

# HYDRO POWER

## Business Area Managers



**COMPREHENSIVE PRODUCT  
PORTFOLIO: ELECTROMECHANICAL  
EQUIPMENT FOR HYDROPOWER  
PLANTS; PUMPS; TURBO  
GENERATORS.**

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[1]

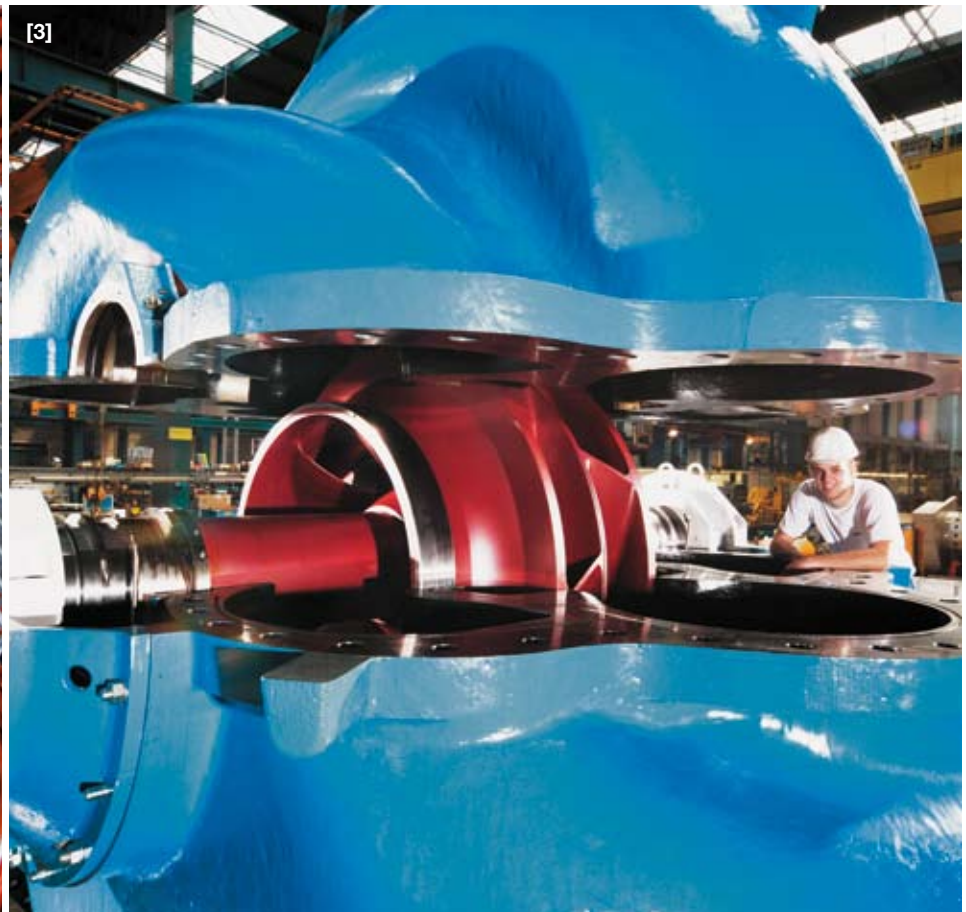
**[1]** Large new plants (like the hydro-power station constructed by Andritz VA TECH HYDRO in Caruachi, Venezuela, shown in the picture), and small power stations are essential contributions toward sustained, renewable, environmentally friendly energy production.

**[2]** In the high-growth energy market, gas power stations and combined gas stations cover a large portion of the demand. Modern, efficient turbo generators form a core of these stations. The photo shows the stator of a 175 MVA turbo generator for General Electric.

**[3]** The global market is asking for ever larger and more efficient pumps specially designed to the customer's individual requirements. The photo shows one of the Andritz pumps supplied to Hui Nan Zhuang pumping station, China. They are the largest pumps of this design ever built anywhere in the world.



[2]



[3]

## PROFILE

The Hydro Power Business Area of the Andritz Group is a leading global supplier of turnkey electromechanical equipment and services for hydropower plants. It offers new hydroelectric power stations, as well as services, rehabilitation, and upgrading of existing plants.

The Business Area also offers the development, design, and manufacture of large-scale pumps for selected applications like water transport, pumps for the primary and secondary loops in nuclear power stations, cooling water pumps for thermal power stations, and centrifugal pumps for the pulp and paper industry.

The Business Area also provides the design and manufacturing of air-cooled turbo generators, used for gas and steam turbines.

## MARKET DEVELOPMENT

In 2007, project activity for hydropower plant equipment developed very favorably. Due to the continued strong increase in electricity demand, several new hydropower plants are in the planning or construction phase, especially in India and China.

