HYDRONEWS

No. 19 / 05-2011

MAGAZINE OF ANDRITZ HYDRO

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ANDRITZ Hydro

HYDRONEWS


Key Figures 2010

Again a new record in all figures: order intake +10%, order backlog +17% and sales +15% compared to 2009.

Order Intake: 1,870 mio. EUR
Order Backlog Dec.31: 3,376 mio. EUR
Sales: 1,579 mio. EUR
Employees as of Dec. 31: 6,530

Cover photo:
Coating of a Pelton runner

Imprint

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Dear business friends

For many years already, Wolfgang Semper has been jointly responsible in leading positions for the international business success of ANDRITZ HYDRO. Together with Harald Heber and Michael Komböck he has been CEO of the ANDRITZ HYDRO GmbH since 2008.

In April 2011, Wolfgang Semper became new board member of the ANDRITZ AG. Together with Friedrich Papst he is responsible for the HYDRO business and for the group-wide AUTOMATION division. **HYDRO**NEWS spoke to the new board member.

HYDRONEWS: **Mister Semper, how was the past year for ANDRITZ HYDRO?**

Semper: The global competition in the hydropower market was undiminished in 2010. Therefore, I am pleased all the more that we were able to close the past year as the best year in ANDRITZ HYDRO's history.

HYDRONEWS: **How do you estimate the business figures for 2010?**

Semper: In 2010, a significant increase in all business divisions could be noticed and we received the largest individual order in our history. In the field of small hydro power plants a total of more than 100 orders were placed to us worldwide. Currently, we have an order backlog of approximately three annual productions and employ over 6,500 people worldwide.

HYDRONEWS: **What is the international significance of hydropower?**

Semper: Globally a continuously rising demand for energy can be recognized, in growing markets such as China, India and Brazil, as well as in Europe and North America. According to international studies only one third of the global hydropower potential is tapped nowadays. The further development of alternate energy such as wind and solar power plants will have an increasing impact on the global energy mix. At the same time, new challenges will arise to the power industry, keywords „Smart Grid" or „e-mobility". Due to its energy storage capacity hydropower is a key factor and an important component for energy balance and thus for grid stability. This is clearly demonstrated in the renaissance of pumped storage power stations.

HYDRONEWS: **Where do you see the challenges in the use of hydroelectric power in coming years?**

Semper: In future, I see two main aspects: The continuous further development of our high technology, in particular for pumped storage power plants with variable speed machines, as well as the entry into new business areas such as generating energy from tidal currents.

HYDRONEWS: **Thank you for the interview.**

Thickness control of the coating on a Francis runner

Coating for sustainable turbine parts

Hydro-abrasive erosion occurs due to high concentration of hard particles in river water. Because of the occurring damages, the efficiency and the TBO (time between overhaul) decreases and the productivity drops. A coating has a higher resistance against hydro-abrasive erosion and therefore damages and the efficiency loss are much smaller. Research & Development in ANDRITZ HYDRO is focussing on new coatings and gaining a fundamental understanding of the hydro-abrasive process.

Damages on the runner inlet of the runner Nathpa Jhakri, India

The challenge

Especially rivers in young unstable geological regions like the Himalaya, Andes or Alps, have often a high particle concentration of hard materials like quartz and feldspar. As the particles are harder than the standard turbine material, they damage parts of the turbines considerably. These damages change the hydraulic design, which decreases the efficiency of the turbine. In addition, they can be so detrimental that a safe operation of the turbines is not possible anymore.

If a large reservoir is available a sedimentation of these particles takes place, which decreases the amount of damages. But the negative side is that the reservoir will fill up very fast. This reduces the capacity to store water for low flood periods. Therefore, sedimentation is not wanted. Some power plants suffer such severe damages after one season of operation from hydro-abrasive erosion that they need a complete overhaul involving a high amount of welding. The challenge is to find a way to protect these turbines. A further challenge, especially during the planning phase of a new project, is to determine if hydro-abrasive erosion will occur and to what extent. For this reason the influencing parameters, have to be known as good as possible.

Damages on Pelton runner, Malana, India

Hydro-abrasive erosion

The main parameters influencing the hydro-abrasive erosion are on the one hand the particle parameter and on the other hand the turbine parameter. The particle parameters are:

- concentration
- mineral composition
- grain size distribution and
- particle shape.

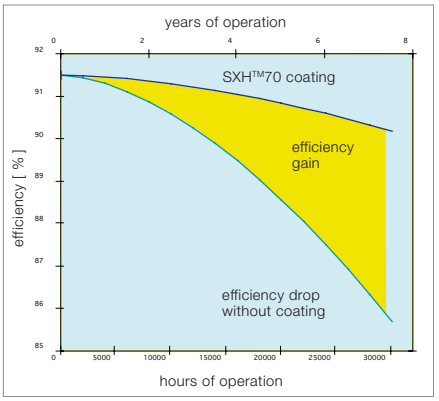
These parameters fluctuate over time, so that especially in smaller, fast flowing mountain rivers the measurements have to be done very frequently to get good information. The second set of influencing parameters from the turbine are:

- type of turbine
- design (e.g. size, speed)
- relative velocity of the particles and
- operation conditions (e.g.duration, part load).

All the parameters have to be taken into consideration, when estimating the time between overhaul (TBO) and deciding whether a coating is needed. Also the customer perceptions for the TBO of the turbine play a significant role in this decision. Due to the high influence of the relative velocity, it is possible to make an about the damages on different turbine types. Kaplan turbines are less affected than Francis or even Pelton turbines. But for each turbine type only certain parts are differently damaged. For instance the runner experiences the highest velocity and thus the highest wear. Due to this only certain parts need a protection. In a Pelton turbine these are the runner, the needle and nozzle head including seat ring, while in a Francis turbine the runner with labyrinths and the guide vanes with facing plates will be damaged most. In Kaplan turbines mainly the blades need protection, if the particle load is too high.

The solution

The problem of hydro-abrasive erosion, especially in the Alps, was the catalyst for ANDRITZ HYDRO together with Sulzer to develop coatings. This culminated in the currently used material SXH™70. This coating is a combination of very hard tungsten carbide particles in a metal basis and is applied onto the turbine parts by a process (HVOF-process) in which the particles are accelerated to supersonic speed by the combustion energy of a fuel. As a result the particles splatter on the surface of the part to be coated and form



Influence of the coating on the efficiency development during operation with high hydro-abrasive erosion

a dense layer. The coating is build up by several layers. With this process the resulting coating has a high hardness and is very dense and shows a very high resistance against hydro-abrasive erosion. This does not mean that no damages occur anymore, but that the hydro-abrasive erosion is slowed down considerably. The owner of a HPP has therefore a much smaller efficiency loss (see diagram) as the geometry is maintained much longer. First damages appear later and grow slower. The TBO increases and the repair work decreases. As a result, the productivity increases by a factor 2 to 6.

Coating Experience

Since the 90s, when the current coating was introduced, the development has not come to a halt but has focused more on the technical application instead of developing new materials. In 2008 the first Francis runner was fully hard coated by a robot, which is now state-of-the-art for ANDRITZ HYDRO. In 2009 a new development led to a higher stability of the Pelton splitter. Since 1995 the orders for hard coating have increased constantly. In Kriens, Switzerland, a second bigger cabin was added in 2007. An even larger cabin replaced the first cabin in 2009, due to a coating order for Francis runners with a runner diameter of nearly 5 m. ANDRITZ HYDRO has another coating facility in Prithla, India, which will be refurbished in 2011. As hydro-abrasive erosion plays also in South America a significant role, sub-suppliers were gained. Metaliza in Chile is a long-term partner of ANDRITZ HYDRO. Cascadura, Brazil, is a supplier for the local market since 2010. The coating shops are placed in today's main coating markets to provide a short reaction time. For new emerging markets and to decrease the lead time further, similar solutions in more locations are discussed.

Research and Development

The research and development in the coating sector can be divided into two segments. The first project is to develop new coatings with even better resistance to hydro-abrasive erosion. This would increase the TBO and reduce the necessary repairs. The second part of the research work has the aim of building up the fundamental knowledge of hydro-abrasive erosion. Today the influences of most parameters are only qualitative or half-quantitative known.

SXH™70-coated Pelton Bucket, Aletsch Mörel, Switzerland

First Francis runner, fully coated by robot, Nathpa Jhakri, India

Coated Kaplan blade, Santo Antonio, Brazil

Free-jet test rig, ANDRITZ HYDRO, Switzerland

Mostly they come from different test set-ups with dissimilar conditions found in prototypes.

As a result the transferability to the prototype is often not given. Therefore, ANDRITZ HYDRO has launched a research program to quantify the influences of the parameters on different set-ups, which simulate the prototypes as near as possible.

The first test rig as seen shown in the photo above simulates a Pelton splitter. While the length of the sample is shorter, the cross section is exactly of a prototype. Also a smaller jet diameter had to be chosen, but the relative velocity of the water on the sample is accordingly to the relative velocity in a prototype. Due to this heads up to 1.500 m can be simulated in this rig.

The particle parameters can be chosen in a wide range for example the particle concentration can be up to 50 g/l. With this set-up the influences of different parameters on the hydro-abrasive erosion on a splitter, as a critical part in a Pelton turbine, can be examined very precisely. Therefore predictions of the damages and the TBO are more accurately.

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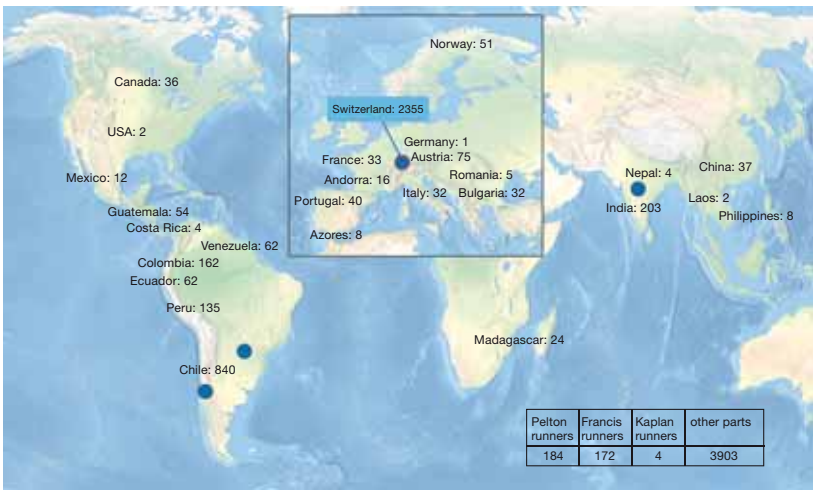
High water jet quality in the free-jet test rig

Coated parts by ANDRITZ HYDRO



Pelton runners	Francis runners	Kaplan runners	other parts
184	172	4	3903

Figures present the number of coated parts by ANDRITZ HYDRO

● Coating workshops of ANDRITZ HYDRO and subsuppliers:
– Switzerland (Center of Competence)
– India
– Chile
– Brazil

Ribeiradio and Ermida

Third contract for ANDRITZ HYDRO in Portugal

After signature of contract

On December 10, 2010 ANDRITZ HYDRO signed a further contract with Energias de Portugal (EDP) for the supply and installation of the complete electromechanical package for the two power plants of Ribeiradio and Ermida on the river Vouga in the northern part of Portugal, around 100 km southeast of Porto.

