

Pressure pulsations in Francis turbines



Peter Joachim Gogstad



Background

Hydropower turbines have suffered

- Excessive vibrations
- Fatigue damage
- Limited operating conditions

Objective

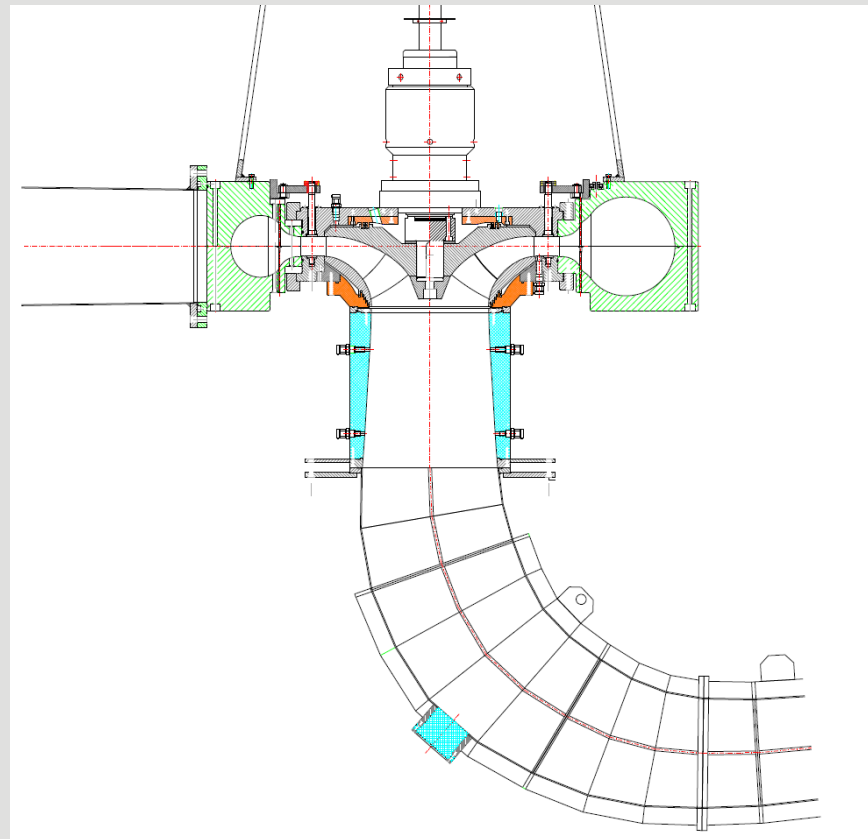
- Why do we have pressure pulsations?
- Why are some turbines so severely affected by pressure pulsations?
- How can they be mitigated or reduced most efficiently?

Case Leirfossene

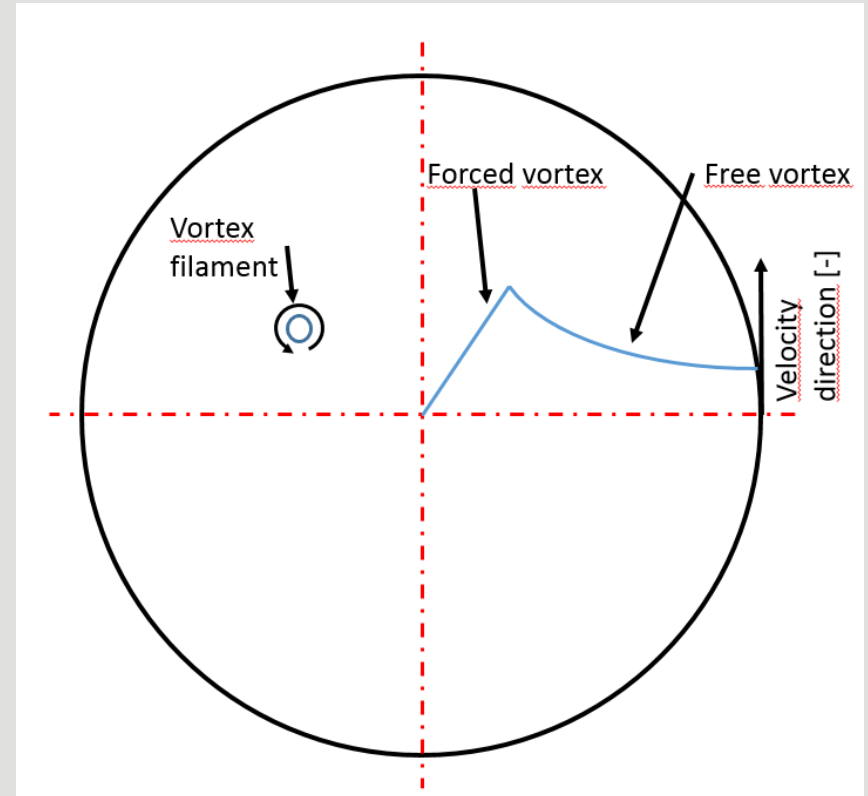
- Problems with vibration
- Air injection
- Measurements