Investments in Europe and North America focused on modernization and rehabilitation, as well as on capacity increasing projects for existing plants. Due to the necessity of securing network stability, pumped storage systems also saw a continued high level of project activity.

Apart from investments by governmental institutions, private investments are also increasing in several countries. Typical examples are Turkey, where the new privatization law has driven local and foreign investors to start new projects, and Canada, where the private sector has become an essential driver of the hydropower development, especially in British Columbia.

The market for small-scale hydropower stations is also seeing a continued positive development. Additional drivers of this segment are the worldwide activities with respect to climate protection and the increase in the use of renewable energy sources.

The market for centrifugal pumps as well as for irrigation and drinking water pumps also showed a very solid development, especially in China. With its successful 60:40 joint venture Andritz-Kenflo in Foshan, Andritz has been the clear market leader in this region for some years now.

The investment activity of the European energy industry has started to increase considerably during the past few years. This trend is likely to continue, not only in the rehabilitation sector but also with regard to new plants, especially thermal power stations, with positive effects on the market for cooling water pumps.

## KEY FIGURES HYDRO POWER

MEUR	2007	2006*	2005	2004	2003
Sales	910.0	467.9	52.7	43.8	32.0
Order Intake	1,216.1	585.4	71.5	58.7	37.3
Order Backlog as of 31.12.	1,954.9	1,659.5	60.5	40.7	27.2
EBITDA	63.6	33.3	4.8	5.5	3.2
EBITDA margin	7.0%	7.1%	9.1%	12.6%	10.0%
EBITA	49.5	25.1	2.6	3.8	3.3
EBITA margin	5.4%	5.4%	4.9%	8.7%	10.3%
Capital investments	25.4	13.5	3.4	2.4	1.7
Employees as of 31.12.	4,390	3,678	474	365	302

Note: VA TECH HYDRO was consolidated into the financial accounts of the Andritz Group for the first time in Q3 2006; no pro forma figures for 2006 are available.

\* restated

## BUSINESS DEVELOPMENT

In 2007, the Business Area developed very favorably. Sales amounted to 910.0 MEUR (2006: 467.9 MEUR), with all Divisions of the Business Area – Large Hydro, Hydro Service, Compact Hydro, Pumps, and Generator Turbo – showing a very solid Sales development. EBITA of the Business Area in 2007 was 49.5 MEUR (2006: 25.1 MEUR). Profitability (EBITA margin) developed as expected and amounted to 5.4% (2006: 5.4%).

Order Intake of the Business Area developed very favorably in 2007, increasing to 1,216.1 MEUR (2006: 585.4 MEUR). All Divisions of the Business Area showed a very satisfactory development.

On September 29, 2007, Andritz VA TECH HYDRO celebrated the delivery of the 500<sup>th</sup> turbo generator for gas turbines from its workshops in Weiz, Austria to General Electric (GE). This marks an important milestone in the very successful business relationship with GE since the early 1990s.

At Aschach power station on the Danube, which is operated by VERBUND-Austrian Hydro Power (AHP), the implementation phase of the machine renewal project is currently taking place. Reconstruction of the first of a total of four machine sets was successfully completed at the end of March 2007. Work on the second machine set commenced during the Third Quarter of 2007.

In 2006, Salzburg AG had entrusted Andritz VA TECH HYDRO with the contract for delivery of a pumped storage unit supplying 75 MVA for the underground power station at Hintermuhr. In 2007, the overspeed tests of the generator rotor were held successfully. At a runaway speed of 1,492 revolutions per minute, the rotor is subject to forces equivalent to up to 3,000 times the acceleration due to gravity. Andritz VA TECH HYDRO has proved once again that it can ensure high quality even near material stress limits.

Based on its analysis of the Sub-Saharan Africa power plant market, Frost & Sullivan, the world leader in technology and market research for various industries, has conferred the '2007 Africa Frost & Sullivan Award for Customer Satisfaction Leadership in Hydro Turbine Service' to Andritz VA TECH HYDRO for achieving the highest levels of customer satisfaction in hydro turbine services. Frost & Sullivan has interviewed plant managers, who ranked Andritz VA TECH HYDRO as the leading provider in terms of quality of work, technical knowledge, pricing, and delivery times. According to Frost & Sullivan, Andritz VA TECH HYDRO is the leader in hydropower generation and refurbishment services in Sub-Saharan Africa.