Artist impression of Ribeiradio power plant

This is the third large contract for ANDRITZ HYDRO in Portugal after Bemposta (2008) and Baixo Sabor (2009). With that step, ANDRITZ HYDRO is confirming its leading position within the Portuguese hydropower market. Ribeiradio/Ermida was the fifth contract for a new large hydropower plant that was awarded by EDP within the last four years. The projects were Picote II, Bemposta II, Alqueva II, Baixo Sabor and Ribeiradio/Ermida. The project was under special attention as the investment of EDP was on the border of being economically viable. Thanks to the efforts of ANDRITZ HYDRO in presenting alternative and more economical solutions, the contract could be received. The project Ribeiradio/Ermida will be executed in collaboration between ANDRITZ and the Portuguese consortium partner EFACEC Engenharia e Sistemas, supplier of the transformer, electrical systems and electrical installation partner. Within ANDRITZ HYDRO, this project is the first contract for execution in collaboration between Large Hydro (Ravensburg, Weiz, Linz) and COMPACT HYDRO (Ravensburg).

The scope of supply of the consortium is the following:

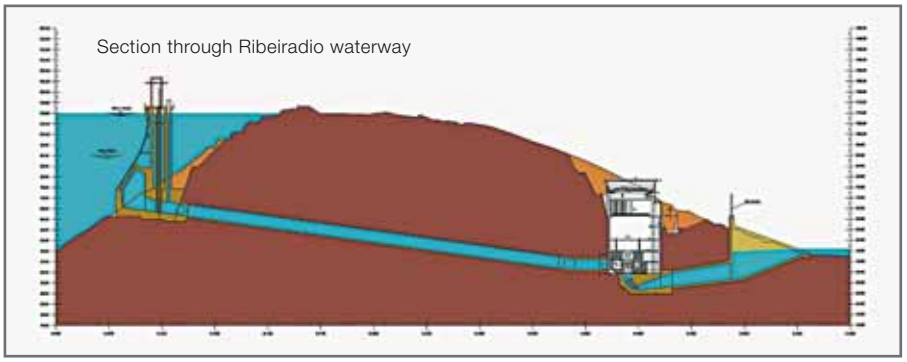
Ribeiradio:

One vertical Francis turbine incl. governor and auxiliaries, one generator W42 incl. excitation system and generator auxiliaries, medium and high voltage systems incl. switchgear, all other balance of plant and hydraulic steel structures incl. gates and penstock.

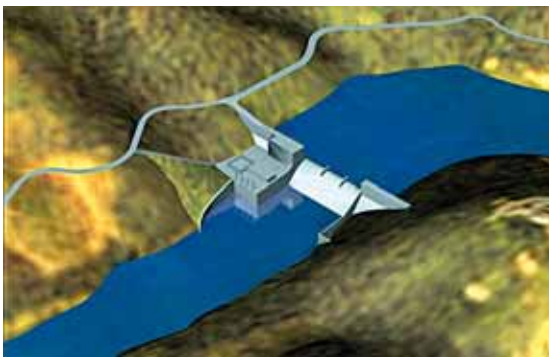
Ermida:

Two horizontal COMPACT Axial turbines incl. governors and auxiliaries, two generators incl. excitation systems, medium and high voltage systems incl. switchgear, all other balance of plant and hydraulic steel structures incl. gates and penstocks.

The project is under construction since mid of 2010 and is foreseen to be installed until early 2014.



Two typical CAT-turbines



Artist impression of Ermida power plant

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TECHNICAL DATA: Ribeiradio
OUTPUT: 77 MW / 83 MVA
VOLTAGE: 15 kV
HEAD: 65 m
SPEED: 176.47 rpm
RUNNER DIAMETER: 3,700 mm
STATOR DIAMETER: 8,900 mm

TECHNICAL DATA: Ermida
OUTPUT: 2 x 3.8 MW / 4.3 MVA
VOLTAGE: 6 kV
HEAD: 16 m
SPEED: 300 rpm
RUNNER DIAMETER: 1,950 mm

Hongrin reservoir

Hongrin Léman Plus and Chippis

Two new orders in Switzerland

In February 2011 ANDRITZ HYDRO received an order of Forces Motrices Hongrin Léman SA (FMHL) within the scope of the Hongrin Léman Plus project. The contract comprises the supply, installation and commissioning of two vertical Pelton turbines including governing systems, all auxiliaries, tailrace stoplogs and the cooling systems for each of the ternary units.

To provide valuable free controllable energy to cover peak demand and to compensate non-predictable wind and solar energy, the installed capacity of the pumped storage plant Hongrin Léman will be doubled. The existing pumped storage power plant Veytaux which is situated near the picturesque Castle of Chillon was commissioned in 1971 and has an installed capacity of 240 MW. The four horizontal pumped storage units use the head difference between the artificial Hongrin reservoir (1,250 m) and Lake Geneva (372 m).
Close to it the new pumped storage power plant Veytaux will be located. In an underground cavern of 97 m length and 24 m wide two vertical ternary pumped storage sets will be installed, consisting of motor generator, 5-jet Pelton turbine, coupling, 5-stage storage pump, the associated auxiliary service control and three spherical valves per unit. The new units essentially use the same headrace system as the existing pumped storage plant. The safety of the existing steel penstock under all possible operating conditions, also in combination with the existing power plant Veytaux, is thus of utmost importance. The construction work for the new pumped storage power plant shall start already in 2011 and the two new units are scheduled to start operation in late summer 2014.

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TECHNICAL DATA: Hongrin Léman Plus
OUTPUT: 2 x 118.8 MW
HEAD: 804.7 m
SPEED: 500 rpm
RUNNER DIAMETER: 2,375 mm

At the power station Chippis in the heart of Valais four generating units with Francis double-runners are driven by the water of river Rhone. In 2009 the HYDRO Exploitation SA, being representative of the power plant holder FMV (Forces Motrices Valaisannes), awarded the delivery of five new runners.

The innovative tender of ANDRITZ HYDRO led to a significant increase in efficiency and, therefore, the order was awarded successfully. In addition to the originally scope of supply provided in the tender, a part of the revision works and the supply of intermediate devices which ensured the functioning of the existing runners were also committed to ANDRITZ HYDRO.

Chateau de Chillon at Lake Geneva

The runners are produced by forming technology and, therefore, the blade material is of highest quality. This affects better mechanical properties of the runner as well as short maintenance periods.

The new hydraulic profile also avoids cavitation. Due to the abrasion-resistant coating SXH™70, the intervals between maintenance can be increased significantly. The delivery of the runners is expected by 2013.

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The Chippis Francis turbine

The Chippis double runner

TECHNICAL DATA: Chippis
OUTPUT: 4 x 12.1 MW
HEAD: 80.4 m
SPEED: 428.6 rpm
RUNNER DIAMETER 1,412 mm

Machinery room of power plant Bärenburg

Bärenburg

Renewal of Francis turbines in Switzerland

ANDRITZ HYDRO received an order of the Kraftwerke Hinterrhein AG (KHR) for the renewal of the turbines (lot M2) for the power plant Bärenburg in October 2010. The contract includes the design and supply of new runners for the four Francis turbines, new hydraulic turbine governors, the major overhaul of the existing units and the re-commissioning.

The power plant cascade of KHR was commissioned in 1963. It uses the water power of the Hinterrhein in three stages and has a total installed capacity of 650 MW. After about 45 years of operation all installation parts need a major investment for renovation and renewal.

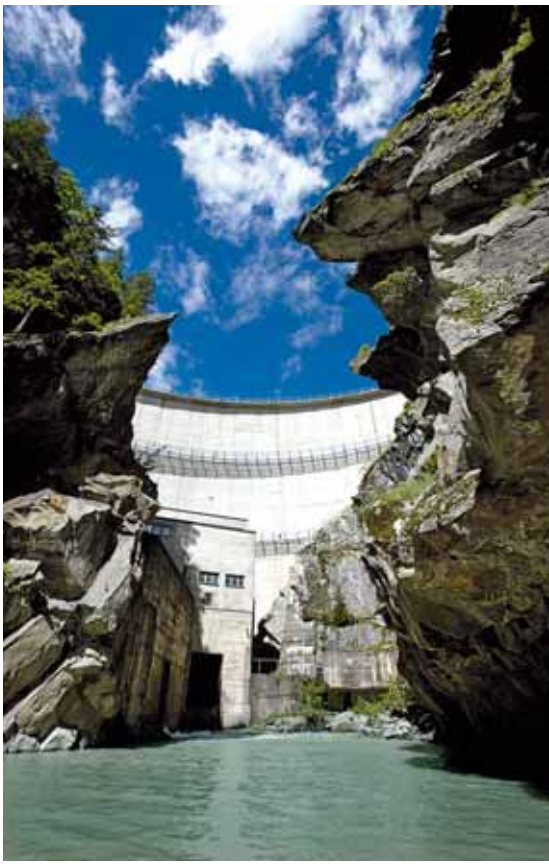
This applies to all embedded and water guiding parts as well as for the electromechanical equipment and the control systems, which no longer correspond to the state of the art. Therefore, the KHR has launched an extensive overall renovation project that will last from 2011 to 2016/17.

Bärenburg, the middle of the three power stations, uses the head difference between the Sufers reservoir (1,401 m) and the compensating reservoir Bärenburg at an elevation of 1,080 m. The four vertical shaft Francis turbines have a total output of 220 MW.

The general review and modernization is carried out for one unit per year. A profitability analysis has shown that the productivity of the overall project can be improved significantly using new runners with a modern hydraulic profile. Thus, new runners optimized by Computational Fluid Dynamics (CFD) are used, which will increase the efficiency.

In addition to the replacement of the runners also hydraulic turbine governors are renewed. The major revision of the turbines is carried out according to a state-oriented conception in which the individual components are extensively tested at the ANDRITZ HYDRO Kriens plant and in cooperation with KHR the scope of renovation is optimized.

This results in a high overall economic efficiency. The dismantling of the first unit at Bärenburg starts in May 2012. The last updated turbine will be connected to the grid by 2015.



The Sufers dam

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TECHNICAL DATA:
OUTPUT: 4 x 55 MW
HEAD: 338 m
SPEED: 600 rpm
RUNNER DIAMETER: 2.300 mm

Dam and switchyard of power plant Bärenburg

Såheim power plant

Rjukanstrengen

New contract signed with Norwegian based aluminium company

The contract includes the upgrading and refurbishment of electrical and mechanical equipment at several power plants of the aluminium company HYDRO in the river system Rjukanstrengen in Norway.

The hydropower system at Rjukan includes the five power plants Frøystul, Vemork, Såheim, Moflåt and Mæl which together have an average annual production of electricity of approx. three TWh, or about 30% of the company's electricity production. This area had an important role in the industrial development of Norway and it has an interesting history. In 1906, HYDRO started the construction of what was to be the world's largest hydroelectric power plant. The 108 MW Vemork power plant at the Rjukan waterfall was opened in 1911, after six years of construction. The project was so expensive that the works had to be financed by overseas sources. The plant became the corporate precursor to HYDRO. Ten 10.8 MW units were supplied by Voith and AEG (units 1-5) and Escher Wyss and Oerlikon (units 6-10). Vemork's main purpose was to fix nitrogen for the production of fertilizer. Vemork was later the site of the first plant in the world to mass-produce heavy water developing from the hydrogen production then used for the Haber process. During World War II, Vemork was the target of Norwegian heavy water sabotage operations. The heavy water plant was closed in 1971 and in 1988 the power station became the Norwegian Industrial Workers Museum.

