HyPower

Customers magazine for Voith Siemens Hydro

5

July 2003

Summary

Editorial

Voith Siemens Hydro Power Generation

Engineered reliability!

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

Dear clients and partners,
dear readers,

Our new issue deals with small hydro as a market focus and I think that we do provide you with an extensive overview of where our activities take place: worldwide.

A newly-structured team in our company takes care of driving this focus on the basis of our new platform concept. Our message is, that especially in small hydro, innovative approaches and high-quality, high-tech solutions, do not automatically result in high-end prices. Our complete packaging concept does apply in small hydro business at least as much as in large hydro. Excellent baseline designs together with short realization times meet cost effectiveness. And still, this is done on the basis of our state-of-the-art research and development experience, that can be considered leading in the industry.

Small hydro is again getting "fashionable", also in terms of policital treatment, and can even help you to get green certificates or can play a role in the Kyoto goals of industries and nations.

The recognition of hydro power – small or large – as the most mature of all renewables in energy generation, is breaking ground again, these days: The World Water Forum in Kyoto, held in March this year, explicitely declared large hydro to be renewable. In our eyes it is high time for hydro to be acknowledged again for what it deserves to be. I congratulate International Hydro Association's tremendous efforts, to put forward their message for hydro in the context of this event!

Above this, our company's technical contributions and efforts to even more environmentally friendly solutions are reflected in the award of NHA to our location in the USA: it was given to the common development of the U.S. Army Corps of Engineers' and Voith Siemens Hydro's aerated runner concept.

The optimization of components as well as complete plants, small or large, is our business, the handling of projects of any size in close and good cooperation with partners and customers as a project company is what we have to offer. We master this with well-established locations in the Americas and Asia, know-how based on excellent staff and equipment, unique and unified standards and quality worldwide. We continue to offer what Voith and Voith Siemens Hydro have declared the company principle:

Engineered reliability!

Whatever your opinions and business interests are: please do not hesitate to let me have these!

Yours sincerely

Dr. Hubert Lienhard

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Worldwide trend towards small hydro

In line with the strategy of global hydro development, small hydro technology is making a significant contribution to sustainable, clean energy policy. Small hydro is playing an increasingly important role in promoting social and economic development, taking into account the fact that electricity supply and availability is essential for developing rural areas as well as for industrial growth.

Decentralized renewable energy can solve numerous local problems relating to energy supply. There are three main drivers behind the global trend towards small hydro:

- The promotion of renewable power is in full accordance with the latest national legislation (green certificates) in various countries.
- An increasing dependence on primary energy sources could lead to serious economic threats. Power supplies from alternative, decentralized sources are becoming more and more attractive.
- Small hydro has the lowest environmental impact of all energy sources, including other renewable energies. It fully corresponds to environmental commitments, including the Kyoto protocol.

Voith Siemens Hydro: big player in small hydro

As a world leader in hydropower equipment and services with a product line covering project handling and technology for all types of hydraulic and electrical machinery as well as a complete range of mechanical and electrical services, Voith Siemens Hydro has more than 135 years of tradition in small hydro worldwide. The most modern research and development centers in Germany, in north and south America provide the technological background for the international activities, thus profiting from research-based large hydro developments.

Technological edge and cost effectiveness

Based upon such long-term experience and state-of-the-art technology, a technological platform concept for small hydro has been established. It defines uniform technical standards on a modular design basis and standardized components. Its development was possible only because of the extensive know-how derived from the huge number of contracts executed by Voith Siemens Hydro. Thus, seemingly conflicting small hydro requirements have been united: cost-effectiveness, flexibility and simplicity on one side, high performance, reliability and availability on the other side.

Locations

The acquisition of a majority stake in the leading French small hydro specialist Esac Energie at the beginning of last year further expanded Voith Siemens Hydro's position in the small hydro market. The technological edge of a leading hydropower company has since been combined with the focus and flexibility of a company fully and solely dedicated to small hydro.

Worldwide activities

Voith Siemens Hydro is involved in numerous successful small hydro projects in Europe, north and south America, Asia and Africa.

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Interested in our new Small-Hydro brochure? Please contact:
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Increasing demand for small hydropower plants in Norway

Vedeld receives E+M-package and special outlet

Voith Siemens Hydro was awarded the contract for the electro-mechanical package by Tussa Energi AS. Extra attention must be paid to a special outlet construction, as part of the discharged water from the turbine goes to a salmon farm. Therefore, Voith Siemens Hydro is installing a by-pass arrangement to secure the water supply to the fish farm even when the power plant is out of operation.

Data

Net head: 247 m
4 jet vertical Pelton turbines
3.4 MW turbine output
3.8 MVA generator output
Commissioning September 2003

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Riksheimdal to be visually integrated in Norwegian landscape

Riksheimdal is being built to utilize the water between an existing water reservoir and an old small hydro power plant. Voith Siemens Hydro was awarded the turnkey contract, including 3,000 m of penstock and a power house, by Sykkylven Energi AS. Together with one of its best Norwegian customers, Nord-Trøndelag Energiverk (NTE), Voith Siemens Hydro will be installing a state-of-the-art electro-mechanical package and an innovative power house. Both solutions have to be chosen very carefully to preserve the original impression of the landscape. For this reason, the power house will be built as a traditional timber log house with a grass roof which blends into the surrounding area. The highly optimized iron penstock will be laid in a trench covered by soil, and will thus be invisible to local trekkers.

Data

Net head: 380 m
2 jet horizontal Pelton turbines
4.6 MW turbine output
5.0 MVA generator output
Commissioning December 2003

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New equipment for Lovik

The Lovik hydropower plant is located in northern Norway. The plant had been in operation for almost 50 years when the machinery broke down. The Lovik project is something special, as Voith Siemens Hydro and the customer, Andøy Energi AS, entered into a directly negotiated contract for the replacement of the complete turbine, the generator, the control systems, and auxiliaries. The benefits of this co-operation for the customer are obvious: it will save delivery time and hence minimize the breakdown costs.

Data

Net head: 84 m
Horizontal Francis turbine
1.3 MW turbine output
1.45 MVA generator output
Re-commissioning February 2004

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Sagnfossen being uprated

Sagnofossen is an old hydropower plant located in eastern Norway, near to the border with Sweden. The customer, Hedmark Energi Kraft AS, decided to rebuild the facility with an increased output. From a variety of possible low head machine concepts, Voith Siemens Hydro was awarded the contract for a direct-driven vertical Kaplan turbine. The engineers will install a turbine with a diameter of approximately 3.5 meters and an air-cooled generator of 130 tons. Certainly not the type of equipment one initially thinks of when talking about small hydro plants. But running at a speed of 136.3 rpm will ensure that the machinery is extremely reliable.

