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Highlights

- Risk-based scheduling of concentrating solar power (CSP) plant is studied.
- Thermal energy storage system is considered to increase the efficiency of CSP plant.
- MILP formulation of the new hybrid IGDT-stochastic method is presented.
- Market price uncertainty is modeled by a set of scenarios using the stochastic method.
- IGDT method is used to model the uncertainty of solar radiation.

Abstract In this paper, optimal scheduling of a central concentrating solar power (CSP) plant which is one of the most promising technologies in the solar energy is investigated in the presence of different uncertainties. Thermal energy storage is integrated with the CSP plant in order to allow the plant to be independent from the instantaneous solar radiation. In order to model different uncertainty such as power market price and solar irradiation, a new hybrid information gap decision theory (IGDT)-stochastic method is introduced which is a mixed-integer linear programming method and presents more reliable results in a suitable computation time. In the proposed method the uncertainty of the solar irradiation is modeled by IGDT method while power market price uncertainty is considered by a set of fifty scenarios. Three different strategies as risk-averse, risk-neutral and risk-taker are introduced to analyze the operation of the CSP plant. In the risk-neutral strategy, obtained profit is equal to $3895 which is reduced in the risk-averse strategy by increasing robustness value indicating increased uncertainty of the solar irradiation. In the risk-taker strategy, the CSP operating profit will be equal to $4245 by 15% of increase in solar radiation, comparing with the risk-neutral case shows almost 8.2% increase in profit.

Keywords Concentrating solar power (CSP) plant, Solar thermal energy storage, Information gap decision theory (IGDT), Stochastic optimization.