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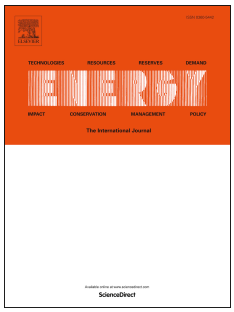

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Cost-based design optimization of the heat exchangers in a parabolic trough power plant

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Abstract

This paper addresses two important concerns of the design of steam generators of parabolic trough power plants: cost minimization and component reliability. A thorough economic analysis of the heat exchangers of the steam generator and oil-to-salt heat exchangers of a 50 MWe parabolic trough power plant is presented. The heat exchanger design is realized following TEMA standards and optimized using a genetic algorithm. Two design strategies are compared: the minimization of the total heat transfer area and the minimization of the total annualized cost. It is seen that the second approach provides substantial savings over the lifetime of the plant.

The economic analysis reveals a global optimum with an outlet temperature of the heat transfer fluid of 293 ºC and an evaporator pinch point of 4.85 ºC. The best design of the steam generator consists of a TEMA-H shell superheater and preheater and a TEMA-F shell reheater. The best design of the oil-to-salt heat exchangers includes six TEMA-F shell heat exchangers in series, with a log mean temperature difference of 7ºC and the molten salt on the shell-side. Lastly, a TEMA-X recirculation evaporator is proposed with a considerably reduced wall thickness when compared to a kettle evaporator.

Key words: *Solar thermal power plant; Parabolic trough; Thermal energy storage; Steam generator; Heat exchanger design; Design optimization.*