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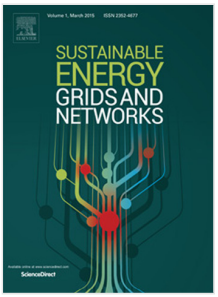

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Battery Energy Storage System for Primary Control Reserve and Energy Arbitrage

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Abstract

The transition to high penetration of renewable energy sources brings about problems related to the security and reliability of the electric power system. For this reason, EU countries are considering extending participation in the provision of ancillary services to distributed generators. Grid-connected Battery Energy Storage Systems (BESS) are a promising technology for enabling this transition. Besides the research efforts to regulate and integrate BESS into the existing power systems, several studies have introduced improvements in BESS control for ancillary services provision. In this paper, attention is focused on primary control reserve (PCR). An introduction to the suitability of using BESS for PCR is followed by a literature review on BESS control strategies and controller models. Then the paper presents a model to investigate methods to increase BESS potential in providing PCR. The model is based on two different operating options: (i) *variable-droop*, meaning the droop-control is allowed to vary in time in order to avoid state of charge saturations and guarantee PCR availability; (ii) *energy arbitrage*, meaning that the battery is charged and discharged when economically favorable. A 1MW/1MWh BESS was simulated in MATLAB®Simulink® by implementing the two operating options via two fuzzy logic controllers that determine the droop and the arbitrage set points. The simulations rely on real metered data inputs (i.e. frequency and electricity prices) and demonstrate that both options improve BESS operations. Specifically, a study on the Italian case was applied to evaluate the feasibility of these applications in a real life scenario.

Keywords

Renewable Energy, Distributed Generations, Ancillary Services, Fuzzy Logic, droop control, energy storage