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Pressure pulsations in
a Francis turbine

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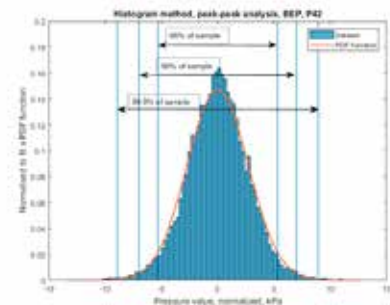
Background and objective

The average age of a Norwegian hydropower plant is 45 years, and many show sign of fatigue and need to be constantly maintained or refurbished. Additionally, some power plants in Norway have experienced failure on new Francis runners. The main problem is the formation of cracks in the turbine runner. Today, new technologies enables us to operate the turbine at variable speed, which gives the possibility to operate the turbine were pressure pulsations are lowest. This can in theory prevent fatigue damage, and prolong the lifetime of the turbine runner.

The objective of this master thesis is to find the operating range for the Francis-99 turbine with variable speed that gives the lowest material stresses in the turbine runner. This will be done by measurements of pressure pulsations in the Francis rig and structural analysis in ANSYS. The results will further be used in fatigue analysis.



Francis rig at the Waterpower Laboratory at NTNU. Picture was taken during measurements.



Pressure data is analyzed by using the histogram method.