HyPower

Voith Siemens Hydro Power Generation customer magazine

The boom without bounds: China's engines just starting up

On-site manufacturing I Large machines for a big country

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Aug 2007

Dr. Hubert Lienhard, Chairman of the Board of Voith Siemens Hydro Power Generation

Dear readers, dear partners,

With the world growing at a rapid pace, a rising demand for natural resources and climate change as the leading daily news story, the question of future energy supply is front and center.

Climate change is caused by humans, according to scientific studies. Countries – developed or not – are striving for their optimum future-oriented energy mix that also balances sound economics, a healthy environment and an improved standard of living for its populations.

All nations want to exploit their domestic resources as far as possible. Those countries with rich fossil fuel resources do not need to spend a good share of national or private income for costly imports. Those with rivers have the potential to generate hydro power to a large extent. The avoidance of emissions has to be weighed heavily in the argument of what other renewable options could be combined with hydro power.

Spearheaded by China, the solution to these national energy supply models is not an easy task. The need for energy creates projects of record size in countries with vast resources. It also creates enormous engineering challenges for solutions that have never been realized before. The 1,000 megawatt hydro power unit is in reach.

China shows vigor on its growth path, however, also meanwhile shows concern about its development, not easily reconcilable with environmental and social conditions. Westerners, especially NGOs, attack this on a frequent basis and request more sustainable approaches.

While we certainly cannot take away the liberty of political decision, or just ignore these projects, we can still help promote sustainable solutions for hydro power projects. In any event, sustainability will become an unavoidable part of project feasibility and realization.

We as equipment suppliers – even though we are almost the last party in the decision and supply chain of hydro power development – have started to not only promote the application of sustainability guidelines as defined by the IHA-set industry standard. We also offer our support in advising on these guidelines and their assessment protocol and are able to relate you to the network in connection with this expertise.

Voith Siemens Hydro – at least – is on its way to safeguard sustainable solutions in hydro power projects all around the globe.

If you have any comments or questions, please simply contact me at Hubert.Lienhard@vs-hydro.com.

Yours


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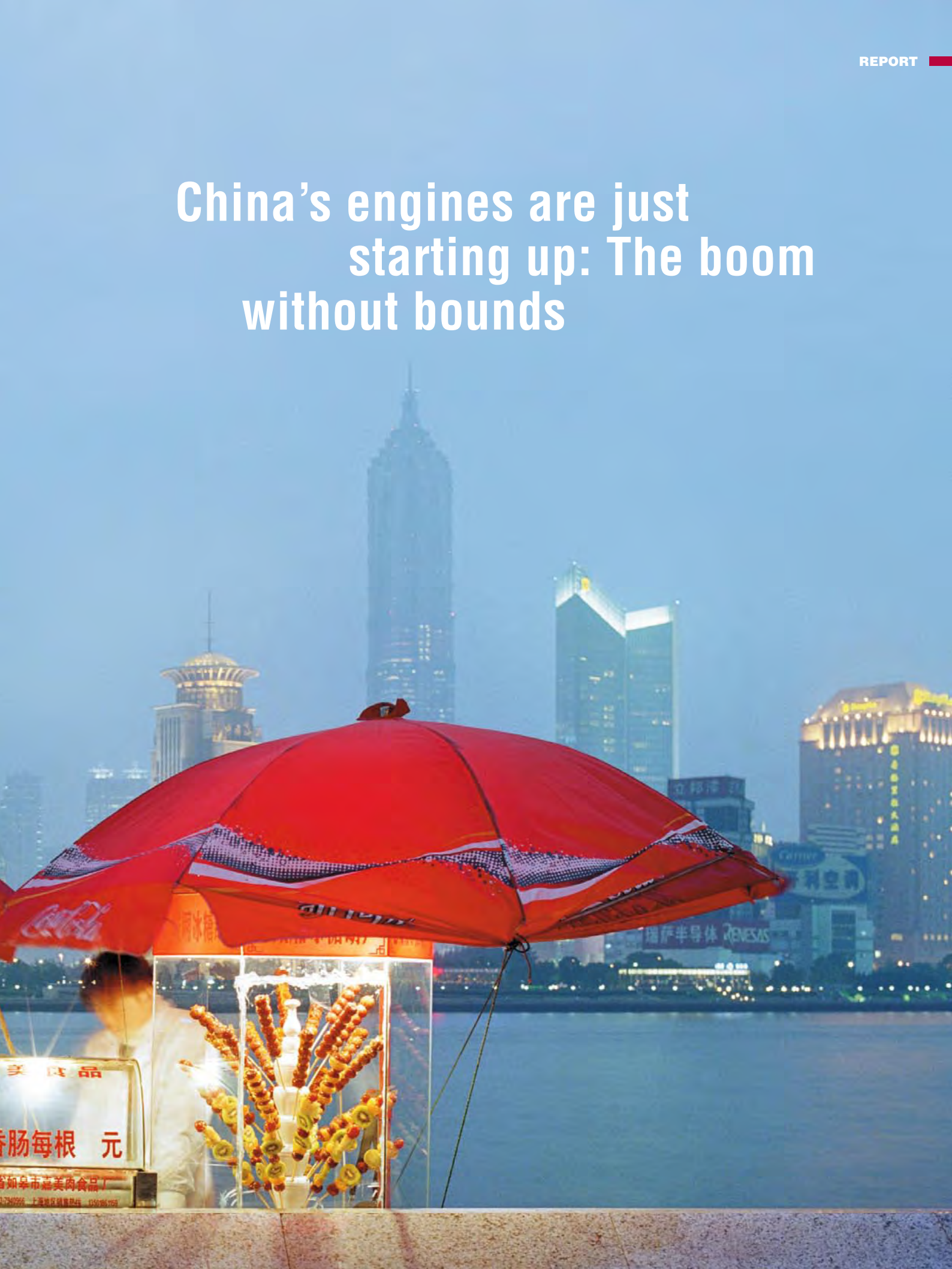
China's engines are just starting up: The boom without bounds



“There are nine million bicycles in Beijing” as the well-known Chinese song goes. But the times when bicycles dominated the streets of the Chinese capital have passed.

Today, three million cars crowd the downtown streets and the five beltways around the metropolis, the symbol of rapid growth.

China is booming. It is experiencing an economic growth never seen before in the world. Just as large as the hunger for success, entertainment, and consumables, is the need for energy. Demand for electrical power is red-hot, with a rise of consumption in the two digit range in the mega-cities like Shanghai and Beijing.

Taking in the view over the Huangpu River at night for the first time will take your breath away. Shanghai is a gleaming spectacle of glowing facades, blinking advertisements and radiant slogans.

On the river, crowded excursion boats push their way in front of the characteristic skyline, where the futuristic Oriental Pearl TV-tower and the gigantic Jinmao Tower seem to hover over the sea of skyscrapers. The 21st century’s pulse is beating faster in modern day China than anywhere else in the world and nowhere else but Shanghai can it be heard so clearly 24 hours a day. The city never quiets down. It redefines itself daily, grows, expands and renews itself at a breath-taking pace. In the Pudong district, you can literally watch the skyscrapers being built, one right next to the other.

A power station at the site of the Yellow River diversion project in Shanxi province.

A miner in Changzi, Shanxi province.

Linfen is located in the northern Chinese province of Shanxi, the center of the coal, tar and steel industries. Linfen is prospering as well and has its own unique skyline. But Linfen's skyline differs from the gleaming coastal metropolis of Shanghai. Chimneys and pit-frames, conveyer bridges and blast furnaces dominate the view. Plumes of steam billow above the cooling towers and brownish yellow flue gases float to the sky from the smokestacks of the coking plants.

One new coal power plant every week

Even at midday, the coal dust reduces the sun to a small globe, glowing in shades of orange and red. Motorcycle riders without helmets and pedestrians alike try to protect themselves with dust masks from the acrid smog. The province of Shanxi has an estimated reserve of 260 billion tons of coal: one third of China's coal deposits. Every week a new coal 1,000 megawatt power plant is connected to the grid in China.

China's growth requires energy – more than can be covered with the currently available capacities of power generation. Shanghai's damp and warm late spring anticipates the humid and hot summer months. Fully air-conditioned office spaces provide a relief when the sweltering heat outside makes your shirt stick to your back the second you leave the house.

Not below 27 degrees Centigrade, please

Often the temperatures in the sweltering months of July and August soar to well over 40 degrees Centigrade. The state-of-the-art mega malls and fancy designer boutiques along Nanjing Road are eager to provide a cooler atmosphere to their affluent customers. However, while strolling through Shanghai's business and shopping areas, you can leave the mandatory summer accessory for excessively air-conditioned malls and movie theaters – the sweater – at home. Shanghai citizens are requested to set their air-conditioners to a minimum of 27 degrees or higher.

If all air-conditioners in the city are running at maximum capacity the energy supply cannot keep up. Thus, in the summer of 2004, the production for about 700 businesses was limited from midnight to 8 am, plus, 500 businesses had already adjusted their production schedules. Affected were energy-intensive businesses, among them steel mills and cement factories. The Beijing government imposed a week long holiday on account of hot weather and raised the price for electricity. Since then, ample additional energy production capacity has been added.

However, with growing energy production, the number of energy consumption intensive projects rises too – a vicious cycle, especially from an environmental point of view, because about three quarters of the Chinese electricity is still produced from coal. The coal and steel city of Linfen may be the extreme, but cities where the burning of fossil fuels darkens the sky with foggy and sooty flue gases are many, too many. But China is starting to rethink the business of producing energy.

Construction workers in Shanghai.

The sustainability of economic development has the highest priority, according to Wu Xiaoling, Vice Chairwoman of the People's Bank of China which serves as the Central Reserve Bank. During a forum on China's economy in Beijing last year, she named a lack of environmental protection as the largest obstacle on the way to sustainability.

Rethinking begins to become more environmentally safe

The call for a more environmentally conscious Gross Domestic Product (GDP), which takes environmental indicators into account, is getting louder as the cost of pollution (an estimated 10% of the GDP) is at the same level as economic growth. "Developed countries were able to develop first and consider the environment later, but China cannot afford to first pollute the environment and then correct it at a later time", stated Pan Yue, Vice President of the State Environmental Protection Administration.

In demand are clean renewable energy sources with low or – even better – no emissions. As for example hydro power: With a total installed capacity of close to 120 gigawatts, China already ranks at the top worldwide and is planning to strengthen this position even more. Electricity production from hydro power is expected to grow by a gigantic eight to ten gigawatts annually until 2020. Furthermore, China will increase efficiencies of all its current hydro power stations and survey small rivers to tap their hydroelectric potential, especially in regions with no coal resources. The country's total exploitable hydro power resources are estimated to be at least 290 gigawatts, ranking first in the world. The vast majority of these are concentrated in western regions, such as Sichuan, Guizhou, Yunnan, Guangxi, Gansu and Qinghai, accounting for about 70 percent of the country's total.

Three Gorges Dam, Yichang province.

The capacity of the first power-house, with its 14 units at Three Gorges is 10 gigawatts. In 2003, the first gigantic turbines were put into operation. The turbine runners, weighing 420 tons, in their colossal concrete spiral cases are propelled by China's longest river, the Yangtze. It will form a 660 km reservoir with a lake surface of over 1,000 square kilometers. Next year, when the project is complete, the waters of the Yangtze will power in total 26 700 megawatt turbines. Then, after a 16 year construction period the world's largest hydro electric power plant with a 18.2 gigawatt capacity will be finished. The project will be completed one year ahead of schedule and will produce 4.2 gigawatt-hours more than originally planned. This clean, renewable energy will also sate the appetite for electricity of Shanghai 900 km away. Not one single gram of carbon or sulfur dioxide will be emitted.

To produce the same amount of electricity as Three Gorges, in one year 60 million tons of coal would have to be burned in traditional thermal plants. China also strives to supply 10 percent of its energy needs from other alternative sources like wind, solar energy, small hydro and biomass.

