SHPP ZAGRODY – **AN IDEA FOR AN OLD MILL**

Small Hydroelectric Power Plant "SHPP Zagrody" was put into operation in September this year. It is already the fortieth SHPP functioning in Świętokrzyskie Voivodeship and the fourth which uses the technology of hydrocomplex in the form of Archimedes' screw. For realization of the project responsible was the project company Instytut OZE Ltd. The power plant equipped in Archimedes' screw, provided by Enerko Energy Ltd., produces electric energy at the level of 150 MWh annually.

Photo: Construction area during installation of Archimendes' screw, on the photo we see the old hydrotechnological system, supplemented with the newly built fish pass.

The small hydroelectric power plant has been build in the immediate conservation zone – of the complex of water mill in Markowizna, in Sitkówka-Nowiny commune. It is the best preserved mill in the commune, with working water system which had to be preserved as an example of a complete installation. Water mills are the monuments of technology of great significance due to the industrial traditions of the commune. Archimedes' screw uses the potential of historically industrious river Bobrza. Industrious because it used to supply a number of factories and mills. Only in the Sitkówka-Nowiny commune's area 3 water mills were located. Bobrza, being a right and the longest tributary of Czarna Nida, flows through the Nothern, North-Western and Western edge of Świętokrzyskie mountains. It is 48.9 km long, and the terrain of its catchment occupies 379 km^2. Localization of the new SHPP is in the lagging of Chęciny-Kielce Area of Protected Landscape.

PROJECT WORKS

The process of preparation of the investment lasted over 2 years. Due to the attractiveness of nature of the localization and environmental conditioning, it was necessary to carry out the assessment of its influence on the environment and to design a fish pass. The environmental decision about water-legal permission and remaining agreements and permissions indispensable for obtaining the decision of permission for construction were made by the company Instytut OZE Ltd. Due to the fact that the investment was being realized in an immediate neighborhood of a monument of technology, the existing part of it had to be preserved. Installation of the Archimedes' screw was designed in parallel to the existing turbine cage where a water turbine used to work for the mill's needs. The elevation of the building of the new SHPP was covered with natural lime stone in order to maintain architectural consistency with the neighboring building of the historical mill. In addition, the owner of the object used the space between the channel of the Archimedes' screw and the residential building for construction of a recreation terrace. Finally, the entire object looks unusually attractive. It is a great example of an adaptation of a historic mill not only for the purposes of a new hydroelectric power plant but also of taking advantage from the charm of localization and of creative use of this potential. Instytut OZE has big experience in designing new hydroelectric installations in the areas of water mills, often devastated. The portfolio of the company includes already over a dozen of such revitalizations. The company works on complex design of small hydroelectric power plants including obtaining necessary administrative decisions based on the proxy granted by the investor.

ARCHIMEDES' SCREW

SHPP Zagrody, equipped with asynchronic generator Cantoni Group, is able to generate 37 kW. The element which distinguishes this installation is the inverter system made by ABB, which enables work with variable rotation speed ensuring maximum use of the potential of flowing waters. The Archimedes' screw was made as a steel construction hanged on the edges in bearing made by FAG. The angle of the turbine axis in relation to the level is 22°. The screw itself consists of a steel tube and Archimedes spirals wrapped on it with a diameter of 2600 mm that are angularly offset from each other by 90°. The hydrocomplex was placed traditionally on a concrete steel gutter. Enerko Energy Ltd. also has in its offer Archimedes' screws built in self-supporting steel structure and Kaplan turbine in various systems of S, PIT, Z types and of vertical axis. Apart from providing water turbines, the company also offers services of complete construction of small hydroelectric power plants.

AUTOMATICS OF SHPP

The control and automation system of the power plant is based on the programmable modular PLC of ABB production and the HMI panel enabling setting param-

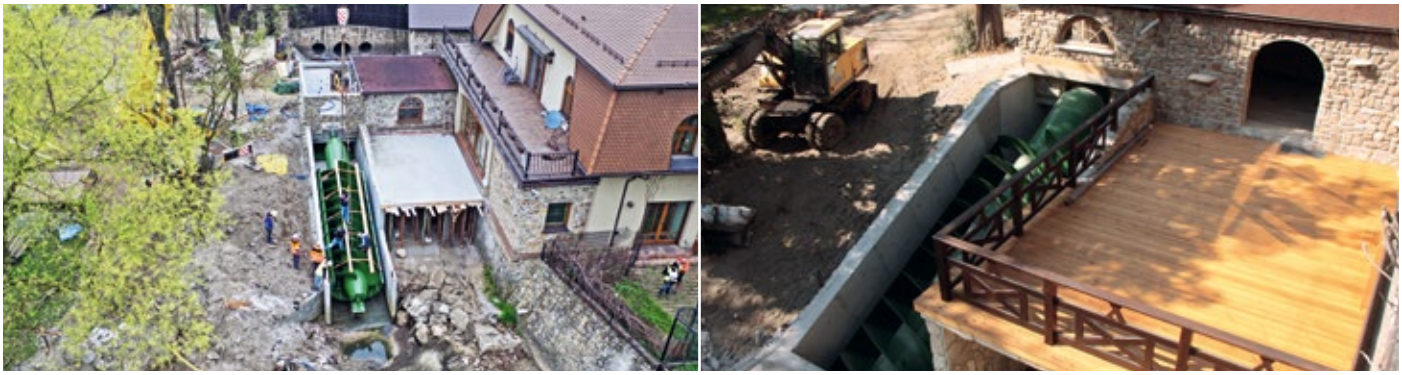
Table: Summary list of the main technical parameters of the hydro unit

