HYDRONEWS

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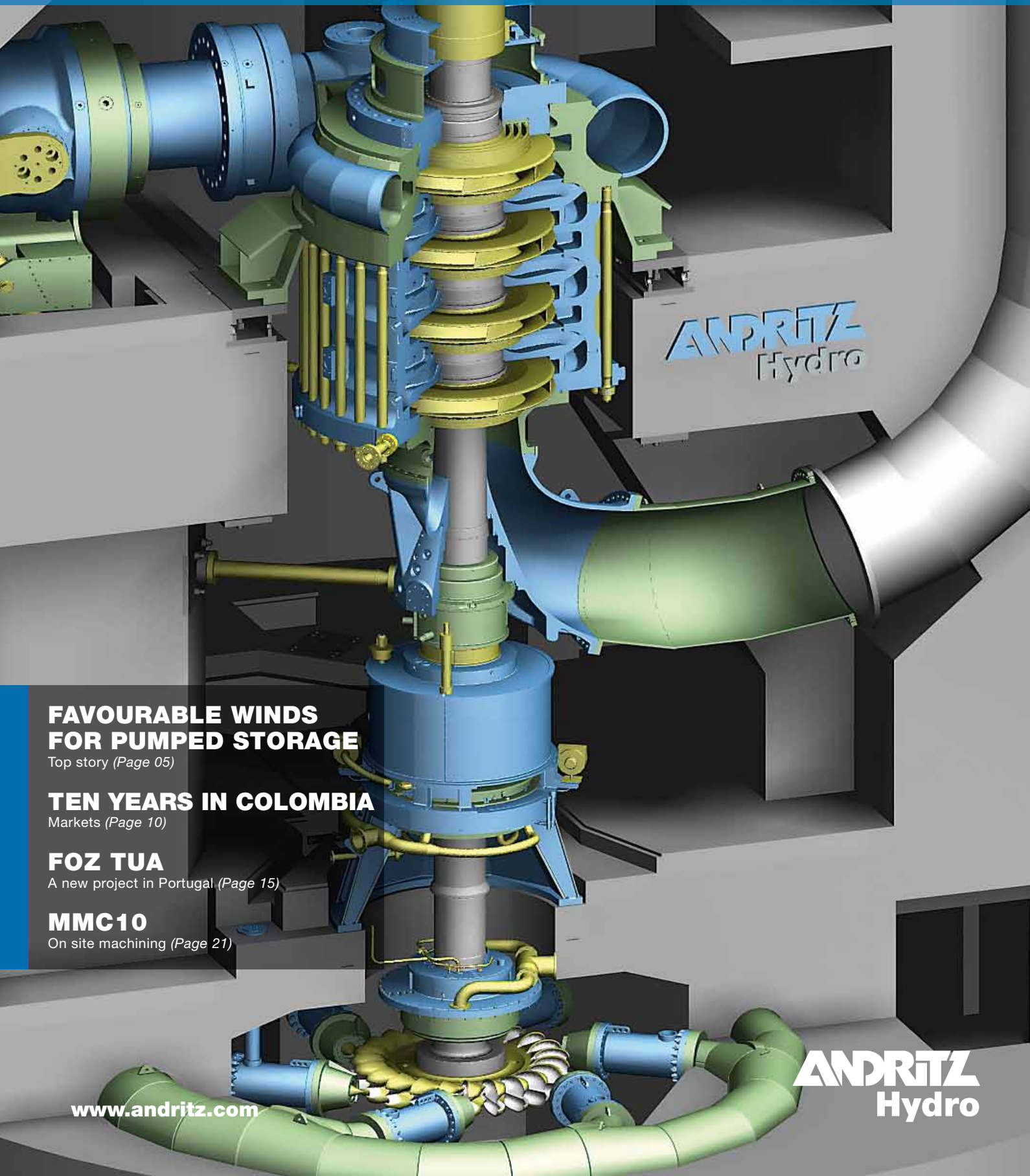
MAGAZINE OF ANDRITZ HYDRO



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ANDRITZ Hydro

Latest **News**

Key Figures 2011

Again a new record in all figures:
Order Intake: 2,096.2 mio. EUR
Order Backlog Dec. 31:
3,671.4 mio. EUR
Sales: 1,772.9 mio. EUR
Employees as of Dec. 31: 7,285

Egypt

ANDRITZ HYDRO was awarded a contract from the Egyptian Ministries of Energy and Water Resources for the supply and installation of four Bulb turbines, generators, and the electrical and hydromechanical equipment for the rebuild of the Assiut barrage, the oldest dam in the Egyptian section of the River Nile.

Brasil

At the end of 2011, ANDRITZ HYDRO Brazil was contracted by the clients AES and Votorantim to modernize the turbines of the hydroelectric power plant Nova Avanhandava and Alecrim. Early in 2012, ANDRITZ HYDRO Inepar do Brasil, was selected to refurbish the hydroelectric power plant Limoeiro (belonging also to the client AES) and Cachoeira Dourada, Matucana and Huinco (belonging to the client Endesa).

Scotland

In December 2011, ANDRITZ HYDRO Hammerfest successfully installed its self-developed HS1000 tidal current turbine with a capacity of 1,000 kW in the waters of the European Marine Energy Centre, Scotland. Operation of the pilot plant is stable, and the first power was supplied to the grid already at the beginning of February this year.

Norway, UK

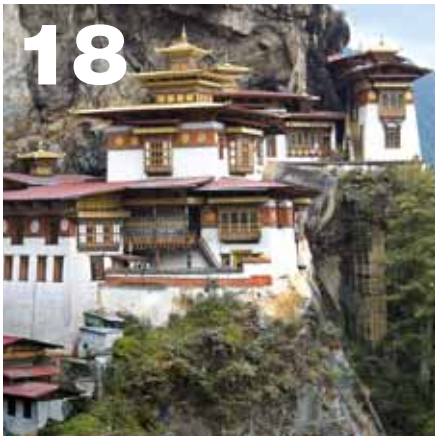
International technology Group ANDRITZ increased its stake in Hammerfest Strøm AS from 33.3% to 55.4%. The other major share holders are the local Norwegian utility company Hammerfest Energi and the Spanish utility company Iberdrola. The company will operate under the name of ANDRITZ HYDRO Hammerfest in the future and is a world market leader in technologies for energy generation from tidal currents occurring in coastal waters.

Costa Rica

ANDRITZ HYDRO was awarded a contract by the Institute of Electricity of Costa Rica for the supply and supervision of the installation of four Francis turbines, generators, and the electrical and mechanical equipment for the hydroelectric power project Reventazón, the largest hydropower plant ever built in the country.

Russia

RusHydro International has signed a Memorandum of Understanding with ANDRITZ HYDRO for cooperation on international projects. Both companies have agreed to commonly develop and execute hydropower plants in different regions of the world. A first focus will be laid on Latin America and Africa.



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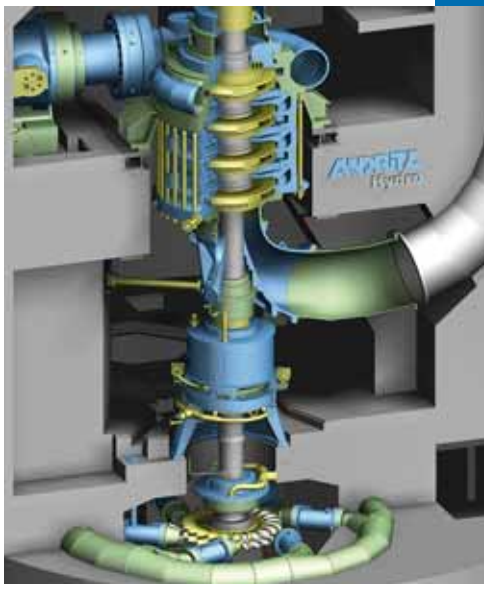
The 4-stage reversible pump turbine Tierfehd (Switzerland) with its start-up Pelton turbine



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Dear **business friends**

The growth of the global hydropower market continued unabated in 2011. This positive development is clearly reflected in ANDRITZ HYDRO's figures.

The status of hydropower in society has changed significantly in recent years. The increasing cost of fossil fuels worldwide, rising greenhouse gas emissions and the tragic accident in Fukushima, Japan have considerably accelerated the ongoing reevaluation of sustainable and renewable power generation.

Hydropower is already a stable and reliable factor in the global energy market. The continuously rising peak power demand, network overloads and the expansion of power generation from wind and solar energy necessitate continuous extensions of hydropower as an applicable short-term power reserve.

Also in the past year, more than 6,000 highly qualified and motivated employees have formed the basis for further positive development. All divisions of ANDRITZ HYDRO as well as regions of the world can demonstrate significant successes. One of the most active European markets for new pumped storage plants is Portugal. ANDRITZ HYDRO has been very successful in this market for many years. At the moment, the new contract for the Foz Tua pumped storage power plant represents the culmination of our work and is also the fourth major order within four years.

ANDRITZ HYDRO has been operating successfully in Turkey for many years, as demonstrated by large orders such as Çetin (total 500 MW), Tartar (133 MW) and Pembelik (132 MW) and orders for seven small hydropower plants.

At the same time, a large number of projects will be completed or successfully handed over to the customer, such as the Hacininoglu and Alkumru hydropower plants.

For years, the markets in Central and South America have also demonstrated an increasing demand for hydropower plants, impressively illustrated by the new plants in Brazil as well as a huge number of smaller hydropower plants such as those in Panama.

However, there were further highlights in 2011. After several years of construction, the world's largest tidal power plant Sihwa (10 x 26 MW Bulb turbines) in Korea, was officially opened for operation with a ceremony headed by the Korean president. Based on the flexible mechanisms of the Kyoto Protocol, an Austrian pilot project, the Tsankov Kamak hydropower plant, was inaugurated in Bulgaria. A further special highlight was the commissioning of the next generation of tidal current turbines, HS 1000, by the Norwegian company Hammerfest Strøm in which ANDRITZ HYDRO has held a 55.4 % share since 2010.

Due to the continuous development of our technologies and the confidence which our customers kindly placed in us, we are also well prepared for future challenges.

With sincere thanks

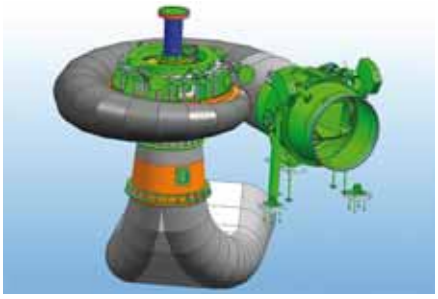
M. Komböck W. Semper H. Heber

Favourable winds for pumped storage

Many countries in the world have announced plans to significantly increase electricity generation from fluctuating sources like wind and photovoltaics. This development will lead to a significant storage requirement for electrical energy. ANDRITZ HYDRO supplies conventional pumped storage plants and innovative decentralized solutions using variable speed electrical machines, both of which will play important roles in meeting future storage demands.

All electrical grids with a significant share of generation from volatile sources will be faced with storage problems. Germany, for example, aims 25% of generation from renewables by 2020, meaning that around 150 TWh is expected to come from fluctuating sources. A large share of non-dispatchable and highly intermittent generation will lead to a need for significant storage capacity, which will also have to cope with frequent high and fast load changes. By 2050, Germany will need over 100 times the storage volume of 2008 in order to be able to bridge a 10-day period of low wind.

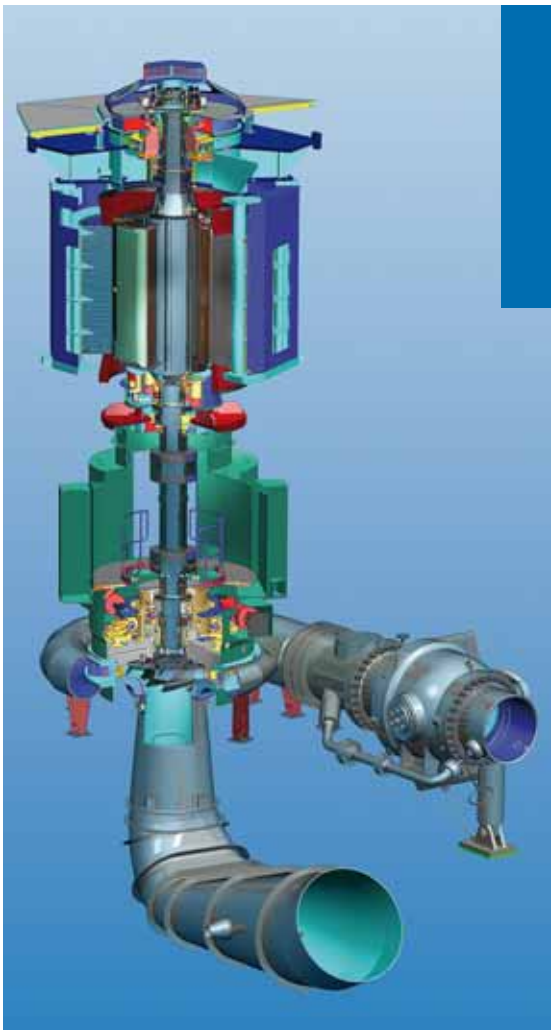
▼ Pump turbine Lang Yashan CAD model



On the other hand, days with strong winds and low demand will lead to oversupply. Several technologies are likely to contribute to meet these future storage requirements. Currently, compressed air energy storage (CAES), e-car battery clusters and electrolysis producing hydrogen are potential contenders in addition to conventional pumped storage. Due to the advantages in capacity, efficiency and overall storage cost, large scale pumped storage will remain the most important storage technology. However, it can hardly cover the expected demand alone. Since other more expensive and less matur e technologies will have to help in addressing the need for storage, pumped storage systems will be both, a technical necessity and an attractive investment in years to come.

