HydroPHIL: a reduced scale PSP model with real-time performance capacity

Improve your pump storage plant's dynamic behaviour & operational efficiency

As a hydro power plant operator, control system designer or equipment manufacturer, our unique test rig allows you to test each individual element of your hydraulic system in real-time, from the equipment to the control system, by replicating the interfaces and performances of a real production site.

OVERVIEW

Pumped storage plants (PSP) are considered the most mature and reliable technology for storing energy in bulk. While they are widely recognised for their ability to store energy in large quantities, R&D efforts are now focused on increasing flexibility to facilitate the integration of renewable energies into the grid.

Emerging technologies such as variable speed, hybridisation, and advanced control strategies, improve the PSP's flexibility, thereby improving response times, increasing the operation range, or increasing the system's life expectancy.

At SuperGrid Institute, we have designed an innovative test platform capable of performing real-time simulations for these emerging hydro power storage technologies, the first of its kind.

We help our customers mitigate the risks of implementing new solutions, at a reasonable price.

DESCRIPTION

The HydroPHIL platform is a unique test rig that replicates various aspects of a PSP's behaviour in real time.

Our platform enables you to validate the control, supervision, system architecture, integration, and hydraulics (non IEC 60193) of your projects in a relevant environment.

Our one-of-a-kind installation includes an embedded hydraulic circuit emulator that replicates the head oscillations at the turbine inlet and outlet, while an embedded grid emulator allows you to study grid code compliancy along with the production unit's contribution to frequency & voltage reserves.

AVAILABLE SERVICES

- Dynamic performance & safety characterisation
  - Wicket gate control: speed and power regulation
  - Transient behaviour: overspeed, start-up, turbine rewatering, water column separation, etc.
  - Grid compliance: fault ride-through, active & reactive power, ancillary services etc.
  - Variable speed control
  - Hybridisation
  - Safety checks using fault injection
- 4 quadrants hydraulic characterisation (non IEC 60193)
- Training in line with your specific needs

TECHNICAL DESCRIPTION & CHARACTERISTICS OF HYDROPHIL

Our HydroPHIL platform replicates your hydroelectric unit, including its hydraulic design, mechanical inertia, actuator performance, electrical machine topology, power electronics, automation and instrumentation.

Reduced-scale model

- 4 quadrants pump-turbine
- Customisable hydraulic design
- Ability to replicate projects from 50 m to 900 m
- Real-time operating ring
- Turbine outlet up to ~20 cm diameter

Control

- OPAL OP4510 Real Time Controller
- MATLAB/Simulink interface
- Ability to connect and test any black boxed industrial controller

Grid emulation

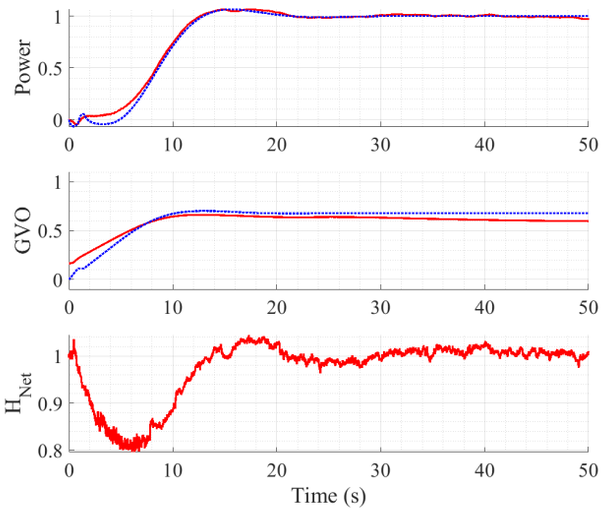
- 15 kVA bidirectional conversion mock-up
- 400 VAC grid, with harmonics up to 40 kHz

Hydraulic circuit emulation

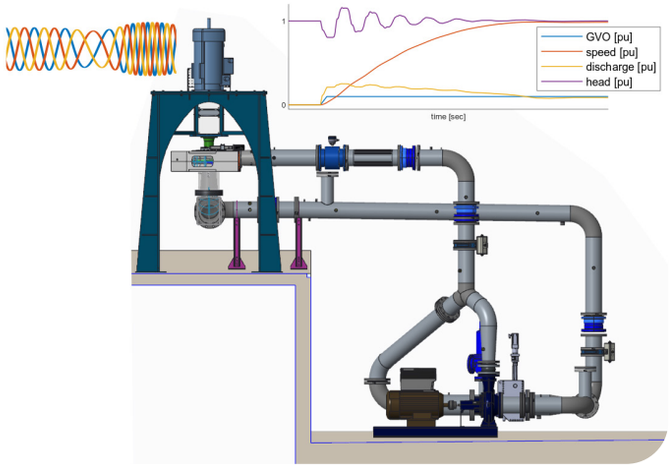
- Emulated water hammer with up to 16 mWC net head, 120 L/s

Time-based proportionality

- Hydraulic inertia & dynamics
- Mechanical inertia
- Electrical time constants
- Actuator's performances



Comparison, per unit, between simulation power (blue) and generated power (red) from the hydraulic reduced scale model together with the expected (blue) and attained (red) guide vane opening (GVO) and measured head at the turbine.



We can simulate a wide range of power conversion system layouts, including: conventional fixed speed units, DFIM variable speed, fully FED variable speed and other topologies such as Hybridised Hydro Power Plants.

HERE'S WHAT OUR CLIENTS THINK...

"The advanced test platform and the expertise of the SuperGrid Institute team allowed us to test and optimise our preliminary control solution for the XFLEX Hydro project demonstrator, bringing to light problems that could not be seen with a pure software model of the controller", Goekhan Sari from GE Vernova.

As part of the European XFLEX Hydro project, GE Vernova aimed to study and validate the use of speed variation in turbine mode, with the aim of extending its turbine's operating range in this mode.

As a member of the XFLEX Hydro consortium, SuperGrid Institute assessed the feasibility and relevance of these new operating sequences on its real-time HydroPHIL platform. We defined the test plan and configured the platform to the characteristics of the test site, taking into account everything from the turbine, to its connection with the power grid.

Our independent tests enabled us to validate the tested turbine's control algorithms and suggest improvements for the supervision of the turbine within this extended operating range.

Our real-time HydroPHIL test platform is a fantastic tool for validating control algorithms, assessing turbine robustness, and facilitating a smoother implementation of new flexibility solutions into industrial sites.

CONTACT

For additionnal information or to ask for a quote, please contact: sales@supergrid-institute.com