IEEE Transactions on Power Systems, vol.34, no.3, pp.1881-1894, May, 2019.

Day-ahead self-scheduling of a virtual power plant in energy and reserve electricity markets under uncertainty

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Abstract-

This paper proposes a novel model for the day-ahead self-scheduling problem of a virtual power plant trading in both energy and reserve electricity markets. The virtual power plant comprises a conventional power plant, an energy storage facility, a wind power unit, and a flexible demand. This multi-component system participates in energy and reserve electricity markets as a single entity in order to optimize the use of energy resources. As a salient feature, the proposed model considers the uncertainty associated with the virtual power plant being called upon by the system operator to deploy reserves. In addition, uncertainty in available wind power generation and requests for reserve deployment is modeled using confidence bounds and intervals, respectively, while uncertainty in market prices is modeled using scenarios. The resulting model is thus cast as a stochastic adaptive robust optimization problem, which is solved using a column-and-constraint generation algorithm. Results from a case study illustrate the effectiveness of the proposed approach.

Index Terms- Robust optimization, self-scheduling, stochastic programming, uncertainty, virtual power plant.

Citation:
Baringo, A.; Baringo, l.; Arroyo, J.M. "Day-ahead self-scheduling of a virtual power plant in energy and reserve electricity markets under uncertainty", IEEE Transactions on Power Systems, vol.34, no.3, pp.1881-1894, May, 2019.