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Thermo-Economic Analysis of a Natural Draft Direct Cooling System for a Molten Salt Power Tower

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Abstract : Reducing parasitic power consumption of concentrating solar power plants is the main challenge to increase the overall efficiency, particularly for molten salt tower technology. One of the most effective approaches to reduce the parasitic power consumption is to implement a natural draft dry cooling system instead of the standard utilized mechanical draft dry cooling system. In this paper, a thermo-economic analysis of a natural draft direct cooling system was performed based on a 100MWe commercial scale molten salt power plant. In this configuration with a natural draft direct cooling system, the exhaust steam from steam turbine flows directly to the heat exchanger bundles inside the natural draft dry cooling tower, which eliminates the power consumption of circulation pumps or fans, although the cooling tower shadows a portion of the heliostat field. The simulation results also show that compared to a mechanical draft cooling system the annual solar field efficiency is decreased by about 0.2% due to the shadow, which is equal to a reduction of approximately 13% of the solar field area. As a contrast, reducing the solar field size by 13% in purpose in a molten salt power plant with a natural draft drying cooling system actually will lead to a reduction of levelized cost of electricity (LCOE) by about 4.06% without interfering the power generated.

Keywords : molten salt power tower, natural draft dry cooling, parasitic power consumption, commercial scale
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