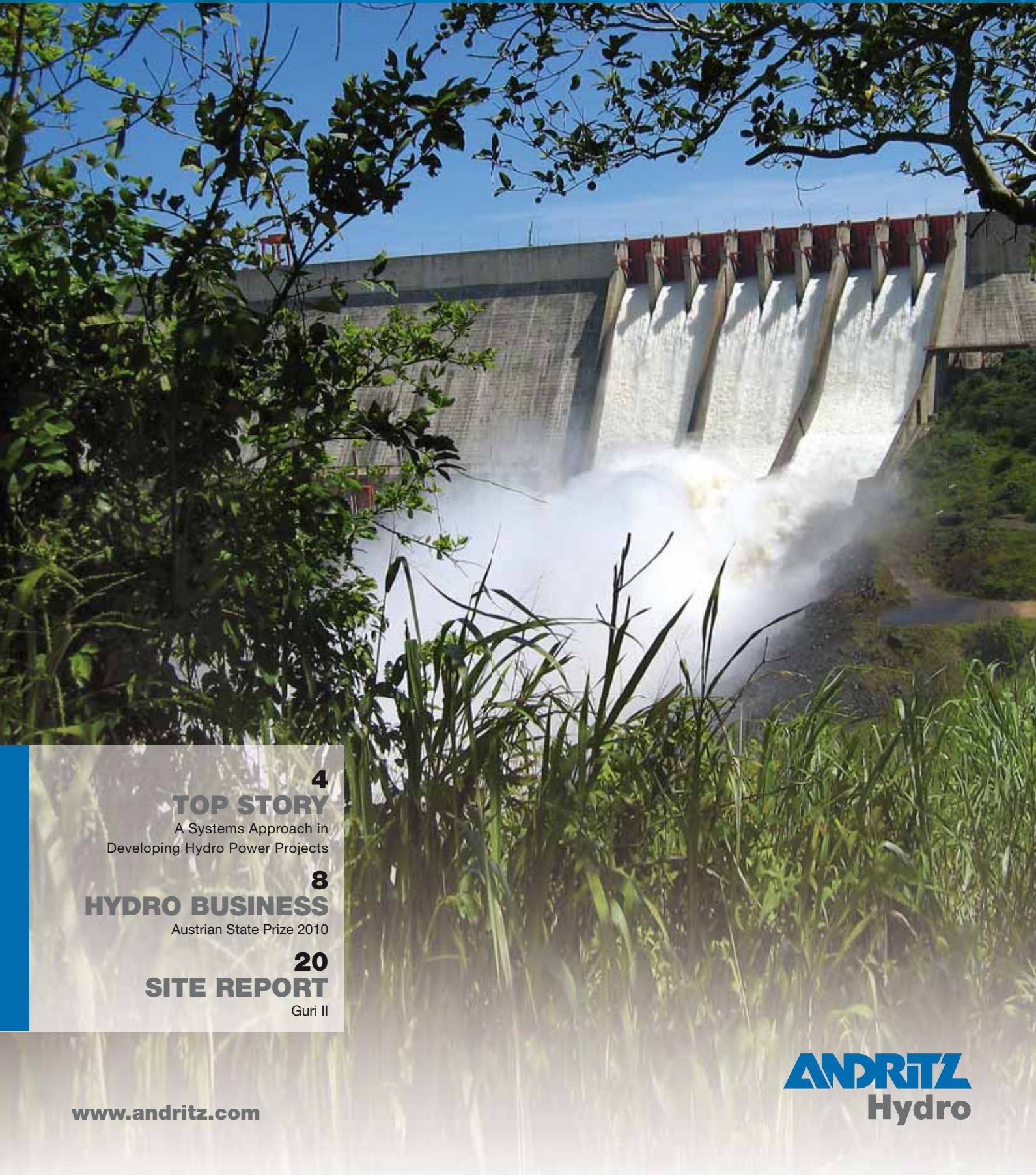


# HYDRO NEWS

No. 17 / 05-2010

MAGAZINE OF ANDRITZ HYDRO



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## Key Figures 2009

Again a new record in order intake.  
Increased by + 10 % compared to the year 2008:

Order Intake: 1,693.9 mio. EUR

Order Backlog Dec.31: 2,894.5 mio. EUR

Sales: 1,378 mio. EUR

Employees Dec. 31: 5,993

### Cover photo:

The photo shows the Guri II dam and spillway in Venezuela.



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## Dear business friends

**2009 was a very successful year for ANDRITZ HYDRO. A new record in order intake demonstrates that we are one of the world's leading supplier of hydropower equipment.**

Hydropower is a stable and reliable factor of the global energy market. This was demonstrated significantly in the year 2009. Despite the global economic crisis and unstable financial markets, there were only minor influences on the hydropower market. The rising demand for electricity, especially in emerging countries in Asia and South America, and the need for modernization of existing power plants are the main drivers in the growth market of hydropower.

In Europe and in North and Central America, there are a large number of existing hydropower plants, which already are operating since more than 20 years.

Therefore, efficiency and availability of these plants do not longer meet today's feasible values. Many of them also provide an unused achievement potential, which can only be tapped with the most modern computer-based calculation and manufacturing processes. As part of modernization projects our customers worldwide demand for an increased efficiency of 20% or more.

ANDRITZ HYDRO with 6,000 highly qualified and motivated employees had the best conditions to be successful also in the last year. The highest order intake in the history of ANDRITZ HYDRO shows once again that we are among the world's leading providers of electro-mechanical equipment for hydropower plants.

Not least because our customers have expressed their confidence to us in various projects all over the world.

The variety of our products ranges

from the pumped storage power project Baixo Sabor in Portugal, to the Bulb-turbine power plant Jirau in Brazil and the complete renovation contract for the hydroelectric plant Ambuklao in the Philippines.

The Nam Theun II hydropower plant in Laos, with a total capacity of over 1,000 MW, was successfully passed to the customer and one of the most powerful turbines in the world (770 MW) was delivered to Venezuela for Guri II.

We are especially proud that we have won the prestigious Austrian State Prize for Environment and Climate 2010 for the HYDROMATRIX® Project Chievo in Italy. Due to the continuous development of our technologies and the confidence of our customers they kindly placed in us, we feel well prepared for future requirements.

With cordial thanks

H. Heber

W. Semper

M. Komböck



Nightview of hydroelectric power plant Muratli, Turkey

# A Systems Approach in Developing Hydro Power Projects

**Development of energy sources, as one of the important keys for industrial progress, is essential for the continuous improvement of living standards for people everywhere around the world.**

ANDRITZ HYDRO has focused its activities in the hydro energy sources sector and has become a well known world manufacturer of main equipment and services for hydro power plants. In doing that, ANDRITZ HYDRO has achieved high quality standards on the world market fulfilling its goal to find optimum and functional solutions in meeting customer requests and expectations in developing hydro-power projects. ANDRITZ HYDRO's internal organization in business divisions, product groups and global functions is structured to integrate all hydro power sub-systems included in our production manufacturing programs into one functional hydro power generation system of the most complex hydro power plants, also provided on a turn-key basis.

This also involves equipment outside of the ANDRITZ HYDRO production manufacturing program (transformers, medium voltage and high voltage equipment, overhead lines, etc.) which should be integrated into complete packages for electromechanical equipment for hydro power plants. In fulfilling the role of system integrator,

ANDRITZ HYDRO services cover different aspects of the hydro power project development which could be identified as follows.

## System Engineering

Technology development and a boost of modern functional and operational requirements in the current energy sector have presented different challenges to the equipment manufacturers which should be studied and solved in developing complex hydro power plant projects. Responding to the requirements and, over the years, ANDRITZ HYDRO has transformed from a classical equipment manufacturer to a systems developer and integrator for hydro power plant projects. This approach covers, at least, the following activities:

- integration of various engineering disciplines and abilities into team oriented structured processes dealing with different complexity of hydro-power plant projects
- identification of general concept-functions and interfaces to be able to combine different subsystems into the general concept.
- management of activities outside ANDRITZ HYDRO dealing with third parties involved in different studies, analyses and calculations requested for the project implementation
- extensive coordination and coaching of ANDRITZ HYDRO offices worldwide

in creating responsive, appealing and competitive design, cost and performance proposals

- participation in the client's early stages of project development in order to achieve optimum solutions for the client's new business opportunities
- integration of internally developed knowledge and experience in methodologies and procedures established in the world to identify the needs and programs for refurbishment and rehabilitation works on hydro power plants
- development of software tools for analyses of hydro power plant project integration in the energy market (tariff optimized operation, etc.).

## Electrical Power Engineering

Electrical power engineering considers services necessary to implement hydro energy sources into an energy system fulfilling grid code requirements about the system stability and reliability as well as hydro energy source availability when it is connected to the energy system. At least the following should be considered:

- analyses of utilities grid code, identifying models and inputs for studies and calculations
- reference to study results selecting solutions and equipment to fulfill grid-code requests
- cooperation with utilities performing-

studies and calculations to justify adaptation of the grid code in implementation of new technologies for hydro power generation projects

- studies and analyses of units in operation comparing units' design parameters with measurements performed on units in operation and during site tests under different operation scenarios and creating recommendations and proposals for improvements.

**Some References:**

**Lower St. Anthony Falls StrafloMatrix™ hydro power plant, Minneapolis, USA**

16 Turbine generators (with permanent magnet) units.

ANDRITZ HYDRO, together with Vienna University of Technology, Institute for Electrical Power Systems and Energy Economics, has performed modelling and study of permanent magnet generators connected to distribution grid of the city of Minneapolis "Grid Integration of StrafloMatrix™ Generators" referring to the IEEE 1547 "Application Guide for Distributed generation". The project is under construction (Fig.1+2).

**TECHNICAL DATA:**

OUTPUT: 16 x 625 kW each
SPEED: 327.3 rpm
MAX. PLANT CAPACITY: 10 MW

**Mica, British Columbia, Canada existing units 1 to 4 and new units 5 and 6**

Mica Hydroelectric generating station is located in the Southern Interior of one of the largest generation bases in British Columbia. Mica is directly interconnected to a 500 kV backbone transmission system at the Nicola substation by two 500 kV transmissions lines, 285 km long. British Columbia Transmission Corporation™ has issued the "System Impact Study of Network Integrated Transmission Service (NITS) Update" – the report deals with integration to the system of two new peaking units, Mica 5 and 6.

One of the analyzed solutions in the report was series compensation on 500 kV lines. ANDRITZ HYDRO re-

ceived a request from the client to analyze stability of the units connection to the system during transient disturbances using existing equipment data (lines, generators, Automatic Voltage Regulator) and data about future installation of series compensation (Fig. 3).

**TECHNICAL DATA:**

OUTPUT: 4 x 526 + 2 x 570 MVA
VOLTAGE: 16 kV
SPEED: 128.6 + 133.3 rpm
INERTIA CONSTANT: 5 + 4,8 sec

**Lower Olt Cascade, Romania**

The Lower Olt Cascade comprises five hydro power plants with four units each located on the lower stretch of the Olt river in the southern part of Romania. The units were originally installed by a Romanian company and commissioned in 1988.

