

MASTER THESIS

for
student Andrea Engøy
Autumn 2019

Development of a Francis Turbine Test Rig at Kathmandu University
Utvikling av en Francisturbin testrigg ved Kathmandu University

Background

The Turbine Testing Laboratory at Kathmandu University was commissioned in 2011, and will be useful for future developments and improvements of hydraulic machinery necessary for the Nepali market and throughout the Himalaya region.

The laboratory is built up around a main pipe system, with the two main booster pumps located in the basement. Various running configurations are possible by utilizing different pipe loops, enabling both open and closed loop conditions. Kathmandu University are aiming to install test rigs equipped with high-precision measuring instruments in accordance with the IEC 60193 standard, enabling performance guarantee tests of Francis- and pump-turbines.

Recently, Kathmandu University received a grant from the Norwegian Government for a large research program named “EnergizeNepal” where one activity is aiming to build a state of the art Francis turbine test rig. NTNU will support the development of this test rig by giving technical support from the Waterpower Laboratory.

The Francis turbine test rig is being used for research and development tests, along with model acceptance tests. The tests comprise determination of performances, such as efficiency, discharge, head and power. The operating behaviors are investigated, such as cavitation behavior and operation at runaway. The dynamic phenomena such as pressure fluctuations, torques and forces will also be investigated.

Objectives

Design a measurement system for axial load and friction torque measurements in the Turbine Testing Laboratory at Kathmandu University.

The following tasks are to be considered:

1. Literature study
 - a. Model test of Francis turbines
 - b. Strain gauge systems
2. Software knowledge
 - a. CAD-drawing by CREO
 - b. ANSYS
 - c. LabView
3. Waterpower Laboratory at NTNU
 - a. Calibration of the instruments used in the test rig.
 - b. Produce measurements on axial load for the existing system
 - c. If time permits, a test for the friction torque will be manufactured and tested
4. Turbine Testing Laboratory, Kathmandu University
 - a. Get familiar with the existing pipe system in the Turbine Testing Laboratory.
 - b. Make 3D-drawings for the main components of the measurement system.

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The work shall be edited as a scientific report, including a table of contents, a summary in Norwegian, conclusion, an index of literature etc. When writing the report, the candidate must emphasise a clearly arranged and well-written text. To facilitate the reading of the report, it is important that references for corresponding text, tables and figures are clearly stated both places.

By the evaluation of the work the following will be greatly emphasised: The results should be thoroughly treated, presented in clearly arranged tables and/or graphics and discussed in detail.

The candidate is responsible for keeping contact with the subject teacher and teaching supervisors.

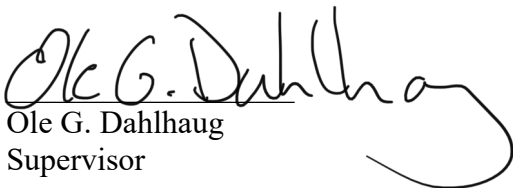
Risk assessment of the candidate's work shall be carried out according to the department's procedures. The risk assessment must be documented and included as part of the final report. Events related to the candidate's work adversely affecting the health, safety or security, must be documented and included as part of the final report. If the documentation on risk assessment represents a large number of pages, the full version is to be submitted electronically to the supervisor and an excerpt is included in the report.

According to “Utfyllende regler til studieforskriften for teknologistudiet/sivilingeniørstudiet ved NTNU” § 20, the Department of Energy and Process Engineering reserves all rights to use the results and data for lectures, research and future publications.

Submission deadline: 24. December 2019.

- ☒ Work to be done in the Waterpower laboratory
☐ Field work

Department for Energy and Process Engineering, *01. August 2019*


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Supervisor

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