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Thesis Dynamic modeling of Target's cooling systems
Student Maximilian Cahlin
Supervisors Marcus Thern (LTH), Jaime Arriagada (ESS)
Examiner Jens Klingmann (LTH)

Predicting how cooling systems respond to operational changes

POPULAR SCIENCE SUMMARY **Maximilian Cahlin**

Dynamic models capture the behavior of cooling systems, as changes in pump speeds, valve openings and heat loads occur frequently in cooling systems. With knowledge of how cooling systems behave to different events, measurements can be taken to keep the cooling systems in safe operation.

There are several advantages with dynamic models. They can be used to optimize the performance of the cooling systems and performing their objectives at the lowest operational and maintenance cost possible. They can also be used for diagnostics, to find abnormalities in the cooling systems by comparing real operating data to normal operating conditions simulated with the dynamic models.

The focus of this thesis was the simulation of "what if" scenarios with the created dynamic models. What if a pump suddenly trips, will the cooling systems reach unsafe conditions, and if so how fast? The "what if" scenario simulations answered these type of questions. With these answers the control of the cooling systems can be adjusted such as setting new alarm limits and new control strategies to ensure safe operation of the cooling systems.

The cooling systems are kept in safe operation if the pressure is kept under the design pressure of the components, thus avoiding damaging them. Boiling of the fluid needs to be avoided and temperature kept low enough together with a minimum mass flow rate to ensure that the cooling objective is reached.

Cost-effective dynamic models were constructed in Dymola with the aid of free component model libraries such as the Modelica Standard Library and the Buildings Library. The graphical user interface allowed for the models to be constructed in resemblance to the corresponding cooling system drawings. The constructed component models were verified with well-known and proven mathematical calculations to conclude that they were modeled correctly. With the models the temperature as a function of time in the fluid and the solid parts were simulated for reasonable computational times.

With the described modeling procedure and the constructed component models, it could be possible to construct and connect the other cooling systems to the already modeled cooling systems and further implement control strategies to the dynamic models.