Besides electric power generation the hydro power plants are also working in pump mode pumping water upstream for irrigation purposes. Part of the refurbishment work was to replace generators, automation and excitation systems.

A special focus of the rehabilitation work was to simulate the direct grid start of units in pump mode with impact to the grid and to the generator. The evaluation after commissioning has shown that the results of studies and simulations are in line with the measurement data (Fig. 4).

**TECHNICAL DATA:**

OUTPUT: 14.5 MVA
VOLTAGE: 6.3 kV
SPEED: 130.4 rpm
INERTIA CONSTANT: 1.15 sec

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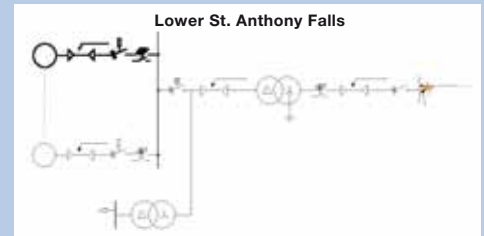


Fig 1. Single line diagram

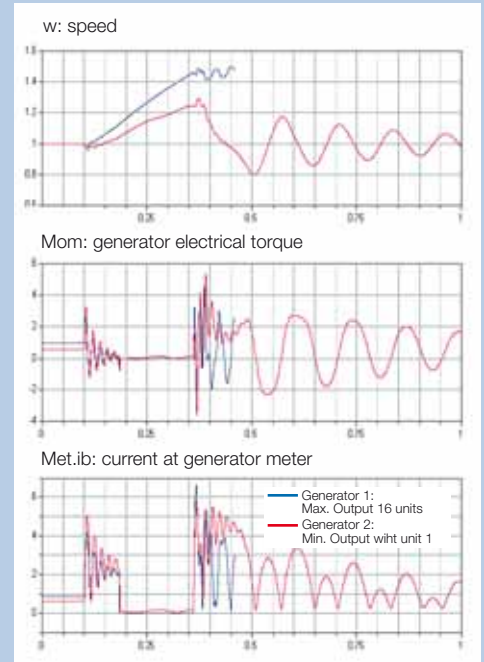


Fig 2. Behavior of PM generators during 3-ph Fault at Point of Common Coupling with radial connection.

Fault time: 0.1 sec;  
Clear time: 80 ms;  
Reclose time: 180 ms

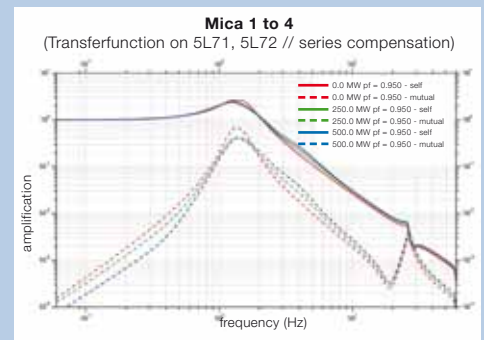


Fig.3 Transfer function showing coupling of units

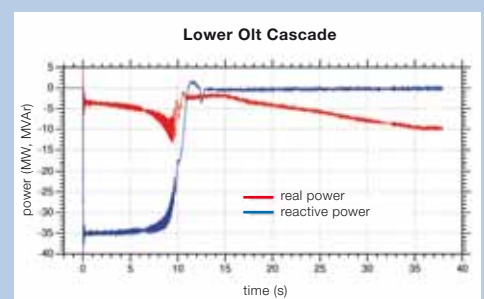


Fig. 4 Direct grid start up sequence in pump mode



Red square Moscow, Russia

## Further Expansion of ANDRITZ HYDRO

Growth means for us also proximity to customers by local presence. Therefore ANDRITZ HYDRO has further expanded its global structure.

**B**ased on the existing network of worldwide offices for many years, ANDRITZ HYDRO has strengthened its local customer focus also in 2009. Besides setting up new offices in Russia and Malaysia also joint ventures in the U.S. and China were established. In Brazil and in Turkey new premises were purchased for a

even better service of the growing local market activities in future.

Through the take-over and the acquisition of the hydro activities of GE Hydro the worldwide presence of ANDRITZ HYDRO on five continents has once again increased.

The integration of all locations and employees of GE Hydro has been successfully completed.

### **New Offices: Russia**

With the newly founded subsidiary "OOO ANDRITZ HYDRO" in Moscow ANDRITZ HYDRO is now locally present in one of the largest hydro-electric power markets in the world. At the new location employees are working in design, engineering, project management and facilities & services for hydroelectric plants.

The first major public appearance took place at the "Russian Power", one of the largest energy fairs in Russia.

### **Malaysia**

South-East Asia is a priority market for ANDRITZ HYDRO since decades. In addition to our long-established offices in Jakarta, Indonesia and Hanoi, Vietnam a subsidiary company was established in Manila, Philippines in 2008. In 2009 this existing network has been supplemented by a further office in Kuala Lumpur. This step was essential for the optimal customer care by ANDRITZ HYDRO in the emerging market of Malaysia.

### **Peru**

ANDRITZ HYDRO has a long tradition in Peru. Also in 2009 we received many new orders. Currently a Micro-Guss™ project as well as the modernization of Francis runners were realized. For further improvement of the local customer service, an office in Lima was founded.

### **New addresses:**

#### **Brazil**

Due to the excellent business conditions in Brazil ANDRITZ HYDRO do Brasil and the ANDRITZ HYDRO



Basilius Cathedral Moscow, Russia

Inepar in Sao Paulo moved to a new and modern building.

### Turkey

Due to the continued growth of the Turkish market and the successful operating of our local subsidiary the number of personnel in Ankara has grown significantly.

This made it necessary to obtain new and larger premises which also offer the possibility to directly handle the local shares of the Turkish projects in house.

### India

ANDRITZ HYDRO has been operating successfully for many decades in the growth market of India.

To be optimally prepared for future requirements, the two locations Faridabad and Bhopal were merged into the joint venture ANDRITZ HYDRO Pvt. Ltd.

### New Joint Ventures:

#### China

The signing ceremony of the investment and partnership agreement



Tian Bao, China



Barueri - Sao Paulo, Brazil

between ANDRITZ HYDRO and Chengdu Tianbao Heavy Industry Co. Ltd. took place in November 2009 in Hangzhou, Zhejiang, China.

With this agreement ANDRITZ HYDRO created a reliable basis for the production of large hydropower plants in Southwest China. Tianbao, with headquarters and manufacturing facility in Chengdu, Sichuan is well situated in the centre of China's hydropower. For ANDRITZ HYDRO this means a significant strengthening of local presence.

#### USA

With its subsidiary in Charlotte ANDRITZ HYDRO is successfully



Spokane, USA



Lewiston, USA

established on the US-market for many years. Professional project management and engineering skills were essential contributors for this success. Early 2010 ANDRITZ HYDRO acquired a majority stake in Precision Machine & Supply, Inc. As a long-standing and established partner of hydropower customers and with its locations in Lewiston, Idaho and Spokane, Washington Precision Machine & Supply Inc. offers an optimal local manufacturing and service capacity. With the location of Spokane ANDRITZ HYDRO has now a direct presence in the hydropower rich Pacific Northwest.

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New office building in Ankara, Turkey

# State Prize 2010

**ANDRITZ HYDRO received the Austrian State Prize for Environmental and Energy Technology for the “Chievo Dam HYDROMATRIX®-Project”**



Minister Nikolaus Berlakovich, Alexander Bihlmayer and Wolfgang Semper presented the State Prize

**T**ogether with the other nominees in the categories environment & climate, energy & efficiency and research & innovation ANDRITZ HYDRO was awarded at the State Prize Ceremony on February 4th, 2010 at the Palais Ferstel in Vienna.

In Chievo, a subdivision of the city of Verona, ANDRITZ HYDRO installed a hydropower plant using the unique HYDROMATRIX® concept. The plant allows the harvesting of the unused hydraulic power of the abandoned ship lock downstream of Chievo Dam without compromising its flood discharge capabilities.

The core element of the Chievo Dam HYDROMATRIX® plant is the steel fabricated module, which can be lifted and lowered by a gantry hoist system under balanced condition in order to evacuate the lock chamber prior to flood release. It houses five StrafloMatrix™ turbine generator units. At this axial straight-flow turbine the generator is placed directly on the periphery of the turbine runner.

Apart from some modifications of the existing lock walls and sill area a fish ladder was constructed along the embankment with its downstream end leading into the Adige river. Along with the intake trash rack, the fish ladder is an important element to enable fish migration and will help to mitigate the environmental impacts of the dam. The existing hoist system of the lock was replaced and upgraded while maintaining the historic look. The HYDROMATRIX® plant at Chievo Dam in Verona was successfully commissioned in August 2009, meeting the energy needs of about 10,000 households.



**Comment of the Jury:**

“This form of hydroelectricity requires little intervention in nature, is flexible and broadly applicable and can also be put into operation in already existing hydroelectric sites. ANDRITZ HYDRO as the world’s leading supplier of matrix turbines and global player in the field of hydro power technology is of great importance for the competitive situation of the Austrian environmental technology industry and utilizes the HYDROMATRIX® technology to further strengthen its leading position.”



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# Partnership between ESKOM and ANDRITZ HYDRO



Gariep Dam and power plant

**A**frica is one of the world's emerging markets and has always been especially interesting because of its vast potential of untapped water resources and for new hydropower stations. One very important motor for many developments in Africa is the economy of South Africa, which has been booming over the last ten years, until the world-wide financial problems slowed down its dynamics.

However, with the soccer world-championship taking place in 2010, increasing business can be expected as South Africa will be in the focus of attraction of the entire world for several weeks. ANDRITZ HYDRO has already been successfully involved in the African power market for more than 30 years. ESKOM is the 10th largest utility in the world in terms of installed capacity. Equipment supplied by ANDRITZ



Palmiet turbine shaft



Turbine hall in Drakensberg pumped storage power plant

HYDRO is generating electricity in some of ESKOM's hydropower stations. Although most of ESKOM's generation still comes from coal-fired power stations, the utility is responsible for operation, maintenance and management of some large reservoir plants (Gariep, Vanderkloof) and pumped storage plants (Drakensberg, Palmiet). In recent years, energy and peak load consumption in South Africa has increased tremendously. There is a need for new generation facilities. Adequate response to such needs has been found in ESKOM's commitment to wards sustainable, clean and efficient solutions from hydropower. Partnership with ESKOM for controls and instrumentation in hydropower stations ESKOM has entered into a partnership agreement with ANDRITZ HYDRO for controls and instrumentation of hydro power stations. The four units at the Drakensberg pumped storage station were equipped in 2001/2002 with the ANDRITZ HYDRO control system NEPTUN, and have performed well. ESKOM has now chosen to extend this technology to its other



hydro and pumped plants. The Austrian company ANDRITZ HYDRO will thus be participating in the upgrading projects of ESKOM's hydro control systems. Generator, turbine and NEPTUN automation equipment from ANDRITZ HYDRO has achieved a well appreciated reputation in South Africa. Enhanced training programs will improve standards of operation and maintenance.