Data

Net head: 9.2 m
Vertical Kaplan
6.2 MW turbine output
6.85 MVA generator output
Commissioning August 2004

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Turbine for New Bjölvo delivered four months ahead of schedule

With a head of 860 m, the 9.2 MW horizontal Pelton machine for the extension of the Norwegian hydro station New Bjölvo ranges among the highest head small hydro turbines built in recent years. Voith Siemens Hydro delivered turbine and valves four months earlier than scheduled.

Data

Head: 860 m
Horizontal Pelton
9.2 MW turbine output
Discharge 1.2 m^3/s

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Small hydro in Europe

New hydropower plant in Hiltenfingen

Voith Siemens Hydro recently concluded work on the turnkey project in Hiltenfingen on the Wertach in Germany. The new hydropower plant was committed to its intended use within the very short time frame of 2 1/2 years from planning, licensing, and commissioning to realization. The plant, which is equipped with an S-turbine (runner diameter 2 m) will from now on generate 900 kW of energy from a 4.4 m head.

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Cargiaca, France

One Pelton unit of 4.6 MW was commissioned at the Cargiaca hydro power plant on Corsica. Voith Esac Hydro was in charge of the mechanical part of the plant, including a horizontal 2-jet Pelton machine.

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Stanley Mills, UK

Voith Esac Hydro supplied a complete bulb unit rated 900 kW, for the Scottish plant at Stanley Mills.

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Work finished at Theodoriana

Voith Siemens Hydro has finished work on the small hydro project Theodoriana in Greece. The contract included two horizontal Francis turbines (2.6 MW and 1.3 MW), two synchronous generators (3.0 MVA and 1.5 MVA), three butterfly valves (diameters 1,100, 900, and 600 mm), and the installation of an automation system including governor oil units.

Data

2 horizontal Francis turbines
2.6 MW/1.3 MW turbine output
3.0 MVA/1.5 MVA generator output

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Complete equipment for Gitani

The Gitani project is situated in the north-north-west of Greece on the Kalamas river, near to Igoumensita, the major port to Italy. Voith Siemens Hydro received a letter of intent from DIEKAT S. A. for the complete water-to-wire package, including two bevel-gear pit turbines with an electrical power output of approximately 2.1 MW each, generators, plant control system, electrical installations, and trashrack cleaning system.

Data

Head: 7.45 m
2 bevel-gear pit turbines
2.2 MW output per turbine
Commissioning early 2005

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New power station for Vorino

Voith Siemens Hydro will install a new power station located in north-western Greece approximately 150 -200 km from Thessaloniki. Gener S.A. and Voith Siemens Hydro signed a pre-contract for the supply of the water-to-wire equipment package, containing one horizontal shaft 2-jet Pelton turbine, generator, plant control system, and the electrical installations.

Data

Head: 550 m
Horizontal 2-jet Pelton turbine
3.9 MW turbine output
Commissioning early 2005

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Turbines for the Turkish plant Hacilar delivered six months earlier

Voith Siemens Hydro, responsible for the entire electro-mechanical equipment of the Hacilar small hydropower station, manufactured two horizontal shaft Pelton turbines of 7 MW each in record time completely in its Heidenheim workshop. The contractual manufacturing and delivery schedule of the original contract had thus been reduced by more than six months. Commissioning took place in June 2003.

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Focus on Small Hydro

San Nicolo small hydro station will yield profit in less than six years

The San Nicolo small hydro project in Italy was carried out as a minimum environmental impact project under a tight time schedule of roughly a year from contract award to commissioning. In normal commercial operation since January 2003, the power station has been perfectly integrated in the mountainous landscape of north eastern Italy. Its four-nozzle vertical Pelton turbine, installed at a net head of 127.5 m, generates a maximum power of 755 kW. The turbine was tested in the hydraulic laboratories of Voith Siemens Hydro in Milan and Heidenheim. Designed for a very flat high-efficiency curve, it can be operated with one or more nozzles at the same time. The unit produces more than 3,000,000 kWh per year and revenues are expected to reach about 300,000 Euro per year. Taking advantage of the so-called "green certificate" incentives (0.06 Euro/kWh), the plant will be completely repaid in less than six years.

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Jerte commissioned in record time

In the extraordinarily short time of just nine months, the Spanish unit of Voith Siemens Hydro manufactured and delivered three horizontal Francis turbines for the Jerte small hydro plant. With these units, the hydro station, located in the famous valley of the Jerte river in the province of Cáceres, can generate a total power of almost 6 MW.

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New contracts for Peneda and Arnoia

The good performance of the Pelton turbine at the Cierves hydro station, which was supplied a few years ago by Voith Siemens Hydro, is the reason why the plant owner, Hidroeléctrica del Giesta, has now ordered two vertical Kaplan turbines of 8.6 MW and 2.4 MW for its Peneda small hydro station and three vertical Francis turbines of 7.0 MW, 3.1 MW and 1.3 MW for its plant at Arnoia.

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Reliable operation: 100 years of hydropower in Würmtal, Germany

More than one hundred years ago, Voith turbine 492 was put into service in the Würmtal hydro power plant near Stuttgart. After being commissioned in 1899, the plant was used to supply power to a sawmill.

After a general overhaul at the beginning of the 1960s, the machine operated continuously until 1970, when the penstock was damaged. In 1980 the station was recommissioned and the electrical components and controls were replaced. In February 1982, the plant was put back into operation. The average energy production since this reactivation is approximately 500,000 kWh per year.

The turbine has not been opened for the last twenty years, merely receiving minor servicing once a year. With the exception of various bolts, sleeves and bushings, the original turbine parts are still in use. A new water-cooled generator feeds its excess heat directly into the heating system of the building.

Today, the plant is used solely for power supplies in parallel network operation. Approximately 10% of the energy generated is supplied to a small industrial estate which has been built on the site of the sawmill in the meantime. Most of the energy generated is supplied to the public grid.

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Small hydro in south and north America

Paraíso, Brazil, commissioned now
Equipped with two horizontal Francis turbines of 10.8 MW each, the Paraíso generating station almost escapes the concept of small hydro: when in full operation, the two machines will produce enough energy to supply 50,000 houses in the northeastern region of the Brazilian state of Mato Grosso do Sul. The commissioning of the units is scheduled for October 2003. As the consortium leader, Voith Siemens Hydro is responsible for the supply and supervision of the erection of all mechanical and electrical equipment.

