underscores our activities in this future market.

Vienna Hydro

Laxenburg, Austria

ViennaHydro was held for the twelfth time in Laxenburg, Austria. The international seminar is hosted by the Vienna University of Technology and targets both operators and suppliers of hydropower plants.



Detailed specialist presentations on pump storage, turbines and generators encouraged in-depth technical discussions among participants. ANDRITZ HYDRO gave a number of specialist presentations, and we chaired four presentation series.

There was also plenty of opportunity to share comprehensive information at ANDRITZ HYDRO's exhibition stand. As in previous years, ViennaHydro provided a superb opportunity for a productive exchange of information with customers and interested professionals.

Dams Congress

Ankara, Turkey



ANDRITZ HYDRO attended the first DAMS CONGRESS, following the annual INTERNATIONAL ENERGY CONGRESS, from 11 to 12 October 2012 in Ankara.

The congress is organized by DSI (State Hydraulic Works), TRCOLD (a subsidiary of ICOLD) and the Chamber of Engineers and Architects.

During this congress local and international experts held presentations about recent and future developments in dam construction. The presentations concluded with two specific examples, which were evaluated and enabled the subjects to be deeply analyzed. The photo shows His Excellency the Minister of Forestry and Water, Mr. Eroglu, with Ministry Undersecretaries Mr. Eldemir and Mr. Kocaker, and Mr. Ozkaldi, DSI General Manager, Mr. Uzupek, DSI (State Hydraulic Works) Dams Department Head, together with Ms. Tugba Ozbal and Mr. Uygur Aydin of ANDRITZ HYDRO during their visit to our booth. This event was an important opportunity for ANDRITZ HYDRO to present its position and our projects on the Turkish market.

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New Office Building

Vienna, Austria

Hydro 2012

Bilbao, Spain

HYDRO 2012, one of the leading hydropower events in Europe, took place last year in Bilbao, Spain. More than 1,300 people from 80 countries participated.

The conference focused on the needs, priorities and plans of developing countries in Africa, Asia and Latin America. ANDRITZ HYDRO participated with lectures and a trade show stand. Specialist presentations focused on Pelton and pump turbines as well as electrical simulation results. HYDRO 2012 was a successful event that once again strengthened ANDRITZ HYDRO's position as a global leader in hydropower systems.

In early November, ANDRITZ HYDRO's global headquarters in Vienna moved into a new ANDRITZ Group office building. The new ANDRITZ location offers space for about 1,000 employees and brings together all business units operating in Vienna in HYDRO, PULP & PAPER, and METALS.

The building was dedicated at a ceremony led by Chairman of the Board Dr. Wolfgang Leitner. Also present were board members Wolfgang Semper (HYDRO) and Humbert Kofler (PULP & PAPER). The core concept of the building's architecture is "communication", which played a role in the

planning of both the workspaces and the central communication areas. The move enables us to share our infrastructure and encourages the use of synergies.

The move is particularly beneficial for ANDRITZ HYDRO because two previously separate units can now work more efficiently together thanks to their proximity. Approximately 600 ANDRITZ HYDRO employees from Large Hydro, Service Rehab, Turbo-generator and Automation as well as from the central group units can now manage our customers' projects – and our global markets and branches – from under a single shared "roof."

International Energy Congress and Fair (EIF)

Ankara, Turkey



The annual INTERNATIONAL ENERGY CONGRESS AND FAIR (EIF) took place between 4 and 5 October 2012.

EIF is a platform at which many different topics concerning energy production in Turkey and worldwide are discussed, and issues related to the future of the energy sector are evaluated by gathering together a large number of high-level authorities and

energy company representatives from Turkey and many other countries. The purpose of the congress, supported by the Turkish republic's Ministry of Energy and Natural Resources, is to evaluate energy sources and energy markets of all dimensions and to create an atmosphere within which the latest developments and applications can be discussed and handled in every detail. ANDRITZ HYDRO participated in this exhibition and fair with two speakers. The congress was an excellent opportunity to present our new technologies and our latest works in optimizing and upgrading projects.

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EVENTS:

HydroVision International
23 - 26 July 2013
Denver, USA
www.hydroevent.com

HydroVision Brazil
24 - 26 September 2013
Sao Paulo, Brazil
www.hydrovisionbrazil.com

Renewable Energy World Asia
2 - 4 October 2013
Bangkok, Thailand
www.renewableenergyworld-asia.com

Hydro 2013
7 - 9 October 2013
Innsbruck, Austria
www.hydroevent.com

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