The power plant Three Gorges saves 60 million tons of coal per year

Among these, wind power plays the most important role. In an interview with The New York Times Wang Zhongying, director of China's Center for Renewable Energy Development, explained: "We have huge goals for wind power development. By 2010, we plan to reach 4,000 megawatts, and by 2020 we expect to reach 20,000 megawatts, or 20 gigawatts."

China will further develop hydro energy

Zero emissions, higher efficiency factors and extended service life with lower operational costs are some prime advantages to hydro power plants' sustainability. It is not surprising that hydro power is prioritized in the current Chinese Five-Year-Plan over other "fuels". Presently only about one quarter of the Chinese potential capacity is actually being utilized. The Yangtze alone, with its average flow of 30,000 cubic meters per second, offers enormous capacity. Only the Amazon, Congo and Ganges rivers transport more water to the oceans. But China has a number of other rivers that do not fall much behind in terms of hydro power potential. Plans are moving ahead to develop the resources of the Yellow River and the upper Mekong as well as the waters of the Langcongjiang, the Yalongjiang, the Hong Shui, and the Daduhe.

Three Gorges seen from space.

Shopping street in Chinese mega-city.

The boom has reached the heartland

With the relocation of energy production to the western provinces, the country's under-developed areas gain an enormous amount of importance. Due to the sluices at the Three Gorges Dam and the significantly deepened waterway, the Yangtze is now navigable for large container ships. These can now travel all the way to Chongqing at the upper end of the reservoir. The largest obstacle for growth, the city's limited accessibility from the prosperous coastal region, has been alleviated. Logistic disadvantages are offset by lower wages and an attractive settlement policy. Meanwhile, large car manufacturers have set up shops in the heartland metropolis. The population's increasing spending power attracts the interest of global retail chains.

At rapid speed old buildings vanish, and new ones are erected. At the city center, modern concrete and glass buildings appear, new office buildings and shopping malls are churned out. Huge bill boards advertise all types of consumer goods from audio-visual devices to fashion – one could imagine being in Beijing. The up-and-coming middle class is heavily courted in Chongqing as well.

An end to the growth is not in sight

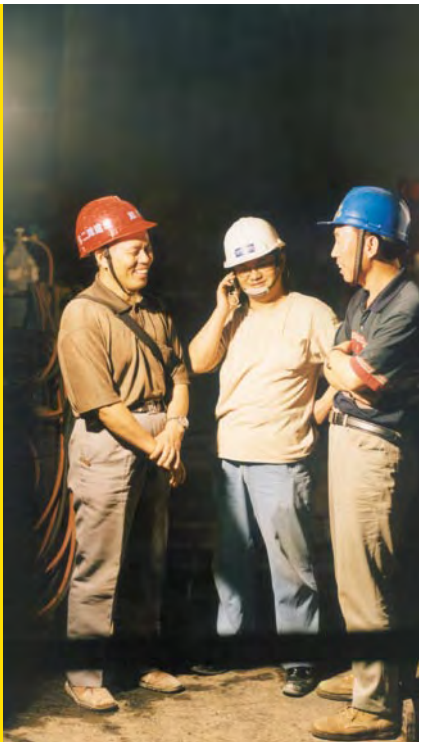
About 150 million people make up China's middle class. In comparison to a total population of 1.3 billion, it does not seem like much, but the number of residents earning more than 500 Euros per month is rapidly rising. The Chinese Academy of Social Science estimates that by 2020 more than 500 million Chinese will be counted in this income bracket.

One half billion people with consumer desires equal to those of Europeans and Americans will need to be satisfied. This new class of consumers will continue the Chinese economic boom, which will include the need for energy there.

The times when the country moved forward at bicycle speed – that much is clear – have definitely passed.

On-site manufacturing – when the workshop comes to the river

China's economic growth comes with an enormous demand for energy. The current installed capacity from all energy sources adds up to 622 GW; however, it is already clear that 1,250 GW will be required in 2020.



Hydro power plays an important role to China's energy mix where an additional capacity of 210 GW within the next 15 years is needed. While the eastern part of China is quite developed with regard to hydro power, new projects are being developed in the western areas. Yet, the factories and resources for manufacturing these types of projects are located thousands of kilometers away from the construction sites. An additional challenge is the sheer size of the newly built units which makes transportation almost impossible, regardless of the distance. That is why Voith Siemens Hydro does it the other way round: The workshop itself comes to the river and manufacturing is done on-site.

The advantages are obvious: There are no transportation issues, on-site manufacturing may react faster to unforeseen events, and manufacturing capacity increases due to the option to work on orders simultaneously in multiple locations beyond the Shanghai main facilities.

But do they justify the enormous effort to build a complete on-site production facility so far removed from the corporate infrastructure, only to remove it afterwards? Yes, they do, says Voith Siemens Hydro Shanghai, and relies on on-site manufacturing in a series of projects already.

In a country which is the fourth largest national economy and the world's third biggest trading nation, but, which is – at the same time – the world's biggest developing country, around three quarters of its energy is still generated by coal-fired power plants. China has already joined the Kyoto-protocol, however, it remains with no committed goal for reductions. Environmental damage now is identified as an encumbering factor for the country's national product and was numbered with approximately 50 billion Euro in 2005. By 2020, the country plans to increase the portion of renewables to 15 percent of its energy mix, with its hydro growing part to about 26 percent. But, it nevertheless struggles with balancing economics, environment, and society with this growth: And at the forefront of this fight is also the development of hydro power.

But, even in China, the opportunities to develop hydro power are not unlimited. In view of the urgency of increased energy production, China focuses on ever bigger power plants and machines.

Ten or twenty years ago, expected unit capacities were 200 - 300 MW; today, this figure is three times higher with runner sizes growing correspondingly. The 700 MW units for Three Gorges were just the milestone in size at the time of starting the project.

Besides the design challenges for the engineers, these 700 MW giants currently in the "pipeline" for many hydro projects create a clear transportation problem. Today, the tendency is for these to grow close to 1,000 MW equalling the size of one coal, nuclear or thermal plant.

So, Voith Siemens Hydro Shanghai transports the whole workshop to the river in order to manufacture the turbines there, directly on-site. This on-site shop is an extension of Voith Siemens Hydro's Shanghai workshop after all. Here and there, the same challenges apply.

Foundation for twice the weight of the international space station ISS

The workshop's foundation cannot be overestimated. Just bear in mind that a single runner may weigh around 400 tons. For comparison: This is the same as a 200 meter-long ICE-train or twice the weight of the international space station ISS.

Working day and night at Long Tan.

Long Tan runner leaving on-site workshop.

In addition, the foundation needs to accommodate the weight of all material, tools, and material handling equipment, including an overhead-crane and a stress relief furnace. Normally, the construction of these facilities takes about a year before manufacturing begins.

A journey of around 20,000 kilometers

The runner crown and runner band are delivered pre-machined, whereas the blades arrive on-site completely finished.

Until then, some components have had quite a long journey: Cast in São Paulo, shipped 18,500 kilometers to Shanghai by sea, and, from there, delivered on-site overland by truck. Only there does the actual assembly of the runner begin: the critical welding. This step can make up for lost time or ruin the master schedule. Therefore, Voith Siemens Hydro attaches great importance to the training of the welders who are trained on-site and certified by their colleagues from Shanghai.

Long Tan ceremony for runner number one.

Welders and key positions are provided by Voith Siemens Hydro. In addition to the site manager, a welding supervisor stays on-site and is in charge of quality assurance. The on-site manufacturing facility's 20 - 25 people work 24 hours a day, 365 days a year, making cooperation and teamwork all the more important. Co-workers often become surrogate families in these remote sites, so good socialization is almost as important as skill levels.

More precise than a Swiss clock

Exactly as it is done in the Shanghai workshop, the runner is manufactured in three steps. First, the blades are positioned and tack welded to the crown before the actual welding begins. The welders work in tandems, welding on opposite sides of the buckets to avoid distortion through the application of heat. This demands many years of experience. Examination of the weld seam's quality is done continuously.

On-site hall for Xiao Wan project.

After all, the same standards apply: Maximum tolerances within a tenth to a hundredth millimeter are required. Relating to the size, turbines run with a higher accuracy than watches. However, they have a diameter of about eight meters and are 4.6 meters in height. When the welds are examined and ground, the runner is stress relieved in the on-site stress relief furnance for around a week. Afterwards, it is machined and balanced so that it rotates vibration-free.

Giants in a headstand

Key in the manufacturing process is the turning of runner. It is turned upside down and placed in a fixture so that the welders can work on nearly inaccessible areas between the blades. Once these welds are complete, however, the runner will be returned to its proper position as for assembly. Once fully assembled, the entire unit is balanced again with the generator.

Experience for future trends

China's boom seems to have no end in sight. And, along the lines of its energy needs, the ever increasing trend for mega projects will continue. By end of 2009, Voith Siemens Hydro will have manufactured 16 massive runners on-site. With its unrivaled expertise in on-site manufacturing, Voith Siemens Hydro is poised to play a considerable role in these type of projects in China and worldwide.

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Examples of on-site manufacturing in Voith Siemens Hydro Shanghai

- Xiao Lang Di (Yellow River)
  - Completed: 2002
  - 6 Francis units
  - Runner diameter: 6.35 m
  - Rated output: 306 MW
  - Rated net head: 112 m
- Long Tan (Hong Shui River)
  - 5 of 7 Francis units manufactured by Voith Siemens Hydro
  - To be completed in 2009, 3 runners delivered to date
  - Runner diameter: 7.9 m
  - Rated output: 714 MW
  - Rated net head: 140 m
  - serves as model on-site manufacturing facility for other projects in China.
- La Xi Wa (Yellow River)
  - To be completed in 2011, commissioning first unit summer 2008
  - 5 Francis units
  - Runner diameter: 6.9 m
  - Rated output: 711 MW
  - Rated net head: 205 m
- Xiao Wan (Lan Chang River)
  - 3 Francis units
  - Runner diameter: 6.6 m
  - Rated output: 714 MW
  - Rated net head: 216 m
- Ji Shi Xia (Yellow River)
  - 3 Francis units
  - Runner diameter: 7.65 m
  - Rated output: 340 MW
  - Rated net head: 66 m

Large machines for a big hydro country

Francis turbines represent the most powerful type of hydraulic turbines and the prime movers with the highest efficiencies. The runners for big Francis turbines belong to the largest and heaviest one-piece mechanical components.

Compared with other types, Francis turbines have several superior features:

- they operate at the highest peak efficiencies
- they can be developed in a wide range of specific speeds to be installed in power stations with heads from below 10 m to above 700 m
- the runner has no movable parts, therefore is robust, and needs little or no maintenance

The runners for big Francis turbines belong to the largest and heaviest one-piece mechanical components, and are the most expensive components, too.

They reach roughly one third of the price of the complete turbine and require the longest lead time in the manufacturing process, which can extend to 24 months or more, among all types of machinery.

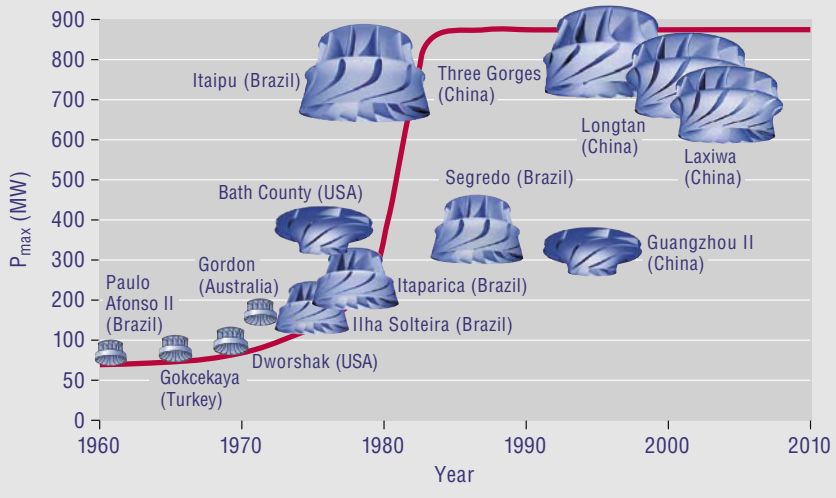
It is, therefore, natural that special attention must be paid when selecting manufacturers of such components.

