

Optimization of river flow capture at micro-hydro power plant intake to increase electricity production

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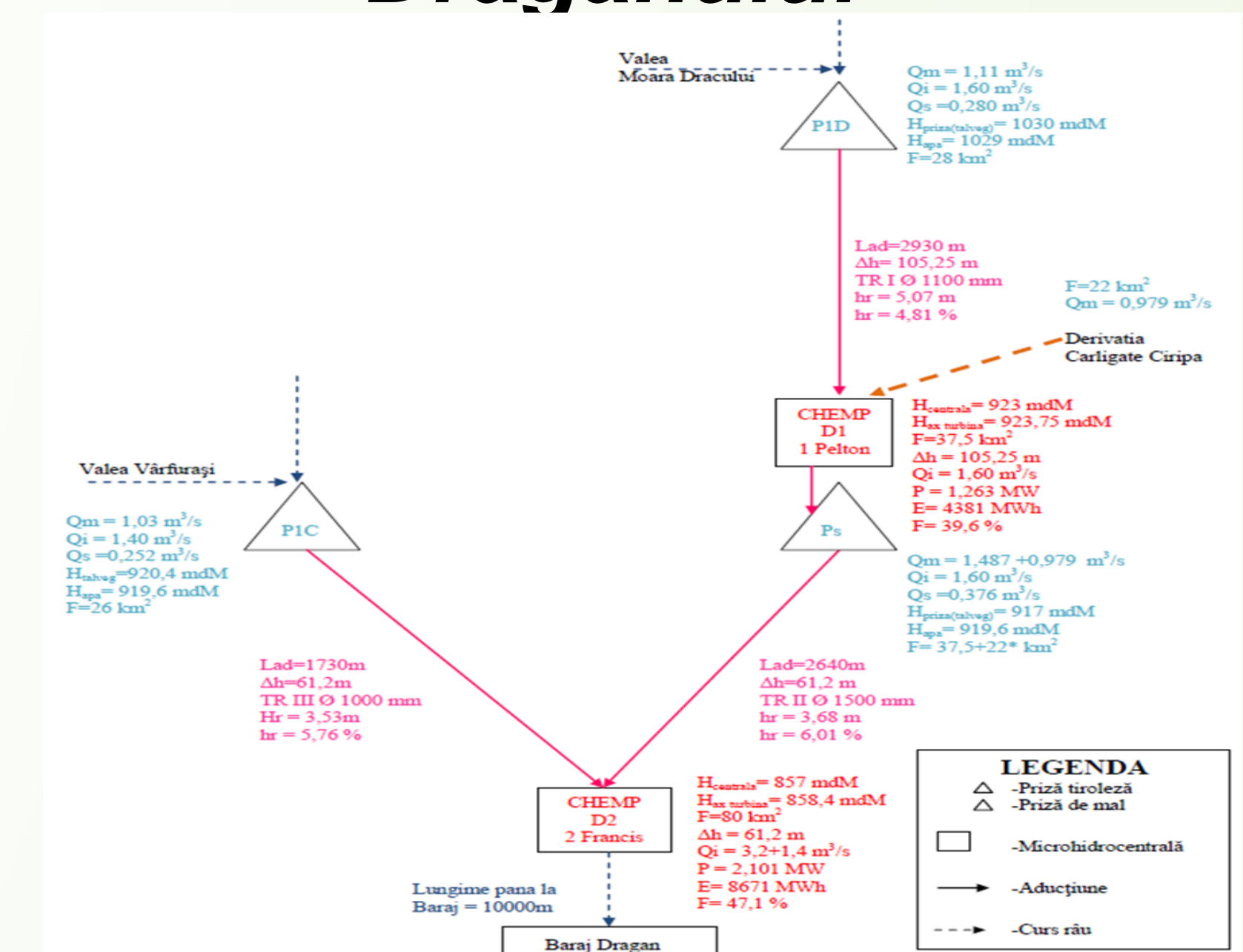
Abstract. Depending on their location, micro-hydro power plants have various types of intakes. The goal of this research is to improve the efficiency of micro-hydropower plants that have incorporated winter inlets. Based on analysis of on-site measurements results and numerical simulations for the process of river flow capture for micro-hydropower plants, we identified a technical solution that, once implemented, can increase the electricity production capacity of the power plant, and in the same time also fully respecting the environmental requirements imposed by the authorities. The case study was realized at MHC Valea Draganului, which have a Tyrolean intake type equipped with winter intake. The installed capacity of micro-hydro power plant is 2.101 MWh, and use a Francis turbine.

EXPERIMENTAL PROCEDURE

In order to increase the power production while keeping the minimum and constant servitude flow following tests were performed:

We monitored the power produced as a function different openings of the winter water intake gate, starting from fully closed, fully opened and two others intermediary positions (1/3 and 2/3 opening). After each of above steps the HPP need a time to accommodate the changes in the flow and to stabilize the electricity production. This experiment was performed for different values of the river flow.