ESKOM is looking into a bright future. In order to strength the local economy, ANDRITZ HYDRO will be contracting as much as possible local staff and procurement.

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Palmiet pumped storage power plant



Intake tower Palmiet pumped storage power plant



Lifting of a large rotor into pit weighing 630 tons



View of Mica Generating Station spillway



Mica Generating Station

# Mica 5 to 6

## First Major Order in Canada

**ANDRITZ HYDRO** has been assigned by British Columbia Hydro & Power Authority of Canada to supply, install and commission two new large Francis turbine and generator units for the Mica Generating Station.

Located in southeastern British Columbia on the Columbia river 150 km upstream of the city of Revelstoke, the Mica Creek project lies in the steep sided part of the Columbia river valley between the Selkirk and the Monashee mountain ranges of the Columbia mountain region.

The Mica generating station is an

underground powerhouse, that was originally constructed in 1977 with four Francis turbines 444 MW each, umbrella type generators and with future provisions for two additional units.

The main purpose of adding two generating units is to increase the Mica installed capacity as well as the BC Hydro's system flexibility. ANDRITZ HYDRO will supply and install two new Francis turbines each runner weighing over 130 tons, including generators with 60 Hz and 0.9 power factor. Since the location is remote, the installation will include a camp to accommodate on site manpower.

The project will proceed with the stage 1 release, design phase followed by the stage 2 release for the actual supply and installation of the equipment with in-service dates of 2014 and 2015 for the units.

The placing of this order to ANDRITZ HYDRO represents the first major large hydro turbine and generator contract based on the expanded



Lifting of runner & shaft weighing 203 tons

capability for large units acquired from the integration of the assets of the former GE Hydro.

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Mica unit 5 to 6 model testing in ANDRITZ HYDRO's Canadian laboratory

### TECHNICAL DATA:

OUTPUT: 2 x 520.3 MW / 570 MVA
VOLTAGE: 16 kV
HEAD: 169.7 m
SPEED: 133.3 rpm
RUNNER DIAMETER: 5,600 mm
STATOR DIAMETER: 15,400 mm



Aerial view of pumped storage power station, Vianden

## Vianden 11

### ANDRITZ HYDRO receives two contracts for the expansion of a pump storage plant from the SEO Luxembourg

**T**he nominal investment of 150 million EUR will be applied in approximately equal parts by the project partners RWE Power and the State of Luxembourg. ANDRITZ HYDRO receives orders for the pump-turbine and the motor generator.

The Société Eléctrique de l'Our S.A. Luxembourg (SEO) was founded in 1951 and operates the Vianden

pumped storage plant with currently ten machines since 1962. The total installed turbine capacity is 1,096 MW. In pumping mode 850 MW are available. The peak current is fed into the German RWE network which also supplies the required pump current. The power station was located in the Our Valley due to the favourable topographical position in the heart of the industrial areas of Northwest Europe, the excellent geological

conditions and the low population density along the Our river, which forms the border between Luxembourg and Germany.

The Vianden pumped storage plant is composed of a cavern power plant and a shaft power plant. The cavern power plant contains nine horizontally arranged three machine units each with a 100 MW turbine and 70 MW pump capacity. The shaft power plant consists of a vertical two machine unit with a 196 MW turbine and 220 MW pump capacity.

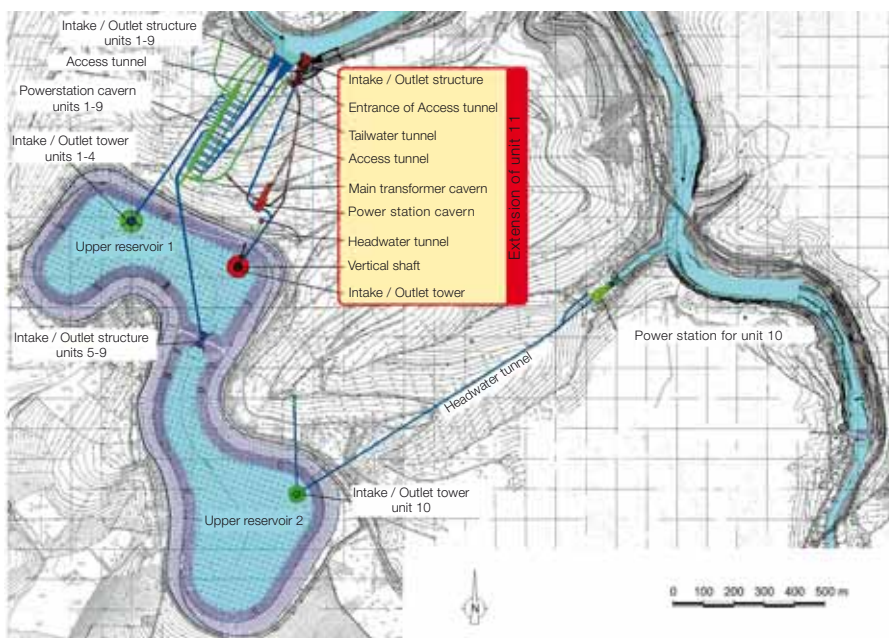
Due to the increasing need for balancing power, the SEO will expand the Vianden pumped storage hydro power station with an eleventh machine which has a capacity of 200 MW and is housed in a separate cavity.

The machine draws water from the existing upper and lower pools, but it has its own inlet and outlet structures and waterways.

Simultaneously the storage should be increased by 500,000 m<sup>3</sup>. The current storage level in the two upper pools will be increased by one meter. According to schedule the ring dam should be increased by 0.5 m.

The construction of the eleventh machine has already been started. After its commissioning, which is scheduled for October 2013, the SEO will be able to feed nearly 1,300 MW of peak power into the European grid.

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Vianden unit 11, planview

#### TECHNICAL DATA:

INPUT PUMP: 196 MW / 224.7 MVA
OUTPUT TURBINE: 200 MW / 230 MVA
VOLTAGE: 15.75 kV
HEAD PUMP: 294 m
HEAD TURBINE: 289 m
SPEED: 333 rpm
RUNNER DIAMETER: 4,232 mm
STATOR DIAMETER: 8,000 mm

# Chancy Pougny



**L**ast November, ANDRITZ HYDRO, as part of a consortium, was awarded by Société des Forces Motrices de Chancy Pougny (SFMCP) a contract for the supply of the electromechanical equipment required for the modernization of the units 3 and 4 at the Chancy Pougny plant.

This contract represents the culmination of the efficient efforts performed by various departments of ANDRITZ HYDRO in successfully modernizing units 1 and 2 and is a testimony to the renewed confidence of SFMCP based on the recognized quality of our services.

## History

Built between 1920 and 1924, the hydroelectric plant of Chancy Pougny is located on the Rhone river 15 km downstream from Geneva. It is owned by the Compagnie des Forces Motrices de Chancy Pougny. The energy is being utilized by the two main shareholders, Services Industriels de Genève and the Compagnie Nationale du Rhone.

Dismantling of an original Francis runner



The nominal output of these turbines was originally 6,400 kW for a nominal plant flow of 490 m<sup>3</sup>/s. Due to the low storage volume of the dam, the Chancy Pougny plant is operating in run of river mode.

The discharge at Chancy Pougny is entirely dependent upon the upstream hydro plant of Verbois which can pass up to 620 m<sup>3</sup>/s through its four Kaplan turbines. Therefore, a portion of this flow is spilled through the gates without generating energy.

This hydroelectric operating discrepancy within the Geneva portion of the Rhone river promoted in creasing the capacity of the downstream plant to 620 m<sup>3</sup>/s.

Over the years, the erosion of the Rhone river bed downstream of the plant has significantly increased the available head, improving the generating potential. However, these improved operating conditions could not be used as the counter pressure was too low to guarantee a cavitation free operation of the original Francis runners.

This condition obliged the owner to install a downstream steel plate at the end of the draft tubes in order to “break” the head and protect the runners.

These site changes, in addition to the fatigue of the 80 years old runners, have naturally driven SFMCP to start a vast plant modernization program with the following objectives:

- adapt the plant to the new operating conditions dictated by the upstream plants: modulation of the Lake Geneva level, nominal plant capacity of 620 m<sup>3</sup>/s at Verbois
- maintain the spilling capacity of 1,900 m<sup>3</sup>/s for the millennium flood condition
- utilize modern and efficient units adapted to the highly variable flows due to the upstream modulations while maintaining a level of efficiency at all flows
- minimize the loss of production during the work
- reinforce the dam structures in order to satisfy modern seismic codes
- help to stop the natural erosion of the river bed and riverbanks downstream of the plant
- improve the integration of the plant into its natural environment and ensure a competitive price of the generated energy
- set a common environmental policy together with SIG on the entire Rhone river near Geneva.

## Feasibility study

Since 1980, SFMCP had already made feasibility studies culminating in the replacement of the existing Francis turbines with new Kaplan type units while conserving each concrete semi-spiral case and inserting a new draft tube inside each existing draft tube. SFMCP then had available all the necessary data to evaluate the economic potential of the operation and all criteria to establish the technical specifications for the corresponding equipment.



Installation of the discharge ring of the new Kaplan unit

### Tendering process

In 1999, the modernization of the generating units was tendered and former VA TECH HYDRO (now ANDRITZ HYDRO) presented a common proposal with ABB Alstom Power Hydro.

This consortium proposal was selected by SFMCP under the condition that a laboratory model test was conducted to show that the guaranteed performance would be achieved.

Being the leader of the consortium and responsible for the hydraulic profile of the turbines, ANDRITZ HYDRO received the contract to perform the model tests.

A model with reduced scale of 1:14.12 was built taking into consideration the perfect similitude of the maintained components, especially the semi-spiral case. These model tests were performed with the active participation of the customer and the consultant, CNR, in order to optimize the geometry of the runner while maximizing the potential of the modernized units.

Finally, a measured average efficiency higher than the guaranteed value was achieved and the turbines have demonstrated a significantly higher output capacity than that defined in the tender documents, bringing new favourable arguments for the modernization.

### Contract for the modernization of units 1 and 2

The construction phase started in 2003 with the replacement of the units 1 and 2 by the consortium. SFMCP was the owner and CNR was acting as consulting engineer. Our active teams dismantled the older units and then erected and commissioned the new units within 20 months, in line with the original schedule.

The units 1 and 2 were commissioned in October 2006 and May 2008, respectively.

The change of turbine type with an increased output of approximately 20% coupled with the increased operating flexibility resulted in a global increase in plant productivity.

### Contract for the modernization of units 3 and 4

Considering the positive results of the modernization of the units 1 and 2, SFMCP decided to continue the modernization with the units 3 and 4 with the same partners but in-cresed the ANDRITZ HYDRO scope to include the complete turbines with exception of the thrust bearing and the generators, the leadership of the consortium and the management of the site activities.

This change is a sign of recognition for the excellent work performed by the ANDRITZ HYDRO employees during the first phase of equipment modern-



New Kaplan runner on the erection bay

ization. The new project team has started the realization of the second phase of the project with a very high motivation level.