Voith Siemens Hydro, through several of its plants in particular in Germany, USA, Brazil and China has accumulated remarkable experience in large Francis runners, with some very successful milestones.

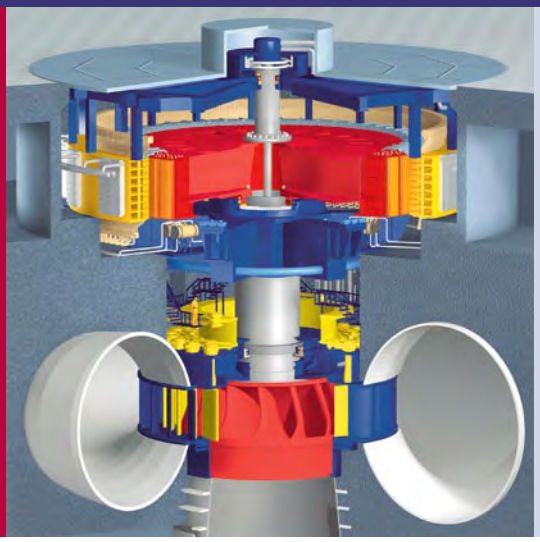
From the beginning, the development of the Francis turbine was aimed to push the hydraulic and mechanical design to reach higher outputs, higher efficiencies, smoother operation, to avoid cavitation damage and to reduce the physical size, in order to minimize the cost for civil structure and for the electrical and mechanical equipment.

The challenge in R&D and design of large turbines is the efficient and accurate prediction of hydraulic performance, loads, and stresses acting on the components as well as the prediction of the dynamic behavior of the total system.

Voith Siemens Hydro record of Francis and pump-turbine development.



Work on a Francis runner.



Three Gorges 3D impression.

Today, the use of the most modern technologies in R&D, design and manufacture assure a product which represents an integration of all aspects and thus leads to a design optimized for each special application.

This goal has pushed the development of highly sophisticated computer tools. The wide application of flow analysis using three dimensional Navier Stokes code and the development of the combined calculation of the tandem cascade consisting of stay vanes and guide vanes, the exact analysis of the flow from the guide apparatus into the runner and from the runner into the draft tube allow tailor-made optimized designs to be developed for each major project. This achieves significant improvements in output and efficiency, compared with the designs developed even 10 years ago.

The mechanical design also routinely uses today's methods such as finite element stress calculation for the static and dynamic stress analysis of the components to add safety to the design and avoid the risk of cracks during operation. With these tools, and using 3D-CAD systems and automatic design programs, the design of 700 to 1,000 MW-class units today is routine for an experienced turbine design engineer team.

The major task today is to meet the requirements of shortened delivery times and to define and control the proper quality standards and measures required to achieve the sound manufacturing and the tight tolerances required for high performance levels to be guaranteed.

Many plants today are built in remote areas with limited access, which requires special solutions in design, logistics and manufacturing.

The machine size driven by large projects in China through a second-to-none growth in energy demand, has also driven Voith Siemens Hydro's build-up in expertise for the largest of machines on record. Voith Siemens Hydro can offer a series of selected examples from China, here.

Wu Qiang Xi

At the time of their commissioning, the turbines for Wu Qiang Xi were the largest units in operation in China and were only superseded by the Three Gorges turbines commissioned in 2004. The Wu Qiang Xi plant is located on the Yuanshui River, a southern tributary to the Yangtze River in Central China. The purpose of the project is, in addition to electricity generation, flood control and navigation. There are five 290 MW units designed for a maximum head of 60.1 meters.

The Francis runners have a maximum diameter of 8.96 meters and a total weight of 255 tons.

Workshop assembly of Long Tan distributor.

Overlooking Three Gorges construction site.

Three of the five runners were totally fabricated from stainless steel in Voith Siemens Hydro's São Paulo workshop in Brazil. Also, all runner blade castings were poured in Voith's foundry in São Paulo; two more runners were welded in China. The customer decided to use stainless steel blades but mild steel crowns and bands for these two runners. To match the metallurgical requirements of both materials, the welding was done using austenitic electrodes.

Xiao Lang Di

The Xiao Lang Di project is one of the largest projects built on the Yellow River, and is located in the Henan province of China. The first unit was on line by the end of 1999; the project was completed at the end of 2002. The contract involves the supply of six complete 6.35 meter diameter Francis turbines. The units produce 306 MW under a maximum head of 141 meters.

The model test was completed at Voith Siemens Hydro in Heidenheim, Germany, in early 1997, where it achieved 96.02 % of prototype peak efficiency, a record breaking value in the industry for a unit at this time. Among the special features of the Xiao Lang Di units are the ring gates between the wicket gates and stay vanes that can be closed to protect the wicket gates from the high silt content in the water while the unit is stopped. The ring gates are lowered and raised through a specially designed electro-hydraulic system that operates each gate through five synchronized hydraulic servomotors.

A noteworthy characteristic of the Xiao Lang Di units is their erosion-resistant hydraulic design and protective coating. Various proprietary numerical methods were used to optimize the hydraulic geometry and identify the areas that would be subjected to the highest abrasive action of the 40 kg hard quartz silt per cubic meter water of the Yellow River during the flood season.

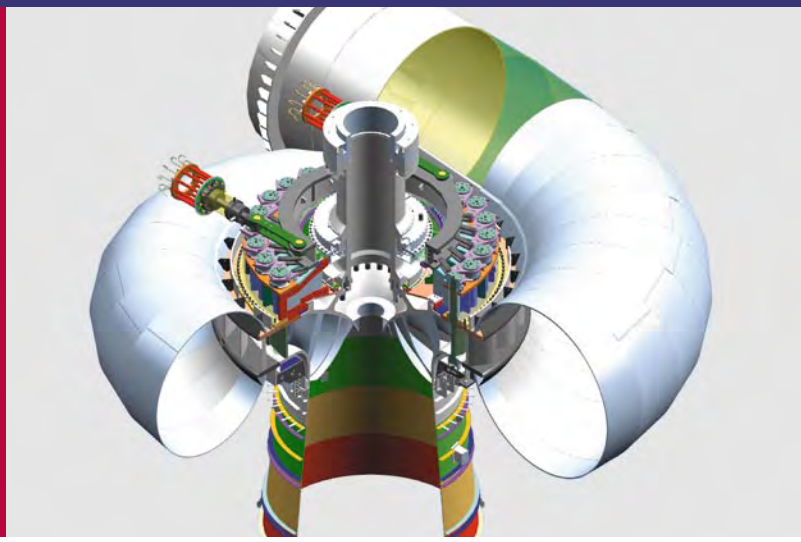
These areas, which include the runner band and large areas of the runner buckets and wicket gates, are protected by a tungsten carbide coating. This coating is sprayed by a robot through a process called High Velocity Oxy-Fuel Coating, and involves special characteristics developed by Voith Siemens Hydro together with the tungsten carbide powder manufacturer.

Three Gorges

After completion, the Three Gorges project on China's Yangtze River will be the largest power plant in the world. It is presently in the final stage of its construction.

The first power house includes 14 units supplied under international competitive bidding and, since last year, is fully operational. Voith Siemens Hydro was selected as part of the GE-Voith-Siemens-Consortium to supply six units, the first of them were commissioned in 2003.

Long Tan stay ring installation.



La Xi Wa 3D section.

The big challenge for the design of the turbines was, besides the large physical dimensions of the equipment, in the operation conditions of the power plant. The multi-purpose Three Gorges scheme facilitates river navigation, electricity generation, and at the same time flood control.

During most of the year, when the water is clear, the reservoir level is kept at an elevation of 175 meters above sea level and the units operate for maximum power generation. Before the flood season starts, the reservoir level is reduced to an elevation of 145 meters to reduce the sediment deposition. At that time, the units operate at full gate. The reservoir storage capacity can then be used to regulate flood water and ensure the safety of the downstream area.

The hydraulic development of the runner was driven by the challenging demands for a wide head range and a maximized output at lower heads.

Long Tan

Long Tan project is located on Hong Shui River, in Guangxi Province, and is equipped with seven 714 MW units under a maximum head of 179 meters. In 2002, the contract was awarded to Voith Siemens Hydro and Dong Fang Electrical Machinery Co. Ltd. for the equipment supply of all seven units. Voith Siemens Hydro is responsible for the hydraulic design, model development and testing as well as mechanical design. The project with a roller compact concrete dam and an underground powerhouse is the second-largest project in China under construction after the Three Gorges project.

The main challenges in turbine design included stable operation under a wide head range, high efficiency, good cavitation performance, and high power output.

After successful commissioning, the first unit was put into commercial operation in May 2007.

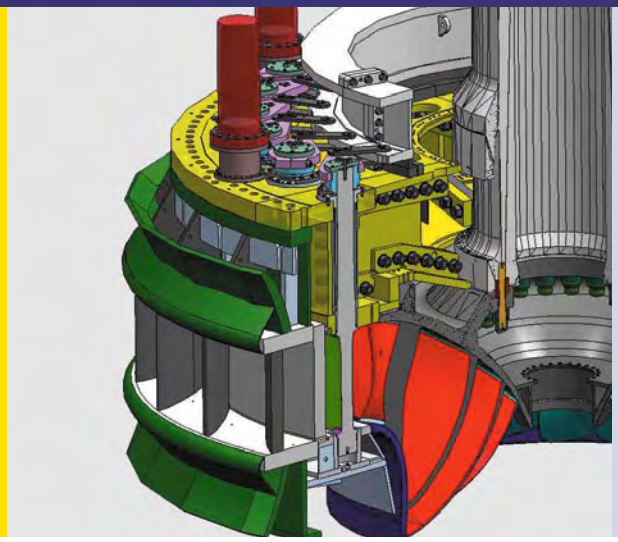
La Xi Wa

In 2004, the La Xi Wa contract was awarded to Voith Siemens Hydro. It includes the supply of five 711 MW turbines under a maximum head of 220 meters. The La Xi Wa Project is located on the upstream of Yellow River, in Qinghai Province. The project includes a 250 meter arch dam, an underground powerhouse, and it is the biggest project on the Yellow River.

The La Xi Wa hydraulic design and model is based on the latest development of Voith Siemens Hydro for projects of more than 700 MW and heads of over 200 meters. Besides good hydraulic parameter selection, comprehensive CFD simulation and analysis were conducted in Voith Siemens Hydro's corporate technology center Brunnenmühle, in Heidenheim, Germany.

The final model acceptance test results indicated very good efficiency levels, good cavitation performance and low pressure pulsation

Model testing for La Xi Wa.



Xiao Wan 3D cross section.

levels, with good and stable operation characteristics. The first unit will be commissioned in 2008.

Xiao Wan

In 2005, after pre-bid competitive model tests in Lausanne, Switzerland, the Xiao Wan contract was awarded to Voith Siemens Hydro and Dong Fang Electrical Machinery Co. Ltd. consortium, for supply of equipment split 50/50 between six 714 MW turbine units and six ring gates. The Xiao Wan project is located on the Lan Chang River, in Yunnan Province. Voith Siemens Hydro was responsible for hydraulic design, model testing, and basic design for the turbines and the ring gates. The first unit is scheduled to be commissioned in 2009, and all six units will be completed for commissioning in 2011. It is the first project in the world for high output units (714 MW), designed for a head over 200 meters with a ring gate.

Turbine size, output, head and ring gate design are extreme engineering challenges, resulting in a series of special design features.

For safe and stable operation, 24 wicket gates and 15 runner blades were defined in order to avoid risk of rotor stator interaction and hydraulic force vibration. The wicket gate, stay vane and runner blade profile were optimized for good hydraulic performance and stable operational requirements.

The task of the hydraulic and mechanical design engineer today is to maintain and improve the performance, widen the operating range and reduce the influences which limit the availability of a hydro turbine. Great attention is given to reduce pressure fluctuations in the draft tube and the vane-less space. Such pressure fluctuations create dynamic forces that can affect mechanical equipment.