Functional scheme at HPP Valea Draganului

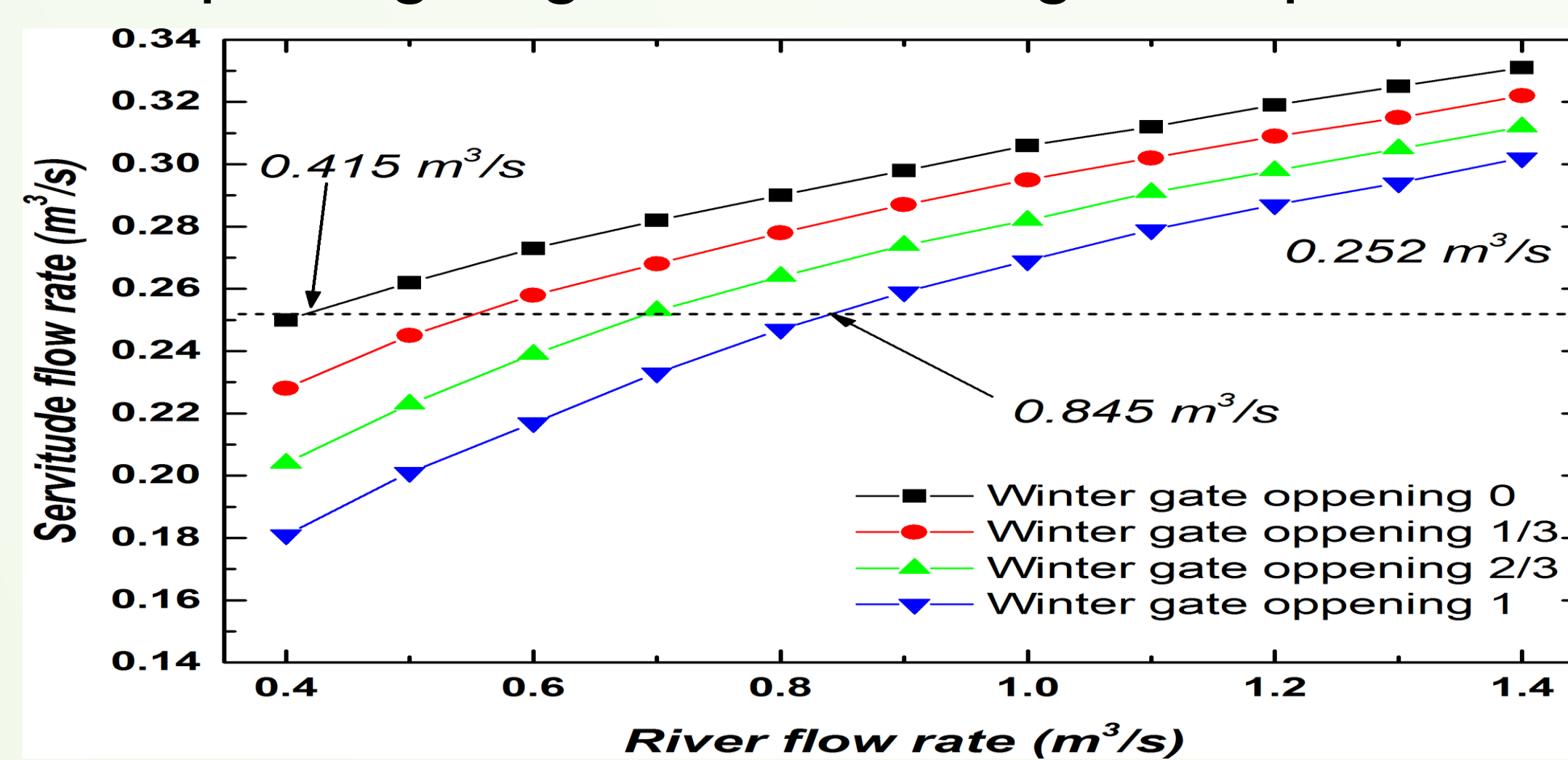


RESULTS AND DISCUSSION

As can be seen from the functional diagram, HPP Valea Draganului is supplied by two inlets, the P1C inlet, which is a Tyrolean type inlet, equipped with a winter outlet and the PS inlet of the shore outlet type, which does not have a winter outlet.

