

SMALL HYDROPOWER STATION WITH THE CAPACITY OF 75 KW IN WOLICA

Sector: Water energy use

Timeframe: 2013

Location: Wolica



PROJECT BACKGROUND

The dam located in Wolica (village near Kielce), at the 10 kilometre of the Black Nida river, was used for economic purposes for over 160 years. The oldest confirmed mentions of the structure come from the 19th century and concern a wooden mill powered with twin breastshot wheels. During the mill's modernisation in 1932 a modern Francis turbine with the capacity of 32 HP was installed. In 1995, following the nationalisation decree, the mill was taken under the state ownership and nearly completely devastated. After 25 years it was possible for the rightful owners to buy the mill building back and restart its operation, which continued until 2001, when the flood destroyed part of the equipment. The need for conducting necessary repairs, as well as progressing economic changes, induced the owners to transform the mill into small hydropower station (SHS). The works included fundamental renovation of the Francis turbine and reconstruction of the turbine cage. Two years later the SHS in Wolica was equipped with additional propeller turbine with the vertical shaft and the capacity of 26 kW, which was placed in a siphon chamber. That is how the plant had been operating until 2013, when modernisation works started.

PROJECT DESCRIPTION

Modernisation of the hydropower station included disassembly of the original station's building and both turbines, construction of the reinforced concrete trough for the Archimedes screw and a cage of the Kaplan turbine, reconstruction of the feeding canal and installation of an intake pipe. The feeding canal structure and the turbine cage serve as a footing for the new SHS building. In order to ensure architectural cohesion with the neighbouring closed-down mill, the building's façade was covered with natural limestone. Building's corners, window openings and door openings were surrounded with a brick, also corresponding to the mill. The renovation works didn't cover the dam (made from reinforced concrete and steel) and the stone spillway. The key stage of the works was the installation of new turbines. Previous hydroelectric generating sets didn't use the full potential of the Black Nida river, therefore the owner decided to replace them with new devices: Kaplan turbine and Archimedes screw turbine, which are better adapted to the local hydrological conditions. They have the capacity of 45 and 30 kW respectively and are adjusted to work with a 2.2-meter waterfall. Achieved torque is transmitted to asynchronous generators through toothed gears (two-stage unit for the Kaplan turbine and three-stage unit for the Archimedes screw turbine). Generated electricity is fed into the electrical grid through the transformer station.



Few ways of controlling hydroelectric generating sets were foreseen in Wolica's SHS - manual control mode allows for starting up any of the two turbines or of both of them simultaneously. Automated control mode allows for starting them up in an optimal way - the system was programmed assuming that the Archimedes turbine will work at low flow, Kaplan turbine will work at medium flow and both of them will operate together, when the water flow is close to maximum. Both the Kaplan turbine and the Archimedes screw turbine cooperate with modern control systems. Additionally, among others for research purposes, the plant was equipped with the inverter system enabling smooth change of the generator's rotational speed, which allows for reaching higher efficiency of the generating set at specific hydrological conditions. Depending on the settings on the operating panel, the inverter can work either with the Kaplan generating set or with the Archimedes one.

The technical concept of the enterprise was prepared by the RES Institute, which also conducted full formal and legal procedure, which ended with obtaining the construction permit. The Enerko Energy company designed, delivered and started up the hydroelectric generating sets (including mounting bearing, installation of elements transmitting drive and installation of generators). The company was also responsible for the production and delivering

of the elbow intake pipe and the screw valve, as well as for the construction of the hydropower plant's building and the electrical connection.

Installation of two turbines with different construction and characteristics, which were tailor-made for the plant, made it possible to increase plant's annual production from 180 MWh to 270 MWh. The plant can supply with electricity nearly 160 households and thus allows to reduce hard coal consumption by approx. 130 tonnes per year.

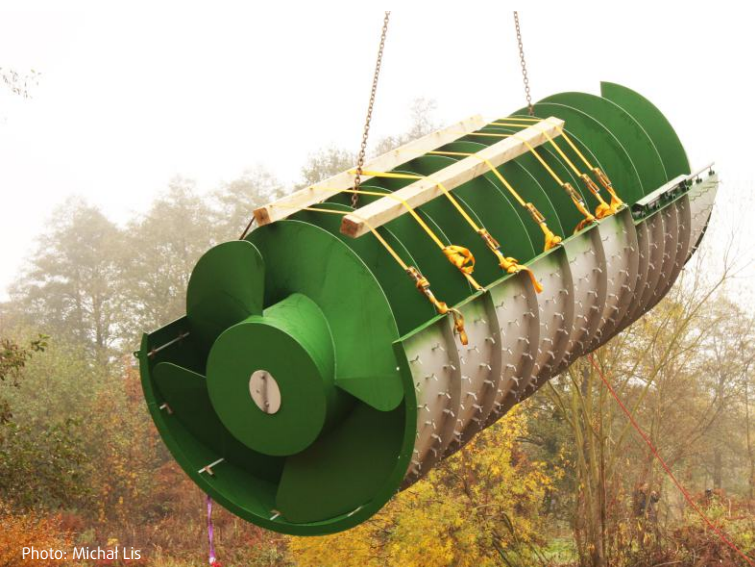


Photo: Michał Lis



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PROJECT RESULTS

Small hydropower station in Wolica not only generates clean energy, contributing to the reduction of air pollution, but also has positive impact on local hydrological conditions by raising groundwater level over the dam. Increasing so called "small retention" helps to improve biodiversity and to minimise negative impact of the dry weather periods, which are especially bothersome for the agriculture. The hydropower plant also decreases the bottom erosion over the dam. According to the provisions of the permit required by the Water Law Act, the owner of the SHS is obliged to maintain the river bed in a good shape, both within the object and in its nearest neighbourhood. These activities help to keep the river bed clean and to secure the scarps, which reduces the threat of flooding neighbouring areas during high water. SHS in Wolica also works as a "river vacuum cleaner", which catches all anthropogenic waste carried by the river. It is worth to mention that the Archimedes screw turbine is friendly for the fish, which is a result of its low rotational speed, open and pressure-free construction, large working areas filled with water and low level of turbulence.

Small hydropower station in Wolica is also one of the tourist attractions on the Black Nida kayak route.



DEVELOPMENT PROSPECTS

Important arguments for the development of small hydropower plants were given by the study conducted within the RESTOR Hydro project, which ended in 2015. Within the project 6 thousand of different types of dams and old water mill installations were identified on the territory of Poland. They are potential locations for future investments in SHSs.



MORE INFORMATION

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