EXPECTED CHANGES OF THE TOTAL HYDROENERGY POTENTIAL FOR THE RIVERS ON THE RIGHT BANK OF THE PRIPYAT BASIN BASED ON THE FLOW FLUCTUATIONS FORECASTS

O. OBODOVSKYI, O. LUKIANETS V. KORNIENKO, O. POCHAIEVETS
hydrolab.kyiv@gmail.com

INTRODUCTION

Recently, the use of river energy has acquired environmental and social significance. It can contribute to solving the problems of providing the population and enterprises with electricity (through the construction of small hydroelectric power plants). For this, it is important to assess possible changes in the total hydropower potential of the rivers in the near future.

WHAT IS THE TOTAL HYDROPOWER POTENTIAL?

The total hydropower potential was defined as the total theoretical sum of river runoff energy, which is calculated as the arithmetic sum of potentials in the river sections from the initial to the outlet of the catchment (linear estimation method).

For each section, its total power (E, kW) is defined by formula

\[ E = g \times \frac{Q_1+Q_2}{2} \times (H_1-H_2) \]

where \( g \) is the acceleration of free fall (\( g = 9.81 \text{ m/s}^2 \)), \( Q_1 \) and \( Q_2 \) are water discharge at the beginning and end of the section, \( m^3/s \); \( H_1 \) and \( H_2 \) - absolute marks at the beginning and the end of the section, m.

The total capacity of all sections is the total hydropower potential of the river and is defined as:

\[ E_{\text{total}} = E_1 + E_2 + E_3 + \ldots + E_n = \sum E_i \]

RESULTS OF INVESTIGATIONS

The THP of the main rivers of the Pripyat basin is 241557 kW (241.6 MW), of which 29.6% (or 94935 kW) is the hydropower potential of the Pripyat River (together with the Belarusian part).

Significant hydropower potential (within Ukraine):
- Horyn River 32259 kW (9.6%),
- the Sluch River 26844 kW (7.99%),
- the Styr River 21300 (6.34%)

To predict changes in the total hydropower potential, it is necessary to anticipate changes in water content.

We analyzed the researches by scientists who predicted runoff changes by two different forecasting approaches:
1. the forecast of runoff changes under the influence of climate change in the near future until 2040 (Snizhko et al., 2014)
2. the forecast of runoff changes by stochastic patterns long-term fluctuations of water runoff - low-water phase (2a) and high-water phase (2b) (Lukyanets and Moskalenko, 2017).

EXPECTED AVERAGE THP DECREASE FOR THE RIVERS OF THE PRIPYAT BY 28%.

According to the forecast of water runoff under the influence of climate change (by the water-balance model):

- During the period until 2040 the THP values for the rivers of the Pripyat basin within Ukraine are expected decrease by 67.6 MW.

EXPECTED AVERAGE THP INCREASE FOR THE RIVERS OF THE PRIPYAT BY 12.4%.

According to the results of prognostic assessment of water changes by to stochastic patterns of long-term fluctuations of water runoff during the high-water phase (2021-2037 (3b))

Conclusions

On average, for Pripyat right-bank rivers are expected to increase by 12.4% during the high-water phase and to decrease by 18.9% during the low-water phase.

For the period up to 2040, the values of THP for the studied basin will be lower than the multi-annual mean value by 28%.