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A tri-level stochastic model for operational planning of microgrids with hydrogen refuelling station-integrated energy hubs

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Abstract-

Energy hubs are efficient energy systems in which multiple energy carriers are converted, conditioned and stored to supply multiple forms of energy demands such as electricity, gas and heat. On the other hand, the penetration of fuel cell vehicles in transportation sector is increasing. The role of hydrogen refuelling stations is to inject hydrogen into fuel cell vehicles. A hydrogen refuelling station may absorb its required electricity from an energy hub. The operational planning of the microgrids with hydrogen refuelling station-integrated energy hubs has not been addressed before; therefore, the main goal of this research is to develop a hierarchical stochastic framework for operational planning of isolated microgrids with hydrogen refuelling station-integrated energy hubs, considering the uncertainties. In a hierarchical framework, the players are not obliged to submit their models to a central agent, so the privacy of players is preserved; moreover, it is computationally inexpensive. Mixed-integer linear programming models are used for hydrogen refuelling stations and energy hubs, while a mixed-integer quadratic programming model is used for modeling microgrid. CPLEX and GUROBI solvers are respectively used for solving the developed models. SCENRED module is used for scenario reduction. The studied microgrid is a renewable-rich 69-bus radial network. The findings approve the efficiency of the proposed methodology. The impact of batteries and wind generators on the operation of energy hubs has been evaluated.

Index Terms- Hydrogen refuelling stations; Hydrogen; Renewable energy; Microgrids; Energy hub. power systems

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