Long history of pumped storage technology

As early as 1890, the town of Zurich, Switzerland connected the local river to a nearby lake with a small pumped storage plant. In delivering this unit, Escher Wyss, now part of ANDRITZ HYDRO, arguably supplied the world's first storage pump. The company has continued to provide groundbreaking pumped storage technology: the storage pumps of Provvidenza (Italy, 1949) as well as Limberg (Austria, 1954) were the world's largest, at the time of order, and Germany's largest pump storage plant in Goldisthal - the first variable speed pump storage plant outside Japan - commissioned in 2003 operates with electrical equipment from ANDRITZ HYDRO.



▲ Pump turbine and generator of Hintermuhr, Austria

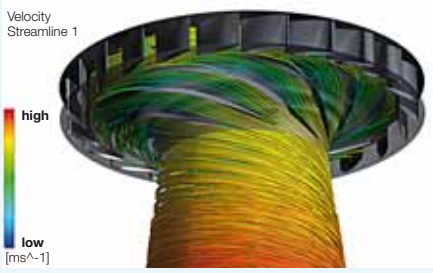
▼ Pumped storage Lang Yashan in China.
View of upper reservoir intake tower

Research at highest level

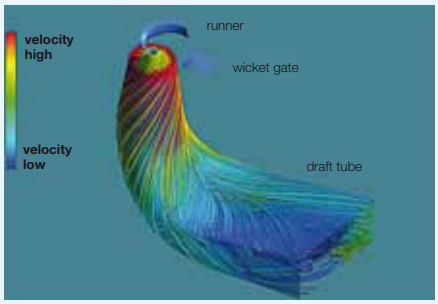
Today, based on this long tradition, ANDRITZ HYDRO provides a pump turbine technology adapted to the specific requirements of each project. As a fullscale supplier of all electrical and mechanical components of pumped storage plants, the company designs individually developed hydraulic machines, e.g. for the upgrading of rehabilitation projects, or integrated systems including pump turbines and generators as well as all equipment necessary for automation and control. In response to the growing importance of pumped storage, ANDRITZ HYDRO has established a Center of Competence for pump turbines in Zurich, Switzerland, which coordinates global R&D activities.

Project	Head [m]	Power [MW]	Runner diameter [mm]	Speed [rpm]	Country
Tierfehd (Nestil)	1,066	142	2,263	600	Switzerland
Feldsee	548	73	1,919	1,000	Austria
Hintermuhr	518	74	1,870	1,000	Austria
Yixing	420	262	4,394	375	China
Goldisthal	338	325	4,593	333.33 / 300-346	Germany
Vianden M11	295	200	4,286	333.33	Luxemburg
Tongbai	289	306	4,802	300	China
Lang Yashan	153	166	4,700	230.77	China
Zarnowiec	128	188	6,008	166.67	Poland
Baixo Sabor Montante	100	77	4,112	214.29	Portugal
Foz Tua	99	125	4,837	187.5	Portugal
Baixo Sabor Jusante	35	18	3,948	150	Portugal

▲ Recent pump turbine projects delivered or under development



▲ Pump turbine Vianden M11: streamlines at rated operation (pump mode)



▲ Pump turbine Vianden M11: streamlines in the draft tube in turbine operation

▲ Model of the pump turbine Vianden M11 on the test rig

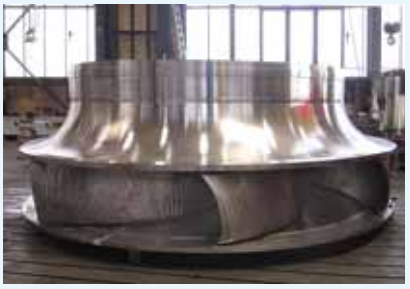
▼ Aerial view of upper reservoir of Vianden in Luxembourg

Flow calculations using unsteady computational fluid dynamics (CFD) as well as model measurements taken from one of the company's three pump turbine test rigs are essential for the development of a modern pump turbine technology prepared to fulfill changing requests. Today's grid regulation requires fast and frequent changes between pumping and generating modes as well as extended operation in off-design conditions. Understanding unsteady phenomena is crucial in developing pump turbines that can be operated with as few restrictions as possible.

Two main features of unstable behaviour in pump turbines are known. One shows in pump operation as a drop-in head as the flow is reduced (saddle type pump instability of head curve). The other sometimes occurs in generating mode at low load off-design operation close to runaway conditions (S-shape of the turbine characteristic) and may impede synchronization in turbine operation. Detailed investigations in cooperation with a Swiss university have increased the knowledge of this phenomenon. Unsteady CFD simulations in the very low load operating range of the pump turbine revealed a rotating flow separation between runner and wicket gates. The results of this research project contribute to minimizing these effects and to ensuring proper synchronization. CFD also plays an important role in the design of non-standard components, verifying and supplementing test rig measurements. For the Baixo Sabor power plant in Portugal ANDRITZ HYDRO optimized two pump

▲ Artist's impression of the power stations Baixo Sabor Montante...

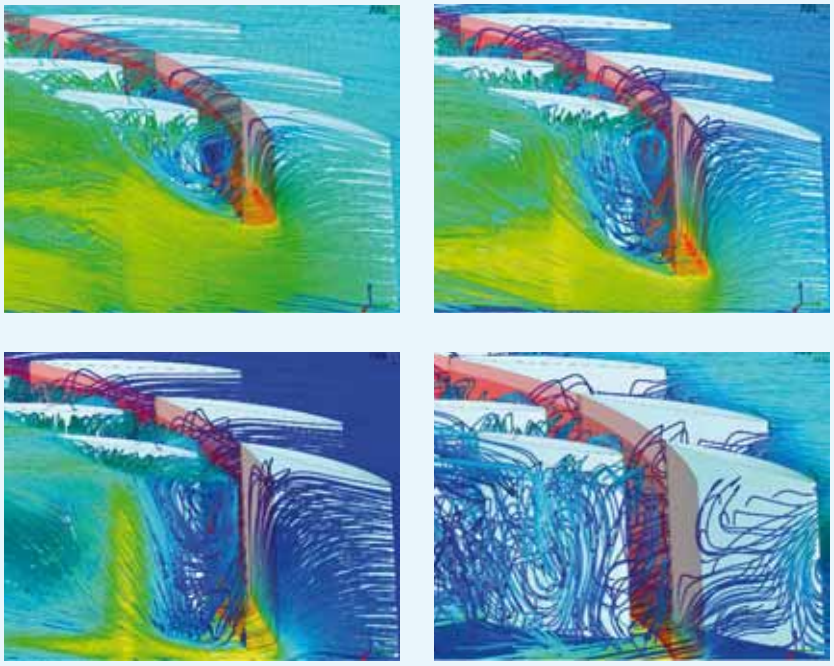
▲ ...and Baixo Sabor Jusante, Portugal



▲ Baixo Sabor pump turbine runner during fabrication in the workshop

turbines in the higher specific speed range, one of which is equipped with ring gates as shut-off devices. A CFD analysis combined with model measurements made it possible to evaluate both the forces acting on the ring gates and the flow in the ring gate area.

During the development of pump turbines, ANDRITZ HYDRO puts special focus on the aspects of hydraulic transients which lead to unsteady behaviour of the flow in the pump turbine. This rotor-stator interaction must be investigated hydraulically and the design of the components must consider the dynamic effects on the mechanical behaviour of the units. ANDRITZ HYDRO has fully examined the new pump turbine for the Vianden M11 pump storage plant (Luxemburg) using unsteady flow analysis and dynamic stress calculations in order to ensure safe and reliable operation in all required load ranges.



▲ CFD-calculated flow around the ring gate of Baixo Sabor Montante at 50%, 20%, 5% and 1% opening

Innovative concepts

In a grid with a high share of installed wind power, the power produced will temporarily exceed current demand, meaning that power has to be extracted in or der to stabilize the grid frequency. The pumping operation of pumped storage plants can fulfill this need, but conventional fixed-speed pump units cannot change their pump input power. To follow wind energy's unpredictable load changes, the absorbed power -, that is, - the pump input power - should be varied continuously. Until recently this was only possible with large variable speed units (double-fed asynchronous motor-generators), which are rather expensive. Considering the specific challenges of balancing wind power, ANDRITZ HYDRO has developed an innovative concept tailored to future requirements. Small, decentralized pump storage plants consisting of standardized pump turbines equipped with a variable speed synchronous generator will be able to provide flexible local power storage adapted to operation close to larger wind or solar installations. With installed power lower than conventional pumped storage plants – a typical unit output will be between 10 and 25 MW – two to five such units will be able to balance a 50 MW wind farm.

▲ Goldisthal, Germany, underground machine cavern

Using a full sized electrical speed converter, the pump input power can be varied continuously over a wide range, and is then able to follow the load changes of the wind farm. The possible head variation of the hydraulic unit is large, and the efficiency characteristic in pump and turbine mode is very flat over a wide operating range.

With these new standardized pump storage units, the use of wind power can be increased in regions where grid stability would not allow a higher percentage of wind power. The combination of wind farms with local energy storage allows the local utility to generate a much more constant and predictable amount of electricity.

Furthermore, this new concept allows increasing renewable energy generation without needing substantial increase in the capacity of transmission lines between classical pumped storage plants in high mountains and wind farms and solar plants in the low lands.

Compared with other storage technologies used to supplement conventional pumped storage, such as CAES, batteries and hydrogen, this new ANDRITZ HYDRO concept provides electricity storage which is reliable, innovative and more economical than its competitors.

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▼ View of upper and lower reservoir of the Kaprun pumped storage power plant in Austria

Turkey

Number one market for ANDRITZ HYDRO

▲ After Cetin contract signing

Turkey is a fast-developing country and, consequently, its energy supply must be increased ahead of this rapid development. Turkey has the highest increase in energy demand among the OECD countries, and the second worldwide after China. Already in 2011, direct energy investments were over 3.5 billion USD.

The table below compares electricity figures from 2010 and 2011. As can be seen, the state still has a 47% share of the total electricity supply. This is still an important factor in determination of free market prices. The Turkish electricity market is in a transition period. In 2012, is the country plans to privatize 18 thermal and 28 hydropower plants. It is expected that by the end of this decade Turkey will have a fully liberated market. However, the privatization of the nations distribution and generation facilities did not particularely well in 2011. The distribution tenders were not completed, as the companies who were invited to sign contracts after successful tenders were forced back down, when credit lines could not be obtained. The state may now try to find a new privatizationmodel for distribution. The Hamitabat gas-fired thermal power plant tender did not go ahead, as there were not enough interested companies to bid. Turkey's first nuclear power plant will be built in Akkuyu Mersin by the Russian state company Atomstroyexport with four blocks having 4,800 MW in total. Engineering work has already commenced. Civil works are expected to start in 2013. Commissioning of the first block is scheduled in 2019.

Since 2006, the wind and hydro markets are virtually privatized with the new investments, except four to five special projects of about 1,100 MW which will be built by DSI (the State Hydraulic Works). It is expected that 20,000 MW of hydro power and 15,000 MW of wind power will be developed by the private sector in the coming years, although the license applications reveal much higher levels. Turkish investors are also very much involved in the development of hydro power plants in the neighboring country of Georgia. Turkey has been a major key market for ANDRITZ HYDRO over decades. It has been and remains the key supplier of hydromechanical and electromechanical equipment to Turkish hydropower plants. Of the 17,000 MW of installed hydro capacity in Turkey, ANDRITZ HYDRO has supplied 245 turbine units totalling 13,662 MW (80%); 99 generators totalling 5,686 MVA (33%); 34,000 tons of penstocks and gates for 53 units. ANDRITZ HYDRO Ltd. Sti., a fully owned company of ANDRITZ HYDRO in Turkey, was established in 1991. In late 2007 and early 2008, the first localization concepts were developed and implemented. These are mainly based on local manufacturing of mechanical welded components for Large and Compact hydro projects. From 1 January 2009, ANDRITZ HYDRO Ltd. Sti. became a fully consolidated "A"-daughter company of ANDRITZ Group to meet rising local market demand.

Presence and strength of local ANDRITZ HYDRO set-up:

- Fabrication of turbine and generator mechanical welded components for Large and Compact units
- Local sourcing and contracting for electrical power systems for Large Hydro plants (full system range, sys-

Year	2010		2011		Increase
	MW	%	MW	%	%
Total installed capacity	49,524	100	53,050	100	7.1
Thermal total	32,373	65.5	34,163	64	5.5
Renewable total	17,151	34.5	18,887	36	10.1
HYDRO	15,831	92 [1]	17,081	90 [1]	7.9
Wind	1,320	8 [1]	1,692	9 [1]	28.2
Geothermal			114	1 [1]	
	TWh		TWh		
Electricity supply	211		228		8.1
Private sector electricity	50%		53%		

[1] % of Renewable total

tem engineering remains in COC's)
- Turnkey electrical power systems and Automation systems for Compact hydropower plants including design and system engineering
- Installation and erection supervision of Large and Compact hydropower plants (mechanical and electrical). Based upon this strong local presence and setup with key-component supplies from the mother company, ANDRITZ HYDRO has proved its competiveness following the award of the Çetin and Boyabat projects.

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Çetin

ANDRITZ HYDRO has received an order from ÇETIN ENERJI A.Ş. a subsidiary of Norway's state-owned electricity utility Statkraft, to supply the electromechanical equipment for the Çetin hydropower plant in Turkey. The project will be Statkraft's largest hydropower plant outside Norway, with an installed capacity of 517 MW. Çetin will have an average annual production of 1.4 TWh, enough to supply electricity to 460,000 Turkish households. The project is planned to be constructed on the river Botan, a major tributary to the Tigris, within the borders of Siirt Province in the southeastern region of Anatolia. The Çetin hydropower plant is situated between the upstream Pervari and the downstream Alkumru power plants and consists of two plants. Çetin Main will have a 145 m high asphalt-concrete core rockfill dam, a spillway with four radial gates and a power house which will be equipped with three Francis machines having a total capacity of approximately 405 MW. Çetin Lower has a 40 m high concrete dam with a gated spillway, integrated intake and a powerhouse which will feature two Kaplan machines totalling approximmately 112 MW. In addition, each plant has a small hydropower unit for handling the minimum water flow required for ecological purposes. The scope of ANDRITZ HYDRO covers all of the electromechanical equipment including turbines, generators, electrical power system, transformers, 380 kV switchyard and control systems. Both power plants are scheduled to start operation in 2015. This order marks another success on the Botan river, where ANDRITZ HYDRO commissioned the Alkumru hydropower plant, ahead of schedule in 2011.

