



Demonstration of Sustainable Hydropower Refurbishment

M6 Online monitoring systems installed in FMG and ELM

Work Package	WP1 Improved hydropower refurbishment performance
Responsible	Martin Boden, Alpiq
Milestone reached	17/06/2025

Task: T1.2 – Online Monitoring of Turbine Performance

Milestone: MS6 – Online monitoring systems installed in FMG

Description: Task 1.2 of ReHydro focused on the joint monitoring of sediment concentration, turbine efficiency, vibrational response during startups and abrasion via cameras. These different monitoring devices were installed at the Vissoie powerplant within the FMG asset and in the Bitsch power of the ELM asset. The installed system consists of the following key components:

- **Measurement of suspended sediment concentration:** A sediment monitoring system at Vissoie measures water turbidity and sediment concentration in real-time, using a turbidimeter and a densimeter. Data is uploaded to an online platform. A similar setup is planned for Bitsch. Additional sediment analysis includes periodic sampling sent to the University of Lausanne and bi-monthly drying and weighing to validate sediment levels.
- **Online efficiency measurements via a simplified thermodynamic approach:** Online efficiency monitoring systems are operational on both demonstrator units, continuously uploading real-time measurement data. The system estimates energy losses by analysing water temperature increase across the turbine, based on thermodynamic principles, and complements this with electrical power readings. It uses a minimal number of sensors to evaluate hydraulic input and electrical output, enabling accurate efficiency assessment. The methodology is based on the CEI 60041 standard.
- **Monitoring of vibration response during startups:** Two condition monitoring systems track bearing vibrations using five accelerometers and tachometers per unit. They provide high-resolution frequency-domain data, including vibration spectra and waveforms. A triggering system records startup events for wear analysis. Comparing spectra across startups helps assess mechanical wear over time.

- Camera based abrasion monitoring:** A high-resolution camera with a synchronized light source is installed inside the Bitsch turbine casing. A key phasor aligns image capture with bucket positions based on runner speed. The system enables remote image analysis of bucket erosion using AI. Initial images are available, and an update to the control system is underway to automate image acquisition.

The installation was successfully completed within the scheduled timeframe, marking a significant step forward in improving real-time monitoring and cavitation assessment at the FMG and ELM sites. Below is the summary table of the equipment installation:

	FMG	ELM
Sediment Monitoring	Operational since 12.2024	Operational since 06.2025
Efficiency Monitoring	Operational since 10.2024	Operational since 03.2025
Vibration monitoring	Operational since 12.2024	Operational since 02.2025
Abrasion monitoring	N/A	Operational since 04.2025

Supporting Materials:

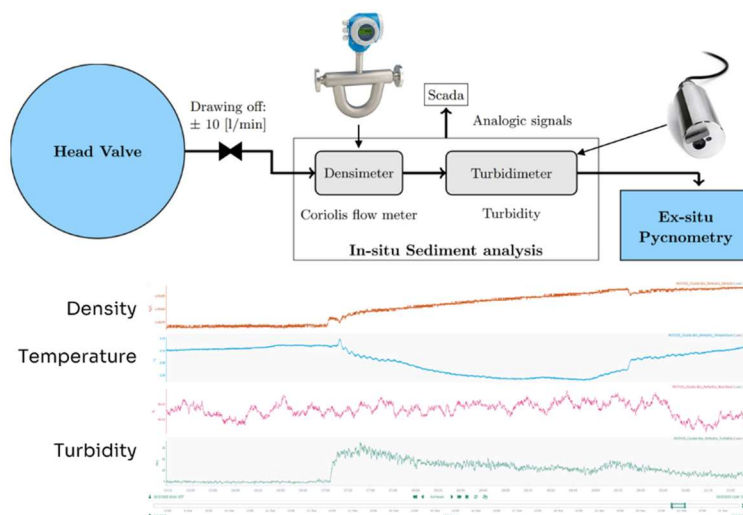


Figure 1. Sediment monitoring: acquisition system (top), resulting signals (bottom)

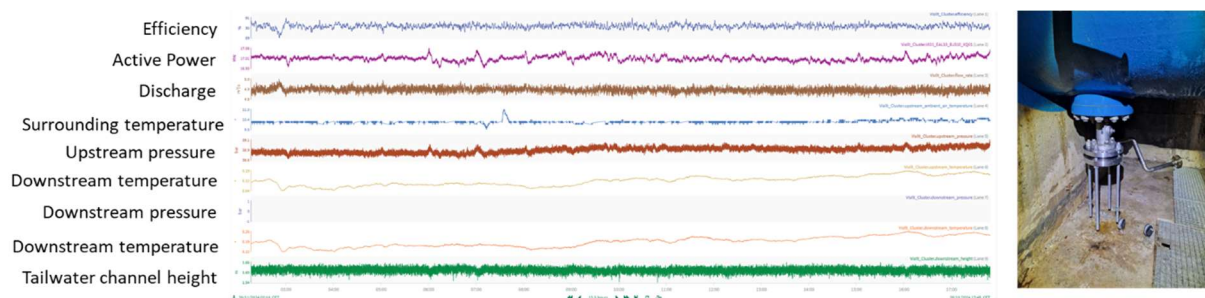


Figure 2. Efficiency monitoring: monitored signals (left), temperature probe (left)

