



Photo 1. View of Maków Mazowiecki SHP

## Pioneering microgrid with a SHP in Maków Mazowiecki

**Last autumn a new small hydropower plant in Maków Mazowiecki was commissioned. Connected to a microgrid, the facility creates a unique system in Poland for direct supply of public sector facilities with energy produced by harnessing the local hydropower potential. Let's take a closer look at the details of this project.**

Situated on the left bank of the Orzyc river, Maków Mazowiecki's new SHP is a visually attractive and highly functional showcase of a modern approach to hydropower facilities. Notably, it is juxtaposed with a protected historic landmark — the powerhouse building of the old SHP, once operated on the opposite bank of the river. The project, implemented using the design & build formula, represents a return to a past method of river water management.

### Hydrotechnical project scope

Commissioned by the Maków Mazowiecki authorities, the investment project com-

prised the construction of a new weir (to replace a structure that had been unfit for its purpose for decades) and the construction of a power plant together with a vertical slot fishway, as well as the development of the area around the facility.

The modern weir now dams the waters using a multi-layer composite rubber dam filled with water, hydraulically controlled and installed in the main span (17 m wide). The water is injected into the shell via process pipelines grouted into the weir slab. In the event of a power failure in the

control system, an emergency mechanism is available to lower the weir. In addition, the weir's second span includes a wooden gate, which can be used for repair work or during the passage of floodwaters. The last, shortest span of the weir was used to install a flushing gate. Above the weir runs another landmark of the site – a wooden footbridge supported by three reinforced concrete walls and a pylon connected to the footbridge by steel cables.

The SHP building is situated near the weir itself and comprises two levels. The



Photo 2. Weir on the Orzyc river before and after the project

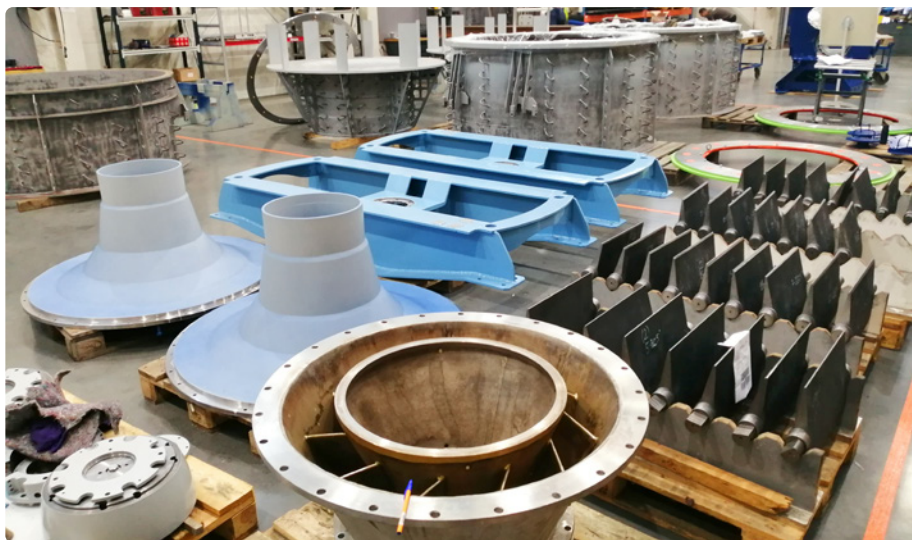


Photo 3. Kaplan turbine components on the assembly stand

first contains the control room, where the control and power cabinets as well as power evacuation system are located. The second, lower, level is the main powerhouse, where the hydro units are installed. The reinforced concrete body of the building, including the pitched roof, is varied by striking glazing with aluminium joinery. Water for the power station is taken in via a reinforced concrete channel, whose geometry has been designed to facilitate the cleaning of the trash rack. Moreover, the facility also features Poland's first automatic horizontal trash rack cleaner.

The SHP's construction process was multi-stage and took the existing infrastructure into account. A mere description of the work in each stage would be long enough to warrant a separate article, so we will use photos to illustrate the scale

of the project, from concept to SHP commissioning.

#### Advanced Plant Automation

The powerplant houses the key technological elements – spiral inflow chambers with complex geometry, steel suction pipes and hydropower units. The Maków Mazowiecki facility utilises twin Kaplan vertical-axis turbines juxtaposed with asynchronous generators, each with a rated output of 55 kW and a maximum flow rate of 4 m<sup>3</sup>/s.

