
Photos: Hydro-Solar

The new Trempel Power Plant on the Thur River is the biggest plant in Toggenburg, Switzerland. It generates an annual output of 8 million kWh on average.

TREMPEL POWER PLANT SHINES IN NEW SPLENDOR

The old Trempel power plant, which was built in the 1920s, had an output of about 350 kW. With a change of ownership a new era began for the plant. During the building season 2007 the traditional power plant was completely reconstructed in a way to respect nature and the surrounding landscape. The outcome was truly satisfactory. Due to two new Francis turbines with a spiral-shaped inlet the output has increased to 1800 kW and the annual production has tripled.

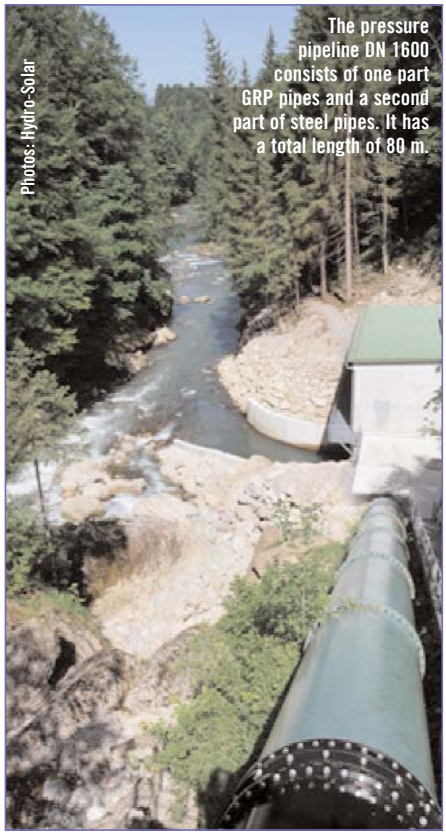
Ever since the 19th century, power has been generated from the Thur River at the natural slope at Trempel-Krummenau, Switzerland. The old plant always fitted perfectly into the romantic landscape at the remarkable gorge. The site itself has always been a beloved route for wanderers. When purchasing the property and the power plant, the owners knew they were responsible for rebuilding the power plant in harmony with the surrounding landscape. The plant was originally built in 1924. It was partly reconstructed twenty years later, but only minor changes had been made since then.

The new owner planned to rebuild the river power plant in two steps using the already existing energy potential at the barrage to its full extent. On April 10th 2007 the plant was shut down and construction began. It only took about 7 months to complete the construction on the plant.

WATER CATCHMENT - A MAJOR FACTOR

For the general contractor Hydro-Solar Engineering the main aspect of the rebuilding project was the design of the water catchment. The water catchment remained on the same spot, as a river diversion on the outside of the Thur River's bend. It consists of a solid barrage, a bottom outlet with an attached flap gate, an intake structure, a sedimentation basin with a pressure pipe intake as well as an equipment room including electromechanical devices for the new catchment. Seasoned bed load is washed out through a huge bottom outlet (1.65 m x 4 m). The attached flap gate and the scumboard, before the intake into the sedimentation basin, drain off rough near-surface floating debris and floating ice. The gravel barrier sticks out and hereby diminishes the amount and size of the gravel components that are transported into the water catchment

A second analysis showed that the two identical Francis turbines were more ideal than the previously intended double regulated Kaplan turbines for reasons of a smaller installation depth.



Photos: Hydro-Solar

The pressure pipeline DN 1600 consists of one part GRP pipes and a second part of steel pipes. It has a total length of 80 m.

by the current. Following the basin, the head gate is responsible for the shutdown of the plant in case of outage or high water. The head gate works as a safety closing device and as a stop log. It is controlled hydraulically. However, in case of emergency it closes only through its dead load. A fine rack cleanses the process water from small floating debris before it is washed into the sedimentation basin. An automatic trash rack cleaner runs over the rack regularly.