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Fumaça supplies aluminum plant
The last turbine-generator unit of the Fumaça small hydro station has just started normal operation and has attracted praise from the client. The plant is located in the Brazilian state of Minas Gerais and is equipped with two horizontal Francis turbines of 5.2 MW each and a brushless type generator of 5.6 MVA. It generates electrical power for the nearby aluminum plant of the Brazilian company Alcan Aluminío do Brasil Ltda. Voith Siemens Hydro, as the consortium leader, is responsible for all the electrical and mechanical equipment at the plant.

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São Bernardo
When commissioned at the end of 2005, the São Bernardo plant will be supplying 15 MW to the grid. Voith Siemens Hydro will contribute the turbines and governors to the project, which is located on the Bernardo José river in the Brazil state of Rio Grande do Sul.

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Furnas do Segredo
This small hydro power plant, located on the Jaguari river in Rio Grande do Sul, is scheduled for commissioning in September. Voith Siemens Hydro will deliver two low head Kaplan S-turbines with 4.7 MW each.

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Esmeralda
Like Paraíso, a high capacity small hydro station that will generate 23 MW of electricity when in full operation. Commissioning is to take place at the end of 2005. Two Voith Siemens Hydro-made Francis turbines will produce 11.5 MW each. A Voith Siemens Hydro governor system will guarantee smooth operation.

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Environmentally sound construction of small hydro station in Chile

One will hardly find another small hydro plant located in such an impressive region of stunning natural beauty as the Lago Atravesado station in southern Chile. The 12 MW plant, owned by Empresa Electrica de Aysén S.A., lies on the shore of the Atravesado lake surrounded by several millennial glaciers. Miles from anywhere, there were no roads leading to the construction site. Due to the strict environmental regulations of Chile's National Energy Commission (CNE), a road could not be built. Consequently, the two 6 MW horizontal Francis turbines, designed and manufactured at Voith Siemens Hydro's location in Tolosa, Spain, like all the material and equipment, had to be shipped there on board of a transport barge.

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Pingston, Canada

Two Pelton units were commissioned in early May, at the Pingston hydro power plant in Canada. Voith Esac Hydro was in charge of the supply and commissioning of the turbine-generator sets, as well as the control panels. This plant is located near Revelstoke, British Columbia, and has a total output exceeding 30 MW.

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Rutherford Creek, Canada

Two vertical Pelton units of 25 MW will be installed at Rutherford Creek Hydropower plant, near the city of Whistler, north of Vancouver, British Columbia. Voith Esac Hydro will supply the turbine-generator sets, with a commissioning date expected in April 2004.

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Small hydro in south-east Asia

Voith Fuji Hydro, the Japan based entity of Voith Siemens Hydro, has been awarded several contracts for interesting hydro power projects in Japan, in close cooperation with Fuji Electric, four of which are:

Ohtaki generating station now commissioned

The contract was awarded for installing a new hydro power station by Kansai Electric Power Co., Inc. The supply for Ohtaki hydro power plant, located on the Kinokawa river, included a vertical Kaplan turbine, a generator with thrust bearing made out of Teflon (PTFE), excitation, automation, electrical BOP, erection, and commissioning.

Data
Head: 80.37 m
Vertical Kaplan turbine
10.8 MW turbine output
11 MVA generator output
Commissioning May 2003

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Shirahagi equipped with new hybrid actuator

The contract was awarded for equipping the new Shirahagi hydro power plant by Hokuriki Electric Power Co. The supply for the new plant, located on the Hayatsuki river, included a horizontal Francis turbine, governor, generator, excitation, erection, and commissioning. As a special feature, a newly developed hybrid actuator was provided for guide vane control.

Data
Head: 74.5 m
Horizontal Francis turbine
3.29 MW turbine output
3.37 MVA generator output
Commissioning December 2002

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New hydro station at Tomada

The Government of Okayama Prefecture awarded a contract for the installation of a new hydro power station on the Yoshii river. The supply includes a vertical Francis turbine, generator, excitation, automation, electrical BOP, erection, and commissioning. Voith Siemens Hydro installed an electric motor operating servomotor for guide vane control, replacing a pressure oil operating servomotor which requires considerable maintenance work and costs.

Data
Head: 33.1 m
Vertical Francis turbine
4.83 MW turbine output
4.9 MVA generator output
Commissioning March 2005

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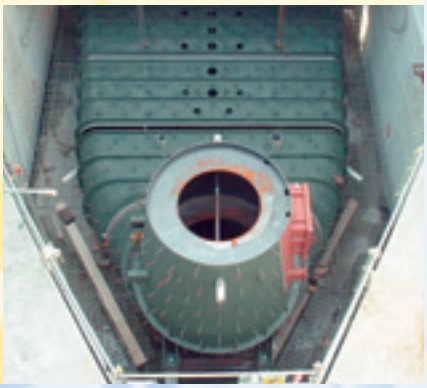
New hydro station on Surikamigawa Dam

The Ministry of Land, Infrastructure and Transport awarded a contract for installing a new hydro power station on the Surikami river. The supply includes turbine, generator, automation, governor, excitation, erection and commissioning.

Data
Head: 51.1m
Horizontal Turgo impulse turbine
1.21 MW turbine output
1.2 MVA generator output
Commissioning April 2004



Wainikasou-Vaturu, Fiji

Voith Esac started manufacturing a horizontal Pelton turbine rated 3 MW and 2 horizontal Francis machines rated 3.4 MW each for two new power plants located on the Fijian island of Viti Levu. Generators are also part of the contract. The hydro plants will replace diesel units presently in operation, and commissioning of both projects is foreseen in March 2004.

Data Wainikasou
Head: 115 m
2 horizontal Francis turbines
3.4 MW output per turbine
Commissioning March 2004

Data Vaturu
Head: 268 m
Horizontal Pelton turbine
3 MW output per turbine
Commissioning March 2004

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New power station for Erathne, Sri Lanka

A new power station will be installed for ZYREX Power Company Erathne, Ltd. located about 100 km south-east of Colombo in the Ratnapura area of Sri Lanka. The work order contains a complete water-to-wire equipment package including two horizontal shaft 2-jet Pelton turbines with approximately 5.15 MW electrical power output each and a plant control system, both of which will be manufactured at Voith Siemens Hydro in Heidenheim, Germany.