The new Vemork power plant was commissioned in 1971. It is a modern plant build in the mountain behind the old plant and has two Francis units with a total output of 180 MW. Today, HYDRO has decided to invest approx. 110 million Euro from 2011 to 2015 in upgrading the whole hydroelectric system in Rjukan. The target is the modernization and refurbishment of the major power plants to ensure a safe and stable power supply in a long term perspective. ANDRITZ HYDRO contracts include delivery of three new Francis runners, rehabilitation of the existing turbines and generators and the upgrading of the existing penstock and gates. The contract was signed in 2010 and our final milestone is in the fourth quarter 2014. This package of projects contributes significantly to value added at the ANDRITZ HYDRO location in Jevnaker. The majority of deliveries will be carried out in 2012. During the summer of 2012 the water system which connects three power plants will be closed down and works on the plants will be done more or less in parallel. This makes both the detailed planning and the execution of work demanding. The projects include both in-house fabrication and on site work. Our sister companies in Spain (Madrid) and Switzerland (Zurich) are of central importance in the design and production of new Francis runners for Frøystul, Moflåt and Mæl. For the ANDRITZ HYDRO location at Jevnaker these contracts represent approx. 65,000 working hours in total including project management, engineering, workshop hours, installation and commissioning. There will be another 30,000 hours if all the options are actuated.

Vemork old power plant

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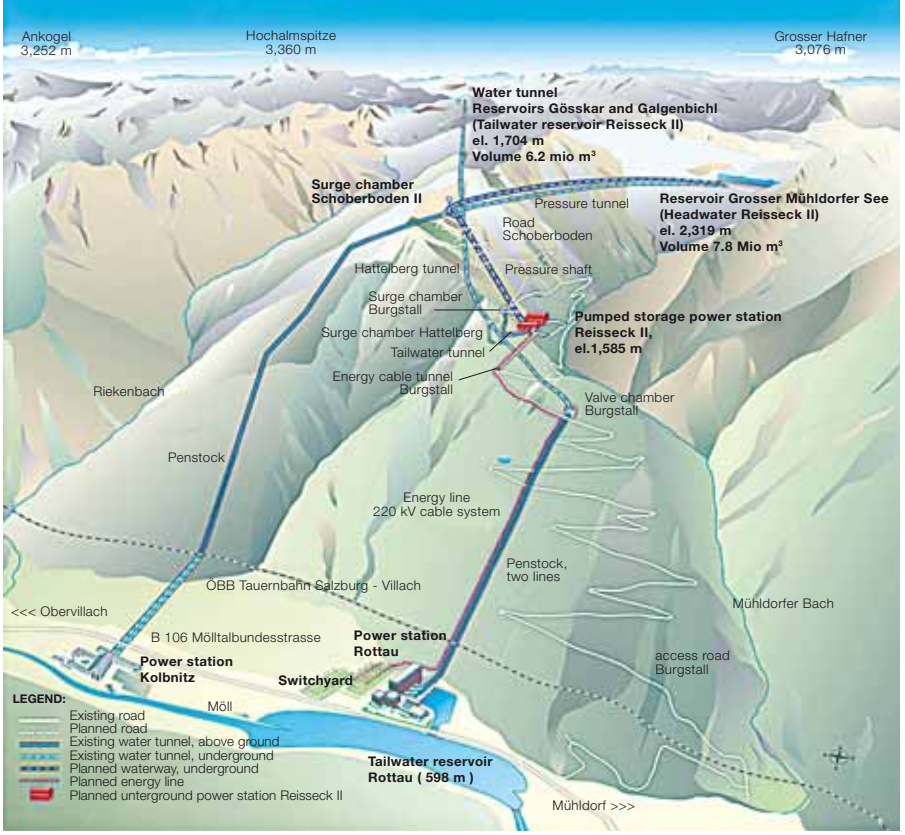
TECHNICAL DATA: Frøystul
OUTPUT: 41 MW / 50 MVA
VOLTAGE: 11 kV
HEAD: 54 m
SPEED: 214.3 rpm
RUNNER DIAMETER: 3,070 mm

TECHNICAL DATA: Vemork
OUTPUT: 2 x 90 MW / 110 MVA
VOLTAGE: 12 kV
HEAD: 282 m
SPEED: 375 rpm
RUNNER DIAMETER: 1,916 mm

TECHNICAL DATA: Såheim
OUTPUT: 63 MW / 70 MVA
VOLTAGE: 10 kV
HEAD: 268 m
SPEED: 500 rpm
RUNNER DIAMETER: 1,625 mm

TECHNICAL DATA: Moflåt
OUTPUT: 30.4 MW / 32 MVA
VOLTAGE: 10 kV
HEAD: 44 m
SPEED: 166.7 rpm
RUNNER DIAMETER: 3,150 mm

TECHNICAL DATA: Mæl
OUTPUT: 39.9 MW / 50 MVA
VOLTAGE: 10 kV
HEAD: 42.8 m
SPEED: 150 rpm
RUNNER DIAMETER: 3,574 mm



Scheme of the pumped storage plant Reisseck II

Reisseck II

Contract for two motor-generators

VERBUND Hydro Power has commissioned ANDRITZ HYDRO with the supply and installation of two motor-generators with corresponding excitation equipment for the hydropower plant Reisseck II.

The power plant belongs to the group Malta / Reisseck / Kreuzeck in Carinthia, situated in southern Austria.
The two units are built in underground caverns and extend the output for the operation of the turbine group by 40%. In pump operation the capacity is even doubled. The existing hydraulic system can be used and no new reservoirs are necessary. The existing lake Grosser Mühldorfersee serves as head water pool, the two compensating reservoirs Gösskar and Galgenbichl are used as lower pools. Therefore, additional balancing and control energy can be provided in an environmentally friendly manner.

In accordance with the requirements and estimating six unit starts daily a calculated life cycle of 70 years was proved in advance. ANDRITZ HYDRO is able to exceed even those requirements. Thanks to the wide experience in the design of such high speed units, ANDRITZ HYDRO was able to rely to the so-called comb-type pole fastening technology.

This technology saves the rotating components at the best also under extreme stress levels due to a central, massive, forged hollow body. This design is also characterized by an extremely smooth dynamic behavior during operation. The high efficiency of these units confirmed ANDRITZ HYDRO with a value of more than 99% once more as leading manufacturer of motor-generators.

The lakes Mühldorfer as headwater reservoirs

The ground-breaking ceremony for Reisseck II took place on October 8th, 2010, the commissioning is scheduled for 2014. After the projects Kops II, Hintermuhr and Limberg II this order further demonstrates the confidence of Austrian energy suppliers in the competence of ANDRITZ HYDRO.

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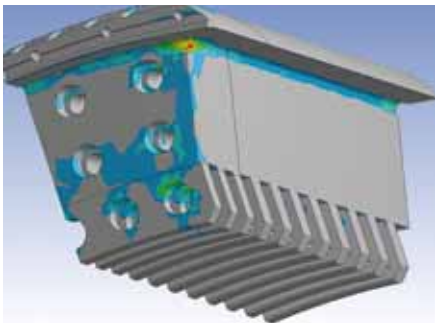
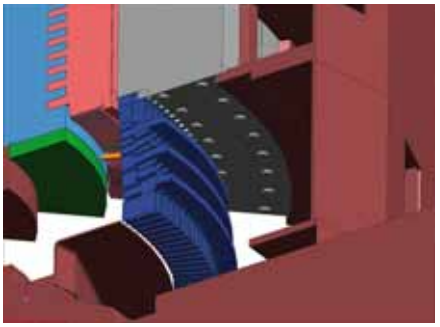
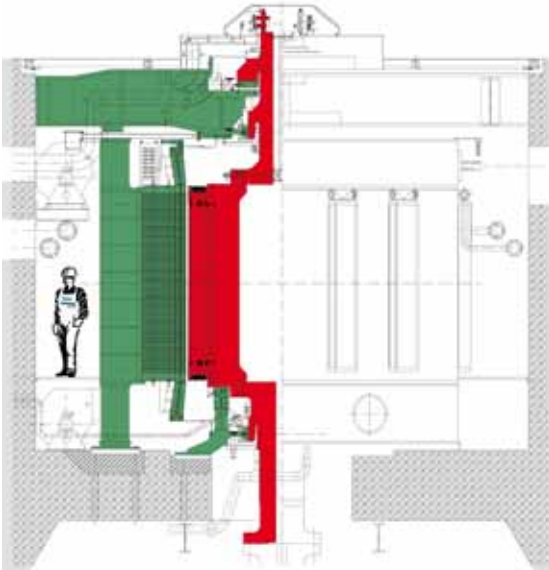
TECHNICAL DATA:
OUTPUT: 2 x 240 MVA
VOLTAGE: 15.5 kV
SPEED: 750 rpm
RUNAWAY SPEED: 1,140 rpm
STATOR DIAMETER: 6,200 mm (hexagon)



Comb-type pole



3D CFD model



Grinding of Pelton turbine runner at the ANDRITZ HYDRO India Prithla plant

Kashang and Pare

Success of ANDRITZ HYDRO in India continued 2010

2010 ANDRITZ HYDRO has secured two additional large hydro contracts in India. This demonstrates once again the commitment and sustainability of its operations. Due to the persistent success to achieve order intakes over the recent years ANDRITZ HYDRO is proud to have received contracts for several utilities and IPP's in various stages of completion totaling a base of more than 3,000 MW. After completion these will constitute a major contribution to the countries enhancement of hydropower utilization.

ANDRITZ HYDRO has signed a contract with Himachal Pradesh Power Corporation Ltd. (HPPCL), India on April 29th, 2010 for the execution of Kashang Hydro Electric Project. This project is one out of four funded by Asian Development Bank. The first contract for Sawra Kuddu, awarded to ANDRITZ HYDRO in 2009 is in the implementation stage. HPPCL is entrusted with a target of achieving 3,000 MW power generating capacity by March 2017 and 5,000 MW by the year 2022.
The project is located in the northern part of India in the state of Himachal Pradesh. The scope includes design, supply, installation, and commissioning of three vertical shaft Pelton turbines, generators and its auxiliaries including the complete balance-of-plant equipment. The Kashang contract has been awarded to ANDRITZ HYDRO against international competition from Alstom, Voith Hydro and BHEL, India. The completion of the contract is scheduled in two phases: unit 1 and 2 in 39 months (Phase I) and unit 3 within additional 24 months (Phase II). Just before the end of the year, on December 23rd, 2010 ANDRITZ HYDRO has signed a contract with North Eastern Electric Power Corporation Ltd. (NEEPCO), India for the execution of the Pare Hydro Electric Project. NEEPCO, a Schedule "A" Government of India Enterprise under the Ministry of Power was set up 1976 to plan, investigate, design, construct, generate, operate and maintain power stations in the north-eastern region of the country. NEEPCO has an installed capacity of 1,130 MW which is 49% of the total installed capacity of this region. The contract is scheduled to be completed in 35 months. For funding of the project a loan agreement was signed with Kreditanstalt fuer Wiederaufbau (KfW), Germany.
This run-of-river scheme is located in the state of Arunachal Pradesh to harness the hydropower potential of the river Dikrong which is a tributary of river Brahmaputra and also utilizes the tailrace discharge of the existing Ranganadi Project Stage I.