TECHNICAL DATA Çetin Main
Output: 3 x 135 MW / 169 MVA
Voltage: 13.8 kV
Head: 130 m
Speed: 200 rpm
Runner diameter: 3,440 mm
Stator diameter: 9,000 mm
One Compact Francis "Ecoflow":
Output: 12.26 MW

TECHNICAL DATA Çetin Lower
Output: 2 x 56 MW / 69 MVA
Voltage: 13.8 kV
Head: 36 m
Speed: 166.67 rpm
Runner diameter: 4,550 mm
Stator diameter: 8,400 mm
One Compact Francis "Ecoflow":
Output: 5.05 MW

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Boyabat

In March 2010, Doğuş Inşaat ve Ticaret A.Ş. signed a contract with ANDRITZ HYDRO for the supply of an electromechanical package at the new Boyabat hydropower plant in Turkey. This plant is located on the Kızılırmak river in the north of the Sinop province, close to the Black Sea. It is owned and will be operated by Boyabat Elektrik Üretim ve Ticaret A.Ş. The plant features a concrete gravity dam with a height of 195 m; a 6,000 ha reservoir area; an installed capacity of 528 MW; and the expected electricity generation is 1.5 billion kWh per year. The project will have the highest installed capacity among private sector investments in Turkey. The scope of ANDRITZ HYDRO's contract covers the complete electromechanical "water-to-wire" package including three Francis turbines, generators, transformers, main inlet valves, the entire electrical equipment and all auxiliary systems as well as a 380 kV cable head yard, a tie-transmission line and a 380 kV switchyard to connect the power plant to the grid. The project is being executed by ANDRITZ HYDRO in Austria together with its subsidiary located in Ankara, which provides support for the electrical power systems as well as all on-site installation activities. The installation of the E&M package started in cooperation with Doğuş civil site activities in the summer of 2011. In February 2012, the commissioning of the first systems will start. The commercial operation of the first unit is planned for the summer of 2012, only 27 months after ANDRITZ HYDRO was awarded this contract. Underlying, again, ANDRITZ HYDRO's leading position in the booming Turkish hydropower market.

▲ View of dam site during construction at Boyabat

▲ Stayring and spiral case during installation in Boyabat

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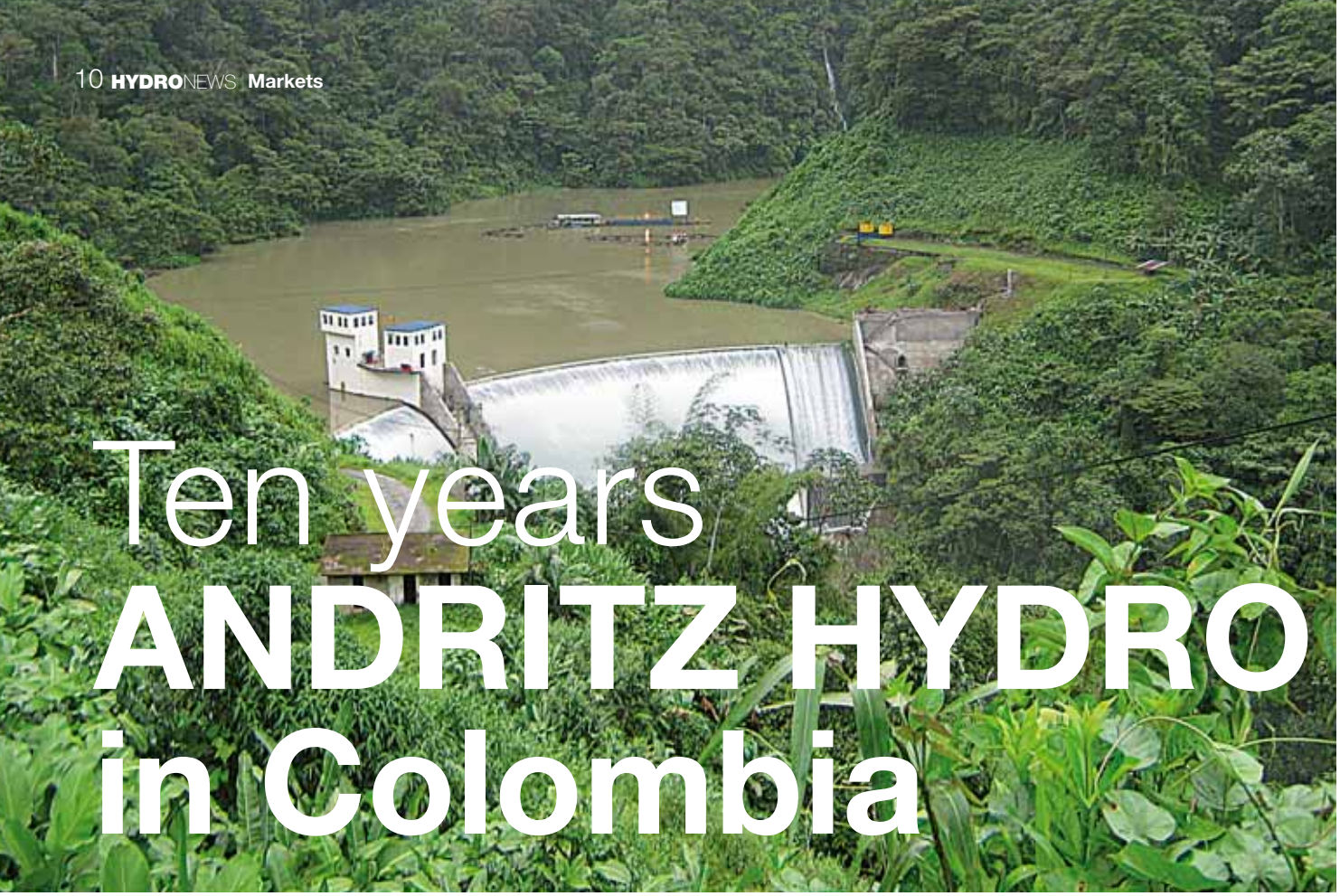
TECHNICAL DATA Boyabat
Output: 3 x 176 MW / 204.78 MVA
Voltage: 14.4 kV
Head: 125.5 m
Speed: 187.5 rpm
Runner diameter: 3,850 mm
Stator diameter: 9,930 mm



Ten years ANDRITZ HYDRO in Colombia

▲ Dam and upper reservoir of Bajo Anchicaya power plant

ANDRITZ HYDRO Colombia was founded in Bogotá, Colombia in September 2001. Historically it follows over 50 years experience in the Colombian hydroelectric market, starting under recognized names such as SULZER HYDRO and VA TECH HYDRO. Over time, the company represented for the ESCHER WYSS, GE HYDRO, HYDRO VEVEY, KVAERNER, CHARMILLES and VOEST brands. Totally more than 50% of the total hydro capacity installed in Colombia uses equipment supplied by ANDRITZ HYDRO.

Starting with seven people in 2001, ANDRITZ HYDRO Ltda. today has more than 50 employees. Since then, the product portfolio and services have grown to keep pace with the development of the market. Today it includes the design and supply of control and electrical equipment for new and existing plants, repair of Pelton and Francis runners (in the workshop and on-site), installation supervision for turbines and generators, and sometimes even for the entire installation. Importantly the Company is involved in three businessareas: Large Hydro, Compact Hydro and Service & Rehab, giving continuous technical and commercial support and playing a key role in the development of new projects. Throughout these years, high standards in terms of products, services and highly qualified staff have led the Company to trade with the most important companies in Colombia's electricity sector such as ISAGEN, EMGESA (Endesa-ENEL), EPSA, HMV, EPM, COLINVERSIONES and AES CHIVOR, amongst others. Concerning Service & Rehab projects, ANDRITZ HYDRO has participated in the modernization of the main and largest hydropower plants in Colombia.

Amongst these projects are San Carlos of ISAGEN (8 PV x 155 MW) with new Pelton runners and turbine governors; CHEC's La Insula and San Francisco (3 FV x 53 MW), with new Francis runners and turbine governors respectively; AES' Chivor (8 PV x 125 MW) with excitation systems and turbine governors; and EMGESA's Guavio (5 PV x 230 MW) with turbine governors. During the past five years the Compact Hydro division has won most of the important projects such as AGUAS DE LA CABAÑA's Agua Fresca (1 PV x 7.5 MW) by AGUAS DE LA CABAÑA; Amaime (2 FH x 10 MW), Alto Tulua (2 FH x 10 MW), Bajo Tulua (2 FH x 10 MW) and Cucuana (2 PHD x 28 MW) owned by EPSA E.S.P., Montañitas (2 PV 13 MW) by COLINVERSIONES; Caruquia (1 FH x 10 MW), Guanaquitas (1 FH x 10 MW) owned by HMV and in the last months Providencia I (1 PH 1.8 MW) and Providencia III (2 FH x 5 MW) by MINEROS DE ANTIOQUIA and El Popal (2 FH x 10 MW) by HMV.

Supply for Compact Hydro plants consists of Automation and governing equipment and electrical power systems. In support, the main, turbine and generators are supplied by ANDRITZ HYDRO sister companies in France and Spain. Importantly ANDRITZ HYDRO Ltda. does not only provide support for projects in Colombia, but also for projects in Peru and Ecuador such as San Carlos and Carhuaquero IV. Colombia's confidence in ANDRITZ HYDRO Ltda. was demonstrated by winning the largest units to be supplied for the Sogamoso hydro power plant. ISAGEN S.A's ambitious project will feature cylindrical valves, three turbines (3 FV x 279 MW), gover-

nors and control equipment. In addition ANDRITZ HYDRO Ltda. is also responsible for the draft tube production for this project. All of these projects show great potential, and illustrate the consolidation of the Colombian market that has developed in the medium term.

FISE Fair 2011 in Medellin, Colombia

From 30 November to 2 December 2011, the IV International Exhibition of Electricity Industry (FISE) 2011 took place at Plaza Mayor in Medellin, Colombia.

ANDRITZ HYDRO's participation was a great success. This major biennial event attracted companies and entrepreneurs from the United States, China, and all Central and South American countries. Importantly the first day attracted 2,686 high level industrial visitors, plus a large influx from the international media, stimulating very significant promotional activity. The object of this event was not only a showcase to promote international contacts and business deals, but created space for interaction between different parts of the value chain, such as manufacturing, government agencies and the academia. ANDRITZ HYDRO gave two talks from Beat Ritschard, Director of ANDRITZ HYDRO Ltda., and Sergio Contreras, ANDRITZ HYDRO Compact Sales Manager France. ANDRITZ HYDRO's presence did not go unnoticed in an event of this magnitude.

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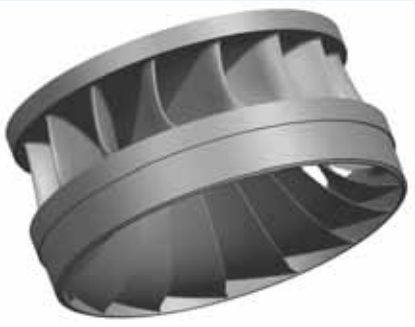
▼ FISE Fair 2011 in Medellin

La Ínsula, Esmeralda

At the beginning of 2011, ANDRITZ HYDRO received an order from Central Hidroeléctrica de Caldas SAESP (CHEC) for two new Francis runners for the Esmeralda and La Ínsula hydropower plants in Colombia. The aim of the replacement is to achieve confirmed higher output with new runner designs as well as improved lifetime and reliability due to new materials and manufacturing processes.

La Ínsula (two units) was built in 1949 and extended in 1979 with a third unit. The original turbine supplier for the two first units was Baldwin Lima Hamilton. For the third unit, Neyrpic was the original supplier with an ouput of 11.5 MW. At Esmeralda, the two existing units were built in 1960 by Charmilles each having an output of 15 MW. All runners have been regularly maintained by CHEC, with available spare runners based on the original designs. Supply of these two new runners is based on ANDRITZ HYDRO's latest design development giving a 10% output increase for each runner. Moreover, the quality and life will be improved with the runners being fully forged and not casted as the original ones. Both runners are planned to be installed by the end of 2012. The expected improved performance should be demonstrated during the client's acceptance tests ensuring his entire satisfaction.



▲ 3D-model of La Ínsula runner

▲ View of penstock and powerhouse

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TECHNCAL DATA La Insula

Output: 12.84 MW
Head: 116 m
Speed: 600 rpm
Runner diameter: 1,230 mm

TECHNCAL DATA Esmeralda

Output: 16.82 MW
Head: 171.3 m
Speed: 450 rpm
Runner diameter: 1,760 mm

Bassi

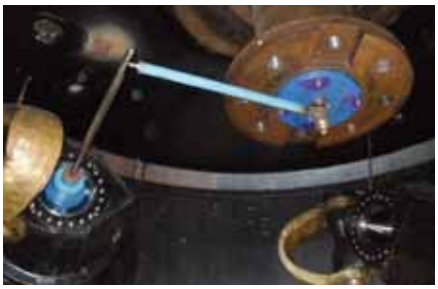
A Success Story of Service and Rehabilitation in India

▲ Top view of Bassi powerhouse

ANDRITZ HYDRO India has successfully renovated and uprated two units at the Bassi hydropower plant from 15 MW to 16.5 MW. The renovation of the machines, which were originally built by other manufacturers, has been achieved with a high level of performance and customer satisfaction. The renovated units were handed over to customer for commercial operation with increased contractual efficiency and stable, vibration free, operation.

