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PIONEERING SOLUTIONS FOR A MODERN POWER STATION IN WESTERN AUSTRIA

Vorarlberg is consistently pursuing the expansion of its hydroelectric capacity. The new Alvierbach Oberstufe power plant officially commenced operation mid-February of last year. A stretch of the river upstream from the more than 100-year-old Alvierwerk power plant in the village of Bürs has now been equipped to generate hydroelectric power. A multi-partner group power plant was realised according to the latest industry criteria under the supervision of illwerke vkw. The expertise of the industry specialists of Wild Metal from South Tyrol had to pass some extreme tests concerning the construction of the water catchment infrastructure which required the development of a new custom-built solution. Today, the new machine room houses a 6-nozzle Andritz Hydro Pelton turbine that produces sufficient electricity to serve around 1700 households in the Austrian province of Vorarlberg.

Austria’s Brandnertal is a valley that runs from the highest peaks of the Rätikon mountain range all the way down to the town of Bludenz, not far from the Swiss canton of Graubünden. Lake Lünersee is the largest alpine lake in the Province of Vorarlberg and the picturesque scenery of the Brandnertal has made it a well-established tourist hotspot in a region also known as the ‘Ländle’. The natural water supply of the Brandnertal flows down the Alvierbach, a lively natural source river. The lowest section of this body of water is channelled through the Alvierwerk I hydroelectric power station. The original infrastructure here dates back to 1911 and constitutes one of the oldest small-scale hydropower plants in Vorarlberg. However, above 830 m above sea level, apart from a tiny watermill for self-sufficient power generation, the Alvierbach has not been used to produce electricity. This changed radically with the plans submitted by Illwerke VKW. “An official group partnership had to be established to implement the Alvierbach power station plans. Alongside Illwerke VKW, the main initiators with an 80 percent share, the project also involves the villages of Brand and Bürs, the town of Bludenz, the Bürs Agricultural Cooperative and six private individuals. Proof that a wide range of bodies and interests can harmonise extremely well”, declared Rainer Salomon (Ing.), retired former head of the bureau for small scale hydropower plants.

TOPOGRAPHY POSES A LOFTY CHALLENGE

“The site for project implementation was officially announced long ago. Local topography, a catchment area of 33.7 km² and the relatively constant flow volumes carried by the Alvierbach, meant conditions
were well-suited to the needs of a small-scale power plant," stated Project Manager Martin Neuhauser (Ing.) from the engineering department for small-scale hydropower plants at Illwerke VKW. An economically viable and technically practicable plan to exploit a stretch of the Alvierbach above the existing Tschappina basin of Alvierwerk I, and a total available drop of 138.5 m, was drafted in cooperation with the planning office at Breuß Mähr Bauingenieure GmbH in Koblach. The concept involved the installation of a diversion plant that would draw its works water from a 3.1 km diversion channel leading from the catchment basin at +/-1000 m above sea level and down to the new machine room. This entailed solving a number of special technical challenges, particularly those regarding the penstock. “The topographical conditions on site forced us to guide the course of the penstock up a considerable rise after the first 2 km. After around 1.2 km the water had to be conveyed over a distance of about 800 metres from markedly lower point up to its maximum height. Due to the steep banks along the course of the channel, without raising it to this height it wouldn't have been possible to install the piping along the course of the river”, explains Rainer Salomon.

SPECIAL WATER CATCHMENT

The works water collects in a compact Tyrolean-type weir. From here it cascades over an overflow edge into a small pool designed to slow flow-speed, and where a gravel trap is also installed, and then on to a desanding zone. The underground desanding installation consists of two parallel rows of Grizzly Optimus Coanda rakes, a popular product sold by the South Tyrol-based steel component hydroengineering experts at Wild Metal. The works water flows left and right from a central channel over a slot sieve to separate out fine floating debris and the system has a maximum intake of 1.8 m³/s.