### Key dates of the project

- Engineering and sub-contracting from January 2010
- Start of unit 3 dismantling: 20 Sept. 2010
- End of turbine installation of unit 3: 10 Jan. 2012
- Provisory acceptance of unit 3: 14 May 2012
- Start of unit 4 dismantling: 19 Sept. 2012
- End of turbine installation of unit 4: 9 Jan. 2014
- Provisory acceptance of unit 4: 15 May 2014.

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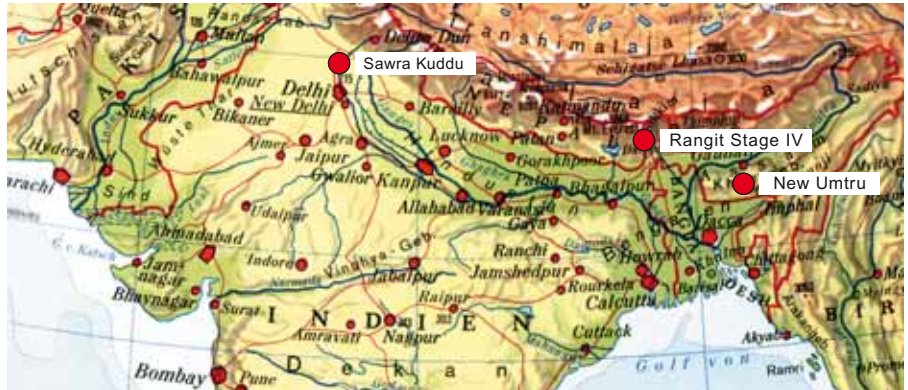
### TECHNICAL DATA:

OUTPUT: 12 MW
HEAD: 11.4 m
SPEED: 88.24 rpm
RUNNER DIAMETER: 4,800 mm

# Success in India

In 2009 ANDRITZ HYDRO has secured three Large Hydro Contracts

In India ANDRITZ HYDRO executes a number of mega and large hydro electric projects for various utilities / IPP's (approx. 2,950 MW) which are in different stages of completion and lead to a market share of approximately 50%. All these contracts further establish ANDRITZ HYDRO's longterm commitment and consistency for the development of the Indian hydro power sector.



Sawra Kuddu, contract signature



Rangit Stage-IV, contract signature



New Umtru, contract signature

## Sawra Kuddu

ANDRITZ HYDRO has signed a contract with Himachal Pradesh Power Corporation Ltd. (HPPCL) on February 27th, 2009 for the execution of the Sawra Kuddu Hydro Electric Project. This project is funded by Asian Development Bank. The contract has been awarded to ANDRITZ HYDRO against stiff competition from Alstom India and will be completed within a span of 38 months. The project is located in the northern part of India on the river Pabbar in the Shimla District of Himachal Pradesh. The scope includes design, supply, installation and commissioning of three vertical shaft Francis turbines, generators and its auxiliaries including complete balance of plant equipment.

TECHNICAL DATA:
OUTPUT: 3 x 37 MW
HEAD: 183 m
SPEED: 500 rpm
RUNNER DIAMETER: 1,550 mm

## Rangit Stage IV

On August 28th, 2009 ANDRITZ HYDRO has signed a contract with Jal Power Corporation Limited, New Delhi, India for the execution of Rangit Stage IV Hydro Electric Project. Scope of work includes design, manufacture, supply, installation and commissioning of three vertical shaft Francis turbines, generators and auxiliaries, excitation systems, governors and SCADA system. The contract has been awarded to ANDRITZ HYDRO against international competition from Alstom, BHEL and Voith India. Rangit Stage IV is a surface powerhouse and located in the north-eastern part of India in West Sikkim District of Sikkim State. The total contract will be completed within a span of 40 months.

TECHNICAL DATA:
OUTPUT: 3 x 40 MW
HEAD: 104 m
SPEED: 250 rpm
RUNNER DIAMETER: 2,500 mm

## New Umtru

ANDRITZ HYDRO has signed a contract with Meghalaya State Electricity Board (MeSEB), for the execution of New Umtru Hydro-electric Project. The total contract will be completed within 28 months. The project is located in north-eastern India in Ri Bhoi district of Meghalaya about 28 km from Guwahati (the state capital of Assam). The scope includes design, supply, installation and commissioning of two vertical shaft Francis turbines, generators and its auxiliaries including complete balance of plant equipment.

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TECHNICAL DATA:
OUTPUT: 2 x 20 MW
HEAD: 62 m
SPEED: 250 rpm
RUNNER DIAMETER: 2,260 mm



Dam and upper reservoir of Malta power station, Austria

## Malta

### Adaptation of Technology for Operating Condition “Full regulated pump operation”

**ANDRITZ HYDRO Automation** was commissioned in March 2009 by the Verbund AHP with the implementation of the new operating condition “Full regulated pump operation” for the power plant main stage of Malta.

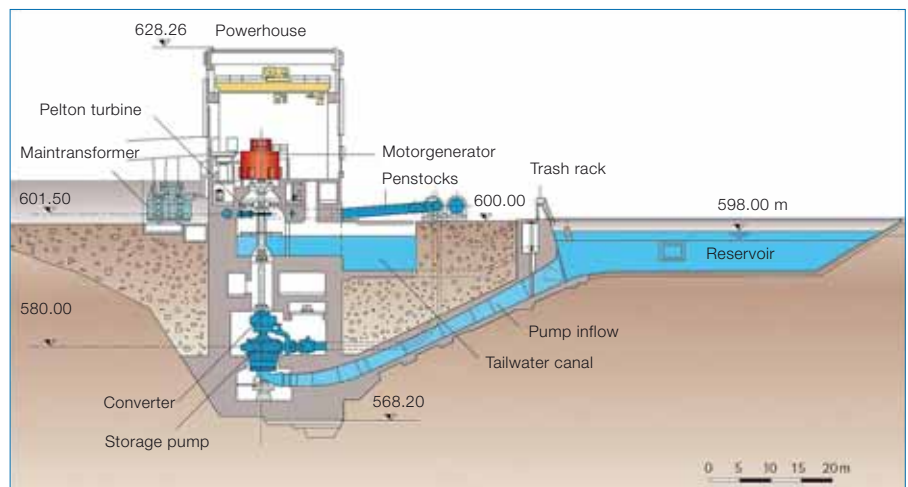
#### Water reservoir group Malta

The Water reservoir group Malta is located in the Austrian Malta and Möll valley and consists of the three stage power plant group Malta main, upper and lower stage. The plant was built during the years 1971 to 1978, and is still the most powerful storage power station group in Austria.

The Malta storage plants supply a total capacity of 891 MW plus 406 MW of the pump storages from the power plants in Galgenbichl, Rottau and Möllbrücke.

They produce annually more than 911 GWh of electric energy from natural water inflow. In the power plant Rottau in Mölltal four machine sets with vertical shaft and a nominal power capacity of 730 MW are installed.

The machine sets 1 and 4 consist each of a six-jet Pelton turbine and a generator. The two machine sets 2 and 3 are additionally equipped with a four stage storage pump, a hydraulic converter and a motor-generator.



Powerstation Rottau

The generated power is high-strung in the main transformers to 220 kV. The energy is deduced directly from the open-air switchyard located next to the power station into the transmission network of Verbund APG.

The Möll is dammed at the weir in the valley floor of Rottau, forming an almost two kilometers long compensating reservoir which serves for the operation of the turbine power station Rottau or as a water with drawal for storage pumps. Thus offers an optimum basis for the operation mode “hydraulic short circuit”.

#### Full regulated pump operation by hydraulic short circuit

At the moment the storage pumps

can only be operated at full power. To provide secondary control of  $\pm 180$  MW to the grid a hydraulic short circuit will be applied.

The difference between the ever constant power consumption of the pump and the additional power provided from the grid will be compensated by the simultaneous operation of the turbines to the required extent.

Due to the excellent control capability of the turbine in the entire power band, it brings a good general ability in pumping over the entire output range of  $\pm 180$  MW.

#### Scope of supply

ANDRITZ HYDRO supplies the control equipment for both machine sets

consisting of a NEPTUNE system for the automatic start-stop control and the necessary adaptations for turbine control and protection devices.

Essential for the acceptance of bid of ANDRITZ HYDRO was the very good plant knowledge and the short implementation time. These two factors result in the best cost effectiveness for our customer.

The first unit was successfully taken into operation in summer 2009. The second commissioning took place in spring 2010.

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# News from Finland

## Hydropower responds Strongly to the Climate Challenge in Finland



Pahkakoski power station

**H**ydro power plants have a long lifespan and they are reliable in producing renewable and non-polluting energy in an effective and environmentally sustainable way. Because of this it is important, especially as to national economy, to continuously improve and develop hydropower.

The extra output gained from hydropower plants will be extremely valuable in the future. It is possible to remarkably improve the efficiency and output of the existing hydro plants with new solutions. The new technology of water-filled runners has been a great success in improving the already environmentally friendly turbines. The Finnish hydropower companies Kemijoki Oy and PVO-Vesivoima Oy have made in good time a clear strategy for the modernization of all hydropower plants to react to future challenges. In the Nordic countries almost every customer is now demanding oil-free

Kaplan runner machining at Tampere workshop



solutions for Kaplan turbines. For more than 10 years also Kemijoki Oy and PVO-Vesivoima Oy have bought only so called water-filled runners. The grease-lubricating systems have been replaced by self-lubricating solutions based on bearings and bushes during the upgrading projects.

Kemijoki Oy is a Finnish hydropower Company. The majority shareholder is the State of Finland. The turbine upgrading of the hydro plants Pirttikoski, Vanttauskoski and last Petäjäsoski unit 1 work in progress. The two other Petäjäsoski turbines have been upgraded 2005 and 2006. Petäjäsoski 1 was upgraded already in 1996, but due to the potential to gain more output and additional energy, it turned out to be profitable to replace the runner. For the new runner ANDRITZ HYDRO can increase the output by more than 10 MW. The strong input from our own hydraulic laboratory as well as the water-filled runner construction developed by us made a remarkable contribution to the profitability of this upgrade project.

PVO-Vesivoima Oy is a Finnish hydropower company, mainly owned by Finnish industry, producing electricity for its shareholders. Now in progress are Maalismaa's two turbines, Kaaranneskoski (the main owner is Tornionlaakson Voima Oy, of which 50% is owned by PVO-Vesivoima



Petäjäsoski 2, Kaplan turbine runner installation



Petäjäsoski power station in wintertime

Oy) and finally Pahkakoski's two turbines. The upgrade including large refurbishment scope will increase power output by 25%.

ANDRITZ HYDRO Oy in Finland is responsible for the turbines including hydraulic design with CFD and manufacturing of water-filled environmentally safe Kaplan runners. Model tests have been made at ANDRITZ HYDRO's hydraulic laboratory in Tampere, Finland. The good and proactive co-operation with our customers has been the key factor in developing this new technology for environmentally friendly turbines. The new technology has been a strong step forward to progress a non-polluting, renewable energy production in Finland.

