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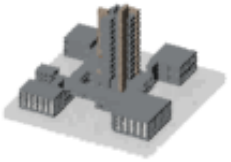

Subdepartment **Engineering Fluid Dynamics - CTW**
Department **Sustainable Energy Technology**

As part of his / her masterassignment

Sudip Adhikari

will hold a speech entitled:

Design of the impeller of a Francis type Reversible Pump Turbine

Date: 21-08-2015
Time: 14:00 hr
Room: Horst Building N109

Summary:

There has been a tremendous increase in the installed capacity of renewable energy in recent years. Power production using solar energy and wind energy will continue to increase in the coming years. These sources of energy are intermittent and lead to fluctuations in energy production. So there is a need for energy storage during the period of surplus production and to utilize this stored energy to balance the peak demand. Pumped Storage Power Plants which use a “Reversible Pump Turbine” (RPT) form a viable option to address this issue. An RPT can be operated in “pump mode” to store water in a reservoir at a certain height, and at the time of power demand the same RPT can be operated in “turbine mode” to produce electricity. An RPT with the option of variable speed operation further improves the performance of the RPT for different operation conditions.

In this thesis, a method is proposed to design the impeller of a Francis type RPT that has a concrete volute and can operate with variable speed. The method aims at achieving the design target head and flow rate in pump mode, and the design target power in turbine mode at the maximum available head. For determining the main dimensions of the RPT, empirical data has been used. The effect of the impeller parameters on the overall performance of the RPT in both modes has been investigated. The effect of designing an RPT solely from empirical data for Francis turbines and for centrifugal pumps also has been studied.

Computational Fluid Dynamics (CFD) simulations of the designed RPT impeller have been performed with NUMECA software to estimate the performance curves of the design in pump mode and in turbine mode. Furthermore, results from loss models for draft tube, volute, leakage loss, disk friction loss and mechanical loss are incorporated in the performance curves. Comparison of the results of the RPT with a reference pump design also has been made. With the proposed method it has been possible to approximately achieve the design targets for both turbine and pump modes. The volute design should be such that it fulfills both the requirements of the pump mode and turbine mode of operation.

Assessment committee:

Prof.dr.ir. C.H. Venner	(chairman)	chairman,
dr.ir. N.P. Kruyt	(mentor)	
ir. B. Kolkman (Flowserve)	(mentor from company)	(Signature)
Prof.dr.ir. G. Brem	(external member)	
		d.d.