The Bassi generating units had vibration levels above acceptable limits and were also unable to generate rated output and had low efficiencies. The major scope of supply and services included runners, governing system, nozzles and deflectors, bearings, main inlet valve, shaft, new stator core and windings, pole coils, generator bearings, new static excitation system, protection and control system, cooling water system, drainage and dewatering system and other auxiliaries. With no drawings or documents available to manage the hydraulic engineering and mechanical design of the turbine and generator components, a comprehensive study was carried out after component dismantling. Reverse engineering for producing component drawings, strength calculations and shaft line analysis were the vital part of this process. A model test was carried out at the Vevey hydro turbine laboratory in Switzerland. The water discharge required for the uprated output was less than predicted by the laboratory forecast. This shows improved runner efficiency with the existing distributor size. The achieved efficiency was better than the contractual figures. Modifications were carried out

▲ Model testing



▲ Nozzle and deflector assembly

▲ Runner installation

to the shaft and bearing top brackets in order to bring the vibrating frequency away from the natural frequency.

Major modifications were done on the turbine bearing support to increase its stability giving reduced vibrations from the previous level of 300 microns to 30 microns with a safe, stable and smooth operation This was a remark-

▼ Control room

▲ Erection activities at service bay

able improvement in the uprated units. The state of the art dam level measurement system, using communication with plant SCADA through an RF link, has been successfully implemented. This technology removed using long route fiber optical cables and facilitated the installation and O & M efforts.

The successful completion of the Bassi renovation was appreciated by the customer. The two units were taken over by the customer for commercial operation on commissioning day. The successful renovation and uprating of the Bassi units has joined the growing number of ANDRITZ HYDRO's successful projects in the Service & Rehab segment.

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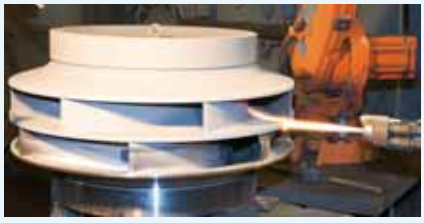
TECHNICAL DATA

Output: 4 x 16.5 MW / 18.33 MVA
Voltage: 11 kV
Head: 332 m
Speed: 500 rpm
Runner diameter: 1,422.4 mm
Stator diameter: 3,480 mm

Coating center in India

Most rivers in the Himalaya have a high concentration of hard particles like quartz in their water. These particles damage the turbine parts and lead to efficiency losses, short times between overhauls and high repair-costs. Due to this, many turbines are protected by a coating, which prolongs the time between two overhauls by a factor of 3 to 7. Already three years ago, due to the increas-



ing demand in the Himalaya region, ANDRITZ HYDRO has built coating facilities in the workshop in Faridabad, near Delhi. Since then, already numerous parts have been coated.

Tillari

ANDRITZ HYDRO Pvt. Ltd. India won its first-ever contract for a 66 MW HIWELD™ Pelton runner for the Tillari hydropower plant in September 2011.

ANDRITZ HYDRO India is a key member of the Pelton runner club within ANDRITZ HYDRO. This contract has arrived fortuitously because the management has decided to develop the HIWELD™ Pelton runner manufacturing technology in the Indian workshop. India is a key market for Pelton turbines. The Tillari hydropower plant is located in the western part of India housing one unit in an underground powerhouse. The original turbine was supplied by CKD Blansko and the generator by the former Elin-Union which is now ANDRITZ HYDRO. The customer wants to procure this uprated runner for capacity enhancement of their unit from 60 MW to 66 MW, which means an increase of 10%. The existing generator seems to be capable of achieving the output. Initially the customer's choice was to go for an integrally cast Pelton runner. But ANDRITZ HYDRO convinced them to select a HIWELD™ runner due to its superior mechanical and structural properties compared with an integral cast runner. The Pelton runner will be manufactured in the ANDRITZ HYDRO workshop in Prithla, India, under the supervision and technical support of the CoE Pelton turbine in Kriens. Supply, installation, testing and commissioning of this runner is to be completed within 18 months. The runner weight will be approximately 7 tons.

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TECHNICAL DATA

Output: 1 x 66 MW
Head: 624.8 m
Speed: 500 rpm
Runner diameter: 2,020 mm

Success in Italy

On the top of the Dolomites

▲ Dolomites - Tre Cime di Lavaredo

The Dolomites are some of the most spectacular mountains in the world. This is what people say, who have been in front of these gigantic rock formations. Compared to other mountains, the dolomites are brighter, more colorful, more monumental, and seem to be architecturally inspired.

In the 17th century the Frenchman and geologist Déodat Tancrè de Gratet de Dolomieu discovered and defined the chemical composition (stratified calcium magnesium carbonate) that renders this rock so different from the rest. The new mineral was classified as "dolomia" in his honor. The name "Dolomites" was extended to the entire mountain region in 1864. While the landscape of the Dolomites has remained unchanged for millennia, the Italian customer landscape has changed a good deal in the past years, and it is still changing. At a time when investment forecasting is very uncertain and difficult because of the economic crisis and the reduction of incentives, ANDRITZ HYDRO has acquired many Italian projects with several clients. The most significant examples of changes are two new joint ventures: "SE Hydropower", between ENEL and the company SEL, controlled by the province of Bolzano. Ten ENEL plants located in the province of Bolzano (550 MW in total) have been transformed to SE Hydropower. 27 ENEL plants located in the province of Trento (totally 1,300 MW) have been transferred to the "Hydro Dolomiti ENEL", a joint venture between ENEL and the company "Dolomiti Energia", controlled by the province of Trento. This took place in 2009 and 2010, during the renewal of water use rights, with the aim of transferring water use ownership to the local administrations. A consquence of this process is the obligation to modernize the plants.

▲ Lappago

▼ Molini di Tures

Therefore, SE Hydropower and HDE are two of the most promising clients in Italy in terms of investment potential – and this potential had already a reality in spring 2011. The two new companies decided to launch the first modernization projects, which would also profit from the present generous incentives for renewable energies (the so called Green Certificates).

Three projects were awarded to ANDRITZ HYDRO between July and September 2011: the modernization of the Lappago and Molini di Tures plants by SE Hydropower (South Tyrol) – and of the Predazzo plant (Trentino) by HDE; all are situated in the heart of the Dolomites. The time schedule is highly challenging: all three projects must be concluded by the end of 2012. The Green Certificate rules will become less generous for projects executed after the end of 2012. The scope of supply is almost the same for each of the three power plants, and includes the replacement of turbines, generators, step-up transformers, inlet valves, auxiliary and governor parts and the complete automation of the electrical power system, including rehab of some parts of the HV station.

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▲ Predazzo

TECHNICAL DATA Molini di Tures
Output: 8.19 MW / 10 MVA
Voltage: 10 kV
Speed: 500 rpm
Frequency: 50 Hz
Power Factor: 0.85

TECHNICAL DATA Lappago
Output: 14.9 MW / 17.5 MVA
Voltage: 10 kV
Speed: 600 rpm
Frequency: 50 Hz
Power Factor: 0.85

TECHNICAL DATA Predazzo
Output: 10.2 MW / 12 MVA
Voltage: 6.3 kV
Speed: 750 rpm
Frequency: 50 Hz
Power Factor: 0.85

Foz Tua

The fourth major order for ANDRITZ HYDRO in Portugal

▲ Artist view of dam and downstream site

Electricidade de Portugal (EDP) is currently implementing an ambitious program to replace old thermal power plants with renewable energy sources. This program focuses on both wind turbines - and hydropower plants, which are used primarily to generate electricity when it is needed (see also Hydro News 19).

In November 2011, EDP awarded another large order to ANDRITZ HYDRO within the last four years. The Foz Tua project is the eighth of EDP's current expansion program in Portugal, and the fourth for which ANDRITZ HYDRO received the order for delivery and installation of the electromechanical equipment. The reasons for this decision were the proposed technical solution, the competitive price and the positive experience in the execution of the previously ordered Bemposta, Baixo Sabor and Ribeiradio. In 2008, ANDRITZ HYDRO received an order from EDP to deliver a Francis turbine for the extension of the Bemposta hydropower plant, one of the largest of its kind in Western Europe, with a capacity of 193 MW and a runner diameter of 6 m. Since November 2011 it has supplied environmentally friendly power to the Portuguese grid.

The order for the newly constructed Foz Tua pumped storage power plant includes two reversible pump turbines, motor generators, governors and control systems, the hydraulic steel works and a comprehensive package of auxiliary equipment. The pumped storage plant will be built on the river Tua, a tributary of the river Douro in the north of Portugal. It will provide a significant contribution to the increasingly important storage of electrical power. A crucial success factor was the intense involvement of two important Portuguese companies to achieve a high local content, despite of the difficult economic situation in Portugal. The project is executed under the leadership of ANDRITZ HYDRO in Ravensburg, together with the Group companies Vienna, Linz and Weiz as well as two

▲ Contract signature

external consortium partners. The two pump turbines are equipped with runners in welded construction, which are manufactured in Ravensburg. The hydraulic properties were proven in a model test in Linz. As a special feature, cylindrical gates will be provided to serve as an additional shut-off valve, similar to the previous order for Baixo Sabor Montante. They are integrated into the pump turbine and allow replace by: reduction of the powerhouse dimensions.

This new order strengthens the leading position of ANDRITZ HYDRO in Portugal, which is one of the most active markets for new pumped storage power plants in Europe. In total, the four orders for ANDRITZ HYDRO in Portugal include ten units of different type and sizes.

Generally, the focus in Portugal is on low pressure pump turbines, where ANDRITZ HYDRO has gained extensive experience, also boosted by the projects in Portugal.

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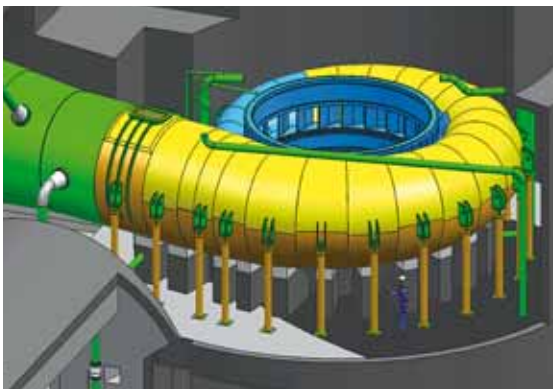
TECHNICAL DATA
Output: 2 x 127 MW
Head: 96 m
Speed: 187.5 rpm
Runner diameter: 4,850 mm

▼ CAD model of spiral casing



Belo Monte

The largest Brazilian hydropower plant under construction

▲ Rio Xingu in the province Para in Brazil

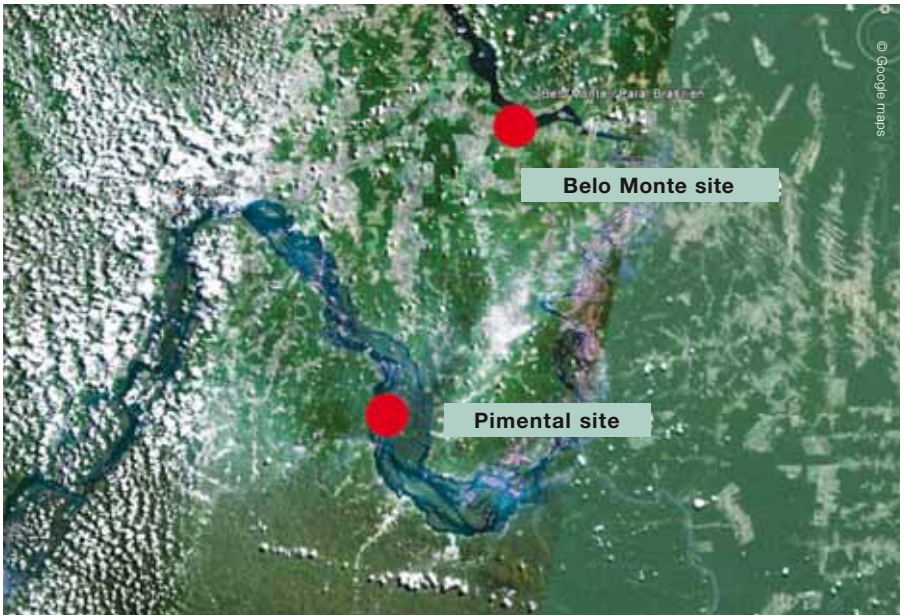
After 30 years of studies, the Belo Monte Hydroelectric Complex will become a reality. With an installed capacity of 11,400 MW, it will be the largest Brazilian hydropower plant and the 3rd largest in the world.

The Belo Monte Hydroelectric Complexis being developed by the Brazilian Norte Energia SA, consisting of Eletronorte, Eletrobras, Chesf, and 15 additional parties. Norte Energia SA won the competitive auction called by ANEEL (National Electric Power Agency) in April 2010. Located in the state of Pará in the Northern part of Brazil in Xingu River's big bend, Belo Monte Hydroelectric Complex consists of two dams and 28 dikes with 32 million cubic meters of landfill:

- Belo Monte dam (90 m height; 3,545 m length)
- Pimental dam (36 m height; 6,248 m length).

Several minor barrages and one large intake channel 20 km in length and 200 m in width (average) allow exploitation through two powerhouses.

▼ The two locations of the Belo Monte and Pimental sites



The Belo Monte hydropower plant will be equipped with 18 Francis turbines with a total capacity of 11,160 MW. Pimental hydropower plant will be equipped with six Bulb turbines with a total installed capacity of approximately 240 MW.

Companies involved

As one of the largest projects ever to be built in Brazil, many important local companies are involved in the project. The equipment to be supplied for Belo Monte, Pimental and their 20 spillway gates represents thousands of tons.

The Consortium ELM, composed of ALSTOM (leader), ANDRITZ HYDRO and VOITH Hydro, has been awarded the contract to supply most of the electromechanical equipment for the project. The construction of Belo Monte and Pimental will take place over the next eight years, with generating operations expected to start by 2015.

The power from these hydropower plants will be fed into the National Interconnected System (SIN) through the existing substations in the region.

Supplies and services for the project

ANDRITZ HYDRO's scope includes three generating sets with vertical Francis turbines and generators, three blow-down systems for this plant, as well as 14 excitation systems for the Belo Monte powerhouse. For the Pimental powerhouse ANDRITZ HYDRO will supply the electromechanical equipment consisting of six generating sets with Bulb turbines and horizontal generators, electrical power systems, mechanical auxiliaries and automation, protection and control systems equipment.