The scope includes design, supply, installation and commissioning of the two vertical shaft Francis turbines, generators and auxiliaries, main inlet valves, control and protection systems, power and control cables and other power plant equipment.

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Stator assembly in the ANDRITZ HYDRO India Mandideep plant

After contract signature of project Pare

Civil works in progress for the Kashang hydroelectric project

TECHNICAL DATA: Kashang
OUTPUT: 3 x 65 MW / 72 MVA
VOLTAGE: 11 kV
HEAD: 818.3 m
SPEED: 600 rpm
RUNNER DIAMETER: 1,920 mm
STATOR DIAMETER: 3,920 mm

TECHNICAL DATA: Pare
OUTPUT: 2 x 55 MW / 61.12 MVA
VOLTAGE: 11 kV
HEAD: 67.36 m
SPEED: 187.5 rpm
RUNNER DIAMETER: 3,210 mm
STATOR DIAMETER: 7,440 mm

Contract signing for La La Shan project

La La Shan and Gong Ge Er

ANDRITZ HYDRO China wins important Francis and Pelton turbine orders

In September 2010, ANDRITZ HYDRO China signed a contract from Huaneng Batang Hydropower Project Construction Preparation Division for the supply, design, manufacture, supervision and commissioning of two Francis turbines, generators, main inlet valves and accessories.

This order is an important milestone in the continuation of the GE high head Francis business. The runners will be manufactured in our own ANDRITZ HYDRO China workshop in Foshan. All other turbine and generator equipment will be manufactured in the workshop of our manufacturing Partner Tianbao. The windings are manufactured in our workshop in India. La La Shan project is located at the west part of China in Sichuan province. The total contract will be completed in a time span of 54 months.

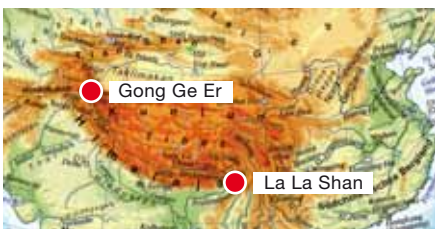
Draft tube for La La Shan

The customer – Huaneng Batang Hydropower Project Construction Preparation Division is a branch of Huaneng Group, one of the largest hydropower companies in China with a history of close cooperation with ANDRITZ. In the year 1998, still under GE Hydro, a contract was signed with the customer for the Leng Zhuguan project, the first high head project in China. Besides, the customer had good cooperation on several projects like Xiaotiandu, Ziyili, Baoxing – and Yinping projects etc.

Now, ANDRITZ HYDRO China was awarded the first high head contract (La La Shan project) with the same customer. Presently the project is executed smoothly, the manufacturing of the first delivery parts (two sets of draft tubes) was done at the end of January 2011.

In August 2010, ANDRITZ HYDRO China signed a contract from Kunming Electrical Machinery Co., Ltd (E & M Contractor) for the supply, design, manufacture, supervision and commissioning of three vertical shaft 6-jet Pelton turbines for project Gong Ge Er. This order is the first Pelton turbine project for ANDRITZ HYDRO in China.

Except the runners and nozzles, all other turbine equipment will be manufactured in the workshop of our manufacturing partner Tianbao. The Gong Ge Er power plant is located at Bu Lun Kou, Kezhou, Xinjiang autonomous regions, approx. 135 km from Kashi City, China. The total contract will be completed in a time span of 33 months. The enduser – Xin Jiang Ke Zhou Hydropower Co. Ltd. is a branch company of Guang Xi Water Resources & Electric Power Group.



Location of the Gong Ge Er and La La Shan projects

The Gong Ge Er hydropower station is the first stage power station in the middle reaches of Gez river in Xinjiang. There are six high head hydropower stations that will be built up in a near future by the same company.

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TECHNICAL DATA: La La Shan
OUTPUT: 2 x 48 MW
HEAD: 212 m
SPEED: 428.6 rpm
RUNNER DIAMETER: 1,640 mm

TECHNICAL DATA: Gong Ge Er
OUTPUT: 3 x 68.72 MW
HEAD: 607 m
SPEED: 500 rpm
RUNNER DIAMETER: 2,556.7 mm

Great Success

for COMPACT HYDRO in 2010

In 2010 the ANDRITZ HYDRO Division of COMPACT HYDRO had great success and booked an excessive number of orders with 131 turbines with a total installed output of 580 MW amounting in an "all time high" order intake for the year. In the following some highlights.

Miedl, Kreuzer and Rössler, Austria

At the beginning of 2010 ANDRITZ HYDRO received orders from three individual farmers for power stations with Pelton turbine units which are located in the province of Styria in the district of Murau.

Power stations within the Alpine region are characterized by a very large flow range. After deduction of the ecological flow the turbines will have about 5% of the rated unit discharge only. All of these stations are of run-of-river type with water catchments by means of Tyrolean intakes. Those Austrian customers rave about the high part load efficiencies of the vertical Pelton turbines offered out of the ANDRITZ HYDRO COMPACT HYDRO program. Even in winter time with minimum available discharges the applied hydraulic technology by ANDRITZ HYDRO enables them to continue with power generation. Convinced of this technology and compactness of the unit design the owners of the power stations awarded the contracts to ANDRITZ HYDRO, each with a scope of supply consisting of a multi nozzle vertical Pelton turbine, inlet valve, inlet transition pipe to the penstock and synchronous generator including installation and commissioning. The power houses are connected via a 30 kV switch gear to supply the power to the public grid. End of 2010 all the units were put into commercial operation within a construction period of nine months.

Budac 1, Romania

In mid of October 2010 SC Rotthaus Construct SRL with the Austrian main share holder of Haider Energy Ltd. awarded a contract to ANDRITZ HYDRO to deliver the turbine generator equipment for the hydro power station Budac 1. The entire construction work of the weir, penstock and power house will be executed by the main share holder's own construction company Gebr. Haider.
The weir at the intake is equipped with a Tyrolean intake, a desilter chamber which forwards the water to a 1,530 m long buried penstock made from GRP to the Pelton turbine. A generator will be synchronized to a low voltage circuit breaker. A further one to a 1,000 kVA (400 V / 20 kV) transformer which is connected by means of 20 kV circuit breaker to the public grid. The scope of supply of ANDRITZ HYDRO comprises a six nozzle vertical Pelton turbine with hydraulic power unit, the penstock connection pipe, butterfly valve (DN700) and a synchronous generator. Furthermore ANDRITZ HYDRO is also responsible for the installation and commissioning of the supply. The start up is scheduled for May 2011.

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Pederobba & Croce del Gallo, Italy

Pederobba and Croce del Gallo are both located in North East Italy near the city of Treviso on the river Piave. The two hydropower plants were commissioned in 1929 and now the customer (ENEL) decided to renew them in order to exploit the potential of the "green certificate" regulation.

The old turbines, vertical Francis for Croce del Gallo and vertical Kaplan for Pederobba, were manufactured and installed by the company Riva in 1928 and will be substituted by two different sized double regulated vertical Kaplan turbines. The scope of supply will include turbines and governors. The expected delivery time foresees 13 months ex works. In despite of the small installed output the combined project confirms the strategically relation between ENEL and ANDRITZ

HYDRO in Italy and abroad not only on large scale projects but even where the competition of small suppliers forces new challenges to our COMPACT HYDRO segment.

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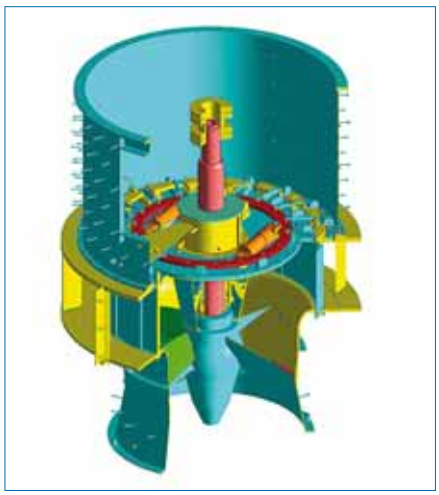
Haslen, Switzerland

ANDRITZ HYDRO received an order from the cotton spinning company Jenny Daniel & Co. to supply a vertical Kaplan turbine equipment from COMPACT HYDRO.

Like a pearl cord the existing new hydropower stations Linthal, Mühlefuhr, Hätzingen and Ziegelbrücke (all of them equipped with COMPACT Axial turbines made by ANDRITZ HYDRO) lines up along the river Linth in the Glarnerland in Switzerland. ANDRITZ HYDRO will supply a further pearl with the order Haslen, which supplements the new upstream power stations at that river. It includes one COMPACT Kaplan turbine at an existing channel. This replaces a 100 years old horizontal Francis flume turbine with a twin runner installed by the company Bell/Kriens with an output of 420 kW. The scope of supply covers a 5-blade vertical Kaplan unit, synchronous generator (400 V), control of the weir equipment, the entire electrical balance of plant, installation and commissioning. To decrease mostly the structure borne and airborne sound the complete power station building is put on insulation mats. In addition, all the turbine and generator bearings are made of sleeve type and the generator will be cooled by a closed water cooling system. This solution provides the additional advantage to reduce the noise coming from the generator. The commissioning is scheduled for August 2011.



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Daran I & II, Turkey

The power stations are located in Turkey between Daran and Dumlugöze in Ermenek district of Karaman Province.
Daran project owner is Kurtsuyu Elektrik Uretim A.S, a partnership between Yılsan Investment Holding and Nokta Investment Holding, who are also owners of Caldere operating a 9 MW four nozzle vertical Pelton turbine supplied by ANDRITZ HYDRO in 2007. Daran I will be composed of two horizontal Francis units. The turbines will be supplied from France, generators from India and electrical balance of plant and site installation services by ANDRITZ HYDRO Ltd. Sti in Turkey.

Daran II consists of two horizontal Francis units too. The turbines will be supplied by ANDRITZ HYDRO in France, generators by Moteurs Leroy Somer, France and electrical balance of plant and site installation services again by ANDRITZ HYDRO Ltd. Sti in Turkey. Contracts of both projects have been signed in November 2010 and plants will be in commercial operation in 24 months.

