World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:17, No:02, 2023

The Impact of Dispatching with Rolling Horizon Control in Sizing Thermal Storage for Solar Tower Plant Participating in Wholesale Spot Electricity Market

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Abstract : The solar tower (ST) plant is a promising technology to exploit large-scale solar irradiation. With thermal energy storage, ST plant has the potential to shift generation to high electricity price periods. However, the size of storage limits the dispatchability of the plant, particularly when it should compete with uncertainty in forecasts of solar irradiation and electricity prices. The purpose of this study is to explore the size of storage when Rolling Horizon Control (RHC) is employed for dispatch scheduling. To this end, RHC is benchmarked against perfect knowledge (PK) forecast and two day-ahead dispatching policies. With optimisation of dispatch planning using PK policy, the optimal achievable profit for a specific size of the storage is determined. A sensitivity analysis using Monte-Carlo simulation is conducted, and the size of storage for RHC and day-ahead policies is determined with the objective of reaching the profit obtained from the PK policy. A case study is conducted for a hypothetical ST plant with thermal storage located in South Australia and intends to dispatch under two market scenarios: 1) fixed price and 2) wholesale spot price. The impact of each individual source of uncertainty on storage size is examined for January and August. The exploration of results shows that dispatching with RH controller reaches optimal achievable profit with ~15% smaller storage compared to that in day-ahead policies. The results of this study may be applied to the CSP plant design procedure.

Keywords : solar tower plant, spot market, thermal storage system, optimized dispatch planning, sensitivity analysis, Monte Carlo simulation
Conference Title : ICSEAPE 2023 : International Conference on Solar Energy and Advanced Power Engineering
Conference Location : Melbourne, Australia
Conference Dates : February 06-07, 2023