## MAJOR ORDERS

- In August 2007, the supply and engineering contracts for the construction of the Ilisu hydropower station in southeast Anatolia, Turkey were signed. The total project volume amounts to approximately 1.2 billion Euros, of which 530 million Euros fall to the European supply and engineering consortium, consisting of Andritz VA TECH HYDRO, Alstom, Züblin (a member of international STRABAG Group), Stucky, Colenco, and Maggia. The Turkish project operator, the Turkish government, and the export credit agencies involved have agreed upon a series of comprehensive accompanying measures and requirements for environmental protection, social cushioning, preservation of the cultural heritage, and protection of neighboring countries. Compliance will be monitored by an independent international commission implemented by the export credit agencies. Thus, the project meets the high Western standards of OECD and the World Bank. The order will be put in force in Q1 2008. The Ilisu hydropower station – which is urgently needed in Turkey due to the country's fast economic growth – will have an output of 1,200 MW and will supply two million households with electricity from environmentally friendly hydropower starting in 2014/2015. Compared to a thermal power station, this will help avoid approximately three million tons of carbon dioxide per year, or replace one or two nuclear power stations.
- The Business Area received two major orders from India, thus further extending its excellent market position in the fast-growing Indian hydropower market. For Teesta Urja Limited, Gurgaon, New Delhi, India, Andritz VA TECH HYDRO will supply the complete electromechanical equipment for six vertical Pelton machine sets for Stage III of Teesta Hydropower Station. The total nominal output will be 1,200 MW. The six sets will go online by August 2011. Jaiprakash Industries placed an order with Andritz VA TECH HYDRO to supply four erosion-resistant Francis turbines with a total output of 1,200 MW for Karcham Wangtoo Hydropower Station on the river Satluj. These four units will also go onstream by August 2011. Both the Satluj and the Teesta rivers carry large amounts of sand from the Himalayas during the rainy season. Due to its high quartz content, this sand can cause major erosion damage to the turbine parts. Therefore, the aspect of erosion-resistance was given special attention in the turbine design. In addition, all turbine runner surfaces in contact with water will be provided with a very hard, special ceramic coating.
- Electromechanical equipment for a new weir power station on the Rhine will be delivered for Rheinkraftwerk Albruck-Dogern AG, 77%-owned by German RWE. Together with the existing facilities, the power station will supply electricity to more than 180,000 households. The heart of the new plant will be a bulb turbine generator set with a runner diameter of 6.1 m.
- Andritz VA TECH HYDRO AG, Vevey was awarded a contract to deliver four MicroGuss™ Pelton runners to Chhukha, Bhutan. Each of the four units has an output of 84 MW and consists of 21 buckets with a total weight of more than 17 tons. Andritz VA TECH HYDRO was able to win the contract thanks to the outstanding reliability of the proven MicroGuss™ Pelton technology installed in more than 300 hydropower plants worldwide. In Bhutan, where approximately half of the electricity produced is exported, hydropower has become a very important source of electricity generation, thus supporting the strong growth of the country's economy.
- After having successfully rehabilitated unit 1, Andritz VA TECH HYDRO also obtained the order for rehabilitation of units 2–5 of the Rock Island hydropower station, the oldest hydropower station on the Columbia River, Washington, USA. One of the decisive criteria for the order award by Chelan County Public Utility District was the fish-friendliness of the design offered. A habitat conservation plan aims at improving the migration of the red salmon in this region.
- Refurbishment of hydropower plants to the north of Rome will be carried out for Endesa Italia by Andritz VA TECH HYDRO through its affiliate VA TECH Escher Wyss S.r.l. in Schio, Italy. In total, this supply includes six Francis turbines and two Kaplan turbines, as well as new power systems and complete plant automation based on the Andritz VA TECH HYDRO NEPTUN concept.