Type of turbine	Archimedes screw
flow rate	2.0 m^3/s
head	2.5 m
runner diameter	2 600 mm
runner speed	22.3 rpm
installed capacity of the generator	37 kW
average annual production	150 MWh

Source: Enerko Energy

Photo: From the left – historical turbine case, revitalized water mill before transformation into SHPP

Photo: From the left. A challenge during installation of Archimedes' screw was its transport from the semi-trailer to the channel because of high trees located in the immediate neighborhood. Development of the old outlet channel into recreation terrace.



eters of work of the hydrocomplex and updated screening of current electric and mechanical parameters. The operating panel is equipped with the port of Ethernet standard and software enabling online view on selected computer connected to the Internet, according to the same rules of access that direct operation. The controller having modular construction allows a hassle-free extension of its functionality in additional modules. The controller is powered by constant voltage 24 VDC by buffer power supply equipped with gel batteries enabling work in case of power failure. In normal conditions it functions as an automation system power supply and battery charger. In case of power failure, it automatically switches off it and transfers power from the batteries. After return of power, it charges batteries. The controller is collecting up to date signals from a number of installed sensors as well as of gauges of network parameters. The most important monitored elements include:

- rotation speed,
- temperatures,
- water level before and behind the grille,
- logical positions of the equipment,
- water flow through the turbine,
- the level of dam opening,
- energy quality,
- energy production,
- level of hydraulic power.

The power plant uses an inverter system thanks to which a smooth change of rotation speed of the generator is possible, what, at particular hydrological parameters, enables obtaining higher efficiency of the hydrocomplex. The power plant has also been equipped with information system SCADA for communication, monitoring and archiving of exploitation parameters of the power plant, thanks to which there is a possibility of efficient constant remote control over proper work of this object. The solutions used here allow making work of the object's operator more efficient through the remote collection of measurement data from the power plant work and archiving them. In turn, the implemented software enables showing data in the tabular, numeric or graphic form, what increases correctness of functioning of such installation, enables optimization of work, what is followed by increased security and efficiency of the power plant.

EXAMPLE OF A GOOD PRACTICE

This investment is another revitalization of an inactive hydrotechnological object thanks to engagement of private sector. It is a good example of development of formerly functioning water plants using locally available hydroenergetic potential. Existing infrastructure and comfortable terrain conditioning enable obtaining high profitability of projects in such localization. It is worth to recall the information about the hydroenergetic potential of Poland provided by the Polish Association for Small Hydropower Development. In the 1950s around 6.5 thousand hydroelectroc power plants were functioning in Poland. Today, their number does not exceed 770 and over 81 percent of technological potential (about 50% of economical potential) is not used in the territory of our country. According to current assessments, there is around 7.5 hydrotechnological objects in Poland which are not used for energetic purposes. Poland has conductive conditioning for the development of hydroenergetics, especially in the form of SHPP, although the pace of activating the new production powers is still too low.

However, considering the fact that the Act of RES supports, in particular way, the development of hydroenergetic installations in Poland, in the coming years we will surely observe a boom in the industry of small hydroelectric power plants.

Łukasz Kalina
Business Development Manager
Enerko Energy

We are grateful to **Flyingfox Michał Lis** and **Enerko Energy** for sharing photos.

HYDROPOWER | WATER MANAGEMENT | ENVIRONMENTAL PROTECTION | INLAND NAVIGATION | ENERGY RECOVERY

ENERGETYKA WODNA

3/2018 (27)
FREE COPY
ISSN 2299-0674

SMALL HYDROPOWER SECTOR IN POLAND – – FACTS, OPPORTUNITIES AND CHALLENGES

str. 16

ERO EXPLAINS HOW TO ENTER **THE FIT/FIP SYSTEMS**

str. 31

THE CZORSZTYŃSKI **RESERVOIR ENERGY CLUSTER**

str. 32

LOWER VISTULA FROM WŁOCŁAWEK TO THE ESTUARY – A BALANCED APPROACH

str. 44

TRMEW