1 METER ADDED IN HEIGHT

The old concrete weir plant had been pulled down and replaced with a new barrage, which was lifted by 1 m. The outside granite cover shows an improvement in design. "With the flap gate turned over, we achieve a free flow breadth of 33 m. This guarantees a harmless drain of the Mean Diurnal High Water Inequality DHQ of 350 m^3/s," degreed engineer Markus Hintermann from Hydro-Solar explains. The water level is about 3.10 m above the weir crest. The upper section of the 80 km long pressure pipeline DN 1600 has been set up as a GRP pipe. The steep section, which is exposed to more rock slides, has been installed as a steel pipe.

At first the residual flow rushes through the water catchment at a fixed rate of 415 l/s. Through the rinsing channel the water then enters the trash rack cleaner. The upper edge, breadth and the longitudinal gradient of the rinsing channel are constructed in a way to ensure that an exact amount of 415 l/s enters the tailwater of the Thur River at steady, turbine-controlled water levels. The water level at the dam is constantly recorded and the outlet residual flow can be controlled at any time. The length of the residual flow stretch, from the weir sill to the water return, is 150 m.

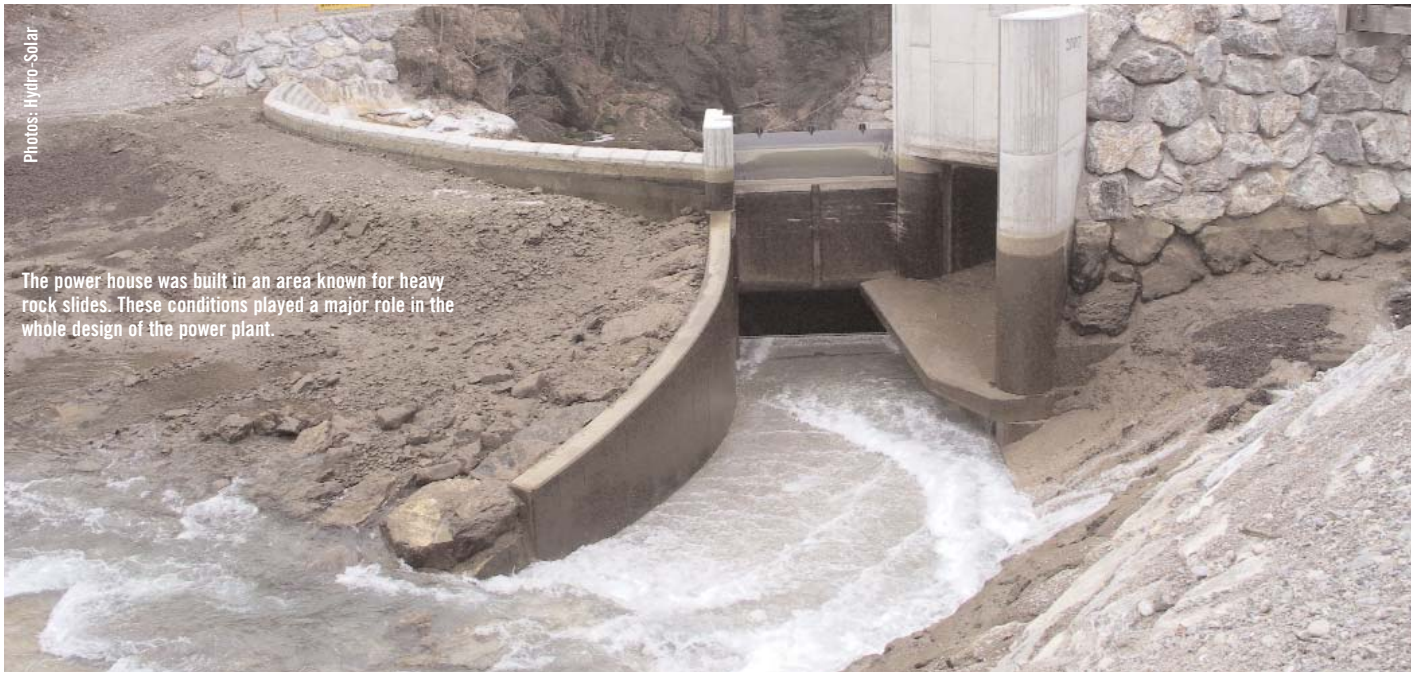
DECIDING ON THE RIGHT TURBINES

The original concept was to vertically install a double regulated Kaplan turbine. "Due to the cavitation conditions of that rough area with massive rock slides, a deep installation position combined with a steep attachment of the outlet region to the Thur riverbed would have been necessary. This would have increased the risk of silting-up the outlet region of the Thur River, which is known for carrying a heavy amount of seasoned bed load," says the project manager of Hydro-Solar. Since the owners were aware of the great geological risks of the deep installation position, they decided to have the turbine concept analyzed once more during the public tenders.

And indeed, the profound analyses showed that the concept had to be reviewed. The owners agreed on two identical Francis turbines. A higher positioning of the turbines has diminished the excavation depth of the power station by 3.5 m and has resulted in about the

Technical Data:

Design Flow: 6.2 m^3/s
Gross Head: 26.27 m
Turbines: 2 Francis Spiral Turbines
Turbine Brand: Wiegert & Bähr
Design Output: 1.800 kW
DRL: GRP and Steel DN 1600
DRL: 80 Meters
Generator: Hitzinger Asynchronous Generator
Energy Capability: approx. 8 GWh


Photos: Hydro-Solar

The power house was built in an area known for heavy rock slides. These conditions played a major role in the whole design of the power plant.