Reducing these loads will also reduce the strain on other components such as bearing, guide apparatus, and draft tube cones. It also supports the needs of the owner to increase the availability and to minimize the maintenance cost of a hydro power plant.

With the rich experience in the development of high output Francis turbines above 500 MW, Voith Siemens Hydro has reached an extreme level of quality and reliability and is poised to safely provide turbines with outputs of 900 MW and beyond.

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Current opportunities for hydro power in China

Interview with Aage Dalsjoe, President of Voith Siemens Hydro Power Generation Shanghai

Aage Dalsjoe,
Voith Siemens Hydro Shanghai

The company is located in the Minhang district and is a joint venture between Voith Siemens Hydro Power Generation and Shanghai Electrical Corporation (SEC).

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What's Voith Siemens Hydro's history in China?

Dalsjoe: As individual companies, both Voith and Siemens trace their history in China back to the early/mid-19th century. This includes the installation of the very first hydro power machine in China, at Shi Long Ba, Yunnan Province, in 1909. After this initial project, Siemens supplied the world's most powerful generators to China in the 1930s, and in 1983 supplied machinery for the Lubuge project in Yunnan Province, the first World Bank-financed technology transfer project in China.

How did the company grow here and what is its main purpose in China?

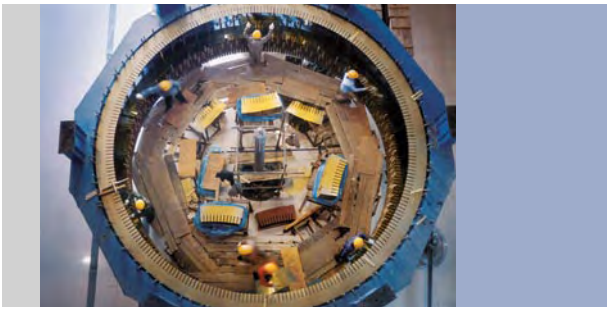
Dalsjoe: Until the 1990s, supply for Chinese hydro plants came from overseas. With the growth in volume and magnitude of hydro power projects in China, the first joint venture, Shanghai Hydropower Equipment Co. Ltd. (SHEC) was established in 1994, between Voith Siemens Hydro Power Generation and the Shanghai Electric Corporation (SEC), to provide hydro power technology, solutions and services in China.

What operations are performed at the Shanghai plant?

Dalsjoe: The Minhang base became operational in 1997 located in an area adjacent to the SEC premises, which is also involved in other areas of power generation, such as thermal and nuclear power. SEC had wanted to add hydro generation to its portfolio. This is a green field site, which gives us considerable freedom to tailor-make capacity to meet the needs of China's hydro power market.

"We offer everything from individual components to completely customized hydro power concepts."

Today, at Minhang, we have a stand-alone operation covering all aspects of hydro power equipment supply and employ 430 staff in sales, project management, engineering, manufacturing and field service. Due to our location beside the Huangpu River, we have access to a 600-ton capacity loading dock, enabling us to directly ship materials and products for hydro power projects. We are currently expanding our plant in order to increase our machining capacity but also to increase generator manufacturing capacities and capabilities.



We offer everything from individual components to completely customized hydro power concepts, including turnkey delivery of new plants and modernization of existing power stations. The basic designs come from our technology center in Germany, but beyond that, all our resources are localized here. On all our projects, the lead engineer from Shanghai works in Heidenheim during the basic design. After returning to China, he is responsible for the detailed engineering. On some projects we also work together with other Voith Siemens Hydro operating units.

China is a hungry consumer of power; how can hydro power be integrated into the national power strategy?

Dalsjoe: Energy is a basic need for economic development and growth. To help meet its rapidly expanding energy needs, China is prioritizing the utilization of hydro power, particularly in the western part of the country, as well as optimizing thermal power and building new nuclear and wind turbine plants. Hydro power has some specific unique features. It is a clean energy source with no emissions or pollutants; you can even drink the water after it has passed through the machine. Hydro plants also have a greater lifetime value. If upgraded, they can be operational for 60 - 90 years, whereas wind plants average 20 - 25 years and thermal plants 35 - 40 years.

Today, as part of improving the national power grid, China is building new pumped storage plants along the east coast, which can provide peak load power at short notice. Voith Siemens Hydro supplied the turbines for the first Chinese pumped storage plant Gangnan in Hebei in 1967 and other pumped storage projects later, including recently completed Tai'An.

And, hydro offers the most efficient means of providing this high peak load. China is also developing 8 - 10 gigawatts of new hydro plants per year, and several of the major upcoming projects will be as large as the Three Gorges project. Most of these are in western China.

Hydro power is very reliant on advanced technology and high-level technical skills. Has it been difficult to recruit suitably qualified staff?

Dalsjoe: The Shanghai region has a strong need for competent people, especially as more new companies enter the marketplace.

But, so far, recruitment has not been a limitation for us; however, in the context of the global hunt for talents we feel it is getting harder. A lot of our engineers have been sent for training at our facilities in Europe, the United States and Brazil. These training periods vary from between two months to one year. But you also have to develop your own local resources and we have been developing programs for our own local people. Our plan is to localize management positions; currently the Head of Manufacturing and myself are from other countries.

What are the challenges of bidding and fulfilling hydro power generation contracts in China?

Dalsjoe: Implementation of such big hydro project requires good team work between us as a supplier, the customer and the design institutes. Certain turbine components need to be delivered early and on schedule for embedding in the concrete to avoid delays in the project. For each project, we must guarantee performance, which must be demonstrated by a witnessed model test. On some projects, we even have to demonstrate the performance tests as early as during the final bidding stage.

The Shuibuya project in Hubei Province and Jin Ping II in Sichuan Province were examples of this practice, where bidding suppliers had to undertake a competitive model test before the contract was awarded.

All our projects require a lot of materials, and sourcing these is currently a major challenge. For example, the large, high-quality castings required are only produced by maybe two or three manufacturers worldwide. Other special components have to be imported and because of the high demand for steel, prices have risen substantially in the last two years. Contracts used to stipulate that high-stress-level materials had to be imported from outside, though this is less frequently applied now. Going forward, more and more materials will be manufactured in China, and our customers do recognize the increasing quality of Chinese suppliers.

As China's economy continues to grow, and its energy needs intensify, what opportunities open up for Voith Siemens Hydro?

Dalsjoe: The potential for hydro power development is huge across China, and in certain parts of South East Asia, whereas in Europe there is perhaps only 10 - 15 percent undeveloped.

Our position gives us a good basis for taking the company to a 15 percent market share within 2 - 3 years. Voith Siemens Hydro Shanghai is currently involved in several new hydro power projects across China. What we can offer to our market with our strong and innovative headquarters in Germany, including R&D resources, is world-class technology for turbines and generators in China. Also, with the investment in the new generator electrical workshop, we now offer the generator to customers who appreciate our full localization of turbines and generators. They reward us with a series of big projects to come. So this investment, along with our strong local team and our support from our partner SEC, positions us well in the market.

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General Site Manager honored by Shandong Power

After commissioning the first pump-turbine for Tai'An hydro power project last summer, its operator Shandong Power honored representatives of equipment suppliers.

View of the headwater in Tai'An.

Otto Kienle at the award ceremony.

Thirty men and women received recognition for their outstanding merits in the execution of the project. Among them was Otto Kienle, Voith Siemens Hydro's General Site Manager for Tai'An hydro power project, who is the first foreign national to whom Shandong Power has ever awarded a prize.

Tai'An pumped storage power station has now started commercial plant operation and was celebrated with a solemn festivity. The power plant in the Shandong Province, 600 kilometers south-east of Beijing, is equipped with four complete machine sets each rated at 255 MW, including reversible pump-turbines, motor-generators and their respective control systems. In Shandong, a region of strong economic growth, the power station and its contribution to a reliable and stable grid operation is of strategic significance.

The uninterrupted trial run under different modes, followed by dewatering and inspections, paved the way for completion of the turnkey power plant not only in a challenging environment but also with a comprehensive scope of supply. Commissioning was a joint effort of Voith Siemens Hydro in China, Japan and Germany under a very tight schedule.

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New Member of Board of Management of Voith Siemens Hydro Shanghai

Tang Xu joined the Management Board in Shanghai.

Mr. Tang Xu has been appointed Executive Vice President and Member of the Board of Management of Voith Siemens Hydro Power Generation Shanghai, China. Tang Xu joined the Chinese Voith Siemens Hydro operating unit in March 2001 as Marketing Manager and was appointed Vice President Marketing in November 2004. His efforts have essentially contributed to the securing of a series of very large hydro power projects in China over the last five years for Voith Siemens Hydro Shanghai.

He received his Bachelor of Science degree in Material Engineering from the North-East Engineering University in Shengyang in 1982 and in Electronic Engineering for Mechanical Application in the Electronic Science University in Chengdu in 1994. He earned his Executive MBA degree in the Shanghai Jiao Tong University in 2005. Previously he worked for a Chinese company as a Deputy Manager for International Operation and as Director in the Sanxia Project Office from 1995 to 1998. He worked for western companies in China and Canada, as Marketing Manager and Project Sales Manager from 1998 to 2001.

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A temple, a getaway, and a luminous town

Karl Mustière in 1927, 16 years after returning from his business trip to China.

A villager crossing a bridge with farm animals near Lamaden, Yunnan, China.

The adventures of Voith engineer Karl Mustière and the first-ever hydro turbine in China.

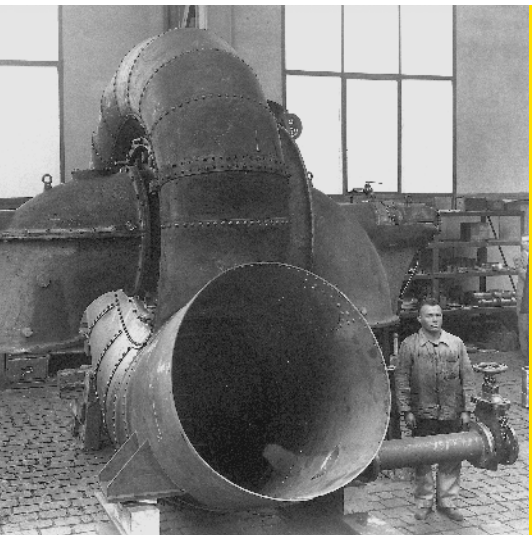
There was a time when Karl Mustière longed for the simple things in life: a long winter evening, for example, or a sip of ice-cold water. “Can you even imagine what it’s like?”, the engineer wrote in a letter to one of his friends. Probably not. He was writing in 1910, at a time when the world was still relatively placid. Two years after joining Voith, 34-year-old Karl Mustière had taken on an assignment that, in those days, was really quite adventuresome: he was to supervise the construction of a power plant and the assembly of the hydraulic equipment to be installed there – the first ever hydroelectric power plant in China, to be known as Shilongba, in the province of Yunnan.

Mustière’s presence on site was one of the terms negotiated in Voith’s contract. And with good reason: it was a first for both Voith and the country of China. Not only was it the first time Voith had ever supplied this far away land with a hydroelectric turbine; it was China’s first ever hydroelectric power plant.

Shortly before, the Augsburg-born engineer had made a name for himself through the construction of a Pelton turbine in the Brunnenmühle, Voith’s Corporate Technology Facilities in Heidenheim, where hydraulic research continues today. (Incidentally, this turbine is still in use today.) A specialist from Siemens-Schuckert took care of the electric portion of the China project.

“Scrambling around the mountainside at 35 - 40 degrees Centigrade in the shade taking measurements is not what I consider to be one of life’s many pleasures,” wrote Mustière. “And with no paths – the whole area is overgrown with thick shrubs that need to be cleared or burned before you can get through with the instruments.”

In his diary, Mustière not only documents the events leading up to the commissioning of Shilongba in the town of Yunnanfu, which initially comprised two Francis turbines each with an installed output of 700 kilowatts; there are also many entries in which he describes at length his everyday life and culture shock in the then technologically undeveloped province of Yunnan.



In 1937, this 950 HP Francis spiral turbine replaced the one delivered by Karl Mustière.

