Dynamic Modeling of a Central Receiver CSP system in Modelica

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A dynamic model of a Central Receiver type CSP plant (CRS) was implemented in Modelica. The model consists of a set of CRS specific components, along with a Rankine cycle to form a complete system. Main components include models of a sun, heliostat field, receiver, storage tank and a Rankine cycle including a steam generator. The system uses a molten nitrate solution, called Solar Salt, as heat transfer fluid.

The components were modelled and configured after a reference system – the Solar Two test facility in CA, USA, operational in the late 1990's – but are generic and rescalable. A graphical view of the combined system model is illustrated in Figure 1.

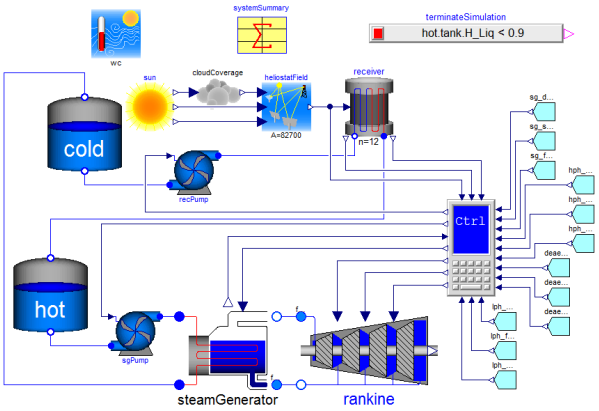

Figure 1. Combined system model.

The components and the full system were tested in a series of simulations – both dynamically and during steady state conditions – and the results were compared to data from the reference system. The dynamic behavior of the models aligned with expectations, although time constants could not be evaluated due to lack of dynamic reference data. The steady state characteristics were adequate for most models, although some complementary work needs to be done on the Receiver model.

This work is the result of a Master Thesis project at Lund University in collaboration with Modelon AB, Lund, Sweden (Edman, 2014). The models developed are largely based on the various model libraries in Modelons portfolio, especially the ThermalPower library, the LiquidCooling library and the Modelon Base library.

References

J. Edman, "Dynamic Modeling of a Central Receiver CSP sytem in Dymola," M.S. thesis, Dept. En. Sci., Lund Univ., Lund, Sweden, 2014.