THREE GORGES HYDROPOWER PLANT

CREATES EQUIVALENT OF 18 NUCLEAR POWER PLANTS

by Donna Guinivan

Hydro generators from Astom are turning waterpower into electrical energy in the largest hydropower project ever built, the Three Gorges in China.

The world's number one company in hydropower generation is based at the foot of the Alps, in Grenoble, France, where hydropower was born. Casimir Brenier started work on hydraulic turbines in 1854 to convert the power of flowing water into electrical energy. Today, the company he founded is a subsidiary of Alstom Power and the global Technology Center for its hydropower business.

"The US still has the largest hydropower capacity, but Asia, led by China, is the fastest growing market," says Jacques Brémond, Mechanical Engineering Supervisor at the Alstom Turbine Technology Center. "In Europe and North America, power generation exceeds the demands of the population, while in China and India increased capacity is desperately needed."

Filling the energy gap has led to the largest hydropower plant in the world, the Three Gorges on the Yangtze River in China. Alstom is supplying almost half the turbines and generators for the project. The project's greatest challenge was its sheer size. Compare the width of the Three Gorges at 2,4 kilometers to that of a typical dam, which is around 100 meters and you begin to appreciate the scale of the undertaking.

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Runner of 425 tons

The main part of a hydro turbine is its runner, where the water flow is converted to mechanical energy. "The external diameter of the runner for the Three Gorges was 23% larger than any other we had produced before," says Brémond. "It was a massive 10,6 meters in diameter with a height of 5 meters." It was impossible to produce the runners in the Alstom workshop in Grenoble. When completed they needed to be transported over the town's bridge, but a single runner's weight of 425 tons was greater than the bridge's 300-ton weight limit.

Consequently, the runners were manufactured in a specially constructed

In a gravity dam, the water flows down from a reservoir into a hydro turbine. It enters the runner from one side via a spiral case, which distributes the water around the turbine. A distributor with adjustable wicket gates in the turbine controls the flow of water circulating in it. The energy of the water (head and flow) transforms into mechanical energy (torque and rotational speed). This then converts to electrical energy within the generator connected to the same shaft as the turbine. Once the water has been through the runner it goes down a draft tube back into the river.

workshop in La Ciotat in the south of France. The runners were transported by sea to Shanghai and then transferred from oceangoing vessels to riverboats. It takes six of these just to carry the draft tube elbow.

Bearing tests

For the bearings, Alstom started working with Trelleborg nearly 10 years ago. "We were unable to specify Orkot bearings on the left bank of the Three Gorges," says Brémond. "We had little experience with the product at that stage and the customer requested that we design in a known solution."

To support their product, Trelleborg provided details of two independent tests on the bearings specifically for this application. "Based on these reports, we decided to trial it in the wicket gate lower bushes during refurbishment of a Francis turbine in the Liu Jia Xia dam in China. After a few more tests in application, the product seemed successful and was first fitted in full scale on turbines supplied to the Alqueva Hydro Power Plant, Portugal commissioned in 2004," says Brémond. "After this experience, when specifying equipment for the right bank of the Three Gorges, we persuaded the customer that this type of bearing would be a good alternative.«

How the runner works

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There were three main reasons for building the Three Gorges dam. The first was to regulate the flow of the Yangtze. Its notorious floods have claimed an estimated one million lives in the past one hundred years.

Orkot bearings are "fish friendly". Most metal bearings need grease to make them work properly and during operation this lubricant goes into the water. Orkot material has excellent friction characteristics, which means no grease is required.

The second reason was to make the river navigable into the center of China. And the third reason for the dam was to generate power. The hydropower plant is expected to create as much electricity as 18 nuclear power plants. It will provide an estimated one-ninth of the nation's energy and replace 40 to 50 million tons of raw coal combustion each year.

An exciting moment

Olivier Calemard is account manager for Alstom at Busak+Shamban France, a part of Trelleborg Sealing Solutions. "Ten years ago the only products we supplied to Alstom were Orkot Wear Rings," says Olivier Calemard. "When I first arrived at Alstom with my 'plastic' bearing they laughed a little. It was so light compared to the metal ones they used; they could not believe it would be strong enough to do a good job." Getting Alstom's business was an uphill battle, but Calemard is certainly not one to give up. "We had to prove that Orkot could stand up to the task," Calemard says. "Alstom would not risk specifying an unreliable component. The cost of replacement of a failed bearing is huge. It took time and lots of independent research and test data to convince them to use the product. Now, however, it is regularly used in the majority of their installations." Orkot bearings are developed and produced at the Busak+Shamban associated manufacturing company Trelleborg Sealing Systems Rotherham. They are also manufactured at Trelleborg Sealing Solutions Eugene for the American market. Due to the scale of the Three Gorges, the two sites worked together to fill the order and shared technology. "We do benchmarking of processes across the two sites," says Barry Davies, General Manager of Trelleborg Sealing Systems Rotherham. "This is to ensure product consistency. Working on a project like Three Gorges brings this requirement right to the forefront." <<


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