Re-visiting: Yunnan delegation in Heidenheim in October 2006.

Today, 50 million people populate this region and their living and working environment creates an enormous demand for energy. As is so often the case at Voith, the link with the region remains strong: in October 2006, almost a century after Karl Mustière's undertaking in Asia, a five-person team of government delegates from Yunnan headed to Voith Siemens Hydro in Heidenheim. The company is currently in the process of supplying the Xiao Wan hydroelectric power plant in the Yunnan province with three 714 MW Francis turbines. China's thirst for energy to fuel its vigorous development is reflected in the decision-making levels of the provinces: the provincial government of Yunnan has set itself the target of developing its industrial infrastructure and undoubtedly, by extension, of stepping up electricity generation – to a large part by means of hydro power. This Chinese province is rich in natural resources. Yunnan is home to three large Asian rivers: the Mekong, the Salween and the Jinsha. All three have their sources in the vast Tibetan plateau and run alongside one another through the north-western part of the province, towards south-east Asia. The three rivers are estimated to be capable of producing around 100 gigawatts of power. That is equal to the installed output of every power plant in Germany combined!

But we digress. Let's return to Karl Mustière, who not only demonstrated the creativity and determination characteristic of Voith engineers in one of the company's first international projects at the start of the 20th century; he also rose to some more universal challenges. He was faced with snakes, endless rain, debilitating heat during the day and cold at night. He experienced his first stay in an old Buddhist temple, was confronted with unfamiliar units of measurement when it came to mixing cement and, after dark, faced a very personal, existential crisis: "Mosquitoes, the specters of the night, advance in great swarms."

This Augsburg boy soon learned to improvise, however, and built himself a brick stove in the temple, "so things are much cosier." This was not the only pleasure experienced by Mustière in these foreign surroundings. He also enjoyed the reception for the viceroy of Yunnan, the construction of a "fashionable Chinese dwelling alongside the power house" and the lush vegetation after the rains: "You could almost hear the grass grow." And the temperatures even dropped, "making these the most magnificent days that I have spent here so far."

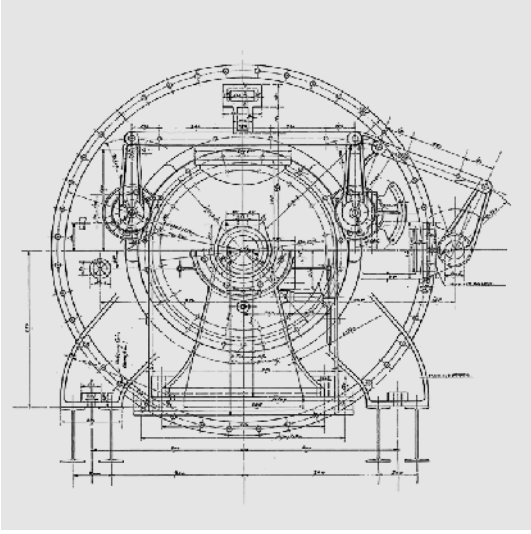
Nevertheless, Mustière was subject to certain social norms which still reigned at that time.

A single man was considered immoral, so during his stay in the multi-ethnic province of Yunnan, he married a Vietnamese woman from the mountains.

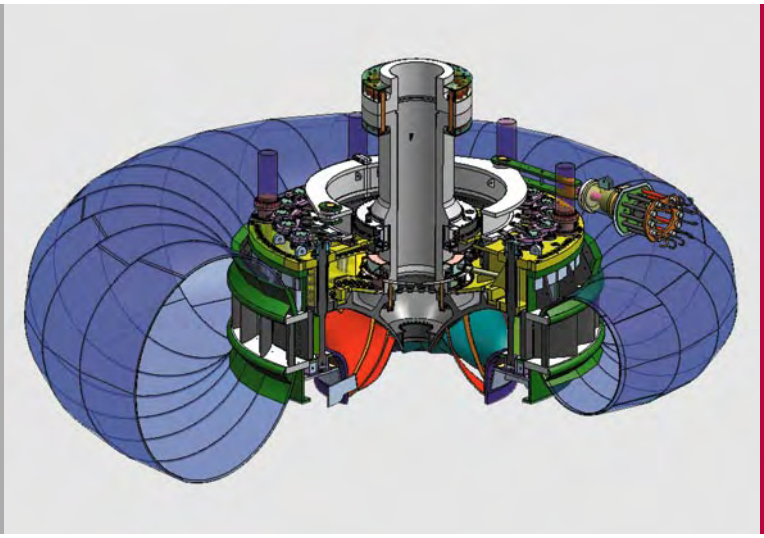
His temporary wife took care of the house and stood by him as the balance of power in China abruptly shifted. At the time of the great revolution, which brought down the empire and led to the birth of the Chinese republic, the couple fled to the seaport of Hanoi, which was then under French rule. They made their getaway on a handcar, a then-commonplace, two-wheel vehicle with no pedals that would only travel as fast as you could run.

Peace then resumed in China. Karl Mustière returned to Yunnanfu and saw to it that the power plant was completed, and was ready for operation on January 1, 1911. The town of Yunnanfu was electrified – Yunnanfu shone brightly.

Not long after the First World War, the Chinese built a second hydroelectric power plant using turbines from Voith. Karl Mustière returned home in the fall of 1912, back to his long, cold winter nights and friends who were eager to hear of the incredible experiences accumulated on this trip.



Old machine section of Shi Long Ba back in the beginning of the 20th century.



Modern 3D section of Xiao Wan project located in Yunnan Province.

Sketchbook from a construction site – Omkareshwar's unit 1 on the grid

Omkareshwar, India, March 12, 2007, 12.30 pm local time. The daily phone call between the customer and the Lead Engineer for Commissioning at the site: "Don't worry, the site staff has your target schedule fully under control."

Music in the ears not only for the customer Narmada Hydroelectric Development Corporation (NHDC) but for everybody involved as the commitment and the motivation level of the whole team and especially the Voith Siemens Hydro Field Service troop has been extraordinary over the last three years.

Cutback. Madhya Pradesh, Bhopal, India, July 18, 2003.

An ambitious schedule is drawn up for the delivery of eight units for the 520 MW Omkareshwar hydro power plant in the state of Madhya Pradesh, Central India. 48 months contractual execution time for a turnkey plant of such a size is a tough job, considering difficult and complex working conditions on the site at the Narmada River. Three manufacturing hubs of Voith Siemens Hydro on three different continents need to be coordinated and equipment supplied from these has to be shipped to central India under extreme logistic difficulties. Some small surprises are unavoidable in such a tour de force.

However, the inauguration ceremony for the commencement of erection of the first unit is held two and a half years later in April 2006. This is the first time the project team realizes there could be a small chance to get ahead of schedule. At full speed, a so-called “early commissioning schedule” is developed. Its target: The first unit shall be in operation by end of March 2007, some four months ahead of schedule. Impossible to achieve without a sound project management and dedicated support of all disciplines from engineering and supply management.

End of January 2007.

With the erection activities well on time, the pre-commissioning and testing starts with the complete electrical common plant including the 220 kV switch yard. A full-fledged commissioning team is at the site, deployed since end of 2006 to ensure the smooth testing of the power unit under the responsibility of Germany’s Voith Siemens Hydro Kraftwerkstechnik together with the electrical balance-of-plant package under the responsibility of Voith Siemens Hydro India. The following weeks, the pre-testing and commissioning phase, are filled with numerous interlinks to the consortium partner Jaiprakash Associates and the customer NHDC.

Then on March 30, 2007: the setback.

July 21, 2007.

Unexpected for NHDC and the consortium, a stay order from High Court of Madhya Pradesh defers the reservoir filling by approximately three months. Notwithstanding the unexpected interruption, Voith Siemens Hydro Field Service proceeds with dry commissioning at full speed. What was hard to believe in the beginning turned step by step into reality and between March and June six units were ready for wet commissioning and generation of power.

The big moment for the project arrived on July 7, 2007 when power unit 1 was turned for the first time to the satisfaction of the customer as well as of Voith Siemens Hydro's German R&D facility Brunnenmühle and the involved operating units in India, Brazil and Germany. After synchronizing the unit to the grid of the state Madhya Pradesh, Omkareshwar's power unit 1 is able to deliver power into the grid for the first time on July 21, 2007. The other units will follow on a three weeks basis. With 48 months in reach for a whole turnkey plant: a record time.

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View of the snow capped Himalayas.

First small hydro award in India

Voith Siemens Hydro India has been awarded its first small hydro contract. 15 Francis units for five projects will be delivered until May 2008.

Voith Siemens Hydro will deliver a total of 15 horizontal Francis turbine generator sets for five projects (each with three 1.5 MW units) to the independent power producer, M/s Subhash Projects & Marketing Limited, for projects located in the valley of Palampur, Himachal Pradesh in northern India. The commissioning of these projects is scheduled for May 2008.

India's small hydro power potential is estimated at 15,000 MW. 420 small hydro plants are already in operation with a total installed capacity of 1,423 MW. An additional 287 are under construction and more than 4,000 projects are in the planning phase. Most of the upcoming projects are being developed by so-called independent power producers because of the Indian government's plans to develop small hydro projects through private sector participation.

India currently runs an electrification program called "Power for all" which aims at supplying all Indian villages with electricity by 2012. This electricity is desperately needed especially in the more rural regions as India's economic growth rate runs at nine percent.

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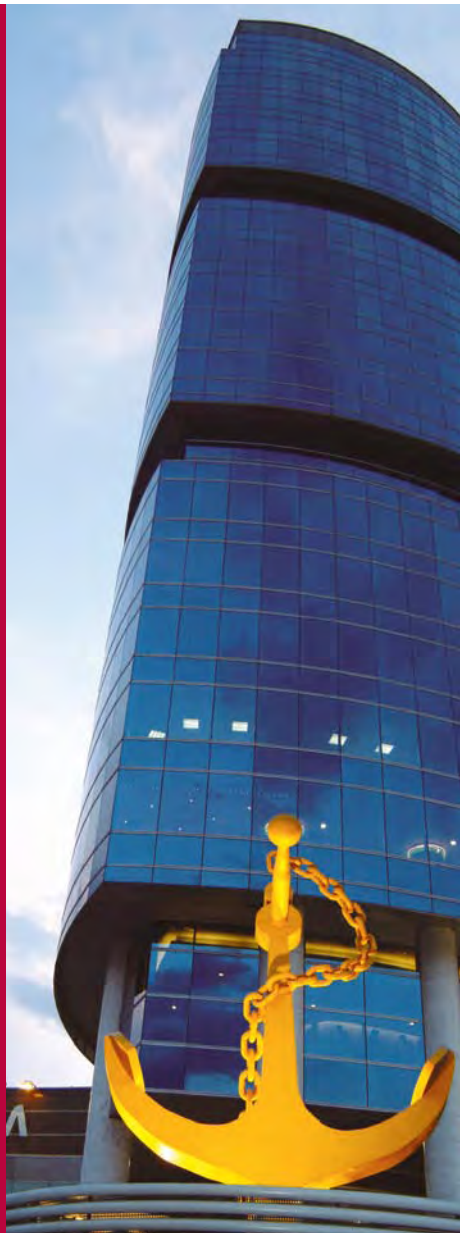
Jürgen Sehnbruch, Executive Vice President, Corporate Sales and Marketing (middle), with the team of Voith Siemens Hydro Ankara.



Turkey – a big hydro player on the border of Europe and Asia

For more than 50 years, Turkey has been one of the most important markets for Voith Siemens Hydro St. Pölten. Around 60 Turkish hydro power plants have been equipped by the Austrian unit of Voith Siemens Hydro.

