STUDY ON A RECOMPRESSION SUPERCRITICAL CO_2 BRAYTON CYCLE FOR A SOLAR POWER TOWER SYSTEM UNDER OFF-DESIGN CONDITIONS

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ABSTRACT

Concentrated solar power (CSP) with thermal energy storage (TES) is a promising technology to provide a dispatchable power output. When it is used for peak load shaving in the power grid, the system runs under operating conditions deviating from the design point (off-design conditions). Among several CSP technologies, solar power tower (SPT) integrated with the supercritical CO_2 (S-CO_2) Brayton cycle attracts extensive attention for high efficiency. Recompression S-CO_2 Brayton cycle with high-temperature and low-temperature recuperators is proposed to decrease the irreversible loss of heat transfer, compared with using a single recuperator, and thus to achieve a preferable thermodynamic performance. Therefore, to meet the variable power demand with possibly higher thermal efficiency, the performance of recompression S-CO_2 Brayton cycle under off-design conditions is necessary to be well understood. However, relevant researches on this aspect are rarely reported.

In this study, a power system of the recompression S-CO_2 Brayton cycle with reheating integrated with the SPT is proposed. Under off-design conditions, sliding pressure operation control strategy is adopted for the power cycle with variable load. The molten salt temperature at the inlet of heater remains constant, whereas the mass flow rate is adjusted to deliver the requested heat to the power cycle. The operating parameters including split ratio and intermediate pressure for reheating are optimized for variable off-design conditions. The results show that the cycle thermal efficiency decreases as the load decreases. The optimal split ratio and intermediate pressure for reheating change for different off-design conditions.