

<https://doi.org/10.7250/CONNECT.2025.025>

HYDRAULIC MODELLING FOR ENVIRONMENTALLY FRIENDLY SMALL HYDROPOWER: INNOVATIONS AND APPLICATIONS

Oksana HALYCH^{1*}, Petr NOWAK², Eva BILKOVA³, Oleksandr RIABENKO⁴

^{1,4} *Department of Hydropower Engineering, Thermal Power Engineering and Hydraulic Machines, National University of Water and Environmental Engineering, Rivne, Ukraine*

^{2,3} *Department of Hydraulic Structures, Faculty of Civil Engineering, CTU in Prague, Czech Republic*

* **Corresponding author.** Email address: o.o.halych@nuwm.edu.ua

Abstract – After the outbreak of war in Ukraine, one of the aggressor country's goals was to destroy the energy infrastructure of our country. Therefore, about half of Ukraine's power generation capacities have been lost (with 90 % of wind and one-third of solar generation lost). In this situation, hydropower plants and pumped storage power plants played and continue to play a key role in the resilience of the power system, covering two-thirds of the peak capacities in the daily load curve of the power system. However, Russia has started to attack the hydropower facilities of large hydropower plants. In such a situation, the role of small hydropower plants should be emphasized. On the one hand, Ukraine has a large hydropotential for developing small hydropower engineering which has the same features as the HPP with large capacities (producing scarce peak energy, providing highly maneuverable capacities, improving the quality and reliability of electricity supply by regulating frequency, voltage, and power reserve, etc.), as well as small hydropower plants are an important element of distributed generation by influencing the operation of power grids. On the other hand, current tendencies require minimizing negative influences on the environment. One such negative effect of small hydropower plants is changing the natural hydraulic and hydrological regime of rivers where the hydropower plants are located. To reduce this, it is necessary to model and predict future hydraulic regimes of SHPPs at the designing stage. The objective of this work is to consider and analyze the example of modelling the hydraulic regimes of small hydropower plants using computer software, which allows to study and analysis of different variants of hydropower plant composition and choose the optimal one with minimal impact on the environment. Using the example of an existing small HPP, the hydraulic conditions in the tailrace channel of the hydropower plant during turbine operation and during flood passage were modelled, which can be characterized by the formation of a turbulent flow in the riverbed and can lead to erosion of the riverbed bottom and banks. Based on the obtained results, the conclusions and recommendations for the safe operation of considered small HPP were made.

Keywords – *Environmental impact; hydraulic regime; modelling; small hydropower plant*

ACKNOWLEDGEMENT

This work has been supported by the program “Strengthening the Capacity of Public Universities in Ukraine in 2025” from the Ministry of Foreign Affairs of the Czech Republic.