

Photo: View of the Niedalino hydrotechnical system
Source: IOZE hydro

An old watermill's new soul – the Niedalino SHP

In Niedalino, on the busy River Radew, there is a more than 120-year-old watermill building that houses a small hydropower plant (SHP). This year, thanks to the efforts of the current owner and the IOZE hydro team, the power generator system was replaced, giving the SHP some new technical panache. Below is an account of the work carried out, with comments from the developer and those responsible for the implementation.

When researching the watermill's history (its German name is *Wassermühle mit Kraftbetrieb, Kammele – Nedlin*), one is likely to come across information that it was built between 1900 and 1901 by the von Kameke family, local landowners who lived near Niedalino from around 1600 until 1945 (when they were forcibly relocated to Germany). A few years later – in December 1949 – the watermill was taken over by the People's Republic of Poland Government under the Ruling of the Minister of Internal Trade¹ and was managed for the next several decades

by the Polish Grain Plant in Stoisław. It served as a wheat mill with a throughput of 60 tonnes per day. Over the years, the watermill's drive was modified to include a hydroelectric system, with the facility operating two Francis turbines – a larger 125 hp turbine, as well as a smaller one with an output of 53 kW. The building and its equipment have been renovated several times during their lifespan.²

In 2001, the watermill ceased operations and was put up for sale. This is how it ended up with the current owner, who has converted it into a power plant using the existing on-site infrastructure and began to generate electricity as "Niedalino SHP".

² <http://www.rosnowo.pl/mlyn-niedalino.html>

THE SMALLEST AND OLDEST IN THE CASCADE

The Niedalino SHP is part of a cascade of hydropower plants that also includes the Energa Group's Niedalino Hydropower Plant built in 1912 (370 kW capacity) and the Rosnowo Hydropower Plant built in 1922 on the Rosnowski Canal (1.1 MW capacity). All plants cooperate with each other; this allows the Niedalino SHP's staff to receive data on the water discharge schedule from the Niedalino HP manager.

The close proximity of the run-of-the-river power plant built at the dam at Lake Hajka (a.k.a. Lake Niedalino) ensures that the flows directed to the Niedalino SHP turbine units remain stable. However, replacing obsolete, low-performance technology was a necessary step to maximise the facility's potential.

Though the building is not formally under conservation protection, its historical value is undeniable. Consequently, the



Photo: Niedalino watermill in 1901 and today



Source: IOZE hydro

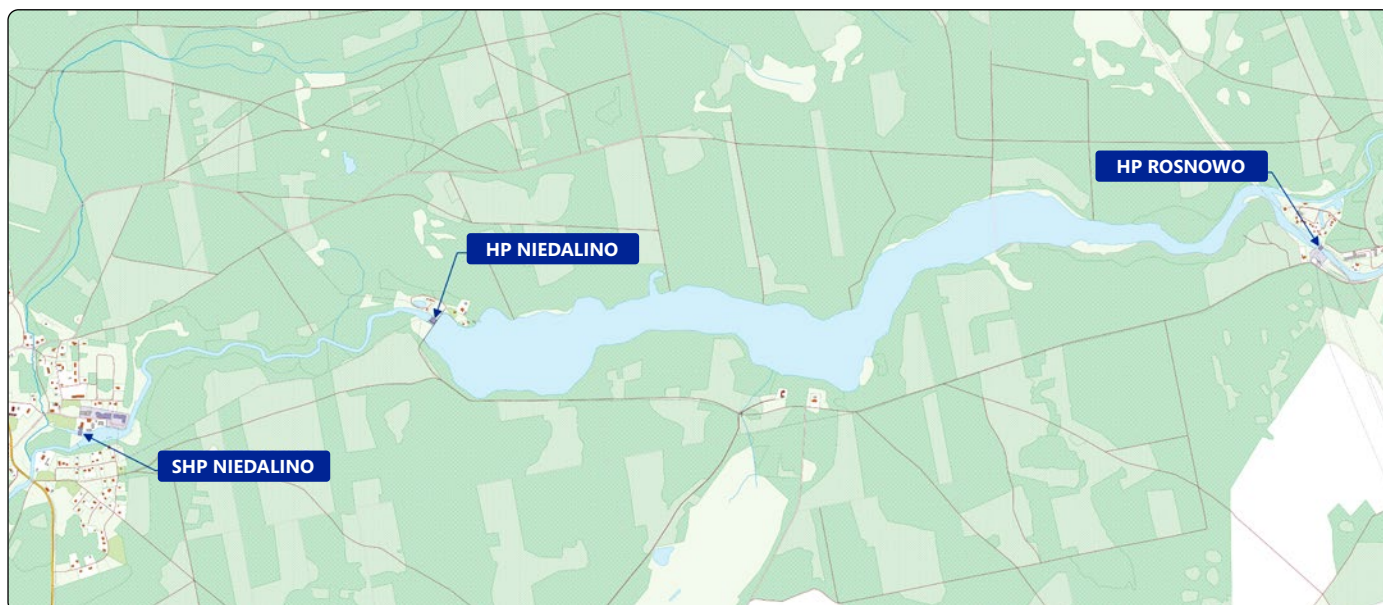


Figure: Location of hydropower plants along the Radew River's cascade



Photo: Bringing the turbines inside the watermill

modernisation effort had to be carried out carefully and with respect to the age-old architecture of the building. Today, it can already be said with certainty that the venture has been a success. At the time

Łukasz Gołąb, IOZE hydro
Installation Manager:

Although the turbine installation work at the Niedalino SHP facility went very smoothly, it involved some eccentricities. Using this word is no coincidence: at certain points, we had to manoeuvre the large, several-tonne turbines with precision to within a few centimetres. We brought the turbines into the watermill building through the front door. For this, we used a metal framework sliding on rollers. Next, we used metal ceiling beams to suspend the turbines and place them in the prepared assembly positions. The concrete draft tubes were undercut to accommodate the new metal draft tubes. We replaced the old German-made electricity infrastructure with four modern automation and control cabinets. The Niedalino SHP was one of those projects where well-thought-out in-house installation logistics and a flexible approach to any arising difficulties were crucial. Still, given the numerous power plants we have worked on so far, there has not been a technical obstacle that we have not been able to overcome.

of writing, the Niedalino SHP has already been feeding electricity from the operation of the new generator system into the grid for more than a month.