In order to offer closer proximity to its customers Voith Siemens Hydro St. Pölten has established a Turkish subsidiary in Ankara, which was inaugurated in May of this year. The ceremony was attended by Austrian Ambassador Dr. Heidemarie Gürer, Austrian Commercial Counsellor Richard Bandera and representatives of Turkish authorities, customers and consultants. "We deliver up-to-date and long-term reliable solutions and technology in the true sense of a partnership: innovative, reliable, fair and trustworthy", emphasized Jürgen Sehnbruch, the company's Executive Vice President for Sales and Marketing: "With these core values of Voith and Voith Siemens Hydro the new team has come to stay – and to support you with *Engineered reliability.*"

In Ankara, seven staff members primarily work on small hydro power stations but coordinate larger projects as well. Furthermore, they provide sales and marketing, sourcing and project management support for their Austrian colleagues. Thirteen different projects in various stages of execution are currently handled in Ankara, including the Borçka hydro power plant, inaugurated recently by Turkish Prime Minister Recep Tayyip Erdoğan.

The 300 MW power plant on the Çoruh River in the northeastern part of the country has been built by national utility DSI State Hydraulic Works.

At the push of a button: Turkish Prime Minister Recep Tayyip Erdoğan starts operation of Borçka hydro power plant.

Hydro power plant Borçka on the Çoruh River in northern Turkey.

The plant is equipped with two Voith Siemens Hydro Francis turbines, producing 1,039 GWh of energy per year. The order value was around 26 million Euro.

According to the Prime Minister in his inauguration statement hydro power is Turkey's most important energy resource. "Today, its share is 36 percent of the Turkish energy mix. If the necessary measures are not taken immediately, energy shortages could be a trouble for all of us. Therefore, we are taking precautions rapidly", he emphasized. He affirmed to further support hydro power generation.

Borçka was developed under a bilateral agreement between Austria and Turkey. It will be the penultimate power plant in the Çoruh basin, northeast of the Black Sea, built by DSI. The consortium consisted of Andritz VA Tech Hydro, Verbundplan (PÖYRY), Strabag, Voith Siemens Hydro Austria and local Turkish partners.

Country information

- Turkey is a promising hydro power market for several reasons. The energy sector has been privatized since 2001, power consumption increases about seven to eight per cent per year and the government has a strong policy in place for renewables with financial incentives. With only a third of the hydro power potential under development, the realization of another 13,000 MW is considered feasible.

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Dismantling of the runner hood.

Dr. Lienhard meeting Darius Mesca, State Secretary, Ministry of Economy and Finance.

Main erection phase started: Ipotesti hydro power plant on the Lower Olt River

The start of the main assembly phase of Ipotesti hydro power plant modernization was celebrated with an impressive ceremony. Located on the Lower Olt River near Slatina in Romania, the hydro power station is being refurbished by a consortium acting as general contractor with Voith Siemens Hydro as consortium leader and Andritz VA Tech Hydro.

This turnkey project does not only include the supply of state-of-the-art bulb pump-turbines with an output of 14 MW each, but also of all corresponding auxiliary equipment, as well as local and remote control systems. Ipotesti is part of the refurbishment of all hydro mechanical equipment in each of the five hydro power plants on the Lower Olt downstream of Slatina. The project scope includes a total of twenty machines to be commissioned by September 2010.

The arrival of the first new turbine and generator at the Ipotesti hydro power plant prompted a good reason for the ceremony.

Romanian officials of the Ministry of Economy and Finance, Dr. Hubert Lienhard, Chairman of the Board of Voith Siemens Hydro and the Management of Hidroelectrica S.A. as well as representatives of the local authorities witnessed the unloading of the main components ready for final assembly and installation.

This step was a milestone in the Lower Olt Project. Preparations for the project design and engineering had started as early as 2003. Two years later, the basic design was finalized, while the contractor's on-site infrastructure facilities were realized in 2006 in order to begin the final phase of work.

While attending the ceremony Dr. Lienhard pointed out that he considers this refurbishment project as a top priority project in Romania's electricity generation from hydro, and that the company intends to assist also in other modernization projects, such as Islaz hydro power plant, connecting the Lower Olt Cascade to the Danube, the refurbishment of Lotru hydro power plant and other hydro projects.

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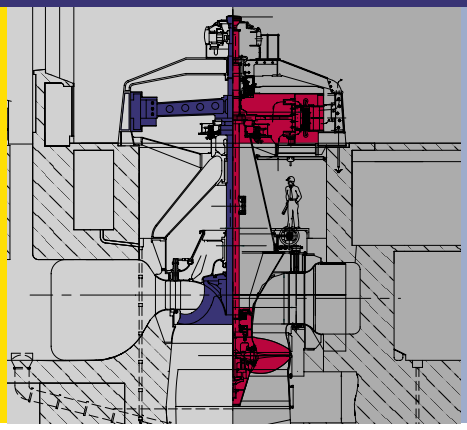
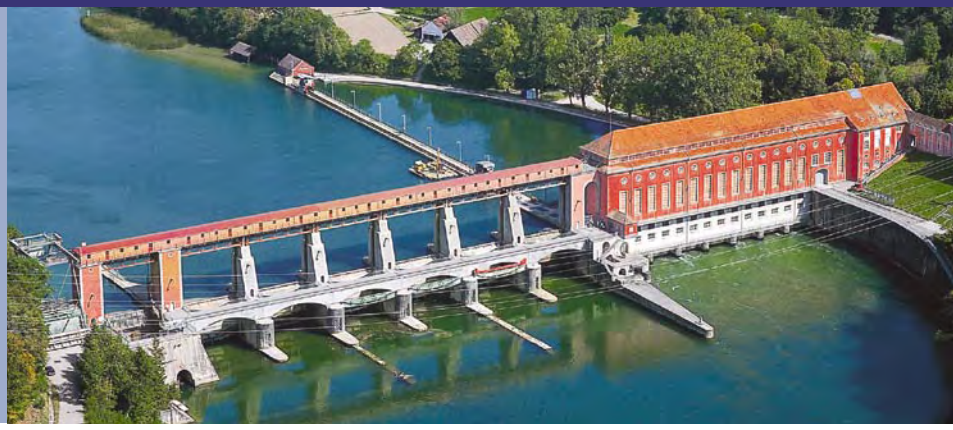


Sectional drawing of Eglisau comparing the turbine before and after the rehabilitation.



Aerial view, Eglisau.

Rehabilitation contract won for Swiss power plant Eglisau

Voith Siemens Hydro was recently awarded a contract to deliver the electromechanical equipment for the rehabilitation of the Eglisau hydro power plant of Kraftwerke Eglisau-Glattfelden AG, a subsidiary of the Nordostschweizerische Kraftwerke AG.

By 2012, the Heidenheim-based Voith Siemens Hydro Kraftwerkstechnik will deliver seven 6.7 MW Kaplan turbines, generators and governors as well as the complete control package. The new Kaplan units will replace seven Francis turbines which began operation between 1915 and 1921. Originally each of these Francis turbines had an output of 4.6 MW. Being a historical landmark, this project is considered a special challenge in terms of changing of turbine type, but also of preservation obligations for the plant and its architecture. Much of the plant's technical equipment is still in its original state of 1920 and shall be preserved in its entity.

In its more than 85 years of operation, Eglisau hydro power station produced more than 20 billion kWh of electricity. Using Kaplan turbines instead of the previous Francis units, increases the flow rate from 385 m^3/s to 500 m^3/s. Thus, annual performance can be raised by about a third from 246 to 314.5 GWh. This will be enough electricity to power around 80,000 households.

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Breaking ground for Rheinfelden

It was with a symbolic cut with a spade that Energiedienst AG, the German owner of Rheinfelden hydro power plant, with all project partners celebrated the start of construction of the new power house.

The February ceremony marked the beginning of the final stage of the modernization project – five months earlier than scheduled. A consortium lead by Voith Siemens Hydro has been awarded the contract to supply turbines and generators. Swiss Alstom Hydro AG is Voith Siemens Hydro's consortium partner.

The new Rheinfelden complex, estimated at 380 million Euros, is currently the largest investment in renewable energies in Germany. The new plant will be equipped with four 25 MW Kaplan turbines for the mandatory water release. The efficiency tests were successfully conducted in the hydraulic laboratory in Heidenheim in June 2007. All performance garantees had been met.

Rheinfelden construction site in December 2006. (Courtesy of Energiedienst AG)

Voith Siemens Hydro's team with representatives of Energiedienst AG and Fichtner Consulting during the model acceptance test.

Start up for these new units is scheduled for 2010. With a total of 100 MW of installed capacity, the performance of the newly-built plant will be four times the current plant capacity. Average annual production will be raised from 185 million kWh to 600 million kWh, serving demand of approximately 170,000 households.

The Rheinfelden hydro power plant is located on the Rhine River that marks the border between Switzerland and Germany. The plant was the first large hydroelectric power plant in Europe's history of energy generation.

Commissioned in 1898, the electricity generated by this plant significantly contributed to industrialization and build-up of economic infrastructure as well as improving the standard of living in the entire region. The new plant, now under construction, will utilize to a much higher degree the enormous renewable potential of the power of water.

Since 1928, Voith Siemens Hydro has regularly serviced this power plant and looks forward to continuing its 80 year customer relationship.

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São Paulo unit leads consortium for Brazilian Estreito

Voith Siemens Hydro leads the construction consortium for the supply and erection of electromechanical equipment, as well as the management of the Estreito hydro power plant project in the Brazilian State of Maranhão.

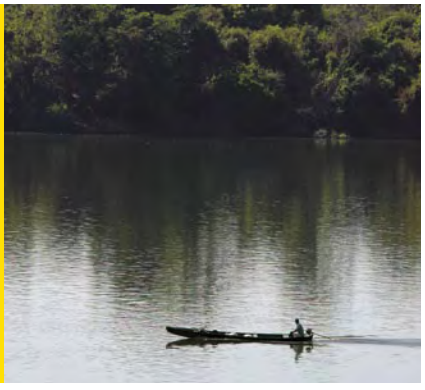
As part of Brazilian government's growth strategy, the power plant will have a total capacity of 1,087 MW. The first among the eight generating units is scheduled for commercial operation in June 2010.

The turnkey contract, worth over one billion Brazilian Reais, was signed on February 1, 2007. The Kaplan turbines, governors, automation, protection system, mechanical auxiliary equipment, main transformers and group circuit breakers will be supplied from Brazil's manufacturing facilities in São Paulo.

Voith Siemens Hydro is also responsible for the integration engineering, erection and overall management of the project. Alstom, Voith Siemens Hydro's partner, is responsible for the supply of generators, hydromechanical and lifting equipment, and electrical auxiliary equipment.

Brazilian CEO Osvaldo San Martin personally headed negotiations for this milestone project. Noteworthy is the challenge of the design, manufacture, transport and erection of eight of the largest Kaplan turbines produced in the world so far. Each 139 MW Kaplan runner has a diameter of 9.5 meters.

The Investor Consortium (CESTE), consisting of the Suez Energy, Companhia Vale do Rio Doce, Alcoa SA and Camargo Corrêa Energia SA companies, pursues two purposes with its enterprise: generation of electric power to be traded and supply of electricity to their own industrial plants.



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Tadêu Azevedo during his presentation.

The conference team with Osvaldo San Martin (middle), President of Voith Siemens Hydro Brazil.

Voith Siemens Hydro Brazil sponsors Abinee TEC 2007

Voith Siemens Hydro Brazil sponsored one of the most important events in the Brazilian electric and electronic sector – Abinee TEC 2007. It was promoted by the Brazilian Association of the Electric and Electronic Industry. The event ran from April 23 to 27, in the country's capital São Paulo.

Companies from all over the world exhibited their innovations in equipment and solutions, during the simultaneous course of the 24th FIEE Elétrica (International Fair of Electric, Energy and Automation Industry) and the 4th Electronic-Americas (International Fair of Components, Laser and Optoelectronic Technology and Instrumentation).

Voith Siemens Hydro São Paulo contributed to technical sessions on April 25, 2007 with a presentation entitled "Kaplan and Bulb turbines: the future of the projects in Brazil".

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Gathered for the inauguration of the Canadian headquarters from left to right: Denys Turcotte, President and CEO of the company in Canada; Jörg Metger, Consul General of Germany in Montréal; Jean-Marc Pelletier, Mayor of Brossard, and Dr. Hubert Lienhard, President and CEO of Voith Siemens Hydro.