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Mooserboden and Wasserfallboden reservoirs

# Kaprun

## Upper Stage Power Plant Refurbishment of Pumped Storage Unit 1

**In 2008, ANDRITZ HYDRO Graz was awarded a contract by VERBUND-Austrian Hydro Power AG for general refurbishment of pumped storage unit 1 at the Kaprun upper stage power plant. In addition to refurbishment of the pump, turbine and spherical valve, the scope of supply also included the rebuilding and renewal of the hydraulic and electrical turbine governor, as well as all disassembly and reassembly work by ANDRITZ HYDRO's personnel on site of the power plant.**

The construction of the Kaprun upper stage power plant began in 1950. Since 1955 the two units installed have been generating annually around 200 million kWh of electrical energy with a nominal output of 112.8 MW. Each unit consists of a Francis turbine, a motor-generator, a gear coupling and a two-stage double-flow pump. The power house is attached to the Limberg dam at the Wasserfallboden reservoir. On the one hand Wasserfallboden reservoir is the storage lake for Kaprun main stage power plant, on the other hand water can be pumped from it into the upstream Mooserboden reservoir using the two pumps in the upper stage power plant, with a combined rating of 130 MW. Mooserboden reservoir supplies

water to the Kaprun upper stage power plant. With a maximum storage level of 2,036 m and minimum raised water level height of 1,960 m, 85 million m<sup>3</sup> of water are available for generating electricity. This is equal to an energy content of 237 GWh. The reservoir is three km long, one km wide, 70 m deep, and is dammed up by two dams – the 107 m high and 494 m long Moosersperre and the 112 m high and 357 m long Drossensperre. During general refurbishment of the Francis turbine, new protective walls and replacements for all labyrinth and split rings were supplied in addition to the new wicket gates. In order to provide good wear protection, the new components were all equipped with a tungsten carbide coating. Furthermore, the grease lubricated wicket gate bearing assembly underwent a rebuild to provide a maintenance-free system. The greatest challenge in general refurbishment of the storage pump and in site installation work was the horizontal design of the machine. In particular, exact alignment and setting of the 51 tons pump rotor required installation staff with the maximum experience available. After being dismantled on site, the spherical valve was brought in one piece to the workshops in Graz for general refurbishment. Transport proved to be highly complex because of the



Machine room with pumped storage unit 1



Lifting the refurbished pump rotor into place



Bottom pump housing section with built-in rotor



Spherical valve on its return trip to the power station

dimensions involved (nominal width 1,700 mm and weight 62.4 tons). Since the entire project was completed to the customer's fullest satisfaction, ANDRITZ HYDRO in Graz is optimistic to be also accepted for refurbishment of pumped storage unit 2, planned for 2011.

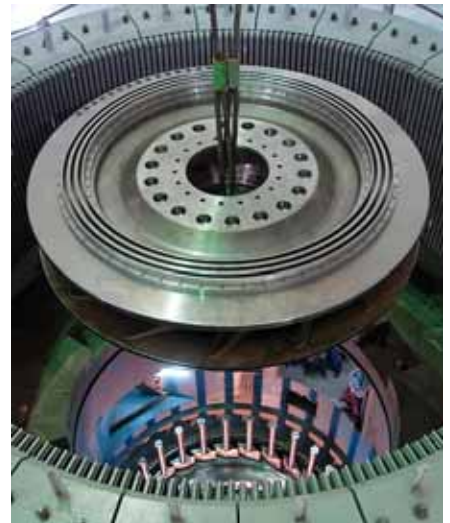
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### TECHNICAL DATA:

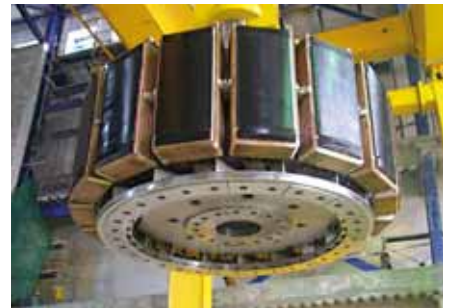
TURBINE OUTPUT: 57.1 MW
PUMP INPUT: 62.6 MW
HEAD: 364 m
SPEED: 500 rpm
RUNNER DIAMETER TURBINE: 2,332 mm
RUNNER DIAMETER PUMP: 2,310 mm



Nam Theun power plant from tailwaterside



Runner installation



Generator rotor installation

# Nam Theun II

## Project in the People's Democratic Republic of Laos

**O**n December 14th, 2009, the EM1 Consortium led by ANDRITZ HYDRO successfully handed over, all six generating units of the Nam Theun II project.

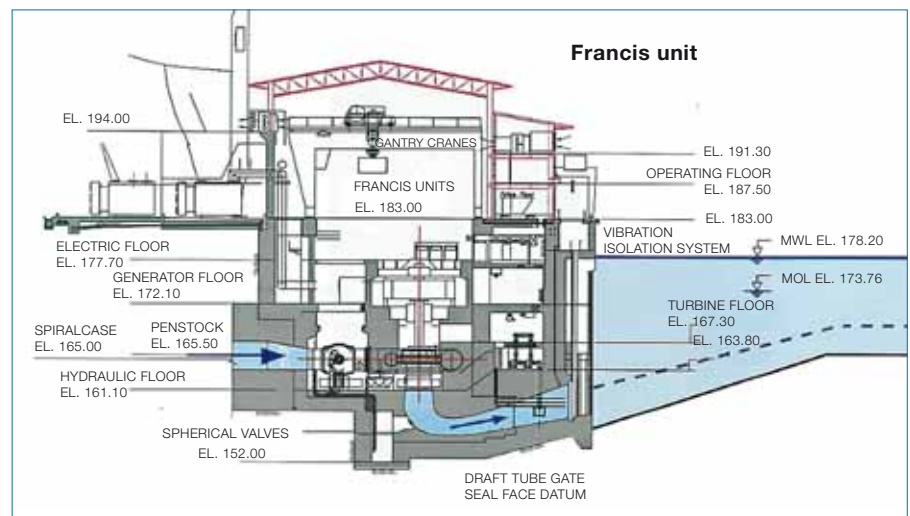
The Nam Theun II (NT2) Project is located in central Laos approximately 250 km east of its capital Vientiane. It exploits a head of approximately 350 m between the Nam Theun and Xe Bang Fai rivers, both tributaries of the Mekong river, and has a total installed capacity of 1,070 MW of which 995 MW are for export to Thailand and 75 MW are for use within Laos.

Total project investment is equivalent to USD 1.45 billion. Funded by public and private lenders and guarantors, it has been developed by the Nam Theun II Power Company (NTPC).

NTPC contracted the construction of the project to Eléctricité de France, the Head Contractor, who in turn contracted the main electromechanical supply to EM 1 Consortium contract. Commercial export of the Nam Theun II

project began in March 2010, following several months of testing and commissioning. All electromechanical equipment for the project was designed, manufactured, supplied, installed and commissioned by the EM 1 Consortium, comprising ANDRITZ HYDRO Canada, responsible for the main generating equipment and a large portion of the balance of plant, ABB Canada and Sweden, whose

main responsibilities are protection and controls, transformers, SCADA system; telecommunications and 500/115kV substations, and Clemessy, France, mainly responsible for the bus ducts, cabling, fire protection and electrical auxiliaries. While ANDRITZ HYDRO is currently the leader of the consortium, the contract was originally given to GE Hydro who assigned the contract to ANDRITZ HYDRO Canada after the acquisition of GE Hydro

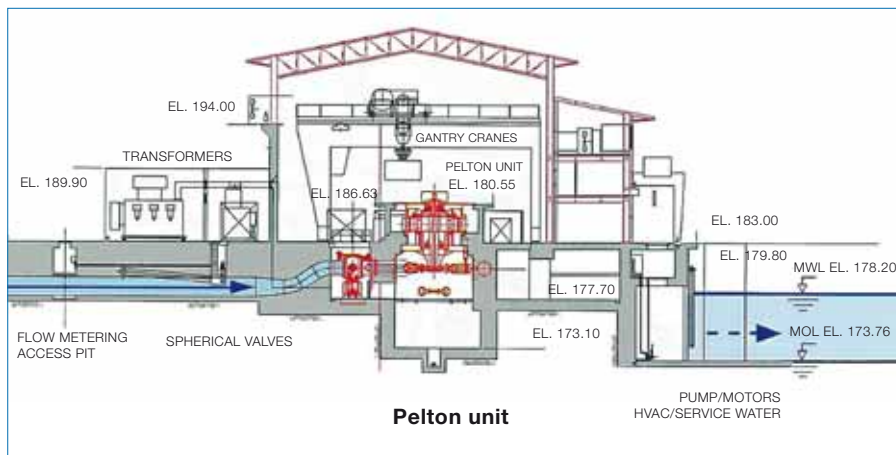




Turbine head cover installation



Turbine runner lifted by crane



under a very tight schedule and resulted in the commissioning of all six units in parallel to overcome delays. With the completion of this contract ANDRITZ HYDRO has oncemore demonstrated its ability to overcome technical and logistical difficulties and execute international projects in challenging environments successfully. The Nam Theun II experience will be of great help in the execution of the other ANDRITZ HYDRO project, the Theun Hinboun, which is currently underway.

by ANDRITZ HYDRO in July 2008.

**ANDRITZ HYDRO's scope of supply:**

- four vertical axis Francis turbine generators
- two vertical axis Pelton turbine generators
- governors for Francis and Pelton turbines
- six main spherical inlet valves.

**Auxiliary Services including:**

- power station finishing civil works
- HVAC central system
- cooling and potable water systems
- power station cranes
- sanitary installations
- power station workshop.

**Challenges**

From a technical perspective the Nam Theun II project might be called conventional, as the units do not include special innovations or extraordinary features. However the power station houses two different types of units, each with their own typical high headengineering challenges. In addition the execution of the contract presented special challenges

not only because the project was being taken over from GE Hydro in the middle of its execution.

Moreover the delivery of components to an area with transport limitations and the installation of the equipment in an environment without the typical infrastructure required to support the construction of a hydroelectric plant, required innovative solutions. Particularly noteworthy was ANDRITZ HYDRO's responsibility to build, staff and operate the site facilities for the EM 1 Consortium.

During the peak of the construction phase, ANDRITZ HYDRO had over fourty expatriate members of staff from all over the world and ANDRITZ HYDRO's subcontractor, Promec Energy, employed more than 1,000 Thai and Lao workers to install the equipment and provide all the services on site for the EM 1 Consortium. All this added to the complexity of the project.

Last but not least, the installation of the units was performed

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Partial view of Expatriate's camp

<b>TECHNICAL DATA: Francis</b>
OUTPUT: 4 x 247 MW
VOLTAGE: 18 kV
HEAD: 350 m
SPEED: 333.33 rpm
RUNNER DIAMETER: 3,640 mm
STATOR DIAMETER: 7,315 mm

<b>TECHNICAL DATA: Pelton</b>
OUTPUT: 2 x 43 MW
VOLTAGE: 11 kV
HEAD: 344 m
SPEED: 375 rpm
RUNNER DIAMETER: 2,665 mm
STATOR DIAMETER: 5,300 mm



Runner manufacturing in Ravensburg workshop, Germany

## Guri II

### Arrival of the First Runner in Venezuela

**O**n Sunday, December 6th, the runner with a weight of 200 tons and a diameter of 7.3 m received in time after a 70-day journey by land and by boat on rivers and sea at the power station Guri II.

