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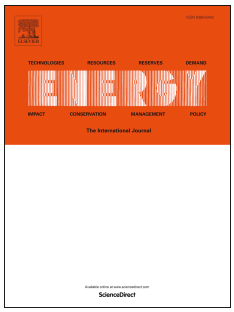

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Design and Experimental Validation of a Computational Effective Dynamic Thermal Energy Storage Tank Model

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Abstract

Concentrating solar thermal power plants rely in thermal energy storage systems in order to provide a stable power supply. However, they might not been able to meet power plant demands, mainly because of their storage sizes which are restricted due to economic reasons. One way of mitigating this effect is to control in an optimal way the charging and discharging processes. For the design and validation of advanced control strategies, an accurate dynamic model is essential. For this reason, a dynamic thermal energy tank model intended to be used in concentrating solar thermal power plant models is presented in this paper. The developed tank model is validated in charging and discharging processes and also at rest state in order to validate thermal losses dynamics. Simulation results are compared against experimental data from the CIEMAT-PSA molten salt testing facility.

Keywords: Thermal energy storage, sensible heat, dynamic modeling, transient simulation, molten salt, Modelica.

1. Introduction

Dispatchability on demand is the keystone to provide electricity in a stable and reliable way, and one of the main issues that renewable energies must tackle. Solar thermal power has the advantage, over other renewable energies, of storing thermal energy and thus the ability of mitigating solar irradiance variability to some extent [1]. This advantage makes solar thermal power appropriate for large-scale energy production.

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