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TECHNICAL DATA: Miedl
OUTPUT: 709 kW
HEAD: 115 m
SPEED: 600 rpm
RUNNER DIAMETER: 710 mm

TECHNICAL DATA: Kreuzer
OUTPUT: 670 kW
HEAD: 112.9 m
SPEED: 600 rpm
RUNNER DIAMETER: 710 mm

TECHNICAL DATA: Rössler
OUTPUT: 837 kW
HEAD: 317.0 m
SPEED: 1,500 rpm
RUNNER DIAMETER: 480 mm

TECHNICAL DATA: Pederobba
OUTPUT: 2,800 kW
HEAD: 8.80 m
SPEED: 167 rpm
RUNNER DIAMETER: 2,600 mm

TECHNICAL DATA: Croce del Gallo
OUTPUT: 3,000 kW
HEAD: 22.4 m
SPEED: 375 rpm
RUNNER DIAMETER: 1,600 mm

TECHNICAL DATA: Haslen
OUTPUT: 926 kW
HEAD: 9.64 m
SPEED: 333.3 rpm
RUNNER DIAMETER: 1,450 mm

TECHNICAL DATA: Budac 1
OUTPUT: 691 kW / 850 kVA
VOLTAGE: 400 V
HEAD: 74.87 m
SPEED: 428.6 rpm
RUNNER DIAMETER: 790 mm

TECHNICAL DATA: Daran I
OUTPUT: 2 x 24,400 kW
HEAD: 129 m
SPEED: 500 rpm
RUNNER DIAMETER: 1,500 mm

TECHNICAL DATA: Daran II
OUTPUT: 2 x 10,000 kW
HEAD: 50.8 m
SPEED: 428.6 rpm
RUNNER DIAMETER: 1,500 mm

Pedregalito II and Cochea, Panama

Panama improves its resources through energy development. In April 2010, ANDRITZ HYDRO Spain was awarded two contracts by Cobra Infraestructuras Hidráulicas S.A for the supply, installation and commissioning of the electromechanical equipment for Cochea and Pedregalito II power plants, both located in the province of Chiriquí, in the east part of Panama.

Owing to the energy liberalisation, several power plants are being developed in the whole country. ANDRITZ HYDRO Spain is participating actively of this expansion through Spanish Civil Work Companies.
The complete scope of supply of these projects includes design and supply of two vertical Francis turbines in Pedregalito II and two horizontal Francis turbines in Cochea, synchronous generators, butterfly valves and digital speed governors, as well as installation and commissioning. Thanks to the vast selection of existing design within COMPACT HYDRO range, it is possible to optimize the delivery time as an additional benefit for our client. After the full satisfaction of the customer in Pedregalito I, and the strong involvement of ANDRITZ HYDRO Spain in the pre-project phase, the customer opted to implement other units with the same arrangement and are confident these new projects will be also a success.

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Stanley Adamson, Canada

In October 2010, Trent University has decided to refurbish its power plant, built in 1890, with four Francis camel-back turbines. ANDRITZ HYDRO was awarded the contract and will provide three EcoBulb™ units to be installed within the modified existing water passages.

There is a long history that links ANDRITZ HYDRO to Trent University. The land where both the University and the power plant were built was donated by Mr. Stanley Adamson, a former director of GE, that became part of the ANDRITZ HYDRO organization few years ago. It can be said that ANDRITZ HYDRO contributed to the construction of the power plant at that time. ANDRITZ HYDRO, on top of fulfilling client needs, will use this project to introduce a power converter prototype to connect the permanent magnet generator, driven by a variable speed turbine, with the grid.
This solution will extend the EcoBulb™ market to the areas where the grid has been an issue up to now. The client, being an university, is interested in seeing the application of this new technology. In the contract, beside the three EcoBulb™ units with PMG, all auxiliaries are part of the water to wire scope, including HPUs, air compressors, low and medium voltage cubicles, step-up and auxiliary services transformers, control and protection cabinets and the SCADA system.

The preliminary design has already started and the final acceptance is scheduled for August 2012.

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Nam Song, Laos

ANDRITZ HYDRO India secured an important order for the supply of three horizontal S-type Kaplan turbines from one of the leading EPC Contractors, M/s Angelique International Ltd.

This breakthrough order marks the entry of COMPACT HYDRO, India in the country of Laos PDR. The end-user is EDL who has huge growth plans for the development of hydro power in Laos. ANDRITZ HYDRO is poised to be one of the front runners in this growth.

The scope of work includes design, manufacturing, testing, supply, transportation to Mumbai port and the supervision of installation and commissioning of electro-mechanical equipment including turbine, generator, gear box and related auxiliares.

TECHNICAL DATA: Pedregalito II
OUTPUT: 2 x 6,630 kW
HEAD: 36.87 m
SPEED: 400 rpm
RUNNER DIAMETER: 1,560 mm

TECHNICAL DATA: Cochea
OUTPUT: 2 x 7,750 kW
HEAD: 121.85 m
SPEED: 600 rpm
RUNNER DIAMETER: 1,020 mm

TECHNICAL DATA: Stanley Adamson
OUTPUT: 1,300 kW
HEAD: 4.0 m
SPEED: 180 rpm
RUNNER DIAMETER: 2,350 mm

TECHNICAL DATA: Nam Song
OUTPUT: 3 x 2,000 kW / 2,350 kVA
VOLTAGE: 6.6 kV
HEAD: 5.5 m
SPEED: 130 / 750 rpm
RUNNER DIAMETER: 2,800 mm

TECHNICAL DATA: Sumez
OUTPUT: 7,000 kW / 8,750 kVA
VOLTAGE: 6.6 kV
HEAD: 614 m
SPEED: 750 rpm
RUNNER DIAMETER: 1,310 mm

TECHNICAL DATA: Irisan 1
OUTPUT: 4,017 kW
HEAD: 444.5 m
SPEED: 1,200 rpm
RUNNER DIAMETER: 710 mm

Sumez, India

ANDRITZ HYDRO India booked an order for the supply of two units of double-jet horizontal Pelton turbines from one of the leading Hydro Power Developers, M/s Ranga Raju Warehousing Pvt. Ltd., Hyderabad.

The scope of work includes design, manufacturing, testing, supply, transportation, installation and commissioning of two units of electro-mechanical equipment consisting of Pelton turbines, spherial inlet valves (DN 450 mm) and generators and electrical and mechanical auxiliaries. This project is situated in Shimla district of Himachal Pradesh.
One of the most challenging aspects of this project is that the conditions of the road which leads to site are very treacherous and transportation of heavy components like generator and crane is difficult. To overcome these problems, the generator is being shipped in disassembled condition, which is not a usual procedure for COMPACT HYDRO. This project was won after having a series of heavy negotiations with a demanding client and fierce competition with Indian and Chinese suppliers. The Sumez hydro power plant was one of four orders that ANDRITZ HYDRO received from that region.
The other projects are:
Nanti:
Two Francis 6 MW each, 207 m head
Upper Nanti:
Two Pelton 6 MW each, 253 m head
Joingini:
Two Pelton 6 MW each, 266 m head.

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Irisan 1, Philippines

ANDRITZ HYDRO in Ravensburg received an order to deliver one vertical Pelton turbine to Hedcor Inc., the largest developer of run-of-river plants in the Philippines.

The project will be installed and commissioned in Tuba, Luzon until September 2011. The scope of the ANDRITZ HYDRO supply comprises one COMPACT Pelton turbine, hydraulic governor, main inlet valve as well as turbine and generator control cabinets. INDAR our consortium partner from Spain will deliver the synchronous generator. The consortium under the lead of ANDRITZ HYDRO won the contract against international competition, convincing the customer with the concept design of one 4-jet vertical COMPACT Pelton turbine. Further on the well established long term relationship between our representatives in the Philippines and Hedcor Inc. gave us a substantial benefit in obtaining the order.

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Bajina Basta dam and powerplant with open spillway

Bajina Basta

Taking over of first unit in Serbia

In November 2007, the state owned hydropower provider EPS, Electric Power Industry of Serbia, has awarded ANDRITZ HYDRO with the rehabilitation of the run-of-river project Bajina Basta. The investment is made by the power plant owner DRINKSO LIMSKE HE Bajina Basta (DLBB) in connection with the German based KfW bank.

The Bajina Basta project which was originally inaugurated in 1966 is located on river Drina on the border between Bosnia and Serbia. It consists of four Francis turbine and generator sets having a total installed capacity of 438 MVA. On the same location there is also a pumped storage plant which increases the total output to app. 1,000 MW. With this output Bajina Basta is the second largest plant having 8% of the total Serbian electricity production. The refurbishment project includes the design, uprating, manufacturing, transport, installation and commissioning of four Francis turbines, generators, control, excitation, main transformers, medium voltage and outdoor high voltage switchgear. The revitalisation will increase output by 13%; the production of valuable energy will be increased by 40 GWh. In addition to above values, the delivered new turbine is 3% better as the contracted values and the generator has a better efficiency of 0.1 %.

Successful commissioning teams of client and ANDRITZ HYDRO

During the official celebration of handover the first unit to the owner, the CFO of DLBB, Mijodrag Citakovic expressed his satisfaction and positive experience with the main contractor ANDRITZ HYDRO and its Serbian sub-suppliers.

The Austrian Ambassador Clemens Koja and German Ambassador Wolfram Maas expressed that the successful project is a good example of cooperation between the European countries, whereas the Serbian Minister of Energy and Mining Petar Skundric highlighted the importance of reliable energy produced by own renewable energy resources. ANDRITZ HYDRO's Senior Vice President Alexander Schwab explained that with the successful commissioning of the important Bajina Basta project ANDRITZ HYDRO has an excellent base for a further cooperation with DLBB and in the Serbian market. The successful commissioning of the unit has been made by the teamwork of ANDRITZ HYDRO teams from Vienna, Weiz, Ravensburg and Serbia.

Turbine runner ready for installation

Generator rotor ready for lifting into final position

Wicket gate mechanism with individual servomotors

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TECHNICAL DATA:
OUTPUT: 4 x 105.6 MW / 109.5 MVA
VOLTAGE: 15.56 kV / 50Hz
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 OFAF
VOLTAGE: 15.56 / 242 kV

Ashta I and II

The world's largest HYDROMATRIX® project takes shape

Ashta II powerhouse construction in April 2011

After winning the concession rights to build and operate the Ashta I and II project in Albania in 2008, Energij Ashta, a joint venture held by VERBUND Hydro Power AG and EVN, and its project partners ANDRITZ HYDRO, PYÖRY and PORR have made big strides in the design, engineering and construction of what will be the world's largest HYDROMATRIX® power plant. As the powerhouse of Ashta I already takes shape, it seems appropriate to give an update of the progress which has been made in the 16 months since the supply contract for the major electro- and hydromechanical components was awarded to ANDRITZ HYDRO.

Two very busy construction sites
The construction sites at the future locations of the Ashta I and II hydropower plant located on the Drin river near the city of Shkodra in Albania are bustling with activity: tons of earth have already been moved to shape the future 6 km long canal which will connect the two HYDROMATRIX® plants and to allow the foundation works for both powerhouses. While the concreting on the sill level of Ashta II has just been completed and the placing of the first draft tubes is about to begin, the powerhouse of Ashta I is already spreading in its entire length and continues to rise. All 45 draft tubes have been installed and embedded in concrete. In March the first sections of the powerhouse have reached the elevation to allow the installation of the powerhouse crane and trash rack cleaning machine. The installation of the intake trash rack and guiding rails for the turbine generator units and draft tube gates will begin as soon as the powerhouse crane is operational.

Manufacturing and testing of HYDROMATRIX® components well on track
In January 2010, ANDRITZ HYDRO has started an extensive and complex manufacturing and logistics operation to ensure that the 90 turbine generator units and associated components are all arriving on schedule at the construction site. The delivery of all hydraulic steel structures for Ashta I is completed and is ongoing for Ashta II. After successful completion of the two hydraulic model tests ANDRITZ HYDRO has subsequently passed the prototype testing for the turbine generator units in cooperation with GAMESA, the chosen subcontractor for the permanent magnet generators. Serial production began shortly thereafter. The first lot of units has been assembled and is ready for shipment. The powerhouse gantry crane and the trash rack arrived at site, while the crane for Ashta II was waiting for its transport. For Ashta I, the hydraulic power units, 45 servomotors and nine generator step-up transformers have been shop tested and are scheduled to be sent to site in July 2011 to be installed inside the powerhouse gallery.