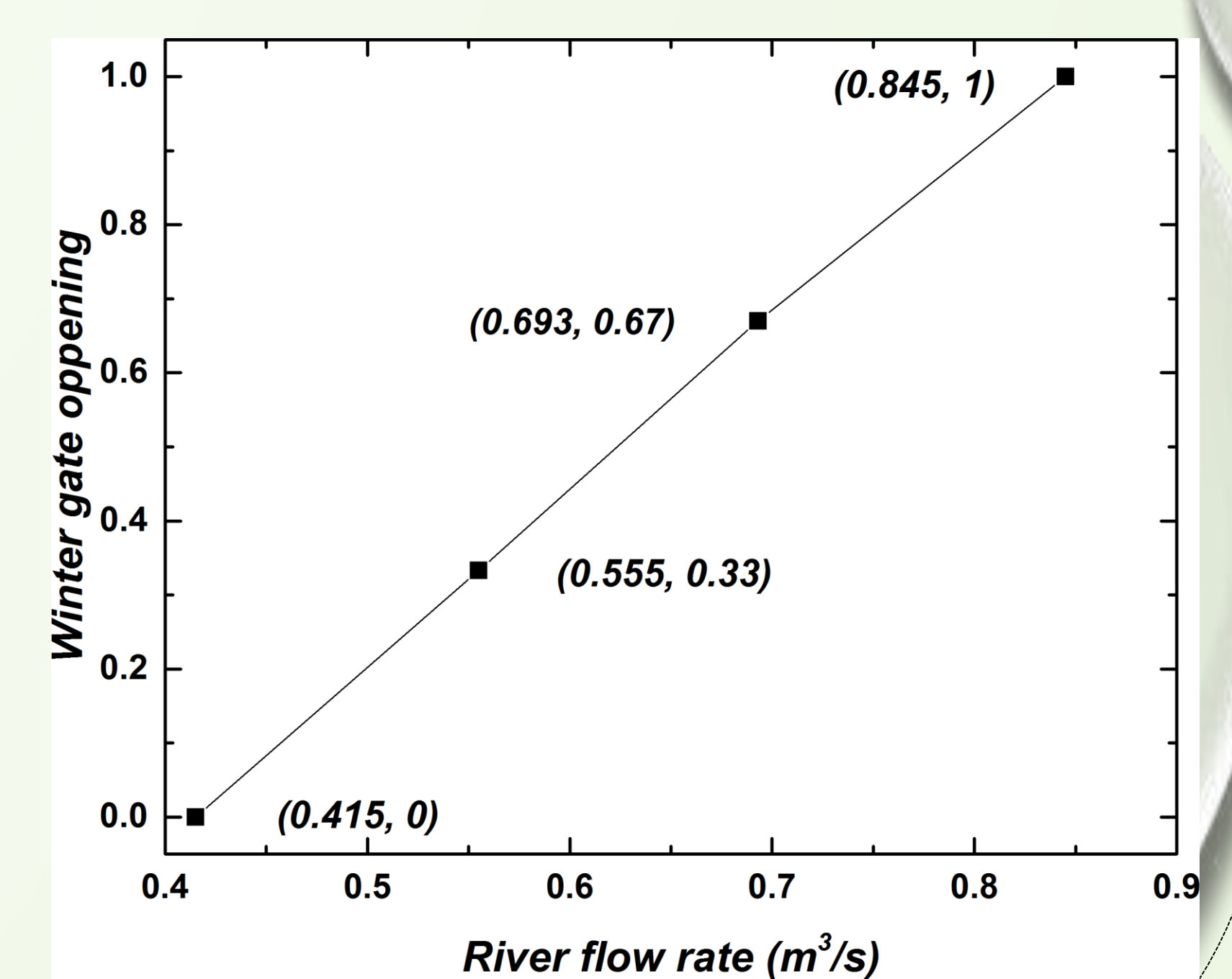
Analyzing the process of flow collection at HPP Valea Draganului, to the P1C inlet, it was found that during the operation of micro-hydro power plant, a significant amount of river flow is lost on the fish ladder in addition to the easement flow required by the legislation.

We made new series of measurements on site and simulations, as in the case of HPP Racatau, to show the advantages brought by actuating the gate of the bottom intake, in no frost periods. As a result there is an increased production (3% - because the HPP is supplied by two inlets), without any impact on the ecosystem. On the below pictures the fish ladder flow values dependence on the opening degree of winter gate is presented.



Analyzing the results from these graphics, the importance of using an automatic intake system is justify, increasing thus the energy production, in this situation with about 5-7%, depending on the river flow.

In the right figure is presented the opening degree of the winter intake in function of the river flow, for keeping a constant flow on the fish ladder.



CONCLUSIONS

- The present study show the influence of the winter gate opening degree on the produced power of HPP. The main power production increased with about 5-7% depending on the river flow.
- The process can be automatized in order to have a minimum constant servitude flow rate, so that all the difference river flow rate is converted to energy.
- After this measurements on site and simulations at HPP Valea Draganului, we concluded that our method can be implemented at different micro-hydro power plants.

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