New Canadian headquarters inaugurated

Voith Siemens Hydro officially opened its new Canadian headquarters in Brossard, Greater Montréal, in the presence of business and industry leaders, government representatives, and the company's senior management.

The inauguration was held under the patronage of Mr. Jörg Metger, Consul General of the Federal Republic of Germany in Montréal, who declared: "Canada is a top hydro power producer and Québec is a world leader in the field; therefore, it is only natural that Voith Siemens Hydro would choose to set up shop here, develop its network of suppliers, and consolidate its expertise. The presence of this symbol of German technological excellence contributes to reinforcing the partnership, and economic and commercial relations between our two countries."

"Voith Siemens Hydro is a well-established player in the hydro power sector in Europe, South America, Asia, Australia, and the United States. By establishing Canadian headquarters on the Montréal South Shore, we can proudly state that we are present in all major hydro power markets in the world," said Denys Turcotte, President and CEO of the new Canadian company.

A leader in hydro power equipment and services, the company is responsible for having built and installed close to one third of the world's hydro power turbines and generators.

Voith Siemens Hydro strengthens its presence in Canada with this new head office. Today, 50 people work for Voith Siemens Hydro in Brossard, Québec, and 125 are located at the manufacturing plant in Mississauga, Ontario.

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Conferences, seminars and symposia

Date/Event	Further information
July 23 - 26, 2007 **Waterpower XV** Chattanooga, Tennessee	**Wave Power in Europe – The contribution of Voith Siemens Hydro (discussion panel)** Dr. J. Weilepp/Voith Siemens Hydro, Germany **Simulation of overload-surge pressure and power oscillations at a pumped storage power plant** Dr. J. Koutnik/Voith Siemens Hydro, Germany **Field Machining – Rehabilitation of hydro turbine embedded components** S. M. Perry/Mechanical Engineer & Project Manager, Weld Mart
October 15 - 17, 2007 **Hydro 2007** Booth No. 70 and 74 Granada, Spain	**Small Francis turbines working with a wide range of head variation** C. Aguerre/Voith Siemens Hydro, Spain, L. Félez Gutiérrez/Endesa **Hydro generator uprating/upgrading with requirements for intermittent operation** L.-E. Kämpe/Voith Siemens Hydro, Sweden (VG Power) **Progress on wave power at Voith Siemens Hydro** Dr. J. Weilepp/Voith Siemens Hydro, Germany www.hydropower-dams.com
October 22 - 25, 2007 **CIGRE Joint Colloquium on Insulation Systems for Electrical Machines** Kyenongju, South Korea	**CIGRE Study Committee D1 and A1, Korea National Committee of CIGRE, KIEE and C Society** http://www.cigre-a1.org/Site/Events/download/CIGRE_A1-D1_2007_Korea_CFPID32VER14.pdf
November 6 - 7, 2007 **Forum on Hydropower** Ottawa, Canada	**Adapting to Change, Creating Change – organized by the Canadian Hydropower Association** www.canhydropower.org
November 11 - 15, 2007 **20th World Energy Council Congress** Rome, Italy	**World Energy Council** www.rome2007.it IHA paper on hydro power

IHA President Prof. Dr. H. Doğan Altinbilek.

Alessandro Palmieri, World Bank, chaired the panel on national perspectives.

Entering a new era of expertise – IHA World Congress on Advancing Sustainable Hydropower

The event, convened by the International Hydropower Association (IHA) from May 29 - 31, 2007, in Antalya, Turkey, along with 35 partner organizations turned out to be an extremely valuable one. IHA, as the voice of the hydro industry, had assembled an agenda and set of speakers which certainly brought a new approach to such meetings.

The growth potential of renewables with their major contribution of reducing emissions for the future generation mix as almost contradictory drivers were under scrutiny. In a series of sessions the answer to the question with what rate of progress this would take place could only be answered with "Act now!"

With sustainability criteria at the heart of the conference, IHA achieved another major step in the recognition of its Sustainability Guidelines and Sustainability Assessment Protocol.

A workshop on the Guidelines and the Assessment Protocol was held as a pre-conference training course with an impressive number of participants of around 70 from all nations.

But also during the conference, the Guidelines and the Protocol were viewed to be so far the best of all available frameworks for implementation of sustainability practice.

Solutions-oriented NGOs such as the Nature Conservancy and WWF International expressed their view that the IHA guidelines constituted the best basis with which to work towards certification and speaking one common language on sustainability of hydro power stations. Also the many panelists and participating audience embraced the broadest range of key stakeholders from civil society, government, business and industry. They explored and confirmed the opportunities of sustainable hydro power according to future contexts and expectations: "We are going from compensation to benefit sharing" and "Let's move forward and achieve some real results" as well as the goal to find "the balance between locations for hydro power stations with minimum ecological impact and maximum economic benefits needs to be approached" were just a couple of strong statements.

"We are going from compensation to benefit sharing."

The new and opened view at opportunities and drawbacks was the overriding result, despite the fact that International River Networks tried to draw attention to its obvious and complete anti-dam approach with a few protesters carrying a big banner. The clear consensus through the conference was the common approach with system-relating solutions and early, balanced involvement of all stakeholders. Even if one does not like dams, as David Harrison of Nature Conservancy emphasized again and again: "It is not about more dams or no more dams. There will be dams. But the question is how many, where, and which ones, and with which functionalities. We can do better and solve the problems and – even for the sake of economy – use the synergies between environment and hydrological flows."

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Workshop discussion.

Dr. Jochen Weilepp presenting on ocean energies.

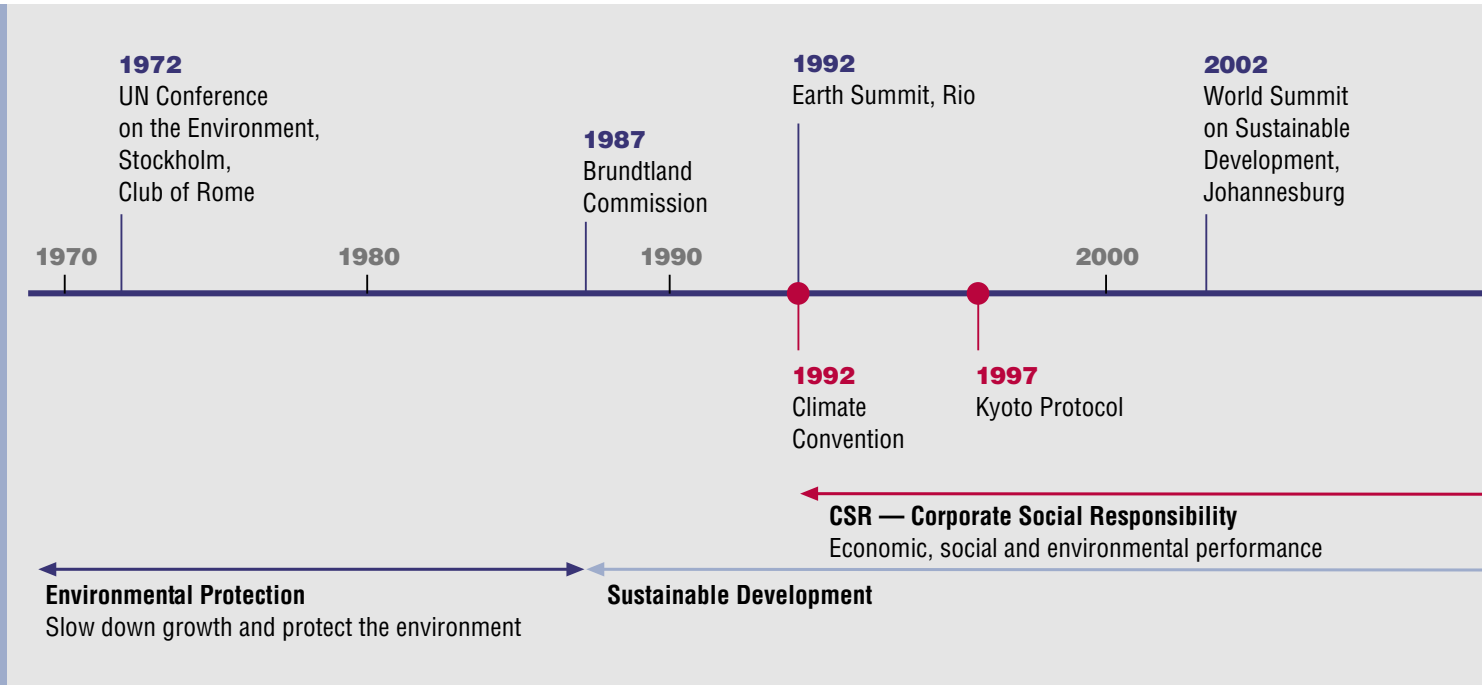
The road to sustainability for hydro power: value added for hydro power through IHA

"A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences."
United Nation's Environment Programme (UNEP) 1972

The start of consciousness of having to develop the world and its resources in a sustainable way begins as far back as the Seventies. The Club of Rome 1972 report then certainly was the first important report to reach a wide public audience on the fact that exploitation of the globe's resources are overdoing the pace they can be "re-newed" or "sustained".

A further event in the follow-up series of building new consciousness was the 1972's UNEP annual report for its program on environment. Concrete sectors like energy and water came later. A United Nations conference on Water in 1977 in Mar del Plata, Argentina, stated that "…relatively little importance has been attached to water resources systematic measurement. The processing and compilation of data have also been seriously neglected."

Important dates in history for sustainable development.



Looking at the list of succeeding events, one can see how sustainability grew not only by definitions, but also by merging into the mind set of global activities in business, environment and social development through multi-national organizations.

But one should also reflect in this review what the International Hydro Association has accompanied or moved forward in a series of efforts within events and guideline development for hydro power to stay in the boat among renewable energy generation overall. By the time when energy generation from fossil fuels was seen as exhaustible and also a threat in terms of pollution, hydro power did not gain recognition as a solution, as expected.

On the contrary, it was regarded as critical in its obligation to fulfill the tri-chord of sustainability or even more than that by many an NGO.

After the IHA World Congress on Sustainable Hydro Power, one should, therefore, maybe reflect on the situation as it would be without all these efforts. We are not at a point where we can stop to develop more approaches in defense of hydro and its sustainable implementation.

In order to strengthen IHA's position, a major recruiting initiative has been started. With the goal to have more corporations in the hydro industry consider what their personal or corporate contribution should be. If you are not a member, it is time to think about joining.

It is everybody's environment and hydro business that benefits from a joint and forceful action to let hydro play the role it should play: clean, large-volume, multi-purpose, multi-benefit, renewable and sustainable energy for this globe.

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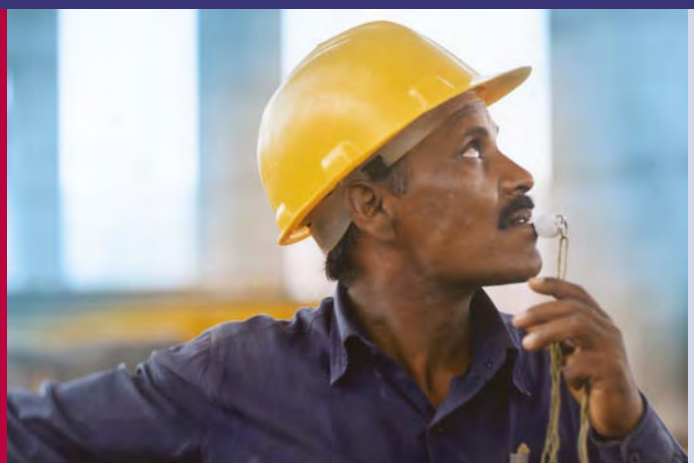

New and global Integrated Management System

Voith Siemens Hydro as the first group division in Voith AG has implemented a global Integrated Management System that has recently been independently certified.

The comprehensive and holistic quality management system integrates the respective areas of occupational health and safety as well as environmental protection and, of course, general quality management.

The global certification is based on well-known international standards for quality assurance (ISO 9001), environmental protection (ISO 14001), as well as occupational health and safety (OHSAS 18001). All Voith Siemens Hydro locations are in complete compliance with these three standards, handle all processes in an identical way, and are formally certified under one unique certification.