Fast track construction continues
With the nearing construction completion of the Ashta I powerhouse in June 2011, the Ashta II site will soon become crowded with ANDRITZ HYDRO installation personnel. Although the difficulties encountered during the initial excavation works (compounded by major flood events in 2010) have impacted the construction schedule, Energij Ashta and all its partners work towards bringing the two plants online by end of 2012 and beginning of 2013.

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Ashta I downstream view

TECHNICAL DATA: Ashta I
MAX. PLANT CAPACITY: 24.03 MW / 24.64 MVA
VOLTAGE: 3.3 kV
HEAD: 4.98 m
SPEED: 300 rpm
RUNNER DIAMETER: 1,320 mm

TECHNICAL DATA: Ashta II
MAX. PLANT CAPACITY: 45.14 MW / 46.29 MVA
VOLTAGE: 3.3 kV
HEAD: 7.53 m
SPEED: 375 rpm
RUNNER DIAMETER: 1,320 mm

HYDROMATRIX® turbine generator units

Installation of turbine runner

Guri II

The installation of unit 12 is completed

The waiting has an end: The first unit at Guri II turns! At the end of last year the rehabilitation of the first of five units of the hydropower plant Guri II was completed successfully by the team of EUROBRAS in Venezuela. So there were no more obstacles for the commissioning by our customer EDELCA. The first hurdle of this final inspection is taken: unit 12 accomplished after nearly 18 months of rehabilitation the first turn with water without any problems. A major achievement for all employees, who are involved in this project and all of them can be proud of that.

To get there has not always been easy. Additionally to the normal operations that were planned for the delivery and implementation of all the contracts works specified in the contract, such a large rehabilitation project contains always unexpected challenges within itself.

These often remain hidden in the planning phase and can only be solved by the precise and coordinated teamwork at the construction site with the know-how of the ANDRITZ HYDRO departments. Knowledge and team spirit were exhausted for the work on this first machine from its start to finish, to keep the project under control and to confirm to our customers that ANDRITZ HYDRO is more than a reliable partner.

For example concrete injections in the regulating ring were necessary to stabilize the foundation of the machine in this area. In addition, corrections had to be made at the installed draft tube geometry because during the replacement of the new discharge ring a deformation of the draft tubes lining was found.

Works inspection of the second runner in Ravensburg

A particular challenge was the removal of concrete around the discharge ring to create a new support for the runner. The new runner is hydraulically much better, but 1 m longer than the original one. Additionally it was necessary to make space for the aeration system, if fins are required in the draft tube.

However, the improvements can only be determined in the commissioning phase.
The machining processing of indivi-

Re-assembly of the servo motor

dual components was carried out directly in the turbine pit and could be executed on time and above all with the necessary precision. The tight schedule was met also during the "Line-Boring" and the site machining of the flanges.

A further unexpected challenge to the team was the additional work at the two existing servo motors each with a weight of 30 tons and an oil pressure of up to 51 bar which control the distributor of the machine. Due to scheduling reasons a delivery to an experienced workshop in Europe was not possible to implement the necessary special rehabilitation.

These works were also successfully executed from the installation team in Venezuela to the full satisfaction of the customer. However, these works extended the rehabilitation period for this unit by about five months. Customer satisfaction and recognition for our technical and logistical skills resulted in a number of additional orders which ANDRITZ HYDRO has obtained during the last 18 months.

The last additional order concerned the rehabilitation work for the servo motors. The ANDRITZ HYDRO team in close cooperation with EDELCA has made a weighing up of the risks of a possible failure of these components.

The result is the delivery of eight completely new servo motors, which are to be installed by EUROBRAS in the other four units whose rehabilitation still lies ahead. The existing servo motors should be rehabilitated by EUROBRAS and then they should be stored as a reserve by EDELCA.

At the same time while the installation on site was completed, the second runner, manufactured by ANDRITZ HYDRO in the workshop in Ravensburg, was accepted by the customer. End of December this 200-ton runner with a diameter of 7.3 m was transported to the North Sea harbour and it is currently on the way to Venezuela.

On February 11th, 2011 ANDRITZ HYDRO celebrated in Ravensburg contemporaneously two successes in two distant parts of the world: While the speeches for the inauguration of the new office building in Ravensburg were held, the runner delivered by ANDRITZ HYDRO Ravensburg in December 2009 turned for the first time in the power station Guri II in Venezuela. The largest Francis runner, ever built in Europe, greeted with its awakening the modern ANDRITZ HYDRO competence centre in Ravensburg. There are certain events in life that cannot be planned better.

Installation of the generator shaft

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TECHNICAL DATA: Guri II
OUTPUT: 770 MW
HEAD: 144 m
SPEED: 112.5 rpm
RUNNER DIAMETER 7,300 mm

Installation of generator rotor

Construction site flooded before coffer dam removal

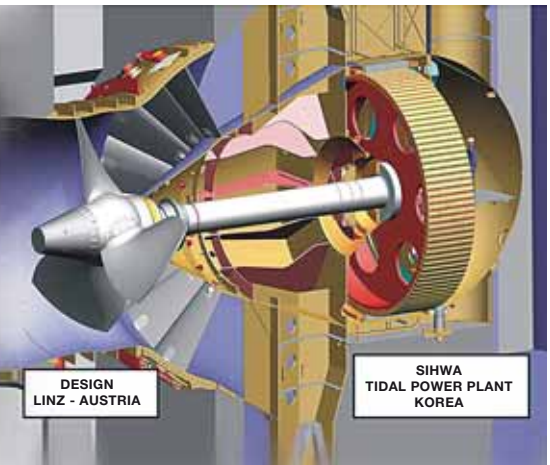
Sihwa

The world's largest tidal power plant in Korea is ready for final testing

In an effort to diversify the country's energy supply, the Korean Water Resources Corporation (K-water) decided to build the world's largest tidal power plant at Lake Sihwa in the Midwest of the Korean peninsula. Lake Sihwa is an artificial water body created in 1994 by the construction of a dam to reclaim land and to secure irrigation water for the region with a basin area of 56 km².

However, due to population growth and rapid industrialisation, the water quality of Lake Sihwa deteriorated immediately after its construction. Therefore, different schemes for the re-establishment of a water exchange between the reservoir and the sea were assessed out of which the implementation of a tidal power plant was deemed to be the most promising. Beside the production of electric energy, the plant will improve the water quality of the lake by the circulation of seawater. The working principle is flood generation, i.e. the turbine generator units work in the direction from sea to the lake. During ebb, the turbines support the water exchange through the dam gates by turning reversely in sluicing mode.

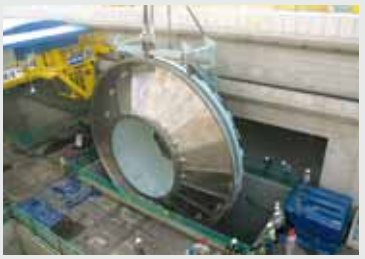
3D section of unit



ANDRITZ HYDRO is a subcontractor of DAEWOO Engineering & Construction Co., Ltd. who is the leader of the Korean joint venture acting as the main contractor for the installation of Sihwa Tidal power plant. The scope of ANDRITZ HYDRO comprises the design of the three bladed Bulb turbine generator units and their ancillaries. Moreover, ANDRITZ HYDRO supplied the core components for turbines and generators, the automation system and supervised the site installation and will execute the commissioning.
The installation of the turbines, generators, automation system and it ancillaries, as well the dry commissioning of all ten units has been completed end of 2010. Because of the large size of the major components and transport restrictions, the stators, rotors, runners and wicket gate mechanism had to be pre-assembled at site before putting into place. The heaviest parts for installation were the stator (127 tons), the rotor (110 tons), and the wicket gate mechanism with gate barrel rings (104 tons). Dry commissioning activities included signal testing, leakage tests and adjusting the governing systems.

The flooding of the area between the dams and the powerhouse is currently ongoing. The removal of the main dam has commenced and subsequently the cofferdam will be removed. In March 2011, after completion of flooding and partial removal of the dams to open the waterways, the wet commissioning has started. Comparing with a run-of-river power plant, water for generating at a tidal power plant is available for a few hours per day only. This leads to extend wet commissioning times and needs detailed planning of the activities. The completion of the wet testing is scheduled for mid 2011.

Unit finally installed



Distributor installation

Generator rotor installation

Ready for filling with water

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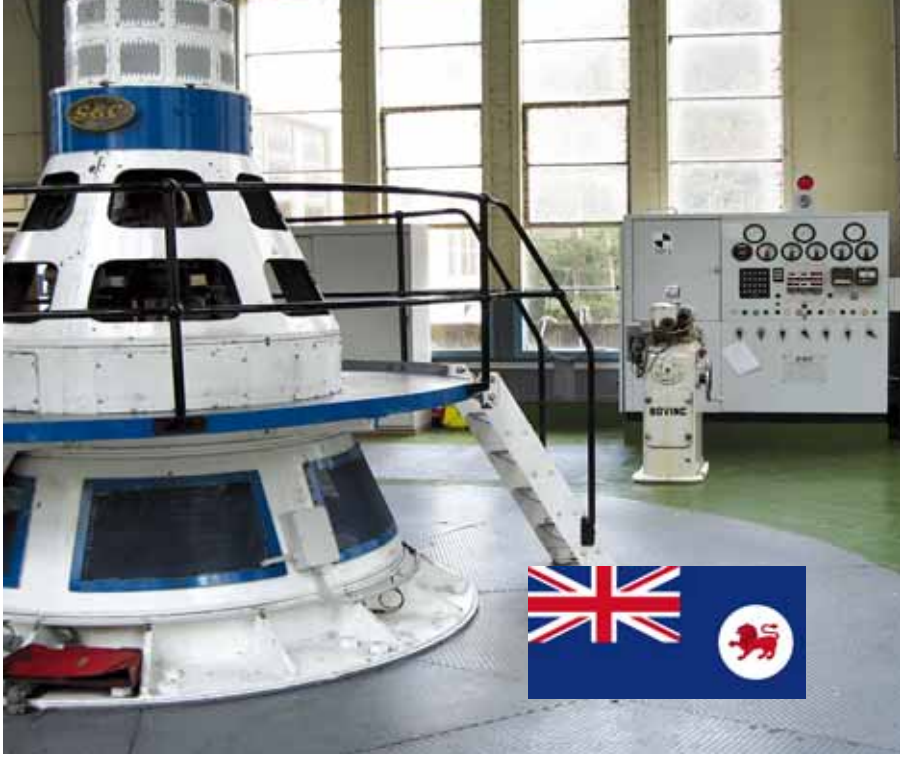
TECHNICAL DATA:
OUTPUT: 26 MW / 26.76 MVA
VOLTAGE: 10.2 kV
HEAD: 5.82 m
SPEED: 64.29 rpm
RUNNER DIAMETER: 7,500 mm
STATOR DIAMETER: 8,200 mm



Tungatinah machine hall

Tungatinah

Collaborative approach for refurbishment of Hydro Tasmania's powerstations

Tasmania is an Australian island and a state of the same name. It is located 240 km south of the eastern side of the continent, being separated from it by the Bass Strait. Tasmania is promoted as the "Natural State" owning a large and relatively unspoiled natural environment. Harnessing water to produce energy is part of Hydro Tasmania's business goals, also as to provide future generations with a clean and healthy environment.