Data
Head: 450 m
2 horizontal 2-jet Pelton turbines
5.15 MW output per turbine
Commissioning early 2004

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Way Ganga: The largest privately financed hydro project in Sri Lanka

DIDUL Pvt., Ltd. Is carrying out the largest privately financed hydro power project in Sri Lanka. Way Ganga powerhouse, located about 130 km south-east of Colombo, will get its water via a long channel, including a newly built aqueduct to cross the river valley. Voith Siemens hydro will install a complete electro-mechanical equipment package spanning three horizontal shaft Francis spiral turbines with approximately 3 MW electrical power output each, generators, a plant control system, and the electrical switchgear.

Data
Head: 58 m
3 horizontal Francis spiral turbines
2.93 MW output per turbine
Commissioning end 2003/early 2004

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Efficient automation for small hydropower plants

No power plant can today be operated without at least a minimum degree of automation. The basic goals of automation are the same as they were a century ago. But automation systems today are much more efficient. In addition, remote control and remote operation now play a significant role in the design of power plant automation.

Since the relative costs of energy production decrease while the overall output of a power plant increases, small hydropower plants are under greater cost pressure than large power plants. That applies particularly to automation, as its cost percentage decreases the larger the power plant is. Long pressure pipes, for example, present significant control difficulties for both large and small power plants. These are even more difficult to overcome in small power plants than in large ones, due to the smaller mass of the generating system, thus leading to a higher engineering effort and therefore of course also to higher costs. This basic disparity in costs cannot be entirely eliminated – but it can be reduced. Voith Siemens Hydro has developed the Efficient automation system to solve this problem.

Voith Siemens Hydro's Efficient system offers high performance at low prices

In order to reconcile the demands for high performance and high safety standards on the one hand and for low costs on the other, Voith and Siemens developed the Efficient system for smaller power plants in the course of a reassessment of the companies' products conducted in Heidenheim. The goals of the development project could only be attained by means of standardization – but it had to be standardization of a sort which does not compromise on functionality or performance.

Efficient meets all of the criteria for fulfilling the greatest demands of small hydropower plants: it is highly performant, safe, easily accessible, compact, inexpensive. Thanks to the Voith Siemens Hydro standards and to sophisticated simulator technology, the automation system can now be "pre-commissioned", thus reducing time and risks involved when the

equipment is actually put into service. This does not only bring benefit to the new equipment, it also reduces the amount of working time lost during the modernization process.

Two factors made it possible for Voith Siemens Hydro to meet the high demands for performance and safety while maintaining low costs:
The company drew on its specialized knowledge of equipment and machinery from its many years as a hydropower plant specialist, and thoroughly integrated this knowledge into the Efficient Standard Module. This system was developed concurrently with the Excellent system for large facilities, which created the opportunity for many synergy effects, because many of the basic functional blocks of the Excellent system can be employed in the Efficient system for small power plants as well.

The system has meanwhile been installed in several power plants and tested successfully. The high-quality modules designed to increase the power plants' rates of yield have received particularly high praise.

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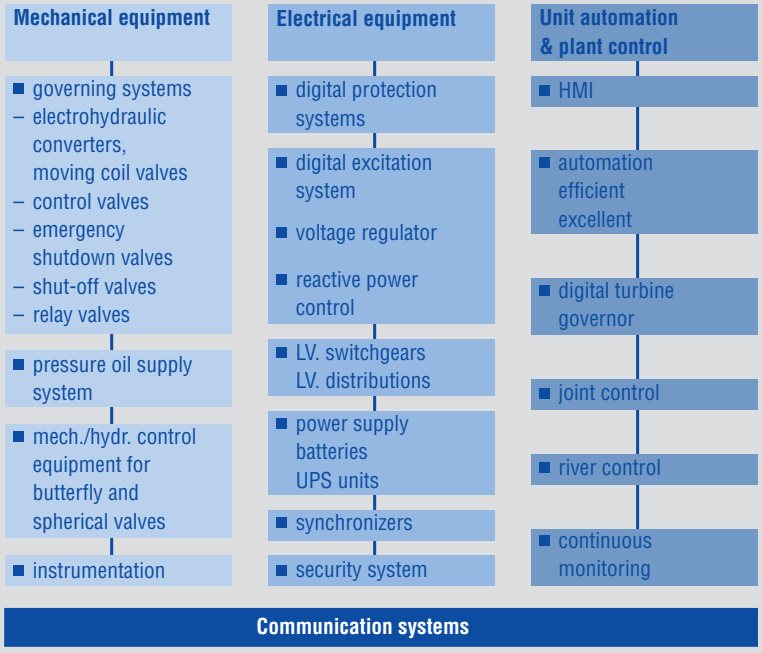
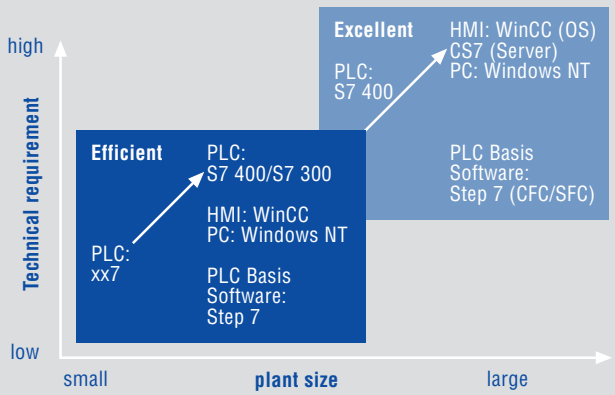
VSHyCon: The Voith Siemens Hydro Control Family – Efficient



VSHyCon System Family



Hydro power in the desert: successful beginning to operations in Pakistan

After more than five years of construction, the first 300 MW turbine for the Pakistani hydro plant Ghazi Barotha was put into service in the presence of the customer, the Water and Power Development Authority (WAPDA). The WAPDA Chairman reported a successful wet test and a smooth start to operations. Ghazi Barotha, located on the Indus River in north-western Pakistan, will provide a total of 1,500 MW once it is completed in June 2004, thus providing for one tenth of Pakistan's electricity needs.

At the end of 1997, Voith Siemens Hydro received a contract to provide the hydro plant with 5 Francis turbines, 5 regulators, and cooling and drainage systems. Now, 50,000 engineer hours, 120 shipments, and 800 drawings later, a new hydro plant has been built: The assembly took place in a desert landscape in heat reaching 50 degrees Celsius.

This project will surely not be the last. Since Pakistan has the potential to produce an estimated 40,000 MW of hydro power, but currently utilizes only 6,500 MW of that capacity, additional projects of this kind can be expected in the future.