Environmental and socio-cultural aspects

From the beginning of the project, the Brazilian authorities and Norte Energia SA have been concerned about its environmental implications mainly regarding the local population and including indigenous communities.

In line with strict Brazilian laws and regulations, detailed studies investigated the project's influence on the environment and living conditions of the indigenous communities. The results led to a completely new concept. Instead of one big power station, several stages and channels for two hydropower plants now reduce the reservoir area from 1,225 km² to 503 km² (approximately 0.01% of the actual Brazilian rainforest area). Certain legal disputes around parts of the project are still ongoing. The reservoir surface is divided into 134 km² for the channels and 382 km² for the Xingu river reservoir, which is exactly the same size as the part normally flooded by the river in the rainy season. Today, 328 km² are already flooded by the existing riverbed. More than 35% of the area to be flooded is already affected by human activities (forestry, agriculture, cattle raising, etc.).

▼ Aerial view of the Pimental dam

▲ 3D CAD drawing of the Belo Monte powerhouse

The water level of the reservoir will never exceed the normal high water level in the rainy season. Based on the project redesign, the indigenous communities living in this area will not be affected. Norte Energia has been granted the installation license to protect the population and the indigenous communities as well as the environment. The costs relating to environmental matters and measures to mitigate environmental impact will exceed the sum paid to Consortium ELM for the equipment supplies.

14 plans have been defined with a total of 54 programs aggregating 86 environmental projects. To guarantee the water quality of the Volta Grande do Xingu river the new design maintains a constant flow of water passing by the Pimental hydropower plant and/or the main spillway. Additional ship locks, fish ladders, a sewage system, and a drinking water treatment system will be installed. The project will significantly boost the regional economy. In general, more than 18,000 direct and 80,000 indirect jobs will be created. During the peak construction period more than 23,000 people will be employed to work on the project.

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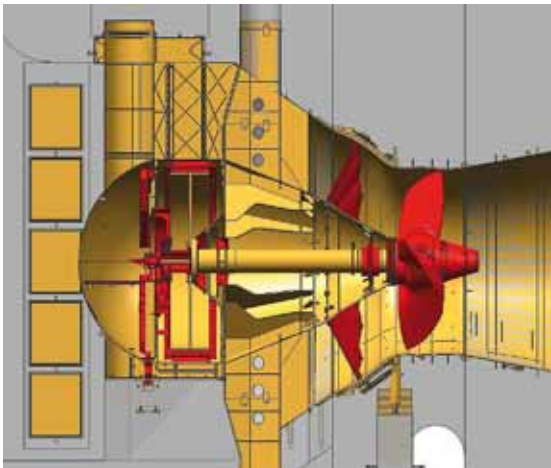
TECHNICAL DATA Belo Monte
Output: 18 x 620,4 MW / 679 MVA
Voltage: 18 kV
Head: 87.0 m
Speed: 85.71 rpm
Runner diameter: 8,500 mm
Stator diameter: 22,400 mm (estimated)

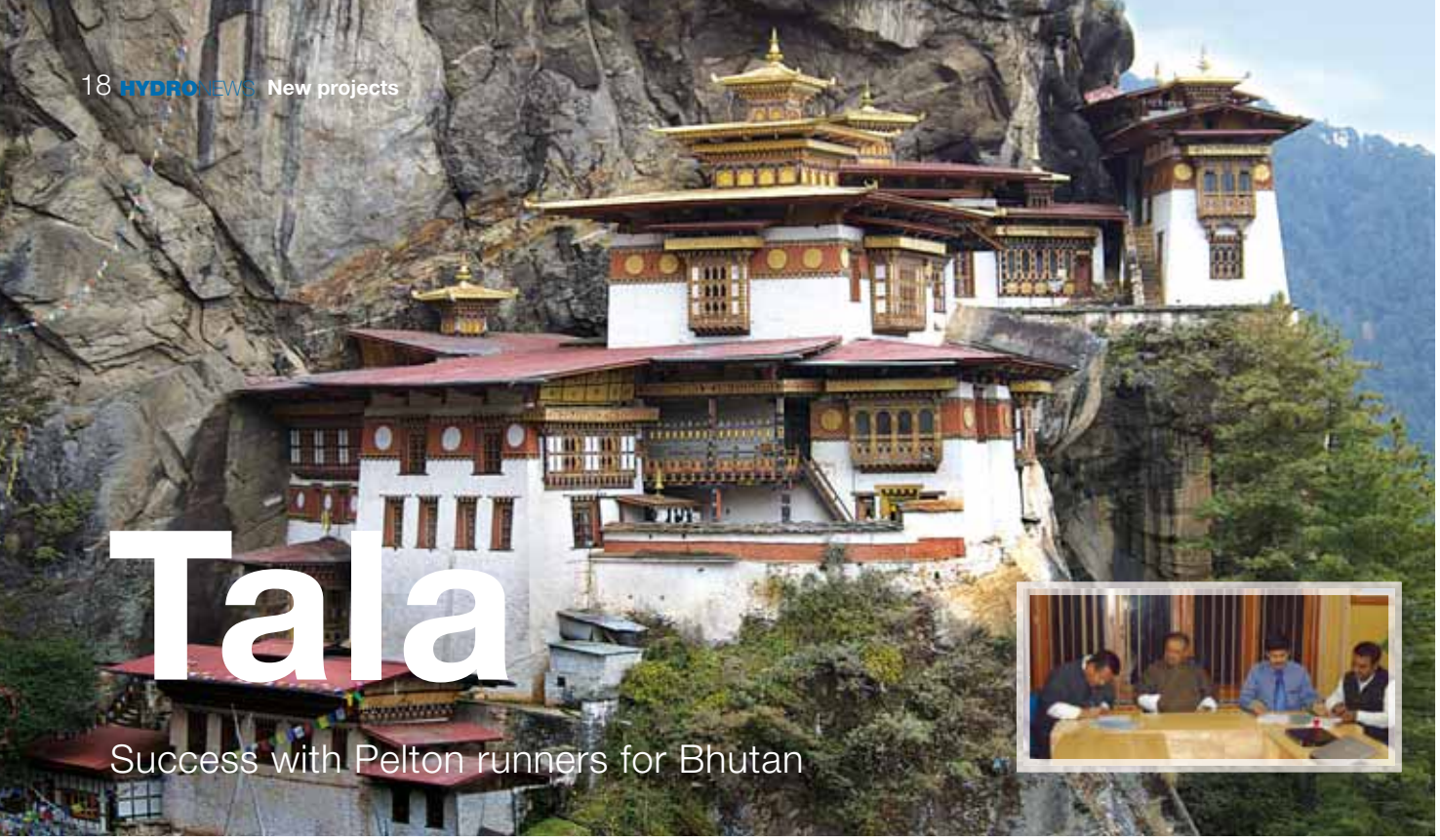
TECHNICAL DATA Pimental
Output: 6 x 39,8 MW / 40.9 MVA
Voltage: 13.8 kV
Head: 11.4 m
Speed: 100 rpm
Runner diameter: 6,500 mm
Stator diameter: 8,450 mm

TECHNICAL DATA Balance of Plant
Generator busbars:
Rated current: 10,000 A

TECHNICAL DATA Spillway
Spillway – 20 gates
20 m width x 22 m height

▼ Section through turbine set of Pimental hydropower plant





Tala

Success with Pelton runners for Bhutan

▲ Tigers nest Dzong

In December 2011, ANDRITZ HYDRO won an important contract for the supply of MicroGuss™ hard coated Pelton runners for the Tala hydropower plant in Bhutan.

Druk Green Power Corporation (DGPC), owner of the Bhutan power plants, selected ANDRITZ HYDRO due to fully meeting the pre-qualification requirements with MicroGuss™ technology proven runners and having more than 300 worldwide references without accident. At the pre-bid stage ANDRITZ HYDRO was able to convince the customer that he should not use unreliable integral cast runners.

The Tala underground power plant is currently the largest hydropower plant in Bhutan housing six units. The plant, which is located near Tala village, was commissioned in 2007. It utilizes the water from the Wangchu river and is located downstream from the Chukkha hydropower plant with a capacity of 500 MW. Now the customer plans to phase out all old integral cast runners with new reliable runners. It is important to note that all operational power plants in Bhutan are owned by DGPC which is responsible for their operation, maintenance and upgrade. DGPC is also developing new hydropower projects in the country. During 2010, DGPC plants generated 7.3 TWh of electricity, an increase of almost 6% over previous years generation. The export of hydropower is one of the primary sources of revenue for the government of Bhutan. But the abrasive water in many rivers, mainly during the monsoon period, dramatically reduces the lifetime of the runners. Therefore, the customer initially decided to use silt erosion resistive coatings for the Tala runners to maximize their availability for generation. After beeing convinced that ANDRITZ HYDRO has been developing

▲ Jumolhari lake and montains

high-quality coatings since 1986 - initiated by projects in the Swiss Alps with hydro-abrasive problems related to glacial silt – and after experiencing the proven protection in the Indian Himalayan region's silty water, the customer selected the SXH70™ coating: a TC-CoCr coating applied using a programmed robot in a High Velocity Oxygen Fuel (HVOF) process. Under this new contract each hard coated runner will consist of 22 buckets and weigh about 18 tons. Two of the four runners will be supplied in 19.5 months, and the remaining two in 25.5 months. All runners will be supplied by the ANDRITZ HYDRO Kriens workshop in Switzerland. The scope of supply also includes conducting and proving the performance guarantee parameters of the coated runners through field efficiency tests. Recently, the customer has also decided that two of the runners from the contract of 2009 should be hard coated with the SXH70™ coating.

Through open competition ANDRITZ HYDRO has secured another contract from the same customer in Bhutan to supply a 12.53 MW Pelton runner for the Basochhu hydropower plant. Winning all these contracts has further consolidated ANDRITZ HYDRO's position in Bhutan, which has emerged with hydro potential of over 10,000 MW projected for the coming ten years.

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TECHNICAL DATA
Output: 6 x 170 MW
Head: 819 m
Speed: 375 rpm
Runner diameter: 3,908 mm

Degerforsen

Upgrade of an aging power plant in Sweden

▲ View of dam, spillway and powerhouse

In October 2011, ANDRITZ HYDRO was awarded a contract by E.on Vattenkraft Sweden for the supply of one vertical Kaplan refurbishment runner. The power plant is equipped with two Kaplan units and the delivery includes an option for the second unit. The reasons for the upgrade are an oil leakage on the old runner and cracks on the Kaplan blades.

E.on Vattenkraft AB owns 80 power plants in Sweden, with a installed production capacity of 1,700 MW. In the future E.on is planning to refurbish four to five power plants each year. Degerforsen was constructed in 1966 and the machines were built by Maier. It is located in the center of Sweden, just outside the small village of Junsele, located on the river Ångermanälven only 170 km from the ANDRITZ HYDRO workshop in Vaplan. The delivery includes a model test, one new oil-free self-lubricated Kaplan runner with six blades, new bearings, new guide vanes and a new high pressure oil unit. The power plant is scheduled to be taken into operation in autumn 2013.

▼ Main machine hall

The fabrication of all new parts will be performed on the ANDRITZ HYDRO workshop in Vaplan, Sweden, and the model test will be done in the ANDRITZ HYDRO test rig in Tampere, Finland. The Degerforsen project also includes contracts with other contractors, new automation equipment, refurbishment of the generator with new cores and windings, overhaul of intake gates and one new spillway gate.

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TECHNICAL DATA
Output: 39.1 MW
Head: 24.9 m
Speed: 136 rpm
Runner diameter: 4,700 mm

San Carlos

Colombia's largest hydropower plant receives new Pelton runners

▲ Runners and spherical valves before installation in the underground cavern

ANDRITZ HYDRO was the successful winner in the public bidding process initiated by the Colombian ISAGEN for the engineering and manufacturing of eight Pelton runners for the San Carlos hydropower plant in December 2010. The purchase order was signed in October 2011.

ISAGEN owns and operates five generating power plants, located in the departments of Antioquia, Santander and Caldas. The company has an installed capacity of 2,132 MW, equivalent to 16% of the national interconnected system's total capacity, divided into 1,832 MW hydro and 300 MW thermal. ISAGEN is the third largest generator in Colombia, and therefore is a fundamental agent in the country's development of its energy industry. The San Carlos power plant is located in the department of Antioquia, 150 km east from Medellín, within The San Carlos municipality, near the El Jordán rural district. With more than 20 years of commercial operation, it is still the largest power plant in the country, with eight Pelton units and the infrastructure necessary to install two more units. ANDRITZ HYDRO is the original equipment manufacturer for the turbine units.

▼ Underground cavern

Pelton runners are generally subjected to extreme loads. Centrifugal force and pulsating jet force as well as material properties regarding fatigue represent the most important criteria to be taken into account in ensuring safety and reliability.

During its service life, a runner must absorb a high number of load cycles. In order to archieve the highest level of reliability and operational safety on Pelton runners the ANDRITZ HYDRO MicroGuss™ manufacturing technology guarantees safe operation and a longer life time for the runner. Fewer inspections and less repair and maintenance work decrease costs and increase the reliability and availability of power plants. Since 1991 around 500 runners (up to 1,980 m net head) were manufactured using the state of the art manufacturing technology of MicroGuss™, and are successfully in operation to the complete satisfaction of customers around the world. Due to the strategic importance of the San Carlos hydropower plant to ISAGEN's electricity generation, the mentioned aspects of operational safety and reliability are priorities in this project. The contract also integrates a service package including regular inspections for the eight Pelton runners over the entire extended warranty period. In addition the superior mechanical features, the new to runners will benefit from the latest hydraulic developments, increasing their performance significantly.

The runners will be supplied in pairs at four-month intervals from May 2013 to May 2014.

