PHD THESIS

Einar Agnalt

Department of Energy and Process Engineering

2016 - 2019

High head Francis turbines

Supervisor:
Ole Gunnar Dahlhaug

NTNU

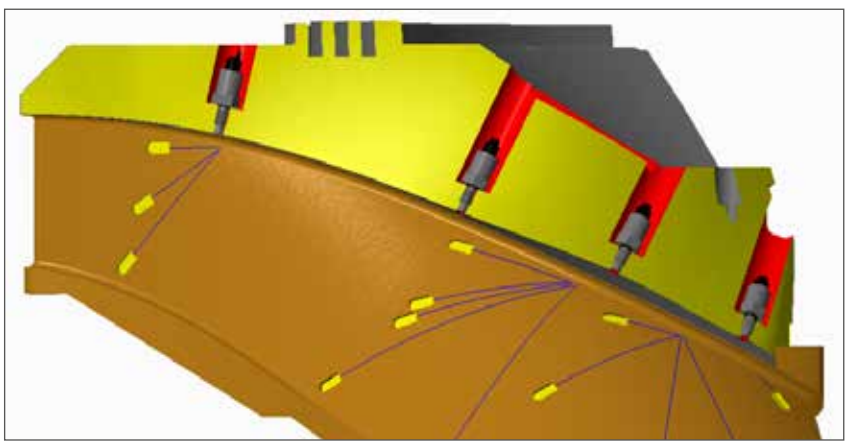
Background

Today, Francis runners are designed and verified by means of numerical methods. The challenge is to get reliable results for pressure oscillations in the fluid and the natural frequency of the runner. To be able to verify and improve calculated and simulated values, experiments must be performed.

Objective and method

The objective of this thesis is to investigate the fluid structure interaction in a Francis turbine runner. To get a better understanding of the physics, measurements will be performed to find the fluid influence on the runner, and the runners response to this influence. Quantities measured include pressure and velocity of the fluid, and acceleration, strain and displacement of the runner. The measurements will be compared with numerical results.

In addition, the relation between a stiff and a softer runner will be investigated to see the effect of runner movement closer to the resonance condition.



Pressure sensors in the hub of Francis99 model runner