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Khopoli connected to the grid

After four years of construction and installation works the last unit of the new Khopoli hydropower station was connected to the grid. With a total output of 72 MW Khopoli equals the electricity supply of a city with around 87,000 inhabitants.

At the beginning of this century, in 1911, a hydro power station with the name Khopoli was already built in the Indian Federal State of Maharashtra. At that time it was equipped with six units with an output of 12 MW each, which are still partially in operation today.

Almost 90 years later end of 1999, Siemens' hydro power section, now merged into Voith Siemens Hydro Power Generation was awarded the contract to built a new hydro power station next to the old one which should be equipped with three units with an output of 24 MW each.

The scope of supply for Voith Siemens Hydro covers three generators, electrical auxiliaries, automation as well as erection and commissioning. The contract came from the private power supply company TATA Power Company Limited, Mumbai, Maharashtra.

The customer expressed his high satisfaction on the efficient new units: the plant now generates more than seven per cent more electricity than before.

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Kiskoere hydro plant model tested successfully

Experts after witnessing the model tests in Heidenheim

The model of the modernized hydraulic systems planned for the Kiskoere hydro plant in Hungary was successfully tested at the testing facilities of Voith Siemens Hydro Corporate Technology Center "Brunnenmühle" in Heidenheim at the end of March 2003. The power plant, located on the Tisza River, around 130 km east of Budapest, is currently being modernized after almost 30 years of service.

Customer present at model test

The model was tested in the presence of the customer, Tiszaviz Vezeroemue KFT, Siemens Budapest as the consortium partner, and experts from Miskolc University, in order to best fulfill all of the guarantees as defined and agreed upon during the bidding and selection process.

Reliable performance for the future

The Kiskoere hydro plant is equipped with four bulb turbines (runner diameter: 4.3 m), which produce 7 MW of power each, at a head of around 6.3 m. In the course of the modernization project, the old runner blades and guide vanes of each machine were replaced with four newly-designed runner blades and 24 new guide vanes.

These measures will help to ensure the reliability of electrical energy supplies in the future, and will also increase the annual production of electricity from its previous 90 GWh.

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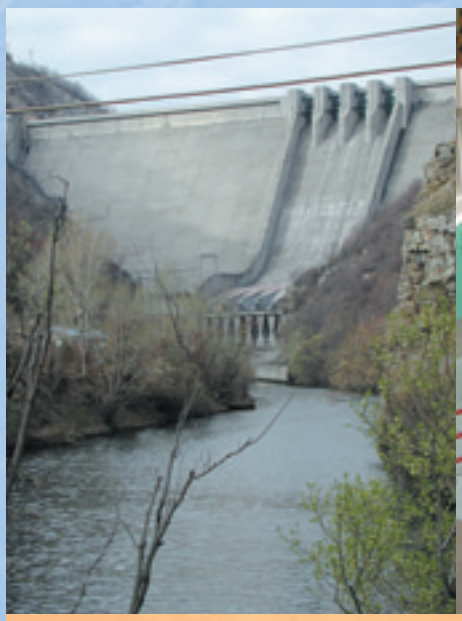
Rehabilitation of Bulgaria's Orfeus and Krichim

At the end of last year Voith Siemens Hydro was granted the contract to rehabilitate the Bulgarian hydropower plants Orfeus and Krichim. The contract, awarded by Natsionalna Elektricheska Kompania EAD (NEK) in Sofia,will be carried out in a consortium with Alstom Power Austria AG.

Bulgaria covers 70 % of its energy requirements with nuclear power and imported fossil fuels. The renovation of the hydropower plants, located near Plovidiv, Bulgaria's second largest city, therefore represents an important contribution to increase the share of environmentally friendly energy in the country's energy mix. Work on the 15 million Euro project began in April 2003 and is to be completed within 36 months.

The comprehensive renewal works include delivery of new mechanical key parts such as turbine runners, wicket gates and regulating mechanism, the supply of new turbine governors, control systems, medium- and low-voltage equipment, static excitation and electrical protection as well as rehabilitation works on worn parts and on the interfaces between old and new equipment.



Dam with spillway at Orfeus reservoir

Insight view of Orfeus power house

The consortium is responsible for basic and detail engineering, supply and project management, software, erection supervision and commissioning.

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Successful frequency conversion modifications and rewinds at Canadian generating station

The small Canadian town of Bishop's Falls, founded in the early 20th century, is situated in a strategically unique location, with access to the vast woodland and water resources of central Newfoundland. Since the turn of the last century, the Bishop's Falls generating station has been accommodating the energy demands of the town's paper mill.

The hydroelectric generators take advantage of the momentum generated by the Exploits river as it flows to the sea from the immense watershed area of the central Newfoundland plateau. The plant has grown from its original capacity of 1,500 kW in 1909 to a rating of 17 MW through several expansions. In the late 1990's, the plant owner decided to upgrade the generating units by installing new turbines in the existing flumes, while at the same time converting the frequency from 50 to 60 Hz. The new turbine design resulted in a higher runaway speed.

When doubts arose as to the suitability of the existing generators for operation with this new runaway speed, Voith Siemens Hydro was asked to perform an engineering study. The new turbine design for the Bishop's Falls Generating Station increased the runaway speed of the units by almost 50 %, and the frequency change altered their normal operating speed from 231 to 277 rpm. Voith Siemens Hydro engineers thoroughly investigated the impacts of these alterations and determined that the existing rotors were not suitable for the new conditions: Stress levels were found to be excessive in a number of areas of the generators. Due to the conclusions of the runaway speed study, Voith Siemens Hydro advised against recommissioning the units without structural modifications. Excessive stresses in the welds and rim could possibly lead to a machine failure. To solve the problem, modifications in the rotor were found to be indispensable.

Following the stress analysis, Voith Siemens Hydro received an order to design and implement modifications that would accommodate the speed increase for the six 1950's vintage generators. From an engineering standpoint, this was quite a challenging task. A non-weld retrofit was desired in order to avoid welding-related

distortion issues, which could have led to increased modification costs and longer outages. The technical strategy was to reduce the load flow through the fillet welds as well as the bending stresses in the rim. Voith Siemens Hydro's rehab specialists installed pre-loaded radial ties to support the increased centrifugal loads that would be produced by the increased runaway speed. In addition, holes were machined in the rotor disks to reduce the stresses induced in the fillet welds.

Working under a tight schedule, four of the units were equipped with new windings to adapt the units to the desired uprate from 2,250 to 3,000 kVA. The remaining two machines had been rewound previously. However, they had to be reconnected from a Delta to a Wye configuration. Furthermore, the engineering analysis had determined that the original field coil interconnectors and coil support hardware were unsuitable for the altered operating conditions. Therefore, redesigned field pole interconnectors and stronger coil support stud assemblies were installed.

