MASTER THESIS

Debora Bardini

Department of Civil and Environmental Engineering

Spring 2018

Direct simulation of surge tank stability

Supervisor:
Kaspar Vereide (NTNU)
Stefano Malavasi (Politecnico di Milano)
Co-supervisor:
Livia Pitorac

NTNU

Background

In a hydropower plant, whenever wicket gates in front of turbines are operated, pressure transients will occur. These can result in large pressures affecting the hydraulic system, particularly in the case of fast shutdown from full load. The amplitude of these transients can be reduced by installing a surge tank, which helps by reflecting incoming pressure waves. In addition, a surge tank improves quality of frequency governing. For these reasons, surge tanks should be installed in hydropower plants with long water conduits.

Surge tanks design is crucial in order to deal safely with mass oscillations. Thoma's equation (1910) is the standard method to select the area of a surge tank sufficient to guarantee stability. However, this method is based on simplifications.

Improvements in computational power give the chance to adopt more advanced methods, relying on complex numerical simulations. Prominent among them is the direct simulation method, consisting in a one-dimensional numerical simulation of the entire hydropower plant, without the simplifications adopted in Thoma's equation.

Objectives

The aim of this thesis is to test whether direct simulation represents a more effective and punctual alternative to Thoma's method. In order to answer this question, a one-dimensional numerical model of the Roskrepp power plant, owned by Sira-Kvina kraftselskap, is established and calibrated. The model is then used to compare results of direct simulation method with those of Thoma's method.