OBJECTIVE

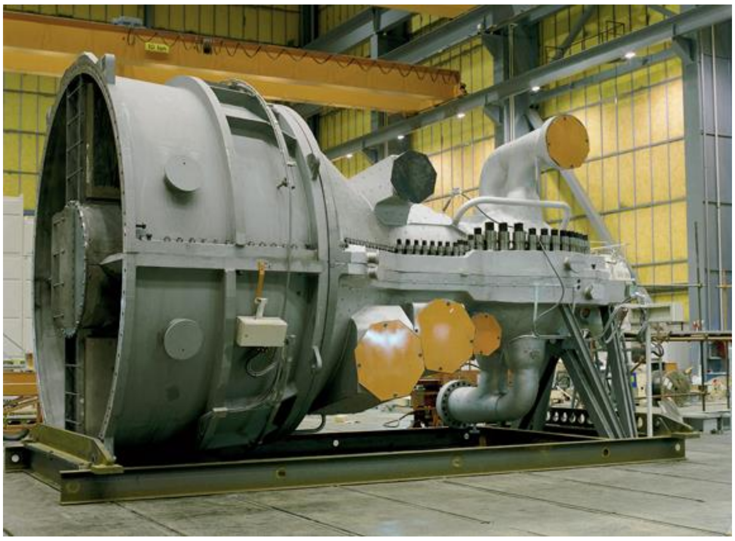
Improvement and Validation of a Steam Turbine Thermal Model for Concentrating Solar Power Applications.

BACKGROUND

Nowadays, a significant amount of the installed fleet of steam turbines is being subjected to an increased variability of operating conditions. For the turbines in conventional power plants, this increased variability is related to the higher penetration of fluctuating renewables (PV, Wind) into the grid. For the turbines in concentrating solar power plants, the fluctuations of the solar resource (day/night, cloud passages) impose these aggravated operating circumstances. The number of start-up cycles endured by solar steam turbines is greater than those in base load plants, with multiple starts possible during a 24h period.

In any of the cases above, the dynamic thermal modelling of steam turbines is crucial for better understanding the machine's behaviour during transient operation. Furthermore, studying such behaviour leads to finding potential operational improvements which in turn increase the flexibility, profitability and viability of the whole power plant. The ultimate goal is to accomplish faster turbine start up speeds while still ensuring safe operation and preservation of the machine's lifetime. For this, the accurate modelling and prediction of the temperature fields within the steam turbines is thus necessary to be able to optimize the operation of installed machines.

At KTH, this modelling is performed using a tool called ST3M. Although this tool has been successfully used for published studies on CSP steam turbines, there is an interest into improving its current calculations. In this thesis project, the main objective is to improve a currently existing ST3M model of Siemens' SST-700 turbine and perform its validation against 72h of measured data of a state-of-the-art concentrating solar power plant.



Siemens' SST-700: widely installed in currently operating CSP plants

SPECIFIC TASKS

T1 **Perform a literature review on steam turbine thermal behaviour and identify the main constraints and limiting criteria.**
Select one particular aspect of transient operation in which to perform calculation improvements and focus the literature search on that.

T2 **Get familiarized with dynamic modelling of steam turbines**
Study the current modelling structure used in KTH CSP Group: ST3M. Especially in terms of the current boundary conditions used to model the aspect selected in T1.

T3 **Implement new boundary conditions on the model and perform a comparison with the former comditions.**

T4 **Validate a current turbine model with and without the changes performed against measured power plant data.**
Measured power plant data from a parabolic trough CSP plant will be made available for the student in order to validate their contributions to the model, both against the data and against the previously existing model.

T5 **Write thesis report.**

STUDENT REQUIREMENTS

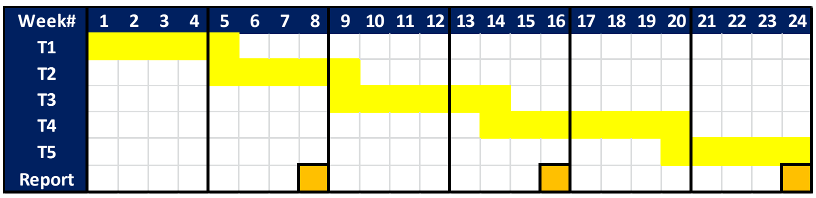
- Strong theoretical background in heat transfer and thermodynamics.
- Expertise in programming with Matlab and COMSOL.

EXPECTED DELIVERABLES

- **MATLAB+COMSOL add-on codes related to tool improvements.**
- **Manual about codes the written and their integration to the current model structure.**
- **Thesis report**

LOCATION AND TIMEFRAME OF THE PROJECT

The project is to be performed at the Department of Energy Technology at KTH Stockholm Campus. The duration of the internship is expected not to exceed ***6 months***. Below is a proposed timeframe:



SUPERVISION AND CONTACT

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