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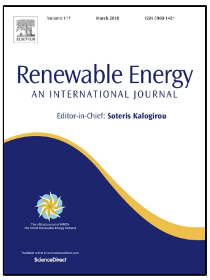

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Three-dimensional transient numerical model for the thermal performance of the solar receiver

Li Xu[1, 2, *], Wes Stein[2], Jin-Soo Kim[2], Zhifeng Wang[1]

1 Key Laboratory of Solar Thermal Energy and Photovoltaic System of Chinese Academy of Sciences, Beijing Engineering Research Center of Solar Thermal Power, Institute of Electrical Engineering, Chinese Academy of Sciences, Beijing 100190, China

2 CSIRO Energy Technology, P.O. Box 330, Newcastle, NSW 2300, Australia

Abstract:

For solar thermal power plants, no steady-state operation occurs in view of inherently transient natures of their initial and boundary conditions. So this study proposes a mathematical model to perform the analysis on the transient behaviors of the external solar receiver in the tower power technology. This 3D transient model was established by dividing the receiver tube into discrete control volumes and then applying the conservation of thermal energy to every single differential control volume. In addition, this model was validated by simulating the HTF temperature distributions and then comparing them with the reference results. By calculating the time-dependent and non-uniform temperature fields of the receiver tube, this paper focuses attention on the evolution of transient processes in several common scenarios involving the mass flowrate variation, the start-up process and the occurrence of the heavy clouds above the heliostat field. Particularly, the analysis of the transient thermal performance highlights some noteworthy characteristics including serious problems such as the corrosion, the thermal stress and the fatigue in the typical transitions, which might require the control system to correspondingly adjust in time.

Keywords: External solar receiver; Tower technology; Molten salt; Thermal

* Corresponding author. Tel: +86 10 82547268. E-mail address: xuli_neu@126.com