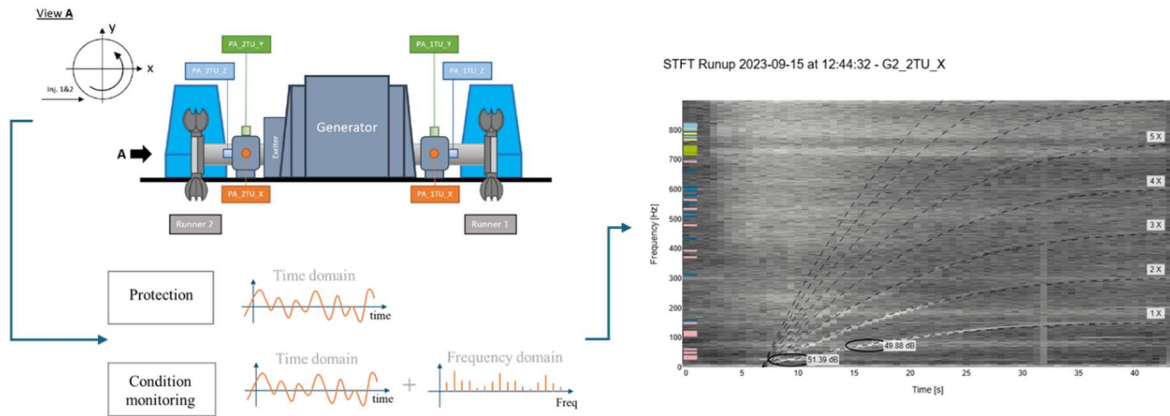


Figure 3. Vibration monitoring system, from acquisition to processing

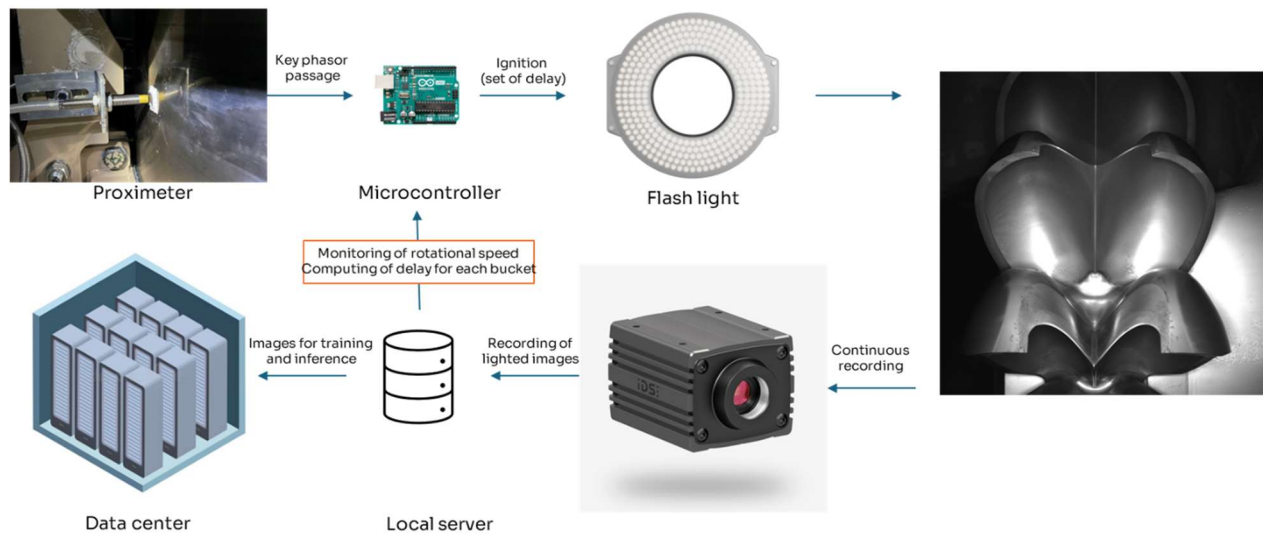


Figure 4. Camera based abrasion monitoring system

DISCLAIMER / ACKNOWLEDGMENT

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

This report is licensed under a Creative Commons Licence.

Attribution 4.0 International License



For more information about the Creative Commons Licence, including the full legal text, please visit: <https://creativecommons.org/use-remix/cc-licenses/>.