While proper planning with experienced hydro equipment suppliers can cover most uncertainties, 50-year-old units can still present a few unplanned challenges. Nevertheless, such difficulties are rather typical of the nature of modernization, and can be effectively addressed by highly qualified personnel applying state-of-the-art analytical methods and technologies. At the Bishop's Falls generating station, all six generators are now operating and performing well.

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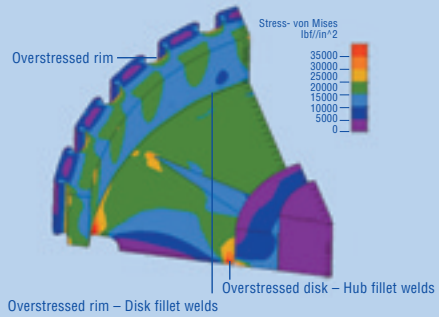
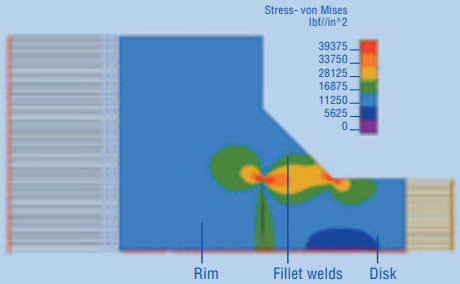
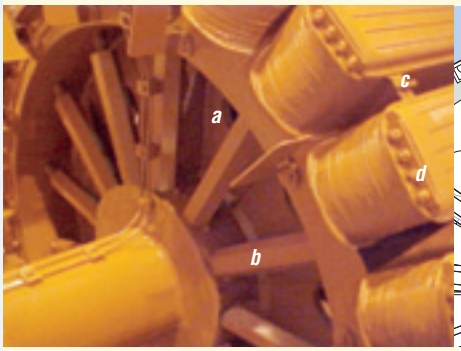


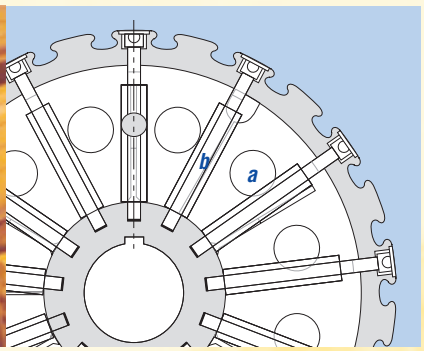
High stress levels predicted in the original spider design at the new runaway speed



High Rim – Spider Disk Weld Stress Levels predicted in the original spider design at the new runaway speed



a *New holes to reduce weld stresses*
b *New radial ties*
c *New field coil interconnectors*
d *New coil support stud assemblies*



a *New holes to reduce weld stresses*
b *New radial ties*

Hydroelectric generator rewinds and modernization

Plant modernization can be an effective way to meet increasing demands for energy without major capital investment. Particularly in older plants, power generation capacity can often be significantly increased by rewinding the generator with redesigned windings manufactured with modern insulation systems. Voith Siemens Hydro in Canada manufactures stator windings and specializes in the uprate and modernization of Hydro Generators.

Uprating and modernizing a hydro generator requires a sound understanding of past and current generator technology. Voith Siemens Hydro has been manufacturing generators for over 135 years and is continually developing and applying improved technologies for the design of new generators. Significant synergies exist in the development of new machine and modernization technologies.

Obtaining the optimal blend of new and old technologies to maximize the customer's return on investment requires specialized knowledge and experience.

Voith Siemens modernization specialists can evaluate any manufacturer's generator to determine its uprate capability. This evaluation requires a review of both the electrical and mechanical characteristics of the machine. By applying state of art analysis and design technologies, generators can typically be modified to provide increased ratings with improved efficiency and reliability.

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Completed stator rewind (Courtesy of Alcoa, Inc.)

Stator bar manufacturing in Mississauga

Events 2003

ELPAH X (Encontro Latino Americano e do Caribe em Pequenos Aproveitamentos Hidroenergéticos), the 10th Latin American and Caribbean Small Hydro meeting, took place from May 4 to 8 in Poços de Caldas, Brazil.

The meeting gathered researchers and professionals from the energy sector, NGOs and government organizations with a broad spectrum of technological, political and environmental discussions. Voith Siemens Hydro not only acted as a main sponsor, but also presented its technology and development for small hydropower plants.

SIMPASE (Simpósio de Automação de Sistemas Elétricos), the Electric Systems Automation Symposium, one of the main forums for the discussion of problems and solutions concerning the automation of electric power generation, transmission and distribution systems in South America. Held its biannual event for the fifth time from May 11 to 14 in the city of Recife, Brazil.

Voith Siemens Hydro presented 14 case studies, giving an insight into their special solutions for the automation of hydroelectric power plants.

Hydro 2003
Dubrovnik, Croatia,
November 3-6, 2003
Booth 54-55

- Our papers presented in the conference:
  - Performance and economic benefits by integration of intelligent supplementary functions into a hydroelectric plant control system
  - Precautions in the modernization of hydrogenerators – how to eliminate old deficiences and avoid new problems
  - Countermeasures to reduce hydro abrasive wear at hydro turbines parts.
- Paper to be published in the conference proceedings:
  - First refurbishment of Kaplan bulb turbines at the Kisköre HPP in Hungary system.

Waterpower XIII in Buffalo, N.Y., USA
29-31 July, 2003, Booth 810

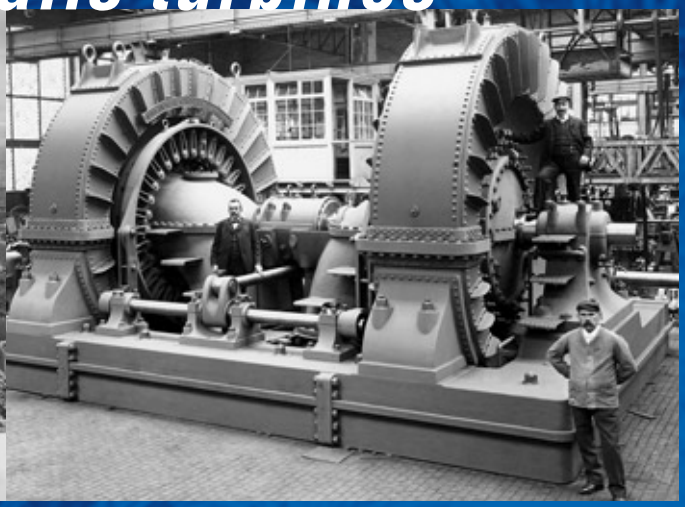
- Papers by Voith Siemens Hydro:
  - Exelon: Automation rehabilitation program at the hydropower plant Conowingo and the pump storage plant Muddy Run.
  - Apgi hydropower modernization – A partnered process approach to system optimization.
  - Optimization of system operation.
  - Wicket gate friction device monitoring system.
- Paper by Avista Corporation, co-authored by Acres International and Voith Siemens Hydro:
  - Turbine upgrade for significant capacity increase at Cabinet Gorge hydro plant.