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TECHNICAL DATA
Output: 8 x 160 MW
Head: 554 m
Speed: 300 rpm
Runner diameter: 4,068 m

MMC10

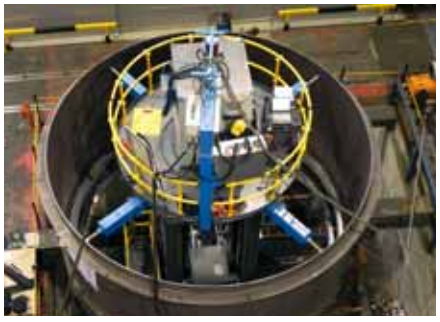
The world's largest mobile CNC machining center

▲ Machining at Boyabat, Turkey

The customers of ANDRITZ HYDRO attach great importance to high quality and rapid implementation of supplies and services. In order to satisfy these needs even better in future, ANDRITZ HYDRO decided to purchase a mobile CNC machining center from Miba Automation Systems.

The MMC10 will be delivered to site in three 20' containers with standard dimensions. Thus, it can be installed worldwide. The assembly takes place first at the erection bay and second in the turbine pit, which needs approximately five days. After exact adjustment in all directions, flange areas, where extreme high precision is required, are turned and milled. In addition, drilling and tapping can also be carried out with the MMC10. Until now, large sized turbine parts had to be divided into parts for transport after final manufacturing in the workshop. At site the they were welded together again and embedded in concrete. Deformations due to the heat during welding or mechanical loads made time consuming grinding works necessary in order to achieve the required precision. Now, with the MMC10, the final machining of the main turbine parts takes place directly at site. These components can be sourced from pure steel construction companies, since the machining does not have to be done at the workshop, but takes place at site.

▼ Shop assembly in Linz, Austria



▲ Machining at a stayring dummy

The most remarkable advantages of the MMC10 are:

- shorter installation time since, no time - consuming grinding works are necessary
- Highest precision up to 1/100 mm
- High flexibility in sourcing welded components, since machining is carried out at site.

▲ The main spindle

The first use of the MMC10 at the site of Boyabat in Turkey was a great success. Hence, this world's largest mobile CNC machining center will be in service at many sites of ANDRITZ HYDRO, to the benefit of all.

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▲ Powerhouse Feldsee

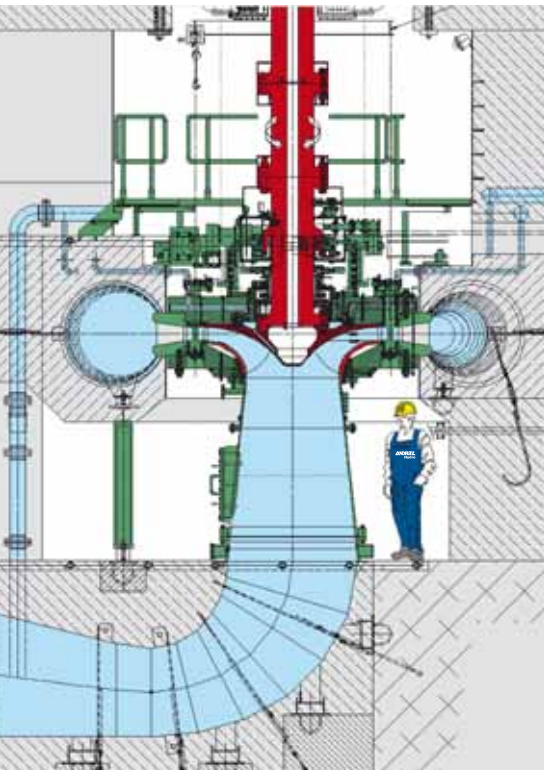
▲ Pump turbine set Feldsee 2

Feldsee

KELAG Feldsee pump storage power plant in Carinthia is now operational

The pump turbines, including auxiliary equipment, for the Feldsee 1 and Feldsee 2 hydropower plants were designed, fabricated and delivered by ANDRITZ HYDRO in Linz. The model test was executed in Zurich. The scope of delivery included two pump turbines, spherical valves, maintenance butterfly valve, hydraulic and digital speed governors as well as additional auxiliary equipment such as ventilation system, shaft seal compressed air supply and other relevant components.

▼ Section through the pump turbine



▲ Spherical valve before installation

▼ Butterfly valve Feldsee 2

In August 2006, ANDRITZ HYDRO was commissioned to supply and install the abovementioned turbine parts for the Feldsee 1 unit, which went into operation in summer 2009. The commissioning of Feldsee 2 followed in October 2008. The Feldsee 2 unit successfully became operational in early 2011. If more power is produced than consumed at the moment, the generator will utilize this power to bring water from the Wurten reservoir up to the Feldsee reservoir by pumping the water up to 520 m.

This water can be used for power generation during turbine operation to cover peak demands. In addition to the high pressure, the speed and the enormous speed rise by load shedding were also technical challenges.

ANDRITZ HYDRO was able to fulfill all customer requests and maintain high degree of efficiency, and can enter another reference unit in the list of a supreme discipline “pump turbines”.

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TECHNICAL DATA
Output pump: 2 x 64 MW
Output turbine: 2 x 68.89 MW
Head: 520 m
Speed: 1,000 rpm
Runner diameter: 1,936.6 mm

Pirrís

Power plant handed over in Costa Rica

▲ Inside powerhouse

The government utility Instituto de Electricidad Costarricense (ICE) awarded a contract for the design, fabrication, supply, installation and commissioning of electromechanical equipment on 21 December 2007 (see Hydro News No.13 /2008). The hydropower plant Pirris will contribute to Costa Rica's grid stability and will help to meet future power demands.

The penstock contract was executed at site with its own personnel and, therefore, it was an additionally important experience for on-site fabrication and installation. Moreover, the specific design of the exposed penstock (unforeseen expansion joints between concrete saddles) and the high grade material (S690QL) made the works very challenging. The steel liner and the penstock with guard valve and accessories (aeration valves, hydraulic and water unit, earthquake measurement instrumentation) was finished and handed over to ICE in July, 2010. The scope for the E&M contract comprises two 5-jet Pelton turbines with vertical axis, including TC1703 digital governors, cooling water system with cooling towers and two inlet spherical valves (1,000 mm inside diameter, pressure 100 bar), two generators, powerhouse crane (140 / 30 tons), main transformers (two blocks with three single phase pieces, 3 x 26.7 / 30) and the complete powerhouse control system including excitation, protection and station auxiliaries. According to contractual requirements the plant was handed over to ICE for commercial operation on 26 September 2011 after commissioning and a successful 60-day trial run.

▲ View from powerhouse to exposed penstock

▲ Section of distribution pipe lowered into the turbine pit

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TECHNICAL DATA
Output: 2 x 69 MW / 89.4 MVA
Voltage: 13.8 kV / 60 Hz
Head: 890 m
Speed: 600 rpm
Runner diameter: 1,980 mm
Stator diameter: 5,400 mm
Steel liner and exposed penstock:
Length: 2,390 m
Diameter: 2,300 / 2,000 mm
Bifurcator: 2,100 / 1,400 / 1,400 mm
Material: S690QL
Spherical guard valve:
Inside diameter 1,400 mm, 80 bar

Tsankov Kamak

Commissioning of outstanding project in Bulgaria

▲ Double curve arch dam and spillway

The contract was signed on 1 October 2003. The commencement date was 1 July 2004, when the brilliant financing structure was established which included the Austrian Kontrollbank, Bank Austria and, additionally, several Export Credit Agencies and several commercial banks from five European states. The sales agreement between the Bulgarian and Austrian Governments concerning CO_2 certificates generated by the Tsankov Kamak hydropower plant made the finance structure really outstanding in scale and creativity.

The extreme geological conditions of the Vacha valley caused many delays during the construction of the dam and concreting of the river bed. The dam, with a height of 130 m, is the highest double curve arch dam in Eastern Europe and was built by the Austrian company Alpine Bau GmbH. Planning was done by the Austrian company Pöyry. The various delays finally resulted in six amendments to the contract covering an extension of time and costs of about three years and, leading to a total project duration of about six years. Meanwhile Bulgaria entered the European Community and underwent enormous changes. The customer's chief executive director changed five times and only one person on the customer's project team remained until the end. In the final stage of the Tsankov Kamak hydropower plant ANDRITZ HYDRO was able to shorten the implementation period by 2.5 months. Consequently, it was possible to fulfill the wish of the Buler, Natsionalna Electricheska Kompania EAD (NEK), to begin commercial operation in December 2010, shortly before Christmas. This early start was only possible through the excellent work of supervisors and commissioning engineers. Due to them, NEK was able to realize power generation with a value of about one million EUR. The various performance tests and fine tuning of the plant were done in 2011.

The Tsankov Kamak hydropower plant is a very important part of a cascade system situated on the Vacha river because it serves to optimize the water flow in the chain of seven power plants. It covers the energy need at peak times and thus provides the most valuable energy. It should work over 3,000 h/year. The realisation of the Tsankov Kamak power plant included many Bulgarian companies and employees in the fields of manufacturing and installation, thus creating many jobs and providing income in Bulgaria. Tsankov Kamak stands for ecological solutions considering environmental issues such as:

- the fish channel, which helps trout and other fish to migrate up the river
- the auxiliary turbine unit of 1.3 MW, which generates energy from the dam's natural overflow to provide ecologically necessary quantities of water.

▼ Upper reservoir and dam of Tsankov Kamak in Bulgaria

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PROJECT HIGHLIGHTS

Location: Bulgaria, Vacha river in the Rhodopi mountains at the border to Greece
Main units: two vertical Francis turbines with 43.2 MW each, with turbine governors, main inlet valves, two generators with 50 MVA each
Auxiliary unit: one horizontal Compact Francis turbine with 1.29 MW, one generator with 1.6 kVA and 0.9 power factor
Hydromechanical equipment:
Dam: four sets spillway radial gates, 8 x 6.15 m, one set spillway stop logs with lifting beam, 8 x 6.2 m
Bottom outlet: two sets upstream trash racks, 3 x 6.3 m, two sets bottom outlet conduits, diameter 2.25 to 1.35 m, 22.75 m length, two sets bottom outlet slide gates, tandem gate high pressure type, with hydraulic hoist and control system
Power intake: two sets intake trash rack panels, 6.0 x 9.24 m, with supporting beams, one set intake stop logs, 5.5 x 6.5 m with rope hoist, one set intake gate, fixed wheel type, with hydraulic hoist and control system, one set flow measuring system, pipe burst detection
Penstock: one penstock 4.4 m / 3.1 m / 2.25 m, total length 638 m
Powerhouse: two sets draft tube stop logs, 2.8 x 3.0 m with rope hoist
Start of operation: 2010

▲ The entire team after contract signing

▲ Francis turbine runner

Kraftwerke **Hinterrhein**

Total renovation of a cascade of power plants in Switzerland

Within a larger project comprising the complete renovation of the Kraftwerke Hinterrhein AG (KHR), headquartered in Thusis, ANDRITZ HYDRO plays an essential role as main partner for the mechanical lots. In addition to major overhauls including the replacement of runners in Bärenburg and Sils (four units each), ANDRITZ HYDRO received an order for the general revision of all 13 spherical valves, as well as the overhaul of two railway power machines for Sils.

The KHR power plants were commissioned in 1963 and use the hydropower of the river Hinterrhein in three stages (Ferrera, Bärenburg, Sils), with a total installed capacity of 650 MW. After about 45 years of operation all components of the plants need major investment for renovation and renewal. This applies to the water flow tunnel as well as to the electromechanical and control systems, which do not meet the latest technologies. Therefore, the KHR has launched a comprehensive total renovation, lasting from 2011 to 2017. The two lower power plants, Sils and Bärenburg, are similarly equipped regarding the main machines and have four vertical Francis turbines each. In addition to replacing the runners with a modern hydraulic profile, the renovation work will include the complete revision of the turbines. The revision will be carried out according to a condition analysis in which the individual components are tested intensively at the ANDRITZ HYDRO workshop in Kriens and optimized together with KHR within the scope of refurbishment. Furthermore, all hydraulic turbine governors must be replaced.

Work on the two plants is staggered. Each summer and winter one machine will be overhauled, starting with the first turbine at Bärenburg in early summer 2012 and ending with the last one in Sils in April 2016. In addition to the turbine modernizations, ANDRITZ HYDRO has been awarded the revision of all 13 spherical valves of the entire cascade of power plants. The three spherical valves of Ferrera, the four of Bärenburg and the six of Sils will be overhauled at the ANDRITZ HYDRO workshop in Kriens and at the factory of the partner company OEMB. After reassembly, these valves will serve as reliable shut-off devices for the pressurized penstocks during the main project phase. Work has already begun at the Sils and Bärenburg power plants with the dismantling of ten valves in October 2011. Within this complete renewal ANDRITZ HYDRO will modernize two more Pelton turbines at the Sils power plant. These turbines serve mainly for the generation of 16.7 Hz of power for the Rhaetian Railway.

