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Robust Design and Optimisation of a Radial Turbine within a Supercritical CO_2 Solar Brayton Cycle

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Abstract

The generation of solar thermal power is dependent upon the amount of sunlight exposure, as influenced by the day-night cycle and seasonal variations. In this paper, robust optimisation is applied to the design of a power block and turbine, which is generating 30MWe from a concentrated solar resource of 560°C. The robust approach is important to attain a high average performance (minimum efficiency change) over the expected operating ranges of temperature, speed and mass flow. The final objective function combines the turbine performance and efficiency weighted by the off-design performance. The resulting robust optimisation methodology as presented in the paper gives further information that greatly aids in the design of non-classical power blocks through considering off-design conditions and resultant performance.