PHD THESIS

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Reversible pump-turbines in existing power plants

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Background

When reconstructing existing power plants into pumped storage plants, new turbine solutions are required when replacing the existing runner. Since a reversible pump-turbine (RPT) must be designed considerably larger to ensure a sufficient pressure head, in addition to demand further immerse, there is a need of a simpler and more cost-effective alternative.

Objective

The aim of this PhD research is to examine if a booster pump installed in the draft tube can replace the need of increasing the runner dimensions and avoid the immersion requirement. The pressure contribution from the booster pump should feed the RPT sufficiently and also ensure that no cavitation occurs in the inlet areas of the runner.

By using a contra-rotating axial pump as a booster, the rotation between the pump and runner can be controlled and manipulate the pump characteristics of the RPT. This could possibly change the necessity of designing the RPT similar to a pump and avoid the runner from running in turbine mode outside best point.

The research work will consist of laboratory work, field measurements, cooperation with pump and turbine manufacturers, literature review and numerical simulations. By the end of the PhD work, a booster pump design should be completed and further be tested in Roskrepp power plant, Sira-Kvina.

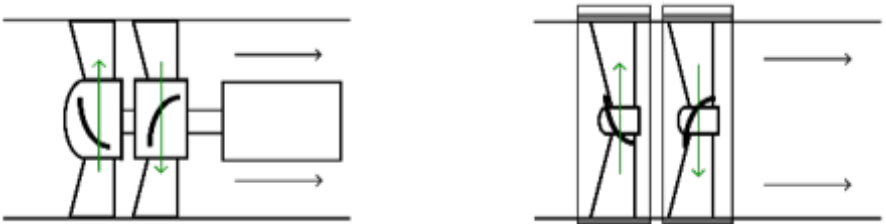

Figure 1: Possible booster pump solutions:
1) Generator installed inside draft tube. 2) Rim-driven generator.