The runners and wicket gates are fully controllable, allowing the entire system to be carefully optimised according to the current hydrological conditions. The hydropower units can operate independently. The turbine controllers work in tandem with high-speed electro-hydraulic systems, enabling rapid



Photo 4. Interior of the SHP with two hydro units and control platform

### Ryszard Mazur,

Enerko Energy Project Manager

*The Maków Mazowiecki project was an interesting construction challenge for us in many aspects. One of them was to protect the historic SHP building during the works while the stilling basin of the new weir was being constructed. The foundation of the existing building was completely uncovered in the course of the works, hence the construction process required the foundations of the old hydropower plant to be shored up so that the planned activities could be carried out safely.*

*Construction work carried out near and in water requires special preparation, including protection against the intrusion of river water into the work area (sealed retaining walls called Larssen sheet piling, among other things, are used for this purpose). There was an additional difficulty in this case because a bypass of the combined sewer, which collects waste from the left bank of the city (and which conflicted with the planned works), had to be made before the works could even begin. As part of the project, a new section of the sewerage system was built along the weir, following a route parallel to its previous course. It connects the existing manholes located on both sides of the riverbed. The overall effect of our work is a delightful sight indeed. I do not think it an exaggeration to say that this is one of the nicest newly built SHPs in Poland. Additionally, the facility's surroundings have been designed in such a way as to be an attractive recreational area for the town's residents while also fulfilling an educational role in the field of RES.*

power changes and synchronisation of the additional turbine with the grid, if the demand at any given time exceeds the maximum output of the operating turbine in the given hydrological conditions. In AUTO mode, i.e. unmanned operation, once the relevant conditions are met (safeguards, water level, grid parameters, temperatures), the hydropower unit oper-



Photo 5. The course of the investment in Maków Mazowiecki – from the concept, through the individual stages of construction work, to the final result

ates on the microgrid in cooperation with a so-called “power guard”, preventing energy flowing outside the microgrid into the national power grid.

A dedicated control system enables the intuitive operation of the SHP facility and the rubber dam. Completing the generation system is an automatically controlled trash rack cleaner, working in tandem

with a flushing channel and a flushing gate. The cleaning system enables efficient, maintenance-free cleaning of the power plant trash rack and channelling debris carried downstream to the tailwater by opening the gate. The facility operator has remote access to a SCADA system to monitor the current status of all equipment and create graphs, reports and summaries of microgrid operation.

**Sebastian Wites**, Chief Automation Officer at IOZE hydro

*During the project, it was decided that all the electricity generated would be used to supply public sector facilities operated by the city council. The microgrid features a grid analyser installed at a point, where the power plant connects to the electricity grid, which feeds information to the control system about the current power consumption of these facilities. Depending on the hydrological conditions and the factors specified in the water permit, the hydropower units regulate their output in such a way as to keep the power level at the connection point close to 0.0 kW.*

*Considering the high dynamics of power demand changes in the buildings connected to the microgrid (in both directions) and the high inertia of the machinery (it takes time to adjust the hydraulic systems to set the proper water flow through the turbine and therefore the power at the generator terminals), this task was rather complicated. However, the result exceeded all expectations — in a positive sense. Preliminary results after the first months of the system's operation indicate that the power generated by the SHP covers approximately 82% of the energy needs of the grid-connected buildings.*



Photo 6. Horizontal trash rack cleaner supporting the operation of the facility

### Smart energy management

A high-tech and highly automated SHP with associated infrastructure is not all there is to say about the project's innovative nature. The control system's designer revealed some more details for this article [see the box].

Due to the solution's scalability, it is planned to further optimise the developed control system and integrate further electricity consumers into the RES microgrid. The expansion of the microgrid is aimed at maximizing the self-consumption of the energy generated and the even greater contribution of SHP to meeting energy demand.

### Inspiration for others

If this does not resonate well enough from the above, then it must be stressed what a nationally unique development we are dealing with in Maków Mazowiecki. Indeed, the investment project undertaken by the city authorities is an example of cost-effectiveness in pursuit of sustainability, which addresses the challenges of the energy transition. An own generation source and distribution network to supply one's own energy consumers is the most profitable solution, preferable even to selling electricity to the grid or operating as part of a energy cluster. The local government has become an active participant and, at the same time, a role model







for other organizations in terms of energy security, economic impact and educational values.

The general contractor for the investment project was Enerko Energy. The technological solutions tailored to the needs of the SHP and microgrid users were designed and supplied by IOZE hydro.

Photos come from the archive of **IOZE hydro**.

**Wioleta Smolarczyk**  
IOZE hydro



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