same energy capability per year as before. "Of course this meant an increase in the costs for electromechanical equipment. But minimum risks during construction work and a decrease in the construction costs have compensated for the investment," Hintermann admits.

CHANGE OF PLANS THROUGH FIT

The two vertical Francis turbines, manufactured by Wiegert und Bähr, have a rated water volume of 4.0 m^3/s each. Regarding the original two-steps construction plan, the absorption capacity of the turbine would have been limited to 3.1 m^3/s at first. The completion of the construction would have been possible only in a second step. But lukkily, political changes in Switzerland spoiled the original plans of the power plant construction firm. In light of the newly enacted FiT (feed-in tariff), the canton promptly ratified the applied concession extension for a rated water volume of 8 m^3/s.

Both turbines are directly connected to the generator. The machine group consists of a combined axial and radial bearing on top of the generator. The guide bearing is set as water lubricated bearing.

FLUCTUATING WATER VOLUME

The direct drainage basin at the water catchment of the Trempel power plant spreads across an area of 165 km^2. Its biggest part is covered with vegetation or woods. There are no glacial zones. In the area around the Säntis mountain and the Churfirsten mountain range only summits and ridges above 1800 m sea level are extremely rocky. The Thur River depends highly on precipitation and therefore shows huge seasonal fluctuations of runoff. For years the Thur-Bütschwil station has recorded all measured data, which were the basis of calculations for dry and wet years. The amount of usable water in an average year is 122 million m^3, 45 % of which is measured during the winter season and 55 % in the summer season.

ELECTRICITY FOR 2000 HOUSEHOLDS

It only took about 7 months to complete the construction on the renewed plant. As early as mid-November 2007 the power plant was put into commercial operation again. State-of-the-art technology now controls the entire plant. The operators are able to check, monitor and control the plant via an internet-based supervisory control system.

The energy capability per year has increased to 8 million kWh since the plant has been completely reconstructed. The output has tripled compared to previous results. Furthermore this electricity yield saves carbon dioxide emissions of approximately 2.800 tons. The renewed Trempel power plant generates clean electricity for about 2000 average households. The traditional power plant itself shines in the same splendor as it did back in its old days.


Photos: Hydro-Solar


Construction and pipeline works were rather complicated due to the rough geological conditions.