Dr. Hubert Lienhard, CEO of Voith Siemens Hydro and Member of the Board of Voith AG, stated: "The high awareness of Voith Siemens Hydro's staff on safety and environmental issues was the absolute prerequisite for reaching this extremely demanding target within a record schedule, namely in a third of the normal time."

All Voith Siemens Hydro units had already been certified globally in the past. The major task of the now completed process done in all units worldwide was in the integration of environmental protection and occupational health into the existing management system.

With this, Voith Siemens Hydro not only sees itself as fully integrated in the tradition of Voith's values under the claim "Engineered reliability", but also considers itself as leading in comparison with other international capital equipment enterprises.

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First breakwater wave plant built in Mutriku

The first commercial breakwater wave energy plant will be built with Voith Siemens Hydro Power Generation's technology on the Spanish Atlantic coast for the Basque Energy Board, Ente Vasco de Energia.

The new plant in Mutriku in northern Spain will work with the Oscillating Water Column (OWC) technology of Voith Siemens Hydro's Scottish subsidiary Wavegen where it has been successfully field-tested over a seven year period. The pioneer in wave power operates the first long-term grid connected wave energy plant.

"Mutriku is a milestone in the history of wave energy. We are proud that the first breakwater wave energy plant will rely on Wavegen's technology", said Dr. Hubert Lienhard, President and CEO of Voith Siemens Hydro. The new project will see the integration of 16 Wells turbines into Mutriku's new breakwater being constructed by the local government. Supplying green electricity to around 250 households with a rated power of nearly 300 kW, the plant will be commissioned in the winter of 2008/2009.

Starting signal for green energy from the oceans

With this innovative power plant concept the production of green energy will be integrated into a marine construction with minimal construction costs.

"This project represents a major step towards commercialization of wave power as we continue to develop the technology and demonstrate its reliability under commercial operating conditions", said David Gibb, General Manager of Wavegen: "And we have already negotiated additional projects in other countries."

How to turn waves into watts

- The wave plant will use the Oscillating Water Column principle which has been utilized in Wavegen's demonstration plant in Scotland since 2000. An opening in the front of the breakwater allows the sea to rise and fall within a chamber due to the natural action of the waves. This motion compresses and decompresses the enclosed volume of air. The energy generated from this pressure differential is then – with the aid of a Wells turbine and a generator – transformed into electricity and fed into the grid.

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Breakwater Technology

Presented at the G8 journalist summit

Dr. Thomas Heath of Wavegen.

Voith Siemens Hydro is one of the regulars whenever future energy generation systems are being discussed – including the recent G8 summit during it associated lecture program. At the press office in Kuehlungsborn near Heiligendamm, Dr. Thomas Heath, Engineering Manager of the Scottish Voith Siemens Hydro subsidiary Wavegen, informed journalists about the potential of wave energy – approximately 15 percent of the worldwide demand for electricity can be generated from wave power. The presentation was part of the lecture series "The Power of Ideas", organized by "Germany – Land of Ideas", an initiative of the Federal Government and German industry.

Limberg II Austria

Successful model acceptance test for pump-turbine

Upper reservoir of Limberg.

In the presence of the operator, Verbund-Austrian Hydro Power AG, model tests for the Limberg II-pump-turbine were successfully completed in Voith Siemens Hydro's corporate technology facilities in Heidenheim. After the ten day model test, the manufacturing phase for the two 240 MW pump-turbines has begun. The machines' optimum design posed an engineering challenge as the unit's head for turbine and pump operation will vary extremely between 288 and 436 meters, depending on the water level of the huge storage lakes that feed the units from a reservoir capacity of more than 80 million cubic meters. Limberg II will serve as an addition to the existing Kaprun group of hydro power stations and will more than double the currently installed capacity. With its two units, the Limberg II power station will supply about 10 percent of electricity to Austria's grid during peak operation times.

Uglich
Russia

Contract for hydro unit upgrade in Russia signed

Inside Uglich hydro power station, Russia.

The contract for the replacement of generating unit number 2 of the Russian Uglich hydro power station was signed between Gidro OGK, a daughter company of Russian RAO UES, and Voith Siemens Hydro Power Generation, Austria, at beginning of April. The contract with a value of 33.2 million Euro includes the replacement of the turbine-generator unit and its auxiliary equipment. The output of the 9-meter diameter Kaplan turbine will be increased from 65 MW to 70 MW. Uglich hydro power station, consisting of two units, began operation in 1940 and was the first hydro power station of the Volga-Kama cascade. Both parties view this contract to be a starter project with the potential for future partnership within Gidro OGK's major investment program, with Gidro OGK being one of the largest investors in hydro power worldwide.

Ermenek
Turkey

Successful workshop test

Ermenek, 200 kilometers east of Antalya.

As part of the consortium for delivering the electromechanical equipment for the Turkish Ermenek hydro power plant, Voith Siemens Hydro successfully completed the workshop tests of two spherical valves in its São Paulo workshop.

Two 150 MW high head Francis turbines are being supplied by Voith Siemens Hydro. The scope also includes the delivery of governors and 2.3 diameter spherical valves with a design pressure of 50 bar.

The customer, DSI State Hydraulic Works, awarded the complete electromechanical equipment for the 300 MW hydro power plant to the Austrian consortium partners Andritz VA Tech, Alstom and Voith Siemens Hydro.

Historic earnings marks the company's 140th anniversary

Fiscal year 2005/2006, ending on September 30, 2006, was the most successful year in Voith's 140-year history. Thanks to strong worldwide economic growth, new orders exceeded 4 billion Euros for the first time, increasing by 25.7 % to 4.1 billion euros. Sales grew by 7.9 % to 3.7 billion Euros. The performance of the Group has continued to improve: the operating result excluding periodic influences increased by 50 % over the previous year. Earnings before tax doubled, amounting to 330 million Euros, and net income reached an exceptionally high peak at 246 million Euros, although it should be noted that this figure included extraordinary earnings from the sale of financial holdings amounting to 112 million Euros.

Voith's President and CEO Dr. Hermut Kormann summed up: "Over the years Voith has reinvented itself again and again, which is why it is healthy and financially strong in its 140th year. We have the freedom and the means to push ahead with our innovation offensive throughout the Group."

Kormann knows he can count on the inventiveness and creativity of his employees – and on their stamina. "We have the resources to pursue any innovation. And we'll make sure it stays that way! We have a wide range of innovative projects, and we are confident they will bring us more than half a billion euros in sales in a few years."

With projects like the tidal current power plant, which Voith is developing together with a Korean partner, the time frame is much longer. "Projects like this extend way into the future. At Voith, our experience has taught us that some things take more time. In a family enterprise, the generation that sows doesn't always have to be the one that reaps," he explained.

As a Group Division of Voith, Voith Siemens Hydro also recorded a substantial increase in orders received. Healthy business in Europe and – after a lengthy pause – a return to a positive South American business climate were behind this development.

European orders came in from Spain, Germany, Austria and Portugal. As in the preceding years, many of these projects involved pumped storage power plants. Limberg II marked Voith Siemens Hydro's second large order from Austria in 24 months. Outside of Europe, supplies for hydro power stations in Turkey, Peru, Mexico and two new plants in China were contracted by Voith Siemens Hydro.

The US presented another focus in the modernization business with numerous component deliveries, also comprising "aerating runners" that considerably enhance aquatic life of tailrace waters through their oxygen injecting effect. A remarkable award from Canada was through the contract for a new additional unit in Revelstoke, a hydro power plant on British Columbia's Columbia River.

Voith's new head office building

Voith AG announced in April 2007 its plans to build a head office for the Voith Group of Companies in its original hometown of Heidenheim/Brenz in East Württemberg, Germany.

With this project, the family-owned enterprise, represented in over 40 countries with more than 250 locations, for the first time creates an optical and physical center for its 34,000 employees all over the world. The head office, whose construction was decided as Voith celebrates its 140th anniversary, underlines the growth of the company and points the way ahead into the future.

Preparations for the project will start immediately. Construction will begin in 2008. Occupancy of the new Head Office is scheduled for the end of 2009. After completion, some 300 employees will work there on a floor space of 7,000 m^2.

The 35 million-Euro-project will be planned and built by the internationally renowned architectural firm Murphy/Jahn from Chicago, Illinois, USA. Architect Helmut Jahn has designed a large number of high-profile buildings all over the world.

With this architecturally pioneering project, Voith responds to the enormous international growth of the company in recent years, resulting in a significant increase of employees, including the workforce in Heidenheim. The new building will accommodate the Management Board, the Board Members of the Group Divisions Voith Paper, Voith Turbo, Voith Siemens Hydro Power Generation and Voith Industrial Services, their direct reporting functions and the Central Divisions of the corporation.

Voith Industrial Services

Premier, a Voith Industrial Services company, has expanded their business with the Ford Motor Company with several recent contracts in USA and Brazil. In the United States, Premier signed a three year contract at the Lima, Ohio Engine Plant Cleveland multi-facility complex in Ohio, and at twelve more product distribution centers scattered across the US. The scope of services at these facilities includes facility management, powered mobile equipment management, and technical cleaning.

Services are also executed at Ford Motor Company Brazil. In 2006, Premier Brazil was recognized as the best service company in 2006. For the last six years Ford Motor Company Brazil has honored its nine best suppliers in Brazil with the Supplier of the Year Award. These companies were deeply analyzed regarding quality and cost of product and services; efficiency and social responsibility actions developed through the ISO 14000 Certification.

Voith Paper

Voith Paper, the leading supplier for packaging paper machines, and Nine Dragons Paper, a Chinese supplier of packaging paper, signed a contract for delivery of four new board machines. All four machines will come on line within the next 24 months. Each pair of the four paper machines are identical. The combined daily production of all of them will be approximately 3,000 tons.

As a tribute to sustainability, Nine Dragons Paper uses waste paper to make cardboard for boxes and other packaging products for the fastest-growing major economy in the world. Consequently the consumption of paper in food and industrial packaging and daily use like tissue is on the rise and the paper industry is booming in China. Last year the consumption of paper and cardboard grew about 16 percent to nearly 70 million tons as the economy grew by 10.7 percent. According to Ming Ming Liu, President of Voith Paper China, sales are expected to maintain an 18 percent growth annually through 2012.

Voith Turbo

Voith Turbo sales soar in China

Sales are soaring for Voith Turbo in China. According to Dr. Birgit Suberg, Managing Director of Voith Turbo China, the group division's sales in the Chinese market doubled to 70 million Euro in fiscal year 05/06. Dr. Suberg, in a recent Beijing press conference, also forecasted Voith Turbo's business in China to grow at 15 - 20 percent annually within the next five years. To service Voith Turbo's customers in China better and better, a new plant has been built in Shanghai at an investment of 29 million Yuan. Dr. Suberg hopes to build a long-term partnership with China by providing reliable technologies and customized services. Currently, Voith Turbo has over 70 percent of China's high-end passenger car retarder market, contributing to China's growth, efficiency and safety of operation. Currently, most Voith Turbo products are already present in China.

Voith Water Tractors to assist cargo ships in Shanghai

Yangshan International Deep Water Port in Shanghai will be the largest container port in the world with an annual capacity of 25 million standard containers. Three Voith Water Tractors (VWT) will assist with the handling of the cargo ships and perform escort and towing duties. This is the first time that Voith Turbo Schneider Propulsion delivers Voith Schneider Propellers directly to a Chinese end customer – Shanghai Port Technology Engineering Service Corporation.

At an average water depth in the port of 15 meters, even the largest VWT-escorted container ships can be handled. They can enter the port safely and reach their terminals without problems. The three VWT are built by San Lin Shipyard, for which Voith Turbo Schneider Propulsion will deliver six Voith Schneider Propellers size 28 (28 R5/210-2), four Voith 1330 DTL turbo couplings and two control desks.

Voith Turbo Schneider Propulsion will also provide nautical training. The 30-meter-long and 11.5-meter-wide escort vessels were designed especially for the new port.

VOITH SIEMENS
HYDRO POWER GENERATION

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