Abstract

A simulation for a solar thermal electric generating system with parabolic trough collectors in Basrah city is presented. This system consists of three parts: solar collector fields to heating the working fluid, a storage system to store the thermal energy, and power conversion system to convert the thermal energy to electrical. The simulation is presented for all parts. The energy conversion of solar radiation into thermal power along the absorber tube of the parabolic collector is studied. The coupling between the collector and the thermodynamic cycle is made up by heat exchangers, yielding the characteristic temperatures of the cycle. The conventional Rankine cycle is used as the thermodynamic cycle, whereby the electric power is calculated.

The performance of a 30 MW power plant, composed of 50 rows with 16 collectors in series (total 800 collectors) was simulated. Finally, the output power of the plant is calculated for two cases: system with storage tank and with out it. A maximum of the overall cycle efficiency is found at temperatures around 320 oC.

All calculations are performed according to Basrah climate's conditions for 21st of each month in 2007.

Engineering Equation solver (EES) software is used to solve the partial differential equations for the solar collector field to estimate the outlet working fluid temperatures from the absorber tube as functions of time. The (EES) software also used to solve the partial differential equations for storage tank to estimate the storage tank temperatures as functions of time. The power plant model is implemented, also in (EES) to estimate the gross power as functions of time.

Good agreements are obtained when comparing the results of the collector outlet temperatures and gross power of the current model with experimental data belonging to the Solar Electric Generating Systems (SEGS) installed in the Mojave Desert in southern California, whose solar field is composed by parabolic trough collectors. The analytical model developed combines precision and flexibility, making it an attractive tool for simulation and design of solar power stations in Basrah city.