- SAF Hydroelectric, LLC placed an order with VA TECH HYDRO USA Corp., a member of the Andritz VA TECH HYDRO Group, to install HYDROMATRIX® units at the lower Saint Anthony Falls Lock & Dam in Minneapolis, Minnesota, USA. The 16 units will produce a total of 10 MW. SAF Hydroelectric was created for the purpose of developing the Lower Saint Anthony Falls Project and is majority-owned by Brookfield Power, a major producer of hydropower in North America. The HYDROMATRIX® Turbine-Generator concept is a leading solution for the development of hydropower at existing low dams and gate structures, utilizing a factory assembled grid or 'matrix' of small propeller turbine-generator units. This contract represents years of engineering and development in close relationship with the customer to bring this first major U.S. HYDROMATRIX® project to fruition.
- IRIDE ENERGIA S.p.A., Turin awarded a contract for refurbishment of the mechanical part of the Rosone hydropower plants to Andritz VA TECH HYDRO, through its affiliate VA TECH Escher Wyss S.r.l., Schio, Italy. The plant is located in the Piedmont Region, northwest of Turin in the Orco valley. VA TECH Escher Wyss will be responsible for the design engineering, manufacturing, installation, and commissioning of two horizontal Pelton units with an output of 41 MW each.
- VA TECH HYDRO AS, Norway received an order from Statkraft for the supply of four new Francis runners for the Tokke hydropower plant. Tokke is one of the largest power stations in Northern Europe, generating approximately 430 MW with four turbines harnessing the 394 m drop from the Vinjevatnet Lake to Bandak. The basis of this order was the successful new runner design, leading to increased efficiency above the guaranteed values. The performance was verified both in Andritz VA TECH HYDRO's laboratory in Vevey, as well as in the laboratory of the University of Trondheim.
- VA TECH BOUVIER HYDRO S.A.S. will deliver hydropower equipment including two Compact S-type turbines with a runner diameter of 2.6 m for the Dafnosonara hydropower station, located on the Acheloos River, for Terna S.A.; Terna is an important private Greek energy producer with an installed capacity of 130 MW wind power and 147 MW thermal power. The Dafnosonara hydropower station will have an installed capacity of 8.5 MW.
- Electromechanical equipment for six hydropower plants in the Harrison Lake region was sold to Peter Kiewit Sons Co., Richmond, British Columbia, Canada. The contractor and Andritz VA TECH HYDRO have established intensive collaboration to develop the design and technical parameters, resulting in optimization of the whole system.

The award of this contract and the fast development of hydropower in the province of British Columbia have prompted Andritz VA TECH HYDRO to open a new branch office in the Greater Vancouver area in late 2007 to enhance the sales and project management activities.

This successful cooperation was strengthened and continued with another order: Peter Kiewit Sons Co. awarded VA TECH HYDRO Canada Inc. a contract for the supply of the electromechanical equipment for the East Toba and Montrose water power plants situated approximately 190 km northwest of Vancouver, British Columbia. Andritz VA TECH HYDRO will deliver two complete machine sets for each plant, with a maximum output per set of 73 MW for East Toba and 44 MW for Montrose. The delivery includes six-jet Pelton turbines, digital speed governors, spherical valves, generators, and excitation. The two power stations will generate an average of 750 GWh of electricity per year, which is sufficient to cover the electricity demand of 75,000 households and represents a savings of approximately 455,000 tons of greenhouse gases per year.

- To BC Hydro, VA TECH HYDRO Canada Inc. will supply three turbines, generators, and governors, as well as related electrical and mechanical auxiliaries for the redevelopment of the Aberfeldie Generating Station, located on the Bull River, 30 km east of Cranbrook in the province of British Columbia, Canada. The Aberfeldie dam and generating facility will assist in filling the growing supply/demand gap for electricity in British Columbia producing enough clean energy to supply 10,500 residential customers annually. →

- Electrogoes S.A. entrusted VA TECH HYDRO Brasil with the electromechanical equipment supply for the new Rondon II power plant on the Comemoração River between the cities of Pimenta Bueno and Vilhena in the state of Rondonia, Brazil. The supply comprises three 25 MW vertical Francis units, penstocks, bifurcations, and inlet butterfly valves.
- Pend Oreille PUD (Public Utility District), State of Washington, USA signed a contract with VA TECH HYDRO USA for the rehabilitation and upgrade of the four 19.6 MW Kaplan units installed at its Box Canyon power plant. The plant, located approximately 50 km from the Canadian border, was commissioned in 1955. The scope of work includes the design, model testing, and supply of four new Kaplan runners, rewinding the four generators, supply of new governors and controls, and the field rehabilitation of all turbine and generator components.
- The Gengiz Group, a private Turkish investor, entrusted Andritz VA TECH HYDRO with the modernization of the complete secondary equipment for the Oymapinar power station, Turkey. The goal lies in the accomplishment of a fully automatic power station with the possibility of remote control. This order marks Andritz VA TECH HYDRO's entry into the developing rehabilitation market of Turkey.
- From Illwerke AG, Vorarlberg, Austria, Andritz VA TECH HYDRO received an order for replacement of two further rotors in Rodund I pumped storage plant, located in the Montafon region in the westernmost part of Austria. The renewal of the first two machines had been awarded to Andritz VA TECH HYDRO in 2004. The horizontal machines built in 1943 will be prepared for an output increase of over 20%, which can be achieved after future replacement of the stators. Rodund I provides an important contribution for the growing need of the European power grid for regulating and peak energy, caused by, among other things, the rapidly growing but inherently volatile wind power. With its pumped storage power plants, Illwerke is additionally making an essential contribution towards flood protection in this region.
- Regional utility company CVA (Compagnie Valdôtaine des Eaux), Italy entrusted VA TECH Escher Wyss S.r.l. in Schio, a member of the Andritz VA TECH HYDRO Group, with the contract for modernization of the 10.4 MW electromechanical equipment at Fauburg hydropower station. The decisive factor in this order award was the long-term, good experience that this customer has had with Andritz VA TECH HYDRO.
- The Order Intake for centrifugal pumps progressed well during 2007 and reached a new record. The total of pumps ordered amounted to approximately 5,600, including major orders from Germany and orders for medium-consistency pumps of the new MC series from China.
- To Navayuga Engineering Company Ltd. Multi-Disciplinary Construct. Eng., Hyderabad, India, the Business Area will supply five vertical large irrigation pumps.