Deutsch-Chinesischer Wirtschaftskongress, October 22-24, 2003, Grand Hyatt Hotel, Berlin, Germany

- Paper presented by Voith Siemens Hydro, Dr. Konrad Roth, Shanghai
  - China. New opportunities for the capital equipment business.

One hundred years of Niagara Falls turbines

Voith historical poster (Power houses of the Canadian side)



Niagara turbines in 1911

In 1903, the City of Hamilton provided the opportunity for Voith to supply turbines for a new hydro station. Prior to this time, some smaller stations in the area were equipped with machines from Switzerland and Italy.

Walter Voith met with the Engineering Committee that was visiting Europe in search of equipment and technological solutions for the hydro equipment. The committee was impressed with the turbines and technical solutions that he offered and the contract was awarded to Voith in April of 1903. The four Francis spiral turbines that were supplied to Dominion Power and Transmission Ltd. Hamilton had an output of 515 kW at a head of 79.5 m.

This was an impressive machine for the time and two additional units of similar size and output were awarded to Voith in 1910 and 1911 based on the performance of the equipment provided in the 1903 contract.

Additional units were ordered by Ontario Power Company for their new hydropower station located at the base of Niagara Falls on October 1st, 1903. This award was made as a result of the superior work performed at Hamilton even before the units there were commissioned.

Robert Moses Niagara Power Plant

This historical order for Voith provided the most powerful and largest turbines in the world at that time and was based on the trust in the German company's technology and performance. Voith's engineers and workshops were motivated to insure that they would meet the challenges and commitments of the project.

Four spiral twin turbines each with an output of 8,826 kW were provided for the contract. These were followed by three more units from 1908 through 1912 with an output of 9,047 kW at 53.4 m head.

Hanns Voith provided the following personal memories of the Niagara turbines: "As a trainee, I was allowed to assemble the first of the Hamilton turbines at the workshop in the winter of 1903/1904. I also participated in the banquet that my father, Friedrich Voith, gave to the Engineer Commission of the Ontario Power Co. in the Heidenheim dining hall.
My father gave a very good English speech, which was difficult for him, especially if one knew the he did not favour holding speeches". The Niagara turbines were decommissioned in December of 1999 after 95 years in operation. Even though they are no longer connected to the grid, they are still operable. Ontario Power Generation explained that their future status will be reviewed from time to time. Turbines that are still operable after 100 years is an impressive record. Another historic plant, the Decew Falls Hydropower Station, was built in 1904. This plant is close to Niagara Falls and is equipped with Voith turbines and generators from Westinghouse whose technology is now merged into today's joint venture of Voith Siemens Hydro Power Generation.

In addition to these early historical projects, Voith Siemens Hydro Power Generation later supplied the generators for the Sir Adam Beck 1 & 2 stations between 1919 and 1955. Another 13 generators were supplied to a station on the US side of Niagara Falls in 1950. The most recent award for Voith Siemens Hydro in the Niagara Falls area is the contract to rehabilitate the first stator of 14 at the Robert Moses Niagara Hydropower Station. The company is proud of the past and current role it has played in the history of hydropower development at the Niagara Falls.

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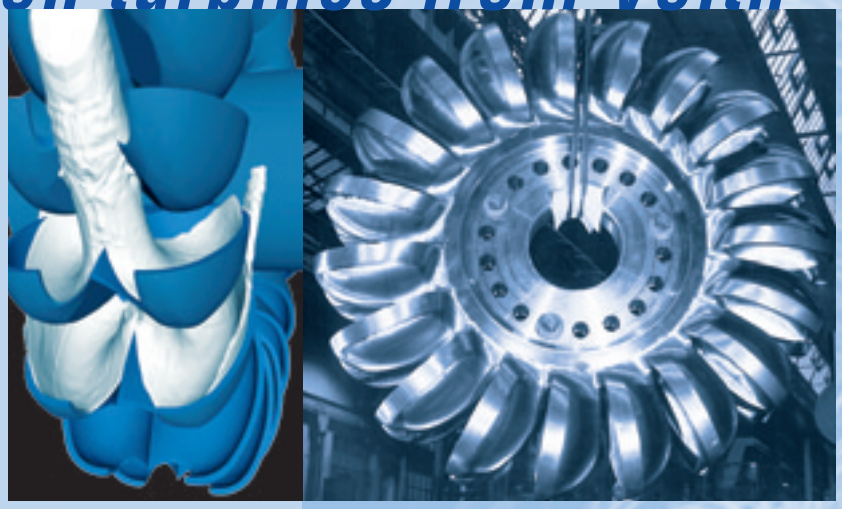
100 years of Pelton turbines from Voith



Exactly 100 years ago, Voith built the first Pelton turbines for the G.N. Gaubitz mill construction company in Mainbernheim, Germany. The first export shipment of a Pelton turbine – to Japan – followed just one year later.

The Pelton turbine is based on an 1880 invention by the US citizen Lester Pelton. Pelton turbines are used for particularly high heads – it is not unusual for heads over 1,000 meters. Water discharged from such a head hits the runner at a speed of 500 km/h.

In the past 100 years, almost 2,000 Pelton turbines for more than 1,100 projects were built. These have been delivered to 55 countries around the globe.

The largest Pelton turbines manufactured by Voith Siemens Hydro were supplied to Italy's Cimego hydropower station in 1953 and the US station of New Colgate with runner diameters of 4.48 and 5.44 meters. The most powerful Pelton turbine was built in 1989 and is located in San Giacomo sul Vomano, Italy, with a capacity of 282.5 MW. New Colgate and San Giacomo also hold the record in bucket widths with 1,100 and 1,030 mm respectively.

The highest head from a Voith Siemens Pelton turbine is 1,404 m, found in the San Fiorano power plant in Italy.

