Ramyar Mafakheri, Pouria Sheikhahmadi, Salah Bahramara, 2020, A two-level model for the participation of microgrids in energy and reserve markets using hybrid stochastic-IGDT approach, *Electrical Power and Energy Systems,* 119 (2020) 105977.

Abstract In this paper, the decision making problem of microgrids (MGs) in simultaneous participation in the energy and reserve markets under uncertainty is investigated using a two-level framework. In the first level, the uncertainties of wind speed, solar radiation, probability of calling reserve, energy and reserve market prices, and demand are modeled using their probability distribution functions regarding which the operation problem of MG operator (MGO) is formulated as a two-stage stochastic optimization approach. The expected total cost and the amount of the provided reserve by the MGO for the reserve market are the output decisions of this problem which are considered as the parameters in the second level problem. The uncertainty of the accepted reserve by the market regarding the required reserve of the system and the behavior of the market players are modeled using the information gap decision theory (IGDT) approach as the second level problem. Therefore, the risk of the MGO is controlled using the conditional value at risk (CVaR) and IGDT risk-aversion parameters. Applying the proposed model on the 15-bus modified MG and 40-bus real test system shows the optimal decisions of the MGO in both markets to manage its uncertainties. Moreover, the sensitivity analysis is done to investigate the behavior of the MGO with changing the risk aversion parameters.

Keywords Micro-grids, Energy and reserve markets, Renewable energy sources, Stochastic optimization, Information gap decision theory