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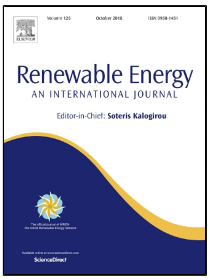

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Abstract

In a parabolic trough solar power plant, the steam generation system is the junction of the heat transfer fluid circuit and the water/steam circuit. Due to the discontinuous nature of solar radiation, the dynamic characteristics of working fluid physical parameters, such as mass flow rate, temperature, and pressure, are more evident in the steam generation system in this kind of plant, increasing the complexity of system operation. In this paper, a zero-dimension dynamic model of an oil/water steam generation system was developed based on the lumped parameter method. Based on the developed model, four typical single-parameter disturbance processes were simulated, and then the control strategy was obtained. System-level simulations on different days (clear and cloudy) and in different seasons (spring, summer, autumn, and winter) were also conducted on a STAR-90 simulation platform using real meteorological data. The simulation results show that PI control can be used to adjust the water level, that system operation on cloudy days should be avoided, and that the system can continue to generate steam after the sun sets. The simulation results can provide a useful reference for plant operators.

Key words

Parabolic trough solar power plant, Steam generation system, System-level simulations, STAR-90

Nomenclature

Latin symbols

A	heat transfer area (m^2)	V	volume (m^3)
a	volume coefficient 1 (m^3)	*Greek symbols*	
b	volume coefficient 2 ($m^3/(kg \cdot s^{-1})$)	α	convective heat transfer coefficient ($W/(m^2 \cdot °C)$)