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Upgrading of
hydropower plants to
pumped storage plants:
reconstruction and
improvements of the
tunnel system

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Background

Due to the increasing number of renewable energy power plants connected to the grid throughout the past years, the role of hydropower in energy systems is changed. The operation strategy of hydropower plants has shifted from stable operation, usually at the best efficiency point, to a more flexible operation, with frequent starts/stops, and more part-load operation. As the present design of the hydropower plants does not match the current needs, it results in lower turbine efficiency and restrictions on the power plant operation. Thus, new design concepts or improvements to the present design are needed.

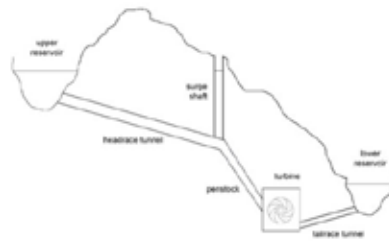


Figure 1 Pump storage plant layout

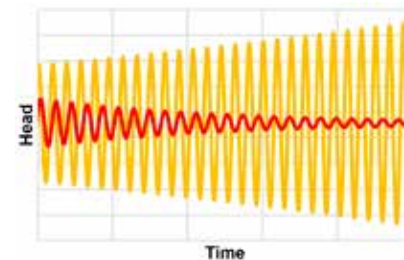


Figure 2 Stability (red) vs. instability (yellow) in surge tank

The general objective of this research is to investigate various possibilities for upgrading hydropower plants to pump storage plants, focusing on possible improvements and reconstruction needs of the waterways. New layout concepts for the tunnel system, surge chambers, intakes, outlets or other tunnel system components could be investigated.

The research method is founded on field measurements, numerical simulations and physical model studies. The study is conducted starting with 1D numerical modelling, followed by research on a physical model, further validated with in-situ measurements.