ReHydro

Demonstration of Sustainable Hydropower Refurbishment

M3 Virtual Powerplants for monitoring and control

Work Package	WP1 Improved hydropower refurbishment performance
Responsible	AKER, LYSE
Milestone reached	M3, 31.03.2025

The milestone of having a Virtual Powerplant (Digital Twin) up and running in real-time using online measurements is reached.

As of 31.03.2025, the Virtual Powerplant is running in real-time using input from Azure online database. A Virtual Powerplant consists of one or more digital twins running in parallel. These are highly detailed physical digital twins with the core simulation being fully transient calculations based on the method of characteristics. A good description would be fully automated transient calculations fed by online measurements. Running several in parallel allows each one to be tailor made for one specific task. By communicating with each other, much more complex tasks and online analysis can be achieved.

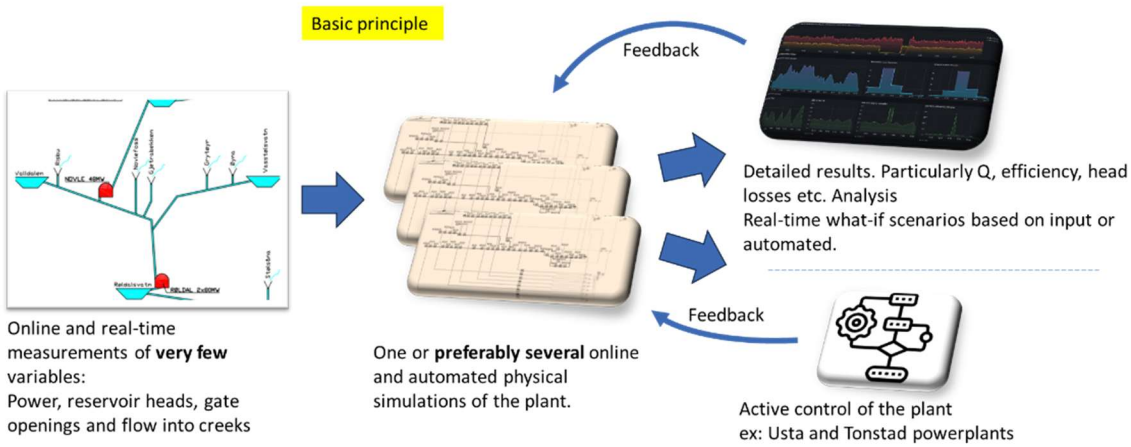

Figure 1 Basic principle of the system. Online measurements feed the autonomous Virtual Powerplants, VP, (digital twins). The VPs then interfaces HMI and/or active control of the plant in a feedback loop. A key aspect is the VPs need very few input variables, while calculating all the other variables - a physical based digital twin.

Røldal VP has preliminary two digital twins. One is mirroring the plant in real-time. This mirroring gives additional output such as total plant efficiency, flow and head loss everywhere. The other digital twin uses all the same inputs except for power setpoint in Novle and the gate at Vasstølsvatn. These inputs are given manually and therefore constitutes an online "what-if" scenario. Later in the project this may be extended to 2 or 3 additional twins for environmental analysis and predictions.

In the previous installed systems, the IO between the physical plant and the active control/HMI is via different industrial standards (Profibus etc.). The VP has always been installed inside "secure zone". Due to limited time and other practicalities at Lyse concerning IO, this system must be installed outside "secure zone". The IO is done with Azure online database. Azure collects and store data from a large array of datapoints in all plants at Hydro/Lyse. The access is not real-time but close to real time, with a latency of max 15-60 seconds. This is a challenge, and since Azure does not have the certainty of data-transfer nor the assurance of data validity compared with industrial IO, this project will also give valuable experience in these aspects.

The interesting aspect is Azure enables more virtualisation. The entire system can be installed anywhere, preferably on a server in the cloud, but also on personal PCs. When active control output is not needed, these aspects are indeed very interesting for monitoring, analysis and everyday operation of one or several plants.

The system installed on a dedicated rack PC in an office/lab environment. Lyse will be able to access it at will through their normal Azure access. This is a temporary solution though, but it will enable all tasks planned for in ReHydro.

DISCLAIMER / ACKNOWLEDGMENT

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