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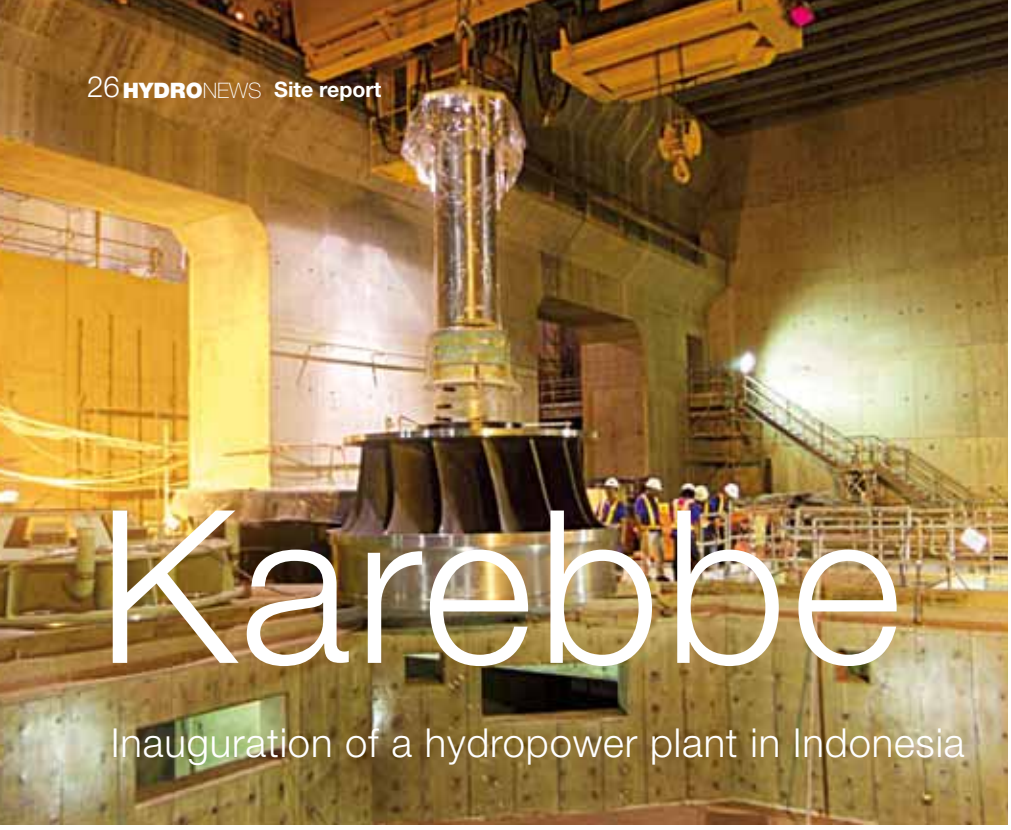
TECHNICAL DATA Bärenburg
Output: 4 x 55 MW
Head: 338 m
Speed: 500 rpm
Runner diameter: 2,300 mm
TECHNICAL DATA Sils
Output: 4 x 60 MW
Head: 387 m
Speed: 600 rpm
Runner diameter: 2,070 mm
TECHNICAL DATA Sils Bahn
Output: 2 x 3.5 MW
Head: 387 m
Speed: 500 rpm
Runner diameter: 1,945 mm



Karebbe

Inauguration of a hydropower plant in Indonesia

▲ Lowering turbine runner and shaft

▲ Final lowering of stator

The official inauguration was held at Karebbe on 11 October 2011. It was attended by officials from PT International Nickel Indonesia Tbk. (PTI), Vale Canada, Vale Brazil and the Indonesian government.

ANDRITZ HYDRO was awarded the contracts for turbines, generators and auxiliaries in 2005, for penstocks and gates in 2008 and for EPS in 2009, and supplied the complete E&M - equipment (except, main transformers, HV switchyard and, emergency Diesel), penstocks, radial and intake gates, stop logs, powerhouse ventilation and fire fighting system. Main installation work began on 15 February 2011. The reliability run of unit 2 started on 17 August 2011, and that of unit 1 began on 20 September 2011. The complete installation of the power plant, which included generator stacking and winding in the Powerhouse, was executed by ANDRITZ HYDRO. More than 300 employees were engaged at site during the peak time.

▼ Spillway radial gate in operation

▲ The penstock during construction phase

The Karebbe power plant was the latest initiative of PTI addressing sustainability and efforts to reduce environmental impact, greenhouse gas emissions and dependency on thermal and Diesel power generation. PTI produces and exports nickel mate, but recent changes in mining law will allow the export of processed nickel only to those driving the investment and development of Indonesia. PTI will therefore invest in new facilities, which will further increase energy demand in the future. PTI also owns and operates the Larona and Balambano hydropower plants. ANDRITZ HYDRO was also awarded the contract for the upgrade of Larona including the supply of two new generators which are currently under installation. ANDRITZ HYDRO has again proved to be a reliable partner and has strengthened its leading position in the Indonesian Large Hydro market.

Close cooperation and coordination between ANDRITZ HYDRO in Jakarta, Vienna, Weiz and Linz made the Karebbe hydropower plant project another success story.

▲ Inauguration

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TECHNICAL DATA
Output: 2 x 63.70 MW / 78 MVA
Voltage: 11 kV
Head: 70 m
Speed: 200 rpm
Runner diameter: 3,250 mm
Stator diameter: 9,900 mm

Azerbaijan
Arpaçay

In March 2011, ANDRITZ HYDRO was awarded the contract for the supply of turbines, generators and associated equipment for the hydropower plant Arpaçay by Girişim Elektrik, a Turkish company. Arpaçay power plant is located in Nahçivan, which is an autonomous state within the Republic of Azerbaijan since 1995. The Arpaçay Damhas been in service since 1980. It has been constructed to store water for irrigation of about 17,500 hectares of land. The distribution is made by a weir, which is about 6 km to the downstream of the power plant. The average annual inflow of Arpaçay is about 450 million m³. The reservoir will be full in these months and the water in the reservoir is released downstream to meet the irrigation demand in summertime. There is always flow in the river. The scope of supply of ANDRITZ HYDRO comprises three horizontal Francis turbines, butterfly inlet valves and generators, including site supervision and commissioning of the supply. The start-up is scheduled for July 2012.

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TECHNICAL DATA

Output: 2 x 8,400 / 1 x 4,600 kW
Head: 63.5 m
Speed: 428 / 600 rpm
Runner diameter: 1,340 / 1,030 mm

Indonesia
Bungin I

In March 2011, ANDRITZ HYDRO India (HIN) made the first breakthrough in the Indonesian market and was awarded a contract for supply of water-to-wire equipment for the Bungin I hydropower plant by PT. Haji La Tunrung Listrik Dan Konstruksi.
This being first Compact Hydro project of HIN in Indonesia makes it a very prestigious and important project thus best quality and performance to the full satisfaction of the client are the key success factors for this project and possible future compact hydro projects that the client is developing in Indonesia. Bungin I hydropower plant is located in Enrekang province on Sulawesi island and the scope of supply of HIN comprises of two horizontal Francis turbines, governors, butterfly valves, generators, excitation system, auxiliaries, control & protection systems and technical services comprising of supervision of installation and commissioning of supplied equipment. The start-up is scheduled for fourth quarter 2012.

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TECHNICAL DATA

Output: 2 x 1,500 kW / 1,875 kVA
Head: 70.93 m
Speed: 1,000 rpm
Runner diameter: 580 mm

Canada
Forrest Kerr

The Forrest Kerr project is located in British Columbia, 1,000 km northwest of Vancouver. Forrest Kerr is a 195 MW subterranean run-of-river hydropower plant of Coast Mountain Hydro Ltd., which is owned by Altagas, an independent power producer from Alberta. The project was initially planned with two large vertical Francis units of 78 MW each and two horizontal Compact Francis units of 21 MW each. But after a detailed study of the ramping requirements, the project was converted into nine horizontal Compact Francis units. In fact, strict environmental requirements on the ramping will be enforced during operation. The tailwater level cannot vary more than 2.5 cm per hour under any operating circumstances. Therefore, during a load rejection, the unit will go into the runaway mode for up to two hours (from 360 rpm to 640 rpm) to keep a fairly constant flow downstream of the plant. The nine Compact units will also help the customer to optimize the water available during low flow seasons. The 252 m³/s river water contains highly abrasive suspended particles requiring the application of SHX70™ coating on the runners, wicket gates, facing plates and labyrinth seals to improve erosion resistance and durability of the components. The scope of work awarded to ANDRITZ HYDRO includes the turbine inlet valves with a very specific erosion resistant design, the turbines, the generators and the electrical power system with unit governor, automation and protection. The delivery of the units will start in mid 2012 and the plant is scheduled to be in operation by mid 2014.

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TECHNICAL DATA

Output: 9 x 22,000 kW
Head: 86.5 m
Speed: 360 rpm
Runner diameter: 1,800 mm

Austria

Königsbach and Mödringbach

At the beginning of December 2011 ANDRITZ HYDRO received orders from ENVESTA, the public utility of the Benedictine Abbey of Admont, for the supply, installation and commissioning of a 3-nozzle (Königsbach) and a 4-nozzle (Mödringbach) vertical Peltonturbine, including synchronous generators, penstock connecting pipes, inlet valves and hydraulic aggregates for governing.

The power stations are located at an altitude of 1,180 m within the high-alpine area and are fed from sources in different valleys. Water is caught for the run-of-river power plants by means of Tyrolian weir types and via a desilter and penstocks made from ductile cast iron supplied to the turbines. The energy of the turbine-driven generators (400 V) will be fed over the transformers and switch gear to the nearby 30 kV grid. Power plants in such high alpine regions are characterized by a very large flow range. After deduction of the ecological flow, the turbines will have less than 5% of the rated unit discharge during winter alone. This is the reason for the use of multi-nozzle vertical Pelton turbines, whereby the technology used is based on model testing. Start-up is scheduled for the end of summer 2012. In summer 2011 Johnbach 2 began power generation for ENVESTA with a 5-nozzle vertical Pelton unit made by ANDRITZ HYDRO.

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TECHNICAL DATA Königsbach
Output: 501 kW
Head: 227.7 m
Speed: 1,000 rpm
Runner diameter: 600 mm
TECHNICAL DATA Mödringbach
Output: 639 kW
Head: 138.9 m
Speed: 750 rpm
Runner diameter: 640 mm
TECHNICAL DATA Johnbach 2
Output: 575 kW
Head: 78.2 m
Speed: 500 rpm
Runner diameter: 705 mm

Panama

Pando and Monte Lirio

As a result of the successful collaboration between ANDRITZ HYDRO and Cobra Infraestructuras Hidráulicas, a key Spanish contractor very well represented in the Central American market, ANDRITZ HYDRO Spain was awarded a new contract for supply of the electromechanical equipment for the Pando and Monte Lirio hydropower plants in Panamá.

ANDRITZ HYDRO had already supplied turbines and generators for other projects with Cobra in this country, like Algarrobos, Pedregalito, Cochea, etc., and continues to work with them on further development in the region. Pando and Monte Lirio are two hydropower plants located on the Chiriquí Viejo river, in the western province of Chiriquí near the border with Costa Rica. Together with the El Alto power plant, which was also supplied by ANDRITZ HYDRO Spain, they belong to a global cascade scheme for the exploitation of the hydraulic resources of this river. The Pando plant is provided with two vertical Pelton turbines with six nozzles each. Monte Lirio is a very similar plant with three vertical Pelton turbines and the same arrangement of nozzles. The overall design is the same for both plants, with slight differences because of the net head. The scope of supply in both cases includes the Pelton turbines, inlet valves, generators, governor and cooling system, with site installation works and commissioning as well. Start-up is scheduled for the beginning of 2013.

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TECHNICAL DATA Pando
Output: 2 x 15,531 kW
Head: 252.5 m
Speed: 450 rpm
Runner diameter: 1,430 mm
TECHNICAL DATA Monte Lirio
Output: 3 x 16,361 kW
Head: 274 m
Speed: 450 rpm
Runner diameter: 1,510 mm

Pakistan
Satpara

In June 2011, ANDRITZ HYDRO was awarded a contract by the Water & Power Development Authority of Pakistan for the supply, installation, testing and commissioning of E&M works for powerhouse 3 and powerhouse 4 of the Satpara Dam Project.
The contract's scope of supply comprises two sets of Compact Francis turbines with generators for powerhouse 3 and powerhouse 4 respectively. Inlet valves, powerhouse cranes and EPS equipment are also included for both powerhouses. Satpara Dam Project is located on the Satpara river, downstream from the Satpara lake, which is about 6 km south of Skardu town. It is expected that the development of the Satpara Dam Project can be used to irrigate 15,000 acres of land, and to provide 11 million litres of drinking water per day, as well as generating 23 GWh of electricity per year. Start-up for the project is scheduled for January 2013.

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TECHNICAL DATA Powerhouse 3
Output: 2 x 1,180 kW / 1,475 kVA
Head: 69.8 m
Speed: 750 rpm
Runner diameter: 611 mm
TECHNICAL DATA Powerhouse 4
Output: 2 x 692 kW / 865 kVA
Head: 41.9 m
Speed: 600 rpm
Runner diameter: 663 mm

Germany
Wittibsmühle

There is a growing trend in Compact Hydro's lower power range toward utilizing belt drives to hydro turbines to their generators. The ANDRITZ HYDRO belt has a power output of approximately 600 kW, and is a cost-effective solution available for low head applications.
There is a growing trend in Compact Hydro's lower power range toward utilizing belt drives to hydro turbines to their generators. The ANDRITZ HYDRO belt has a power output of approximately 600 kW, and is a cost-effective solution available for low head applications Moosburg. The utilization of an existing weir system and a fish passage, as well as the selection of an ANDRITZ HYDRO "Belt Drive Bulb Turbine", were key success factors in minimizing overall investment and ensuring an economically and ecologically viable project for the Wasserkraft Wittibsmühle GmbH. The scope of supply for ANDRITZ HYDRO comprises one "Belt Drive Bulb Turbine", a corresponding hydraulic power unit, stainless steel piping between turbine and high pressure oil unit as well as installation and commissioning services. The plant is scheduled to be in commercial operation as of November 2012.

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TECHNICAL DATA
Output: 508 kW
Head: 2.86 m
Speed: 192 / 500 rpm
Runner diameter: 1,950 mm

Switzerland
Ackersand 11

In May 2011, ANDRITZ HYDRO received the order to supply a new unit for the Ackersand powerplant, replacing two existing turbines which had been in operation since 1909 and 1917 respectively.
The customer is Ackersand I AG and the two power plant operators, EnAlpin AG and Mattmark AG, are the share holders. The power plant is located in canton Wallis, a half-hour's drive south of Visp on route towards Saas Fee, and converts the water power of the river Saaser Vispa and several of its side waters. ANDRITZ HYDRO is the leader of a consortium in which Elin Motoren, as our partner, will supply the generator. Our supply comprises design, planning, manufacturing and delivery, as well as installation and commissioning of the complete machine set. It also includes electric switchgear and the control system. In the ANDITZ HYDRO machine concept the customer requirements regarding power, efficiency and flexibility are best met by a vertical 5-jet Pelton turbine from the Compact program, with a water-cooled generator. Commissioning will be completed at the end of April 2013, and a three-month trial operation period during the peak months of May through July will follow. On 31 July 2013 the plant will be handed over to the customer.

