Start-up performance of parabolic trough concentrating solar power plants - DTU Orbit (09/11/2017)

Start-up performance of parabolic trough concentrating solar power plants

Concentrating solar power plants, even though they can be integrated with thermal energy storage, are still subjected to cyclic start-up and shut-downs. As a consequence, in order to maximize their profitability and performance, the flexibility with respect to transient operations is essential. In this regard, two of the key components identified are the steam generation system and steam turbine. In general it is desirable to have fast ramp-up rates during the start-up of a power plant. However ramp-up rates are limited by, among other things, thermal stresses, which if high enough can compromise the life of the components. Moreover, from an operability perspective it might not be optimal to have designs for the highest heating rates, as there may be other components limiting the power plant start-up. Therefore, it is important to look at the interaction between the steam turbine and steam generator to determine the optimal ramp rates. This paper presents a methodology to account for thermal stresses limitations during the power plant start up, aiming at identifying which components limit the ramp rates. A detailed dynamic model of a parabolic trough power plant was developed and integrated with a control strategy to account for the start-up limitations of both the turbine and steam generator. The models have been introduced in an existing techno-economic tool developed by the authors (DYESOPT). The results indicated that for each application, an optimal heating rates range can be identified. For the specific case presented in the paper, an optimal range of 7-10 K/min of evaporator heating rate can result in a 1.7-2.1% increase in electricity production compared to a slower component (4 K/min).

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