A DEMANDING INSTALLATION PROCESS

Like many recently modernised power plants, the Niedalino SHP belonged to a group of facilities for which the prospects in terms of supporting electricity sales had ended. What ultimately prompted the owner's decision to upgrade was the stabilising new legislation related to RES. The legislation still makes participation in the guaranteed 15-year support scheme (under the feed-in tariff scheme) conditional on the construction of a new system. This corresponded with a pressing need to improve the facility's performance and improve its operators' comfort. The modernisation work was undertaken by the IOZE hydro team. The primary tasks involved dismantling the two existing hydrosets and installing two new ones, implementing a new control and automation system, as well as renovating the concrete surfaces of the inflow chamber and part of the machine room floor.

New technology brings a breath of fresh air

The upgrade involved replacing two obsolete Francis turbines the facility had used for decades with two vertical Kaplan turbines, each with the capacity of 75 kW and a rotor diameter of 1050 mm. This kind turbine is equipped with a rotor that can be adjusted during operation and guide vanes that work by using a hydraulic control system with a hydraulic power unit. This makes it possible to actively control and adapt the entire hydrounit's operation to the current water flow conditions. The turbine is also accompanied by a hydraulic accumulator to protect it during an emergency shutdown. A belt transmission has been installed to transfer power from the Kaplan turbine to the generator. All equipment installed at the facility has been manufactured by IOZE hydro. In terms of facility automation and control systems, IOZE hydro has opted for its proven solutions; these are described in greater detail for the purposes of this article by IOZE hydro's Chief Automation Officer.



Source: IOZE hydro

Photo: One of the two new generator systems at the Niedalino SHP

Jan Tuschik, owner of the Niedalino SHP:

I have been a member of the Polish Association for Small Hydropower Development (TRMEW) for years and, through behind-the-scenes conversations with other Society members, I found out that IOZE hydro could expertly modernise my power plant. The result of the work is not only modern turbines but also improved user comfort at the facility, the body of which has not been affected in any way.

At present, the only work to be done by the power plant staff is keeping the trash rakes clean while I remotely monitor the operation of the turbines on my mobile phone. One month after commissioning, I am happy to say that the plant is

working properly – we have completed the commissioning period and are generating the expected energy output.

Apart from delivering the technological portion, IOZE hydro gave me tangible support in handling all the paperwork for the project, as well as obtaining a certificate from the Energy Regulatory Office to enable the sales of unused electricity for the next 15 years under the feed-in-tariff scheme. I know that the procedure to obtain the certificate requires appropriate formal preparation and a great deal of diligence to succeed. At the same time, this form of subsidy ensured an acceptable rate of return on the investment project.



Photo. A hydraulic unit, new control cabinets and historical elements of the mill equipment in the background

Sebastian Wites, Chief Automation Officer at IOZE hydro:

The Niedalino SHP has seen a tremendous technological leap as a result of its modernisation. We replaced the purely manual power plant controls, utilising pre-war German-made equipment, with modern and intuitive equipment.

We supplied the Niedalino SHP with two complete hydrosesets with asynchronous generators. Due to the type of generators used, the system was fitted with a reactive power controller. Each of the hydrosesets can operate either autonomously or controlled by a master controller. The control system is based on separate PLCs and 10-inch touchscreen operator panels for each machine. If one of the hydrosesets fails, the other takes over the function of regulating the water level or flow, depending on the selected mode of operation. Besides electrical parameters, the controllers monitor such parameters as rotational speed, vibration and a range of temperature readings from all generator and turbine windings and bearing nodes. The facility has also been fitted with temperature sensors in the switchgear and the

turbine house. The headwater levels – upstream and downstream of the grating – and tailwater levels are measured, so we have information on the gross head and the head at the inflow grating of each hydroseset. In addition, we also read the power hydraulics pressures, the position of the drive belt on the pulley, the position of the turbine apparatuses and the current flow. The facility has been equipped with a remote access solution in the form of a SCADA visualisation system. It allows us to generate reports from different periods. Safety control system settings can be changed, and advanced diagnostics performed, separately for each hydroseset, including remotely in the latter case. Operators can access reports on all measured parameters, generated as tables or graphs, either separately for each hydroseset via operator panels or using the SCADA system. This is an indispensable source of knowledge about the facility's operation, which enables such things as timely prevention of serious failures and optimising device operation.

Changes are coming

Currently, pursuant to the Regulation of 9 November 2022, the reference price for hydropower plants with a capacity of less than 500 kW is PLN 770 per MWh (indexed annually for inflation).

The certainty of electricity sales at a guaranteed price, independence from energy market fluctuations and forecast price drops, as well as a relatively short formal and legal process, encourage SHP owners to modernise their facilities under the current legal conditions. Access to modern, high-efficiency hydrounit technology, able to run at the optimum operating point and offer greater availability and reliability, ensures increased electricity generation. Combined with higher electricity sales prices, this offers SHP owners a highly attractive investment opportunity and peace of mind for many years to come. Unfortunately, the proposed legal changes are set to introduce significant restrictions. It is worth taking advantage of the currently available opportunities before these changes come into force.

The IOZE hydro team is looking forward to fully refurbishing further SHPs.

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