On September 28th, 2009 the colossus started on a 19-axle trailer from the factory in Ravensburg in the direction of Heilbronn. It was moved by a tractor and a pusher machine, together with 1,400 hp. In the following nights the heavy haulage attracted many onlookers. Some of them attended this nightly spectacle in their pyjamas, when in some tight spots or corners, there were

often only a few inches and the crews of several police and escort vehicles had to evacuate many obstacles from the path.

On October 2nd, the runner could continue its journey from Heilbronn to Antwerp per inland waterway vessel. Here once again it had to be loaded up for onward across the Atlantic to Venezuela. After several Caribbean ports have been passed, the runner finally arrived on the Orinoco river, where it went upstream. Finally on December 3rd, Port of Palua was reached.

For the arrival of the runner in the

power plant a great celebration was held. Among the participants were the Executive Director and senior representatives from EDELCA, the Austrian ambassador in Venezuela, the commercial attaché of the German Embassy in Caracas, the two directors from ANDRITZ HYDRO Ravensburg, together with numerous representatives of press, radio and television.

The final press conference was broadcasted live from one of the major television stations in the country. Jean-Claude Riesterer, CEO of ANDRITZ HYDRO Ravensburg, underlined the long experience of the company by participating in numerous projects in Venezuela and the great interest in further cooperation in future projects.

In his speech, project manager Oscar



Runner transportation to harbor





Runner final acceptance in Ravensburg workshop, Germany



Lowering into turbine pit at site



Main hall at Guri II, Venezuela



Loading for shiptransport

González listed all the achievements so far. He pointed out the consortium's efforts to fulfill its commitments to EDELCA and the country, which is known to be in a serious energy crisis. The goal is to convince with efficiency and performance, in order to expand the presence of the company in Venezuela in the future.

The dismantling of the first machine began on June 3rd, 2009. Previously works on the wicket gates, the discharge ring, the draft tube and on the spiral casing were executed, distinguished by high quality of welding works and the subsequent coating.

An important factor for the good performance so far is the fact, that in the mechanical processing on site specified accuracy has been achieved,

whereby the time limit originally adopted even fell below.

All the material is already on the site. The work on the overhaul at the wicket gates servo motors, the lower bearing bracket, the turbine and generator shaft are nearing completion.

Currently, the mechanical revision of the coupling between the turbine shaft and the runner is in process. An installation start in mid-March and the subsequent start of the commissioning tests in June 2010 will be achieved. It is expected that the first machine will go into operation in mid-August 2010.

Thanks to the excellent performance of ANDRITZ HYDRO and the consortium partners, we have received an additional order from EDELCA for the

supply of ten excitation systems for all machines in the power house Guri II. This excitation system was designed in record time by ANDRITZ HYDRO Mexico and was already approved by EDELCA. Currently, the production is made in the plant of ANDRITZ HYDRO in Morelia.

The inspection tests for the first excitation system in the plant was scheduled for February 2010 in presence of customer representatives and a company entrusted with the inspection.

Once the inspection approval will be granted, transportation should be made by air freight. This is necessary in order to be able to comply with the strict timetable for the rehabilitation of the first machine of Guri II. This order is the excitation system with the greatest power, which ANDRITZ HYDRO has ever made in its recent history.

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<b>TECHNICAL DATA:</b>
OUTPUT: 770 MW
HEAD: 144 m
SPEED: 125.5 rpm
RUNNER DIAMETER: 7,300 mm



Shop fabrication of pipes



Pelton turbine, 423 MW at 1,883 m gross head

## Cleuson Dixence

### Completion of Pressure Shaft Rehabilitation Works and Successful Commissioning of the Plant

**The Cleuson Dixence hydropower plant, located in the western part of Switzerland, is with a gross head of 1,883 m and an installed capacity of 3 x 423 MW the high head scheme worldwide. ANDRITZ HYDRO was supplier of the Pelton turbines and had also a leading role in the rehabilitation of the pressure shaft.**

The pressure shaft of the Cleuson Dixence scheme is a four km long steel lined tunnel, connecting the valve chamber in Tracouet (at elev. 2,157 m) with the power house cavern in Bieudron (at elev. 481 m). The maximum design pressure for the steel lining is 207 bar, the diameters varied from 3.4 to 3 m. At that time, and for the first time in penstock construction at all, most of the steel lining was made of material grade S890Q. After four years of construction the plant was commissioned end of 1998. On December 12th, 2000 a tragic accident happened. The pressure shaft burst under a pressure of 120 bar, approximately 300 m downstream of Péroua, an area with just 60 m of rock burden, with poor rock

and fault zones. 70,000 m<sup>3</sup> of leaking water caused not only drastic damages but regrettably also three casualties. The reasons for this failure have been, of course, extensively investigated by many independent international experts. In 2003, the plant owners, EOS and Grande Dixence, founded the Cleuson Dixence Construction SA (CDC) as a special purpose company for the execution of the necessary rehabilitation works. Based on numerous expertise, the Engineer's consortium consisting of EDF CIH, Stucky, Bonnard & Gardel decided for the following rehabilitation concept:

Relining of the pressure shaft over the entire length of four km, which means the installation of a second steel lining with an annular gap of maximum 160 mm. This second lining is to be designed against the full internal pressure, the existing lining is no longer structurally considered. The annular gap is to be filled with concrete. The safety factor against internal pressure is increased from 1.5 to 1.8. Due to possible difficulties in the workman-

ship of the S890Q material, the material grade to be used is limited with S690QL.

The bad geological zones in the area of the failure will be bypassed to reach more stable rock (75 m high vertical shaft, followed by a 100 m long horizontal freestanding penstock; the penstock lies on vertically adjustable supports for alignment adjustment in case of future geological settlements). For the construction and installation works new access tunnels are built to the upper bend and the horizontal tunnel.

Prior to the installation of the new steel lining contact groutings are to be executed between the old steel lining and concrete backfill, and, in areas of poor rock, also consolidation groutings.

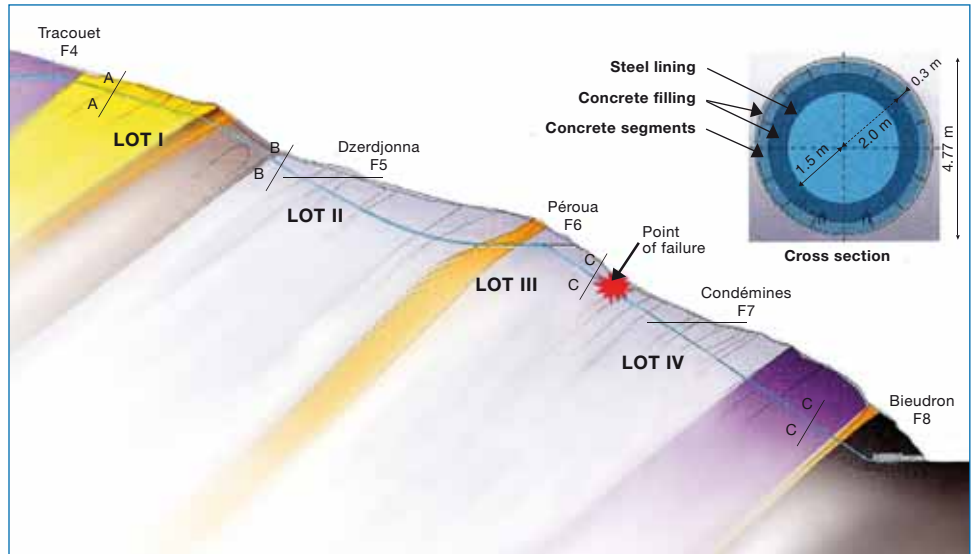
On October 4th, 2006, CDC awarded the contract for the rehabilitation of the pressure shaft to the Consortium AMC, ANDRITZ HYDRO GmbH (sponsor) and MCE Industrietechnik Linz GmbH. The scope of works of ANDRITZ HYDRO was the general project management, engineering, material procurement, fabrication of pipes, transport to site, concrete backfill and the corrosion protection works. MCE ITL was responsible for the extensive qualification program



Pipe transport with 15 ton ropeway



Pipe installation



Cleuson Dixence high pressure shaft longitudinal section and cross section (before rehabilitation)

for welding and ND-testing procedures, erection planning, all site installations, prefabrication of erection units in the vicinity of the access tunnels and the pipe installation itself.

For logistic reasons and due to the high quality requirements MCE MAP Linz and VAM Wels were awarded by ANDRITZ HYDRO with the shop fabrications of pipes.

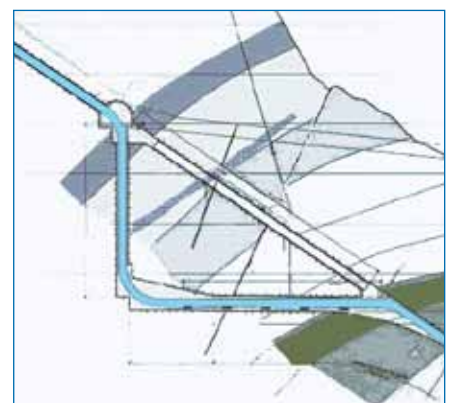
The technical solution prepared by the consortium is based on an average annular gap of just 130 mm, which resulted in diameters between 3.1 and 2.55 m. In the upper part, material grade S500ML was used, in the lower material grade S690QL. The plate thicknesses varied from 18 to 80 mm. The total weight of the new steel lining comes to some 12,700 to, with a 60% share of material grade S690QL. The entire pressure shaft breaks down into four lots, approximately equal in length, with individual access through the tunnels in Tracouet, Dzerdjonna, Péroua and Condémines.

Each of these sections had specific characteristics with different logistic requirements for the installation works. For example, access to the highest installation place was only possible by a 15 to ropeway. To secure the high quality requirements, prior to start of the fabrication an extensive qualification program had to be executed for materials, welding processes and non-destructive testing of welds. For backfilling of the annular gap a self-compacting,

non-shrinking concrete with a pot time up to four hours had to be developed, pourable over a length of 48 m without segregation. These properties had to be proven in a 1:1 scale prototype test. ND-testing of welds had to be done, among other tests, with automatic UT (TOFT technology). In addition to the weld tests executed by the consortium (NDT1) awarded CDC an additional testing agency with a complete, second testing of all welds (NDT2).