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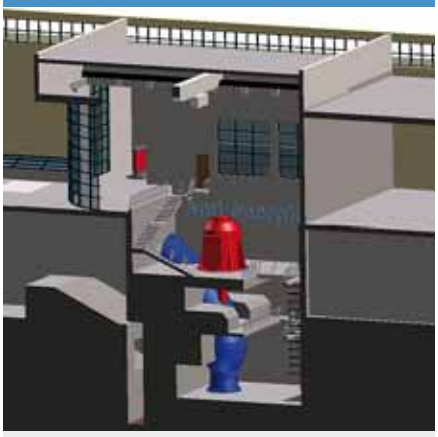
TECHNICAL DATA
Output: 14,795 kW
Head: 710.7 m
Speed: 750 rpm
Runner diameter: 1,415 mm

Italy
San Giovanni Bianco



In February 2011, ANDRITZ HYDRO was awarded a contract to supply the water to wire equipment for the San Giovanni Bianco hydropower plant from SMI Group, an Italian company leader in packaging machines production.

San Giovanni Bianco is located in Val Brembana, North Italy, near the town of San Pellegrino, well known for its thermal and mineral waters. After almost a century of operation the three existing Francis open flume units will be replaced with one vertical CAT turbine. The close collaboration between ANDRITZ HYDRO and the customer's technical advisors allowed for smooth and efficient integration of the new unit inside the existing building. On the investment side, the proposed solution has maximized production while minimizing civil costs. The scope of supply of ANDRITZ HYDRO comprises one vertical double regulated CAT turbine, oil hydraulic unit, cooling system, including installation and commissioning of the supply and efficiency tests. Start-up is scheduled for November 2012.

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TECHNICAL DATA
Output: 1,300 kW
Head: 9.5 m
Speed: 333 rpm
Runner diameter: 1,600 mm

Switzerland
Löbbia / Castasegna

The Zurich 04 Municipal Electric Utility has charged ANDRITZ HYDRO with revision of the Löbbia and Castasegna power plants.

With the joint revision and modernization order the two major power plants will meet the future needs of the power market. ANDRITZ HYDRO's scope of delivery covers the revision and renovation of unit 3 in Löbbia, the delivery of four new Pelton runners with SXH™7X coating and a pump runner. The modernization of the combined set of units leads to an increased output of approximately 5% while improving the optimum efficiency by more than 2%. Key criteria for awarding the contract to ANDRITZ HYDRO were not only the economic improvement of the power plant, but also the longstanding know-how of ANDRITZ HYDRO in the field of rebuilding and modernizing of hydropower plants. Due to the exchange of the Pelton runners, an

efficiency increase of more than 1% is achieved. All runners are coated with the new SXH™7X method, through which a significant edge on life extension can be achieved. The delivery will take place between October 2012 and April 2013.

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TECHN. DATA Löbbia M3
Output: 8.83 MW Pelton / 37 MW
Output: 7.36 MW pump
TECHN. DATA Löbbia M3 / Castasegna
Output: 37 MW / 2 x 26 MW Doublepelton

Poland
Januszkowice

Rehabilitation of a Kaplan turbine after a bearing failure.

ANDRITZ HYDRO in Ravensburg received an order from the Polska Grupa Energetyczna for the rehabilitation and modernization of a Kaplan turbine for the Polish Januszkowice power plant. The relevant criteria for receipt of the order were our professional appearance and the successful rehabilitation of two bevel gear Bulb turbines after flood damage, which has been realized to the client's satisfaction. Additional evidence for the technical competence of ANDRITZ HYDRO and the client's satisfaction is that the rehabilitation and modernization of the second unit is expected in 2012.

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TECHNICAL DATA
Output: 2 x 700 kW
Head: 2.6 m
Speed: 428.6 rpm
Runner diameter: 2,360 mm

India
Automation in India

2011 has been an excellent year for ANDRITZ HYDRO in India receiving a number of Automation orders from this highly competitive market.

The year began with an order for two static excitation systems for the Ghataprabha power plant in Karnataka. The most important contract, for supply of four static excitation systems for four of Neyveli Lignite Corporation's 210 MW lignite based thermal power was won against fierce competition in July 2011. This power plant is located in the southern part of India. By executing successfully this contract, ANDRITZ HYDRO will further consolidate its position in the automation market. In winning a July 2011 contract from NTPC-Sail Power Corporation Ltd. for the supply of digital static excitation systems for two 60 MW units at Durgapur, ANDRITZ HYDRO made inroads with two key customers: National Thermal Power Corporation (NTPC), the biggest thermal power utility in India and Steel Authority of India Ltd. (SAIL), the largest steel producing company in the government sector. Therefore, this project will serve as a key reference for other projects in future. ANDRITZ HYDRO also received an or der from MSPGCL for two 210 MW units for the Nasik thermal power plant. We have already supplied previous contracts to this customer and convinced them of our successful performance. Apart from the above, there were also some smaller orders received for Automation products. Engineering, assembly and testing of Automation products for all of these contracts will be carried out in the ANDRITZ HYDRO workshop in India.

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Turkey
Protection solution

Within the past few months, ANDRITZ HYDRO Automation has successfully increased its lead in the field of electrical protection solutions for small hydropower plants.

Especially for the booming Turkish market, electrical protection solutions for 15 hydropower plants were delivered. The delivered systems consist of DRS protection devices for generator, transformer and wire protection. The advantage of these solutions is based on the high degree of standardization in small hydropower plant applications. Due to the simple operation of the systems, extremely short delivery times are achieved, which are a significant cost factor in their realization. By providing these solutions, ANDRITZ HYDRO is continuously extending its business activities in the Turkish market and is well prepared for future projects.

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Peru
Santa Teresa / Cerro del Aguila

After the successful commissioning of the Peruvian power plant Chacayes, ANDRITZ HYDRO Automation again secured major contracts for the control equipment of two hydropower plants.

End of 2011, ANDRITZ HYDRO Automation received orders for the control equipment of the hydropower plants Santa Teresa and Cerro del Aguila in Peru. The power plant Cerro del Aguila will be built as an subterranean cavern power plant with three 134 MW Francis turbines. Santa Teresa is situated in the region Machu Picchu and has a total capacity of 98 MW. For both plants the famous NEPTUN concept is used, containing the power plant control system, electrical protection for generators and wires, excitation systems, control station system and a Voice-over-IP system. Thanks to previously completed projects, ANDRITZ HYDRO was able to re-qualify for both projects and to increase its presence in South America successfully.

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Germany
Erzhausen

Rehabilitation of one hydropower unit of the Erzhausen pumped storage plant.

The Erzhausen power plant consists of four horizontal hydropower units, each with a turbine, pump and starting turbine, as well as an upstream spherical valve for pump and turbine.

Due to increased operational demands, and in order to ensure the availability of the machine, the hydroelectric units will be rehabilitated again. The last overhaul of unit no.4's pump and turbine was about 20 years ago, and the last repair of the spherical valves was about 13 years ago. ANDRITZ HYDRO in Ravensburg received this order from Statkraft due to a good concept which, amongst others, includes the client's

services on their own account. Reacting with a very short time schedule and potential to react quickly with our own know-how in case of additional challenges during the execution satisfied the client supported by our good references.

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TECHNICAL DATA
Output turbine: 4 x 63 MW
Head: 290 m
Speed: 428.6 rpm
Runner diameter: 2,340 mm

France
La Bâthie

EDF has awarded ANDRITZ HYDRO an order for six new Pelton runners for the La Bâthie hydropower plant in the French Alps.

The commissioning of Roselend-La Bâthie took place in 1961, making this year its 50th anniversary. During this important milestone, ANDRITZ HYDRO will provide EDF, under its scope of work, with a model test, engineering, procurement and manufacturing of six new Pelton runners of 21 tons each, and the rehabilitation of twelve injectors, including a reengineered design. Over the next six years, these new runners will be manufactured using two technologies: MicroGuss™ within ANDRITZ HYDRO Switzerland for the first unit, which will enable short delivery time, and with HIWELD™XL within ANDRITZ HYDRO Mexico for the next units, in response to the opening of EDF to non-European manufacturing. The technical achievements offered to EDF for this impressive 1,112 m net head power plant are remarkable: power output increases of 18% (from 496 MW up to 618 MW in total) and efficiency increases of 1.6%. This project is another important success

with EDF and we are optimistic regarding our continuing and positive future collaboration.

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TECHNICAL DATA old / new
Output: 6 x 82.7 MW / 6 x 103 MW
Head: 1,112 m
Speed: 428 rpm
Runner diameter: 3,250 mm

Groundbreaking in Linz

New assembly hall for large turbogenerators

▲ Good mood during groundbreaking ceremony

The official groundbreaking for the construction of the new assembly hall took place on 7 November 2011 by Members of the Board of ANDRITZ HYDRO (Wolfgang Semper and Harald Heber) and the heads of turbogenerators (Jürgen Holzer and Karl Schlögelbauer), as well as the directors of the company Felbermayr.

After concluding a contract for supply of heavy hydrogen-cooled turbogenerators it was necessary to build a new assembly hall. Due to weight and dimensions, transport of such generators from the Austrian manufacturing site at Weiz is not possible. The new hall is located near ANDRITZ HYDRO in Linz, with dedicated access to the Traun / Danube heavy load port in the former VOEST area.

▲ Director Felbermayr at opening speech

The assembly hall will be used for stator stacking, winding and final assembly of the new heavy generators. In addition, a test field for prototype tests will be installed. The electrical key components (laminations, high voltage insulation) and the complete rotor will be manufactured in the Weiz workshop. Completion of the hall is planned for late August 2012, and delivery of the first generator for mid 2013. This is an important milestone for the future strategic orientation of the turbogenerator division in order to expand its portfolio in terms of higher outputs.

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KEY DATA:

Product range:
- large turbogenerators up to 600 MVA

Assembly hall:
- size: 80 m x 40 m x 20 m
- total area: 3,208 m²
- crane capacity: 300 tons (extendable to 600 tons)
- additional two cranes at 20 tons each
- crane hook height in assembly hall: 14 m
- testfield: 5.5 MW

▼ View of the new assembly hall

▼ A turbogenerator ready for transportation

HYDRO2011
Prague, Czech Republic

"Practical Solutions for a Sustainable Future"

Autumn is trade fair season and from 17 - 19 October 2011, the „HYDRO 2011" international conference and exhibition took place in Prague, Czech Republic. More than 1,200 participants from 77 countries participated. As usual, the conference focused strongly on the needs, priorities and plans of the developing countries of Africa, Asia and Latin America.

ANDRITZ HYDRO participated with six technical paper presentations and a booth, highly frequented every day. Technical papers of ANDRITZ HYDRO covered topics of Pelton and pump turbines as well as electrical simulation results. The white-blue cubic booth design offered excellent opportunities for information exchange between all visitors and ANDRITZ HYDRO. Monitor presentations and HD-movies supported the technical discussions.

Presentation of a new 3D simulation tool, used for research and development, was a special highlight at the booth. As in previous years, HYDRO 2011 was an important and very successful event for ANDRITZ HYDRO, underlining the position as one of the leading suppliers of hydropower equipment worldwide.

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Renewable Energy **World Asia**

Important event for ANDRITZ HYDRO in Malaysia

ANDRITZ HYDRO participated successfully in Renewable Energy World Asia a very important event in South-East Asia. In 2011, it took place in Kuala Lumpur, Malaysia, from 27 to 29 September.

Renewable Energy World Asia is the region's most important conference dedicated to power generation and transmission and distribution from

renewable energy sources. Co-located with POWERGEN Asia at the KLCC Convention Centre in the heart of Kuala Lumpur, Malaysia, more than 7,000 power and renewable industry professionals visited the event.

ANDRITZ HYDRO participated with two technical paper presentations and a booth. The Managing Director of ANDRITZ HYDRO Malysia, Mr. Michael Moggie, took part in a podium session, discussing chances and opportunities for renewable energy in Asia. It was a good opportunity to present ANDRITZ HYDRO as one of the leading suppliers of hydropower equipment in South-East Asia, especially in Malaysia.

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HydroVision Brazil 2011

Successful participation of ANDRITZ HYDRO at the first HydroVision in Brazil

HydroVision took place for the very first time in Brazil. Because of the strong market position in Brazil ANDRITZ HYDRO participated successfully with technical papers and a booth.

HydroVision BRAZIL is designed to introduce hydropower development opportunities within Brazil and Latin America to the rest of the world, as well as to serve the needs of the hydroelectric power and dams/civil structure sectors in Brazil and Latin America. More than 650 attendees representing 33 countries took part in this first event.

ANDRITZ HYDRO participated with two technical paper presentations and a booth. Mr. Sergio Parada, President of ANDRITZ HYDRO Brazil, worked on the organizational committee and co-chaired a session on “Evaluating and Making Hydropower Projects Feasible”. Based on the global layout concept of ANDRITZ HYDRO, the booth design plus large scale HD video monitors, touch monitors for individual presentations, and a model of a Bulb turbine offered perfect opportunities for communication and new contacts. As one of the leading suppliers of hydropower equipment, this event was a good opportunity to demonstrate ANDRITZ HYDRO’s strong position in the Brazilian market.

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EVENTS:

Hydroenergia
23 – 26 May 2012
Wrocław, Poland

Powertage Zurich
12 – 14 June 2012
Zurich, Switzerland

HydroVision USA
17 – 20 July 2012
Louisville, USA

HydroVision Brazil
25 – 27 September 2012
Rio de Janeiro, Brazil

HYDRO 2012
29 – 31 October 2012
Bilbao, Spain

Large Hydro
Pumped storage meets the peak

The pumped storage power plant Lang Yashan is located about 300 km westwards of Shanghai in Anhui province in China. The large underground power station is one of the largest installations in the region with four pump turbines / generating units and a total installed capacity of more than 650 MW and supplies electricity during peak times.

We focus on the best solution – from water to wire.

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