## RESEARCH AND DEVELOPMENT

In the field of hydraulic R&D, both order-related developments and basic innovations were carried out successfully. In the Tokke, Norway and Larona, Indonesia contracts (two Francis rehabilitation projects), the excellent performance of the new runner designs was the basis for receiving the contract awards for further runner deliveries. Hydraulic engineering studies were also initiated in other areas in order to provide clients with advanced and detailed information in a very early project stage (e.g. model test for a pump turbine upgrade in the UK; CFD analysis of a complete Kaplan unit on the Columbia River, USA; transient and safety analyses for a pumped storage plant in Switzerland prior to a planned increase of the dam height).

The progress in dynamic simulations of hydraulic machines has been impressive, both in the field of unsteady CFD as well as in dynamic structural analysis, and was presented at renowned international conferences.

For bulb units in the head range above 20 m, a new generation of 5-bladed runners has been developed and successfully tested on a model for a contract in China.

The excellent hydraulic performance of our new multi-jet Pelton designs was verified both on the model (Bassi contract, India) and on-site (Gerlos contract, Austria).

The development of large pumps for India and China, as well as the basic developments for new pump turbines, benefited from the synergies between the two product lines.

R&D activities in the field of hydrogenerator cooling focused on the optimization of several components of the ventilation circuits and on the enhancement of numerical tools for the ventilation design. Good results have been achieved by means of CFD analysis, particularly for rotor-driven axial flow fans.

Stringent health and safety legislations worldwide require low noise emissions in workplaces. In order to improve the precision of noise prediction, an initiative to assess noise sources as well as transfer paths in operating hydroelectric machines has been started.

Based on operating experience with the newly developed StrafloMatrix™ Generator, which has been running in an Austrian hydroelectric power plant for over two years, the special design of the high voltage stator winding, as well as the heat transfer from the end winding, were optimized.

In the course of cost reduction programs and the generator value-analysis project, a number of new technical concepts were analyzed. A concept for global impregnation of large diameter stator cores, a new plate-rotor design, and an alternative damper winding fixture are among the most promising concepts.

Investigations into concepts for cost and machine operation efficiency resulted in essential improvements of the bearing design.

Investigations for a considerable increase in bulb-type generator output led to a 'Thermomechanical Decoupled Stator Concept' for these generators. After detailed FEM simulations, a prototype generator was installed at the Freudenua hydropower station in cooperation with VERBUND-Austrian Hydro Power. Extensive testing of the new concept was carried out and showed excellent results.

The current main focus in the area of pumps is on the development of a pump series to convey medium-consistency liquids. The first milestone – proof of the functioning of unique features – was passed successfully. This development has already yielded the first order – for nine pumps. Following intensive trial stand testing in the laboratory in Graz, the first units were installed at the beginning of October to confirm series production capability.

Commercialization of a new process pump series marked an essential step forward in the extension of the existing product portfolio and the renewal of existing products in the pump sector; new product developments and advancements of the existing program will be continued in 2008.

A product value analysis project is being carried out for large pumps, from which clear improvements towards cost-effective designs can be seen to emerge.

One focus of R&D activities was on technologies in the field of hydropower plant automation. SAT250, the cutting-edge control center and operator station system, has been optimized in the low-cost range, functionally and ergonomically. The system now covers all man-machine interfaces in a hydropower plant, from small turbine governor panels to sophisticated multi-site control centers for power plant groups. In electrical protection and excitation, traditional fields of HYDRO Automation's R&D, two new devices have been introduced to the market; even more importantly, a very new platform, the first technologically unified protection/excitation platform in the world, has been defined. HYDRO Automation is deeply involved in the definition and implementation of the upcoming international standard for hydropower plant automation devices and systems, IEC 61850-7-410. ○