6 and 12 m long pipes were manufactured in the workshops, and transported by railway to a storage yard, approx. 15 km off the installation sites. For the two upper lots and the bypass two 6 m pipes were assembled to 12 m long erection units, in field workshops in front of the respective access tunnels. The standard erection unit was 12 m long, with a maximum weight of 56 to. Lowering down of these pipes was done with special pipe carriers and by using heavy duty winches. Concrete backfill of the annular gap was in 12 m steps. For welding of the in-situ erection welds the well proven TIG Hot Wire technology was applied for steel S690QL, material grade S500ML was welded by using the FCAW and SMAW process. The simultaneous pipe installation in all four lots was a challenge for logistics, timely provision of site installations and the recruiting of qualified site personnel. The extreme

short schedule pushed all the works from the beginning on. After four months of preparatory works, the pipe installation started on June 18th, 2007 and could be finished already on May 8th, 2009. After completion of the corrosion protection works, the rehabilitated pressure shaft could be handed over to the client on August 19th, 2009, 18 days prior to the contractual completion date. On December 1st, 2009, after nine years of idleness, the first time again 1,231 MW could be generated in Cleuson Dixence.



Longitudinal section of bypass

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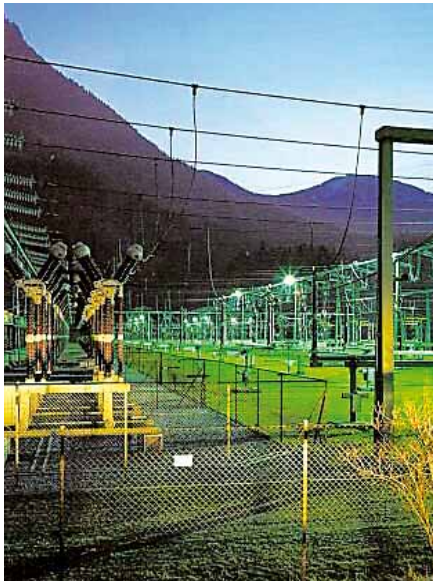
<b>TECHNICAL DATA:</b>	
TOTAL LENGTH:	4,000 m
INTERNAL DIAMETER:	3.1 - 2.55 m
MAX. DESIGN PRESSURE:	207 bar
TOTAL WEIGHT:	12,700 to

**AUSTRIA****VERBUND APG**

In early 2010 ANDRITZ HYDRO was commissioned by the Verbund APG with the renewal of twenty-two busbar protection equipment for various substations.

The numerical busbar protection DRS-BB has a nine-year history of success. 96 plants successfully placed in operation are the basis for the future of this system.

The negotiating team of automation has recently prevailed in concluding a contract for 22 protective DRS-BB



against tough competition.

In addition to the technical criteria in the direction of system extensibility and complexity, ultimately, the price advantage was mission-critical.

During the project period from 2010 to 2012 Austrian substations will be equipped with 110 kV, 220 kV and 380 kV voltage levels with this new busbar protection device.

The supplies include the complete supply cabinet, its installation and commissioning.

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**GERMANY****KARLSRUHE**

ANDRITZ HYDRO Germany received an order for the delivery of one Bevel Gear Bulb Turbine equipped with a synchronous generator and cooling system, as well as the complete control- and electrical equipment, including installation and commissioning for Karlsruhe-Rheinhafen.



Operating for more than 50 years, the coal fired steam power station Karlsruhe-Rheinhafen will be enlarged by a new modern generating unit of 912 MW by the utility company EnBW. The cooling water which is required for the new unit is taken from the river Rhine, adjacent to the power plant. At the outlet of the cooling water pipe a so-called energy-recovery turbine will be installed.

The installation will take place in spring 2011. It is planned that the turbine, which will be previously shop tested, will be delivered completely assembled. Only one mobile crane will become necessary to lift the turbine in place within a few hours.

Installing the well proven bevel-gear Bulb turbine will increase the system efficiency of the total coal fired power station. This represents a great leap forward for environmental protection.

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**TECHNICAL DATA:**

OUTPUT: 1,740 kW
HEAD: 8.30 m
SPEED: 205 / 750 rpm
RUNNER DIAMETER: 1,950 mm

**SWITZERLAND****NAVIZENCE**

Navizence is a river flowing through the canton of Wallis in Switzerland into the river Rhône in Chippis, where an aluminium factory has been placed. There the hydropower station was built in 1908 to power the electrolysis system. After many enhancements over the following decades today there are seven 7.4 MW machines in place.

The owner (Forces Motrices de la Gougra SA) aimed to increase the output by rehabilitation of the equipment.

On February 16th, 2009 the contract for the „Nouvelle Centrale de la Navizence“ (NCN) was signed. In this consortium ANDRITZ HYDRO AG of Switzerland holds primarily responsibility sending Ferdinand Hoffmann as project manager. The seven machines are now being replaced and ANDRITZ HYDRO will supply new 5-jet Pelton turbines including generators and governors.

The project has already begun and the engineering is coming to its finish. First orders on parts have been placed and production is ready to start. The plan foresees the delivery of the first machine at the end of 2010 and the acceptance from customer side is planned for end of August 2011.

Just after that the 2nd and 3rd machine will be delivered. The final acceptance of these machines is due on January and February 2013 respectively.

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**TECHNICAL DATA:**

OUTPUT: 3 x 24.3 MW / 26.5 MVA
VOLTAGE: 9 kV
HEAD: 563.1 m
SPEED: 750 rpm
RUNNER DIAMETER: 1,285 mm
STATOR DIAMETER: 3,270 mm

## FRANCE

**SISTERON**

**A**fter long lasting negotiations ANDRITZ HYDRO was awarded a rehabilitation contract from EDF for the hydropower plant Sisteron in January 2010.

The power station is located on the river Durance approximately 130 km north of Marseille and only 150 km from Grenoble.

ANDRITZ HYDRO's scope of supply will include:

- homologous model test
- two new vertical shaft Francis turbines including new bearings and new wicket gate mechanism and shaft seals
- reassembly of new distributors and bearings including site works
- recommissioning.

The new units will replace the old ones supplied by Alstom in 1972 and will be uprated by 3.6 % in power.

ANDRITZ HYDRO is leader of a consortium which will include also the company ENDEL (GDF-SUEZ), responsible for all the installation and reassembly works.

The recommissioning of unit 2 is scheduled for 2011 (without new runner) and of unit 1 for 2012.

The new runner of unit 2 will be supplied and put in service in 2013.

This large rehabilitation project for EDF is the first one after the refurbishment of the power plant Kembs in 2005 which was also realized by ANDRITZ HYDRO successfully.

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**TECHNICAL DATA: Francis**

OUTPUT: 2 x 130 MW
HEAD: 113 m
SPEED: 187.5 rpm
RUNNER DIAMETER: 4,001 mm

## FRANCE

**KEMBS**

**I**n November 2009, Electricité de France (EdF) awarded ANDRITZ HYDRO S.A.S in Grenoble a contract for supply, installation and commissioning of the complete electromechanical equipment for the Kembs power plant, which is located on the river Rhine in the northeast of France.

The EdF purpose of this new Compact Hydro installation, close to the main large hydro power plant Kembs, is to use mandatory reserved discharge in the river.

After a quite long evaluation stage by EdF, the ANDRITZ HYDRO proposal has been preferred against another



French bidder because of technical and price reasons.

Scope of supply includes two downstream S-type double regulated Kaplan turbines including governors and parallel shaft speed-increasers, synchronous generators from Moteurs Leroy-Somer, upstream sliding gates and down-stream stop-logs.

Commissioning is foreseen to take place in September 2013.

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**TECHNICAL DATA:**

OUTPUT: 4.45 MW
HEAD: 11 m
SPEED: 200 rpm
RUNNER DIAMETER: 2,600 mm

## SPAIN

**EL HIERRO**

**T**he Technical Institute of the Canary Islands has developed a wind park and a hydro plant for El Hierro, the smallest of the Canary Islands.

This island, with 278 km<sup>2</sup> and 10,477 residents, has an annual electrical demand of 35 GWh with a peak of 6.3 MW. The idea is to replace the present Diesel electrical plant by a 10 MW wind farm together with a pumping station and a hydraulic power plant. The wind farm will cover the electrical demand, but when the wind farm provides more power than is needed, the extra energy will be used to pump water to an upper reservoir located at an elevation of 700 m. When the demand cannot be covered by the energy from the wind, the stored water will be sent to the lower reservoir, using the hydraulic power plant for converting the potential energy of the water into electrical energy.

The owner of this wind hydro plant is Gorona del Viento El Hierro, which is 60% owned by Cabildo Insular de la Isla de El Hierro (Local Administration), 30% by Endesa and 10% by Technical Institute of the Canary Islands. ANDRITZ HYDRO Spain, as nominated supplier of Elecnor, the main contractor for the hydraulic system, supplies the electromechanical equipment of the hydraulic power plant based on horizontal Pelton turbines. The reference of this project could be very good, since as Tomás Padron, President of Gorona del Viento El Hierro, said: "The system could be extrapolated to other insular or mainland regions that are remote from the grid".

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**TECHNICAL DATA:**

OUTPUT: 2.86 MW
HEAD: 650 m
RUNNER DIAMETER: 1,000 mm
STATOR DIAMETER: 1,013 mm

**DENMARK****TJELE**

In January 2010 ANDRITZ HYDRO received an order from Energinet.dk for the renewal of the control devices of the rotating phase shifter in the Danish substation Tjele.

Basis for the award of the control device renewal to ANDRITZ HYDRO are already four modernized facilities in Norway with similar design.

The project includes the delivery of a new control for start/stop sequence, a new excitation system, the upgrading of the electrical protection devices, a new static frequency converter for starting the phase shifter, the renewal of the gas monitoring system and the high-pressure oil pumps.

One of the features of this project is the stimulation device with a capacity range of +180 MVar up to -125 MVar. The excitation system THYNES 5, as well as the control components are subsystems of the NEPTUN water power plant solution of ANDRITZ HYDRO and therefore they constitute an integral part of this solution.



Due to the short time span of the project of less than one year, the phase shifter will start operation in late 2010.

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**TECHNICAL DATA:**

OUTPUT: +180 / -125 MVar
SPEED: 750 rpm
IN: 7,100 Amp
LE NOM.: 2,000 Amp DC
UE NOM.: 300 VDC

**SWEDEN****SELSFORS**

Swedish Skellefteå Kraft AB awarded ANDRITZ HYDRO Östersund Sweden with an order for the upgrade of a Kaplan turbine for the Selsfors hydro power plant.

The contract came into force in December 2009 and the runner blades are developed in ANDRITZ HYDRO Research & Development Laboratory in Tampere. The scope also includes a new high pressure unit, new oil pipes, general overhaul of dismantled parts, painting of embedded and dismantled parts and installation on site. Installation work on site and commissioning are scheduled for mid 2012 and will be finalized by end of 2012.



The runner is a Kaplan runner, oil free with self lubricated bushings and servomotor below center axis. As compared to the current rated output, the power output at the rated net head will be raised by approximately 25%.

The scope also includes dismantling of the generator and new edging of stator windings, new guide bearing, testing and commissioning. All design, manufacturing and installation will be done by ANDRITZ HYDRO Sweden.