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Italy breaks the records
Voith Riva Hydro, today a member of the Voith Siemens Hydro group, had already supplied 118 micro and small Pelton turbines between 1896 and 1902.

NHA Award to Voith Siemens Hydro

In April 2003 the National Hydro Association in the United States presented its Technical Achievement Award to Voith Siemens Hydro Power Generation and the U.S. Army Corps of Engineers for the J. Strom Thurmond Project.

The award is presented by NHA to recognize projects that demonstrate significant technical contributions to the hydropower industry. Colonel Roger A. Gerber, Commander, Savannah District accepted the award for the U.S. Corp of Engineers and Gregory Snyder, Project Manager accepted for Voith Siemens Hydro Power Generation. The NHA awards committee saluted the Corps of Engineers for tackling an issue of great import to the region with a solution of equal technological enormity. Insufficient dissolved oxygen in southeast rivers is a serious problem at many hydroelectric projects, adversely affecting aquatic life. By employing the latest technology from Voith Siemens Hydro, remarkable results have been realized. Since the installation of the first new aerating runner and a new turbine control system, levels of dissolved oxygen have significantly increased and even exceeded expectations. Voith Siemens Hydro in York, Pennsylvania developed and patented the aerating runner design that also results in an increase in the rated capacity for the units.

The J. Strom Thurmond Powerhouse is located on the Savannah River in South Carolina, 22 miles north of Augusta, Georgia and houses 7 hydro units originally installed in 1953. Completion of the current rehabilitation is scheduled for 2006. The powerhouse is owned and operated by the U.S. Army Corps of Engineers.

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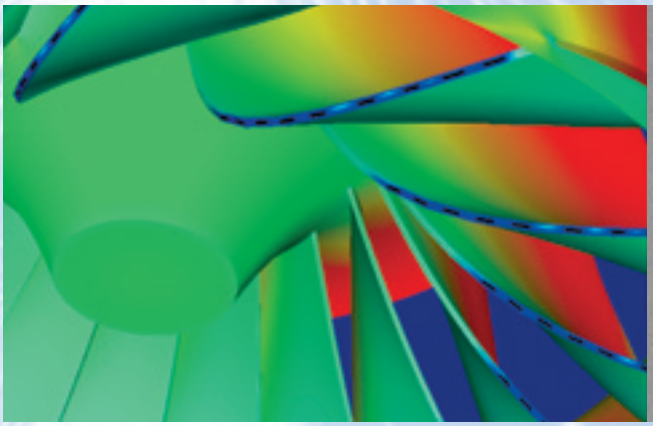
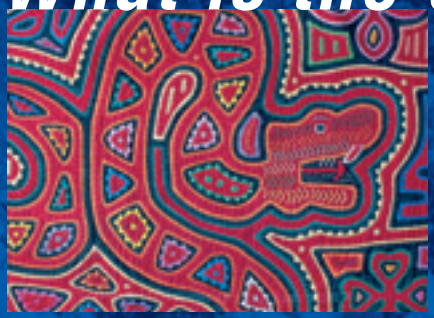


What is the origin of life?



Snakes are often essential parts of myths in many cultures

This is – admittedly – a loaded question, but it can be answered in a reasonably entertaining and colourful way. Life cannot exist without water. Let's look for a reason to this phenomenon first.

From a scientific point of view the solution is complex but logical. Hydrogen is the most abundant element in our Universe. When it encounters oxygen, it reacts with it to form water. The cloud of primeval mineral material out of which our Earth was formed was cold and contained a lot of ice. This cloud was compressed by gravity and thus became very hot. The water contained in the cloud was diffused and formed gigantic clouds of vapour in the atmosphere.

After our planet had reached its final size and temperatures had fallen below 100 degrees as a result of reduced gravitational force, water was also available in liquid form. Part of it evaporates into space and leaves our atmosphere entirely, but since the interior of our Earth contains a lot of water in crystallized form, as springs or as constituted hydroxide water, this loss is compensated for – the total amount of water is actually growing slightly. So much for the technical side of the question.

But how did human beings explain life and the world to themselves before the advent of science? Myths help us to throw light on this question. Myths exist in every culture and are an attempt to paint a complete picture of things we cannot understand. Their approach is a personal one, based on the characters and moods of Gods and Goddesses, to whom human beings are mere playthings.

The oldest and most primordial conceptions are based on the assumption that a snake demon living in and closely linked to the water was the origin of all things.

In Mesopotamia this demon was called Tiamat, the Early Chaos snake that was defeated by Marduk. Marduk cut the snake into pieces, which then formed a division between the waters of heaven and water of lower depths. He then created human beings.

In ancient Egypt a hill emerged from the primeval water Nun and the holy bird Ibis laid an egg that was hatched by the heat of the sun, with the Sun God Re emerging from it.

In China, during the Han Dynasty (206 to 220 AC), people believed that everything had been created from water and that everything lived and

For the papuas a giant tortoise created the first land

developed through water. Water was omnipresent; there was nothing that could not be filled with water. Water accumulates in the sky and on the ground, it is hidden in every object and gives birth to living creatures.

One of India's Hymns of Creation, the Rigveda, puts it this way: "In the beginning everything was unmistakably floods of water." In this primeval water a golden egg began to develop, containing the spirit – Brahma or Purusha. From the two halves of the egg, this spirit stepped out and formed Heaven and Earth.

In the Hindu myth, the God, Vishnu, descended into the watery depths and emerged with the Earth. Even today, Buddhists and Hindus worship water as the primeval substance.

The Papua people in New Guinea believed that in the beginning the surface of the Earth was covered with water. A giant tortoise swimming in this water rested on the water's bottom. With its powerful flippers it shovelled sand upwards from the seabed, and created land.

According to a North American Indian tribe it was a crayfish that pulled the Earth up from the bottom of the ocean and thus created land. For the Algonquians it was the muskrat.

In the Bible, the Book of Genesis says that there was darkness above the primeval flood and the Spirit of God moved upon the face of the waters. The process of the world's creation started by separating the water into Heaven and Earth.

The interesting fact common to all these myths is that our world originates from watery chaos, and only had to be snatched from it. Cosmogony is the doctrine of creation, – the story of a process of transformation accompanied by enormous conflict. An uncontrolled primitive state is transformed into a world of order. In mythological philosophies of life, water has absolute priority above all other elements – it is purely and simply the essence of life.

The fact that we use it to develop our civilizations also goes back to the beginning of time. The intelligent use of the power in water enables us to generate energy, which in turn provides us with all the amenities that make our life safer and more comfortable.

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