Hydro Tasmania (HT) has the intention to modernize their installed hydro power fleet of 27 hydropower stations with standardized, modern protection and control equipment. Therefore selected vendors were invited to participate in a prequalification and selection process. The major factor in this selection process was the vendor's capability and willingness to work cooperatively with HT in developing a standard solution and in efficiently applying this solution to the stations and machines included in the upgrade program. HT was particularly interested in the value that vendors could bring to a collaborative working arrangement. Consequently, this was the key component of the assessment.

Tungatinah power station

During the selection process ANDRITZ HYDRO could convince HT to be the best partner for a cooperation. Best process knowledge and experience to develop and implement an effective control and asset management platform, that can be easily duplicated to other stations and machines at minimal costs, were presented.

Development of a standard solution, assistance in reducing the cycle time for upgrading machines, support in realizing a step change in efficiency and effectiveness during the delivery of the program as well as ongoing support to ensure that the anticipated business benefits are realized over time were further criteria. ANDRITZ HYDRO also offered the necessary training facilities, and the capability to configure, install and upgrade systems as required. In April 2010 the contract was awarded to ANDRITZ HYDRO and work started immediately to create the "Standard Model Design" (SMD) for unit control boards. This SMD should cover at least 80% of applications in all HT's power stations, only 20% at the most should be adapted to plant specific designs. The project phases "Standard Model Basic Design" and "Standard Model Detailed Design" were finalized in December 2010. Consequently, the contract for the implementation of the SMD to three machines in the Tungatinah power station, vibration monitoring systems for three machines, a common control station in Tungatinah and an asset management station in HT´s headquarters in Hobart was signed in December 2010. All subsystems are in the detailed engineering and design phase, considerably applying the output of the previous SMD phases.

Penstocks of Tungatinah

In HT's responsibility cubicles are yet in the assembly process in a Tasmanian workshop, which will be followed by an intensive, collaborative workshop test and FAT. Commissioning of the first refurbished unit is planned for June 2011.

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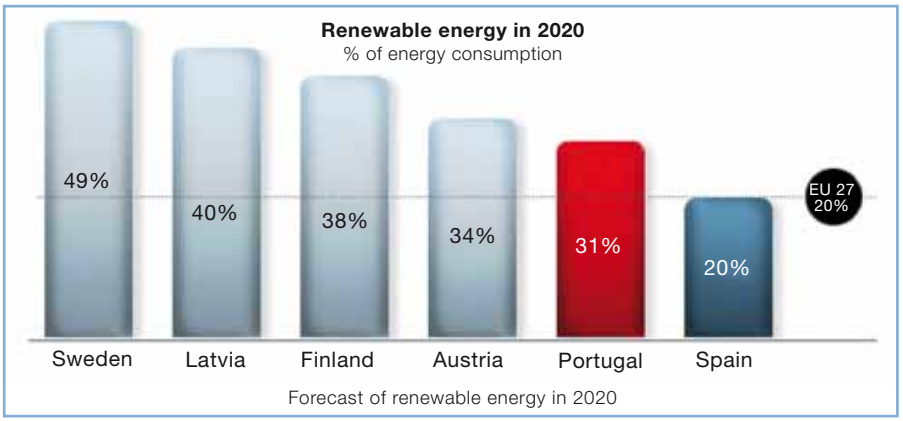
Existing Salamonde reservoir

Hydropower in Portugal

Impressive goals for renewables especially for hydropower

Portugal has committed itself within the new directives of the European Union, to increase its share of renewable energy consumption from 20.5% in 2005 to 31% in 2020.

Within the field of the renewable energies Portugal does have, besides the wind energy, also a strong focus on hydropower. It announced an ambitious investment plan for this resource, the so-called "National Plan for Dams with High Hydroelectric Potential". In total, the Energias de Portugal SA (EDP) will invest approx. three billion Euro until the end of the decade for extensions of existing power plants and the construction of new dams. For the local economy, EDP expects to create more than 30,000 jobs. The Spanish groups Endesa and Iberdrola will build and operate the remaining four dams in the National Dams Plan, whose completion is planned for 2018. At that time the country's hydro capacity should be around 9,000 MW. This will be enough to supply 2.2 million people with electricity produced from renewable energy. Throughout the last four years six important projects have been contracted. Out of these six projects ANDRITZ HYDRO has been awarded three projects with a total of eight units. ANDRITZ HYDRO will realize the projects in cooperation with different local Portuguese partners. The actual projects in detail are as follows:



Forecast of renewable energy in 2020

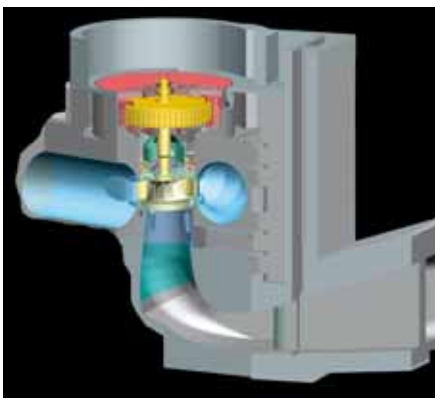
Bemposta II

Contract Signature: March 17th, 2008. Extension of the existing power plant Bemposta I from 3 x 72 MW Francis units which have been installed in the 60ies on the upper reaches of Douro river on the Spanish border. Scope of supply and works:

One Francis turbine incl. governing system and turbine auxiliary systems, one generator incl. excitation and generator

The projects of EDP can be shown as follows:

NEW POWER PLANTS	Start of construction	PAC date	Installed Capacity
Baixo Sabor (under construction)	2008	2013	171 MW
Ribeiradio – Ermida (under construction)	2011	2014	77 MW + 7.6 MW
Foz Tua	2011	2015	251 MW
Alvito	2011	2015	225 MW
Fridao	2012	2016	238 MW
POWER PLANT EXTENSIONS			
Picote II (under construction)	2007	2011	246 MW
Bemposta II (under construction)	2008	2011	191 MW
Alqueva II (under construction)	2008	2012	256 MW
Venda Nova III (under construction)	2010	2015	796 MW
Salamonde II (in offer phase)	2011	2015	204 MW
Paradela II	2014	2017	318 MW



Bemposta II turbine and generator

auxiliary systems, balance-of-plant, medium and high voltage system incl. switchgear and transformers, hydromechanical equipment incl. gates and penstock, complete installation of the mentioned equipment.

Baixo Sabor

Contract Signature: Feb. 25th, 2009. The hydropower plant Baixo Sabor is located in the lower course of Sabor river, a tributary of Douro river, approx. one hour driving distance from Bemposta II. Beside the immediate energy production and storage capacity for the power plants Montante and Jusante the storage capacity of Montante reservoir will also be used to compensate seasonal variations. With that water it is also possible to optimise the energy production of the other power stations in the lower course of Douro river during longer dry phases in summer. As in future an increasing number of projects with pump turbines in the low head range is expected this project has a special meaning. Especially with the turbines Jusante a reference could be created in the lowest head range for pump turbines. The complete project consists of two dams: the downstream barrage Baixo Sabor Jusante and the upstream barrage Baixo Sabor Montante.

Baixo Sabor Montante upstream view location of lake

Bemposta turbine runner loaded on truck

Bemposta stator lifting into pit

Jusante scope of supply and works:
Two reversible pump turbines incl. governing system and turbine auxiliary systems, two motor-generators incl. excitation system, balance of plant, medium and high voltage system incl. switch gear and transformers, hydromechanical equipment incl. gates and penstock, complete installation of the mentioned equipment.

Montante scope of supply and works:
Two reversible pump turbines with cylindrical gates incl. governing system and turbine auxiliary systems, two motor generators incl. excitation, balance of plant, medium and high voltage system incl. switchgear and transformers, hydromechanical equipment incl. gates and penstock, complete installation of the mentioned equipment.

Ribeiradio and Ermida:

Contract Signature: Dec. 10th, 2010. For detailed scope of works and technical data see page 7.

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TECHNICAL DATA: Bemposta II
OUTPUT: 193 MW / 212 MVA
VOLTAGE: 15 kV
HEAD: 65 m
SPEED: 115.4 rpm
RUNNER DIAMETER: 5,905 mm
STATOR DIAMETER: 13,000 mm

TECHNICAL DATA: Baixo Sabor/Jusan.
OUTPUT: 2 x 18 MW / 20 MVA
VOLTAGE: 6 kV
HEAD: 35 m
SPEED: 150 rpm
RUNNER DIAMETER: 3,948 mm
STATOR DIAMETER: 7,500 mm

TECHNICAL DATA: Baixo Sabor/Mont.
OUTPUT: 2 x 77 MW / 85 MVA
VOLTAGE: 15 kV
HEAD: 99 m
SPEED: 214.3 rpm
RUNNER DIAMETER: 4,110 mm
STATOR DIAMETER: 8,200 mm

AUSTRIA

GÖSSENDORF / KALSDORF

In autumn 2010 ANDRITZ HYDRO Automation was commissioned with the delivery of the instrumentation and control equipment for the power plants Gössendorf and Kalsdorf.

The two power plants are located on the river Mur and have a total capacity of 36 MW and an annual energy of 160 GWh, both generated by four Bulb turbine generator units.

The basic design such as turbines and generators and the excitation systems have been awarded previously to ANDRITZ HYDRO in a separate tender.
This successfully obtained new contract includes the control system such as start and stop sequences, mechanical protection and the entire control of the weir facilities, the electrical protection system for generators and transformers, and the connecting of the two power plants to the central control station Styria.
The well known NEPTUN concept is used in the two power plants. The commissioning of the first unit is planned for the fourth quarter of 2011 and confirms the very tight project schedule.

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TECHNICAL DATA:
OUTPUT: 4 x 9 MW
SPEED: 150 rpm
WEIR PLANT: three spillways

GERMANY

SCHLUCHSEEWERK

ANDRITZ HYDRO Automation was awarded a contract by the Schluchseewerk AG for the renovation of the static excitation system of the pumped-storage power plants Witznau, Häusern and Waldshut in April 2010.

The Schluchseewerk AG operates within the power plant group Schluchsee three pumped-storage power plants at Witznau, Häusern and Waldshut, each with four units. The contract includes the replacement of the 20 years old Siemens-excitation system by ten modern static Thyne-5-excitation systems. Key contributions to the award of the excitation renewal were the best price and the quality of the already modernized two units at the power plant Waldshut, a modernized unit at the power plant Wehr as well as the new unit at Albbruck-Dogern wire power plant. All these Thyne-5-excitation systems work correctly and to the full satisfaction of customers.

The mayor challenge of the new project are common systems for all power plants on the one hand and the adaptation to local conditions on the other hand (power supply partly from above, partly from below, longitudinal or cubical arrangement of the four cabinets). We met these requirements using a modular system, particularly to save costs. The unit B3 with the new excitation equipment was successfully put in operation at power plant Witznau in December 2010. The tenth and last unit at power plant Waldshut will follow 2013.