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**TECHNICAL DATA:**

OUTPUT: 23.85 MW
HEAD: 21.4 m
SPEED: 136.4 rpm
RUNNER DIAMETER: 4,130 mm

**ICELAND****MJÓLKÁ III**

Despite the difficult economical situation in Iceland ANDRITZ HYDRO Germany has received a further contract in this region for a complete E&M package with one horizontal Compact Francis turbine.

Our client Orkubu Vestfarda ehf (OV) has previously bought Francis turbines for the plants Thvera (2000) and Tungudalur (2005) from ANDRITZ HYDRO Germany.

OV is responsible for the electric power supply in the northwestern part of Iceland in the Westfjord peninsula. This is a relatively remote area and especially during winter time the grid connection to Iceland's main grid is lost. Therefore OV invests in refurbishment and extension of the Mjólká hydro power plants to improve the grid situation.

The Mjólká plants are located in



the Arnafjörður fjord approximately 80 km south of the regional capital Isafjörður town. Mjólká III is a new plant and will be built upstream of the existing Mjólká land II plants. ANDRITZ HYDRO has already installed more than 20 hydro turbines in Iceland.

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**TECHNICAL DATA:**

OUTPUT: 1,192 kW
HEAD: 95 m
SPEED: 1,000 rpm
RUNNER DIAMETER: 477 mm

**USA****ABIQUIU**

**I**n October, 2009 ANDRITZ HYDRO USA Corp. was contracted to design and supply a single Compact Hydro Francis turbine generator unit for the existing powerhouse at Abiquiu reservoir in New Mexico.

The Abiquiu hydroelectric project is owned and operated by the Los Alamos County, New Mexico and is located on a major tributary of the Rio Grande river. Abiquiu dam was constructed by the US Army Corps of Engineers (USACE) between 1956 and 1963. A 14 MW, two-unit powerhouse facility was added adjacent to the dam in 1990. Releases from the Abiquiu reservoir are directed by the USACE and are driven by flood control, snow melt, and irrigation needs. The county intends to install the new low flow unit for power generation at low flow conditions. ANDRITZ HYDRO will provide the equipment as a sub-supplier to the prime contractor, RMCI, who was awarded the EPC contract to design and construct the addition to the Abiquiu powerhouse and to install the new turbine generator equipment. ANDRITZ HYDRO's scope of supply includes one horizontal Francis turbine, synchronous generator, inlet valve and hydraulic pressure unit. Of note is the high altitude of the



site (1,840 m above sea level) which had an impact on the selection of the turbine design. Commissioning of the unit is expected before mid-2011.

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<b>TECHNICAL DATA:</b>
OUTPUT: 3.12 MW
HEAD: 51.8 m
SPEED: 514 rpm
RUNNER DIAMETER: 975 mm

**KENYA****KINDARUMA**

**K**enya is an equatorial country located on the East Coast of Africa. It is very well known for its abundant wildlife with features such as the Serengeti, Rift Valley, Mt Kenya and the famous animal migration which sees millions of "wildebeests" returning to their pastoral and breeding grounds at Masaimara.

This is the unique setting for the newly awarded ANDRITZ HYDRO project in Africa called Kindaruma. The power plant is located 160 km northeast of Nairobi and was first commissioned and opened in June 1968 by the famous former President Jomo Kenyatta. The first hydro power plant on the Tana River Seven Forks Cascade was built as a two unit station with an extension possibility for a third unit. KenGen, a public owned utility, engaged Scott Wilson, UK based consultant, to perform an evaluation of all plants on the Tana river. This study indicated that Kindaruma was in most need of rehabilitation.

The project tendering phase endured for one year and attracted three leading international suppliers for tendering. After evaluation by the KenGen and Scott Wilson, ANDRITZ HYDRO was selected as the preferred bidder. This result was however contested by the competitors but their appeal was dismissed by the Kenyan Public Procurement Board. ANDRITZ HYDRO proudly signed the contract on January 11th, 2010.

The Kindaruma Project will be executed over 41 months and involves a turn-key rehabilitation of the entire plant and switchyard where as a new third unit will be added.

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<b>TECHNICAL DATA:</b>
OUTPUT: 24 MW
HEAD: 36 m
SPEED: 214.3 rpm
RUNNER DIAMETER: 3,100 mm

**PAKISTAN****NEW BONG ESCAPE**

**I**n early 2010, ANDRITZ HYDRO obtained a further order and was therefore able to build on the successes in Pakistan. The contract covers the complete electro-mechanical equipment for the construction of a low head power plant. Heart of the system are four Bulb turbine sets. In addition ANDRITZ HYDRO will also supply and install the complete electro-mechanical equipment, including balance of plant.

It is the first hydropower plant of this size, which is being built in Pakistan on a private basis. End customer is the Pakistani Laraib Energy Company Ltd., who acts as a project developer and investor. Power purchase agreements were concluded with the state operator firm WAPDA. Laraib Energy Ltd. has instructed the Korean construction firm Sambu Construction Company Ltd., who is a subcontractor of ANDRITZ HYDRO, with the construction of the turnkey plant. The project is located



approximately 120 km east of Islamabad, downstream of the existing Mangla power plant. Under the project, which will be built as a run-of-river power station without its own storage reservoir, the difference in level between existing rivers and canals will be used. Completion is scheduled for end of 2012.

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<b>TECHNICAL DATA:</b>
OUTPUT: 4 x 21 MW
HEAD: 13.5 m
SPEED: 100 rpm
RUNNER DIAMETER: 5,500 mm

# HYDRO 2009

Successful Congress Participation  
in Lyon, France



**T**he important position as a worldwide valued hydropower congress was demonstrated once more by the HYDRO 2009 in Lyon. More than 1,200 participants from 75 countries took part in this three-days event.

In addition to interesting lectures, the attractive congress area offered various opportunities for information exchange, intensive customer discussions as well as the optimum representation of exhibitors. ANDRITZ HYDRO participated with more than ten lectures and

an innovative booth, highly frequented beyond the closing of each day. The papers presented the whole scope of the business from hydraulic machinery, uprating-refurbishment-upgrading, monitoring and small hydro up to latest developments in electrical engineering and pumped storage technology. A special paper presented the problem management of reservoir sedimentation. All papers and the modern booth concept, presenting the new corporate design as well as latest videos in HD-technology, underlined our position as one of the leading suppliers of hydro power.

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## Customer Day in Hangzhou, China

On November 17th, 2009, ANDRITZ HYDRO China held a successful customer day in Hangzhou, Zhejiang, China.

The customer day was titled "ANDRITZ HYDRO China Presentation & Technical Seminar". Over 120 participants attended the event such as customer representatives from various Chinese hydropower investigation design & research institutes, hydropower development companies including Huaneng Group, Huadian Corporation, China Guodian Corporation and Three Gorge Group, as well as Management representatives and experts from ANDRITZ HYDRO headquarters and China. After the welcome speech the management team introduced ANDRITZ GROUP

and ANDRITZ HYDRO China in particular to the customers.

Experts made presentations on ANDRITZ HYDRO's technologies in turbine, generator and auxiliary equipment. Some customer representatives shared their experiences with ANDRITZ HYDRO products. After the presentation a workshop was held to offer face to face discussions with customers in specific technical questions about ANDRITZ HYDRO's technology and products.

This customer day enhanced the understanding of customers towards ANDRITZ HYDRO's organization, history, as well as its advanced technology in all types of hydro turbine, generators and secondary equipment.

The customer day marked the first big step in promoting ANDRITZ HYDRO's strategy in China and will definitely improve our business opportunity.

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# Customer day in Kriens, Switzerland

Quality and Competence at Top Level



**The Swiss customer day took place in Kriens from November 12th until 14th, 2009. More than 500 customers from seven countries took the opportunity to inform themselves about the scope of ANDRITZ HYDRO as well as currently used manufacturing technology.**

Twelve Points of Interest (POI) were distributed over the workshop area in Kriens. Special sessions in German and in French presented additional information about ANDRITZ HYDRO in Switzerland, R&D, Compact Hydro, Center of Engineering Pelton, automation and modernization potentials. Due to the engaged involvement of all project team members from Kriens,

Zurich, Vevey and Jonschwil as well as of all employees preparatory to and during the customer day the event became once again a great success.



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## Russia Power 2010

### First presentation of OOO ANDRITZ HYDRO in Moscow

**F**or the first time ANDRITZ HYDRO took part at Russia Power, one of the most important fairs and conferences of the Russian energy industry. Russia Power was the best opportunity to promote the new location of ANDRITZ HYDRO in Moscow to the Russian market.

Russia is an excellent place for a conference with special focus on hydropower. With more than 55,000 MW installed hydropower capacity Russia belongs to the leading countries in hydropower generation. Today more than 20% of the Russian energy demand are covered by hydropower. Russia Power 2010 offered a good opportunity for local and international exhibitors promoting state-of-the-art solutions and technologies in energy generation and transmission for the audience. It was the first time, that all hydropower related exhibitors were concentrated in a specific "Hydro Pavilion".

All papers and presentations with a hydropower context were put together in a dedicated hydropower paper session. The taking part of ANDRITZ HYDRO at Russia Power was decided short-term and in parallel with the founding of "OOO ANDRITZ HYDRO", the new local subsidiary in Moscow. In addition to the product and service presentation of ANDRITZ HYDRO the main target was to promote the new location to the Russian customers. Russia Power offered in parallel a good opportunity coming in contact with potential customers in the field of rehabilitation/modernizing as well as small hydro. Both segments had a lot of interest beginning with the first day. Already in late 2009 ANDRITZ HYDRO had registered two papers for the specific hydropower session; "Integrated control system – NEPTUN" and "Pump turbines". Both presentations were of great interest to the Russian audience and had good

feedbacks. The whole booth concept beginning with the design and colour definitions until the use of large poster visualizing followed the successful design layout from last year. Large scale monitors for the newest HD-videos as well as two presentation stations were a



good basis for interesting customer discussions. The members of the booth team came from Moscow, Kiev, Ravensburg, Linz and Vienna.

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**Powerage 2010**  
June 1-3, 2010  
Zurich, Switzerland

**Hydroenergia 2010**  
June 16 - 19, 2010  
Lausanne, Switzerland

**HydroVision 2010**  
July 27-30, 2010  
Charlotte, USA

**HYDRO 2010**  
Sept. 27-29, 2010  
Lisbon, Portugal

# Winner of the Austrian State Prize 2010 Environmental and Energy Technology Chievo Dam HYDROMATRIX®-Project



## The Jury's comment to the Chievo Dam HYDROMATRIX® plant in Verona:

"This form of hydropower requires little intervention in nature, is flexible and broadly applicable and can also be installed at already existing dam sites. ANDRITZ HYDRO as the world's leading supplier of HYDROMATRIX®

turbines and a global player in hydropower is of great importance for the competitiveness of Austria's environmental technology industry and strengthens its leading position through its HYDROMATRIX® technology".

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



Minister Nikolaus Berlakovich (BMLFUW)  
Alexander Bihlmayer, Product Manager and Wolfgang Semper,  
Managing Director (ANDRITZ HYDRO GmbH) from left