The planner Markus Mähr declared that the basic maxim for planning the collection system was to reduce the number and length of rinsing cycles to a minimum: “The reason for this was because processed works water is then fed directly into the collection system of the down-river power station. In order to ensure its operation was disturbed as little as possible it was necessary to reduce flushing cycles to a minimum.” The solution for each part was an in-line series of 12 Coanda rakes. Natural push and organic drift usually ensure the debris is continually flushed past. During project conceptualisation, great emphasis was placed on ensuring the prescribed volume of residual water was also used for flushing purposes. “We designed the volumes of the distributor channels to be significantly less than those of conventional desanding chambers. That's why we can flush everything through faster at lower water volumes.” Another advantage in deploying Wild Metal Coanda rakes was the more compact set-up of the desanding infrastructure, since the Coanda system doesn't rely on lower flow speeds to settle out fine sedimentation.

Technical data

- Flow rate: 1,800 l/s
- Net head: 127.00 m
- Rotation speed: 500 rpm
- Number of buckets: 20
- Generator: synchronous
- Current: 1,840 A
- Penstock length pt1: 1.9 km DN1000
- Penstock length pt2: 1.2 km DN1200
- Planning: Breuß Mähr Bauingenieure
- Coanda rake: Wild Metal
- Annual capacity: 8.5 GWh
- Gross head: 138.50 m
- Bottleneck capacity: 2 MW
- Turbine: 6-nozzle Pelton turbine
- Manufacturer: Andritz HYDRO
- Nominal output: 2,200 kVA
- Manufacturer: Hitzinger
- Material: ductile cast-iron pipes Duktus
- Material: GRP Amiblu
- Construction time: 1 y
- Coanda type: Grizzly Optimus
- Commissioning: Februar 2019
6-NOZZLE EFFICIENCY

The compact machine room directly above the Tschappina basin now houses an extremely sturdy machine group consisting of an Andritz Hydro 6-jet vertical-axle Pelton turbine and a directly coupled Hitzinger synchronous generator. As well as the need for efficiency, the experienced operators placed great emphasis on ensuring the infrastructure required minimal maintenance and guaranteed extreme longevity. The turbine was customised to process a maximum flow volume of 1.8 m³/s with a net head of 127 m and has a nominal output of around 2 MW.

To assure maximum turbine efficiency, the globally-active hydroelectric industry business chose to mill the Pelton wheel from a single steel block. It has 20 Pelton wheel buckets – crafted according to the latest design standards for hydraulic infrastructure. Another special quality of this machine is its small-load capability. “The machine group can keep supplying power to the mains grid, even during the coldest winter months of January and February when works water availability is low. The power plant is still capable of producing electricity using a single nozzle and an output of 5 – 10 percent”, explains Stefan Geiger, Project Manager for Andritz Hydro. The turbine is directly coupled to the shaft of the generator rotor. In regular operation it will rotate at 500 rpm. The 3-phase-AC generator was manufactured by a well-established engineering business, Hitzinger of Linz, and set up for a nominal power output of 2200 kVA.

1-YEAR IMPLEMENTATION

The planning phase for the Alvierbach plant commenced in 2013. However, it took a number of years before all the requisite permits for project-related building work had been granted. Work began for real in the summer of 2017. “Obviously, construction work couldn’t be carried out in the winter. Nevertheless, we managed to complete the plant construction in a net building time of one year. As Martin Neuhauser points out: “We commenced electricity production at the plant at the beginning of 2019.” He also provided a very positive summary for the first year of operation: “In the initial year we produced in excess of 10 GWh, approximately 20 percent more than the forecasted annual output of 8.5 GWh.” In an average year, this provides clean energy for approximately 1700 households in Vorarlberg.

A MAJOR STEP TOWARD ENERGY AUTONOMY IN 2050

Overall, the Ländle-region project partners invested around €7.5 million in the new Alvierbach power plant. At the end of last October, investor representatives, political functionaries and a veritable horde of decision-makers gathered at the plant for a modest official inauguration ceremony. During the ceremony, Harald Sonderegger, President of the Regional Parliament, declared the power plant to be another significant step towards the goal of energy autonomy for 2050. He reasserted the commitment of Vorarlberg’s provincial government to the continued expansion of hydroelectric capacities in the region. Illwerke VKW chairman – Helmut Mennel, the CEO of the newly-founded Kleinkraftwerk Alvierbach GmbH – Stefan Kaufmann, and the Project Manager – Martin Neuhauser all provided a very positive review of project implementation.