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TECHNICAL DATA:
OUTPUT: 4 x 75 / 4 x 45 / 2 x 55 MVA
SPEED: 333 / 250 rpm
UG NOM.: 10.5 kV
IE NOM.: 714 – 1,100 ADC
UE NOM.: 155 - 342 VDC

SWITZERLAND

THUN-AAREWERK 62

ANDRITZ HYDRO Switzerland was awarded with the complete renovation of the secondary equipment of the hydropower plant Thun-Aarewerk 62.

The scope of supply includes the significantly components from the NEPTUN-concept such as hydropower plant control, turbine control, electric block and busbar protection as well as the monitoring of the power plant. The old control equipment is replaced by the automation unit TM 1703 ACP, which includes step and group control and the electrical supply unit.
With this reconstruction the existing water power plant receives a new automation system and is integrated into a new water balance control system.

In the past the hydropower plant was permanently occupied. In future the customer can operate it fully automated. The existing visualization system 250 SCALA is extended by two machine units, weir control and the water balance control system. In addition to various control cabinets, the regenerated fiber optical ring for the power plant bus, the weir instrumentation, the integration of the existing unit 3 and the wiring of the entire facilities are also part of the scope of supply.

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TECHNICAL DATA:
OUTPUT: 2 x 3.92 MW
SPEED: 107.14 rpm

FRANCE

SPEED GOVERNING SYSTEMS FOR EDF

The major project RenouvEau from EDF comprises 540 power plant units to be renovated in the next ten years. Now it entered into its active pilot phase. Last September many invitations to tender were launched for the rehabilitation of the speed governing systems.

In spite of an aggressive and increased competition because of the attractive prospects of RenouvEau, ANDRITZ HYDRO successfully maintained its leading position on this market with its product MIPREG 620. According to the concept of the frame agreement developed for EDF, ANDRITZ HYDRO proposes an identical configuration for all the MIPREG 620, no matter which EDF power plant is concerned. In 2011 to 2012 ANDRITZ HYDRO will realise the complete rehabilitation of the speed governing systems for the hydropower plants Auzat and Soulcem in the Pyrenees. The scope of supply includes engineering, manufacturing, delivery, installation and commissioning of the electrical and hydromechanical

systems for the three Francis units with a power of 26 MW each. ANDRITZ HYDRO SA was awarded a similar contract concerning the hydropower plant of Serre Ponçon on the Durance river, one of the most important EDF site in the Alps. Scope of supply includes four MIPREG 620 dedicated to 95 MW Francis units. The commissioning period will last from 2011 to 2013. The purchase order for the Saillant power plant (four units) ensures ANDRITZ HYDRO its position as unique supplier to EDF for simplified speed governors and this since 2007.

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DR CONGO

BENDERA

The beginning of 2010, SNEL placed an order for the rehabilitation, supervision of erection and commissioning for two hydromechanical and electronic speed governing systems for the Bendera hydro power plant.

Built in 1955, the plant is located on the Kiymbi river, in North Katanga in the Democratic Republic of the Congo (DRC). It is interesting to note that Bendera is the only power plant of the DRC functioning with Pelton turbines. The power plant supplies the town of Kalemie located on the shores of Lake Tanganyika – the second largest lake in Africa after Lake Victoria. The 132 kV line is 120 km long. However, this line is not connected to the domestic network. Thus, the speed governing system in the isolated network is very important. The power plant has been totally stopped on July 7th, 2009, due to short circuits affected by its two generators. Therefore, the port city of Kalemie was without electricity since 2009. The first unit was commissioned in November 2010 to the complete satisfaction of our client SNEL. The second group should be ready by the end of 2011 or at the beginning of 2012. ANDRITZ HYDRO is proud to contribute to the development of the North Katanga region and to the expansion of electricity in the DRC.

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PERU

MATUCANA

End of 2009, after an international bidding process, EDEGEL awarded to ANDRITZ HYDRO a contract for the supply of two MicroGuss™ Pelton runners.

The Matucana power plant is equipped with two twin Pelton units, one jet per runner, supplied by Riva in 1971.

The technical tender documents specified that the manufacturing process could use new technologies, in particular forged technology. ANDRITZ HYDRO, pioneer in forged technology, offered MicroGuss™ runners. Since 1992, with approximately 400 runners manufactured without bucket rupture, this technology is well proved.

Main advantages of forged runners in relation to casted runners are well known: higher mechanical characteristics, increased lifetime, higher quality, improved reliability and security.
With the new runners, the turbine output will increase by 1.8%.

With this new order, ANDRITZ HYDRO will deliver its fourteenth MicroGuss™ runner to Peruvian customers.

Paul Richard
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TECHNICAL DATA:
OUTPUT: 64.99 MW
HEAD: 966 m
SPEED: 450 rpm
RUNNER DIAMETER: 2,820 mm

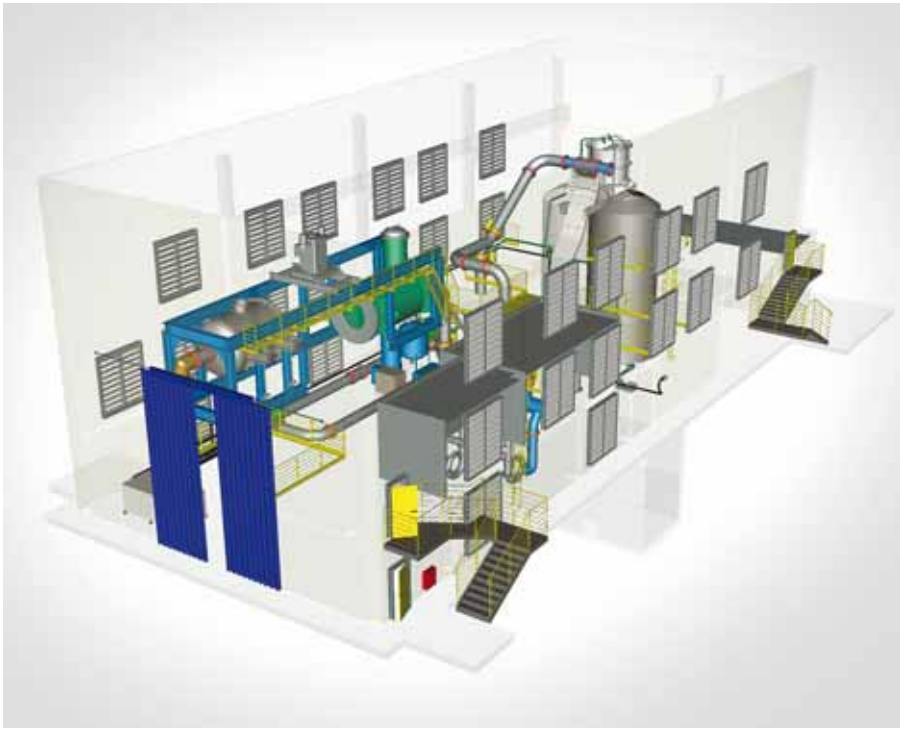
The new hydraulic test laboratory in Araraquara, Brazil

Inauguration in Brazil

The very first ANDRITZ HYDRO hydraulic test laboratory in Latin America

In November 2010, ANDRITZ HYDRO INEPAR DO BRASIL has inaugurated a new universal hydraulic laboratory for hydraulic turbine model tests. This new laboratory is the very first universal hydraulic laboratory built in Brazil.

It is located in the city of Araraquara, São Paulo and part of the ANDRITZ HYDRO INEPAR DO BRASIL plant. The plant itself is the largest and most modern manufacturing facility in Latin America and one of the world's largest manufacturer of turbines, generators, hydro mechanical and electrical equipment.



Section view of the new hydraulic test rig in Brazil

With this new hydraulic laboratory ANDRITZ HYDRO INEPAR is able to test the full range of turbine types with low, medium and high heads. The lab is operated by ANDRITZ HYDRO INEPAR and is a very important benchmark for the Brazilian engineering. The lab design and mechanical equipment was developed and fabricated locally in Brazil. It is based on the general concepts of ANDRITZ HYDRO laboratories, installed all over the world. Developed by the local team of engineers, the lab control system offers plenty of resources that permit the automation of higher level tests. This fact will lead Araraquara to become the hydraulic engineering industrial pole centre in Brazil.

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Ravensburg, Germany

Opening ceremony of new office building

The location of Ravensburg in Germany is an important component of the global market positioning of ANDRITZ HYDRO. In recent years, the local and international growth of the hydropower market resulted in an increasing space requirement at the location. The existing building could no longer meet this growing demand.

The opening ceremony of the new office building took place on February 11, 2011. It was attended by numerous guests from business, politics and science as well as by the board of Andritz AG, the management of ANDRITZ HYDRO and all employees. Within one year, an existing warehouse on the company's premises has been converted to a modern office building for 320 working places. The main focus of the new building was the perfect combination between functionality and representation. Special emphasis was given to the creation of modern and ergonomic working conditions for all employees.

The outdoor area has been realized according to the best ideas of an internal company competition. In the reception area water is flowing continuously over a granite wall. Through a channel covered with glass plates it is diverted to the outside in a larger basin where it moves a Francis runner. The new building guarantees the optimum conditions for future space requirements which will occur due to the growth of the hydropower market.

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Science night in Linz, Austria

Great success for participation in “Science night”

The “Sience night” is the largest initiative to communicate research and science to the public. It should increase the awareness of the Austrian innovative performance. Before the start of the official program dedicated guided tours were organized for ANDRITZ HYDRO employees and their families.

The main attraction at the laboratory were the two operating test rigs. Additional information points explained the challenges of modern hydraulic turbine development.

Vivid discussions with approximately 750 visitors of all ages made this day to a successful event.

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Viennahydro in Laxenburg, Austria

Successful participation at 16th "International seminar on hydropower plants"

In November 2010 the 16th biannual "Internationales Seminar Wasserkraftanlagen" took place in Laxenburg, Austria. The declared target of this event is to bring ideas and innovations into focus, which guarantee an ongoing raising of efficiency and sustainability of this energy technology also in the future.

Following the slogan "Reliable Hydropower for a Safe and Sustainable Power Production" a lot of different topics of hydropower were discussed.

More than 300 experts, market insiders, hydropower plant operators and several interested hydropower specialists took part. ANDRITZ HYDRO took part on this event with paper presentations and a new booth concept. The papers presented different topics, beginning from the latest hydraulic development of Kaplan and Pelton turbines, new coating technologies as well as experiences in HYDROMATRIX® projects.

The modern booth concept offered the optimal background for discussions and experience exchange between all participants in the coffee breaks and at the end of the conference.

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EVENTS:

HYDRO Automation Day
May 26, 2011
Vienna, Austria

ICOLD
May 29 - June 3, 2011
Lucerne, Switzerland

HydroVision USA
July 19 - 22, 2011
Sacramento, USA

HydroVision BRAZIL
Sept. 20 - 22, 2011
Rio de Janeiro, Brazil

14. Intern. Forum for small Hydro (OTTI conference)
Sept. 29 - 30, 2011
Innsbruck, Austria

HYDRO 2011
Oct. 17 - 19, 2011
Prague, Czech Republic

Coating for hydropower plants

More than just a thin layer

ANDRITZ HYDRO is successful developing coatings since more than 25 years. Worldwide more than 380 runners and over 2000 other hydro parts demonstrate the high quality. ANDRITZ HYDRO offers extensive know-how, from the hydraulic design to the coating. All from a single source. Therefore, we can offer our customers the complete optimization.

We invest for your future.

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