Francis turbine

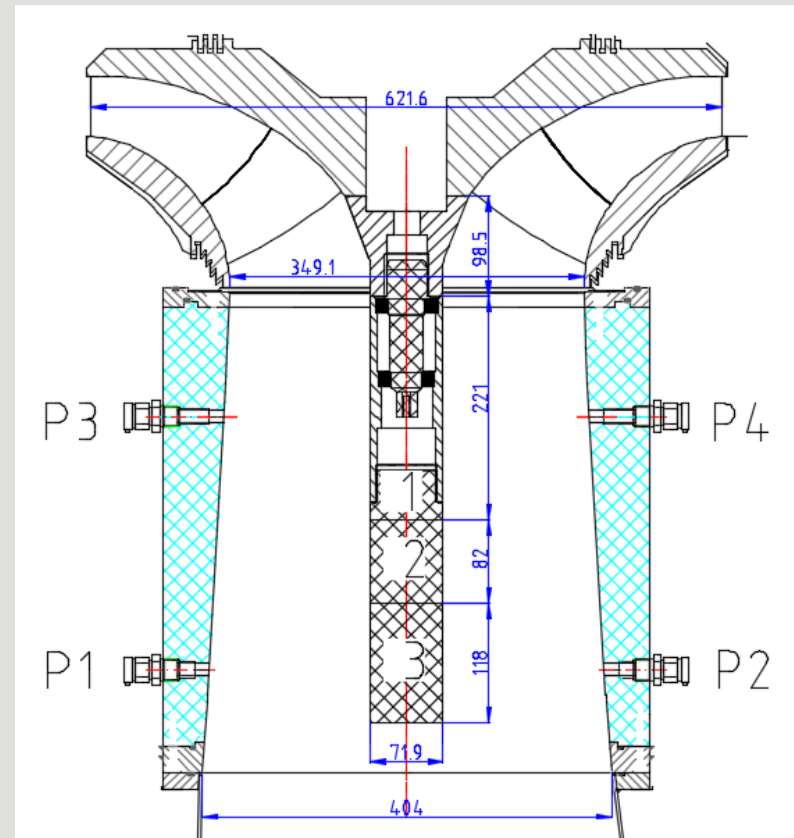


Rotating Vortex Rope



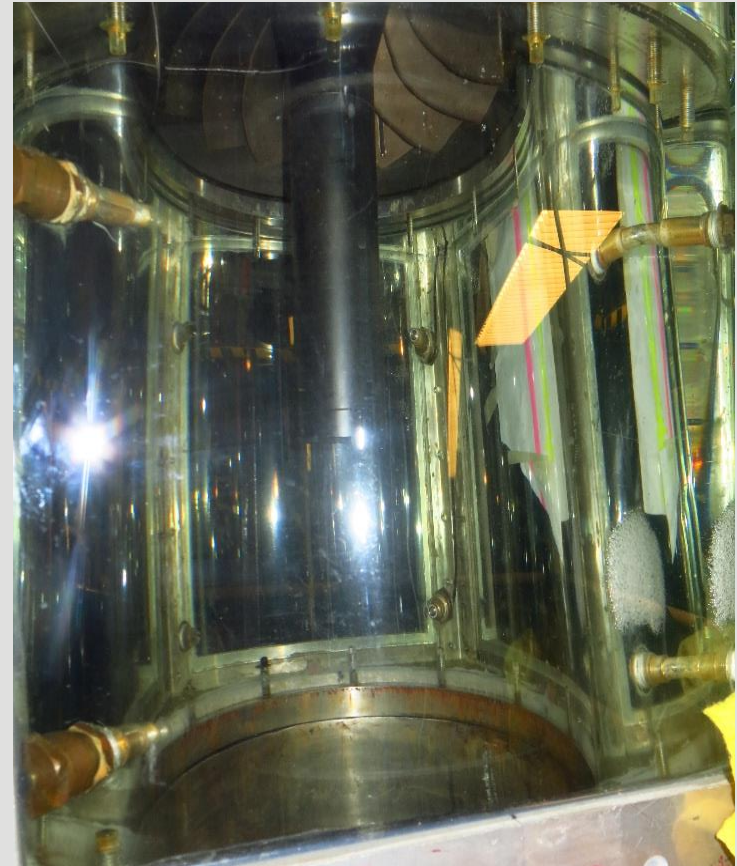
Runner Cone Extension

- Locked or freely rotating
- 3 different lengths



Results

- Efficiency unchanged
- Reduced pressure pulsations
- Length and diameter dependent



Further work

Measurements in Lerifossene

- Different designs
- Efficiency
- Pressure
- Vibrations



Questions?

