World Academy of Science, Engineering and Technology
International Journal of Electrical and Computer Engineering
Vol:12, No:12, 2018

Comparative Studies of Distributed and Aggregated Energy Storage Configurations in Direct Current Microgrids

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Abstract : Energy storage system (ESS) is an essential part of a microgrid (MG) because of its immense benefits to the economics and the stability of MG. For a direct current (DC) MG (DCMG) in which the generating units are mostly variable renewable energy generators, DC bus voltage fluctuation is inevitable; hence ESS is vital in managing the mismatch between load demand and generation. Besides, to accrue the maximum benefits of ESS in the microgrid, there is the need for proper sizing and location of the ESSs. In this paper, a performance comparison is made between two configurations of ESS; distributed battery energy storage system (D-BESS) and an aggregated (centralized) battery energy storage system (A-BESS), on the basis of stability and operational cost for a DCMG. The configuration consists of four households with rooftop PV panels and a wind turbine. The objective is to evaluate and analyze the technical efficiencies, cost effectiveness as well as controllability of each configuration. The MG is first modelled with MATLAB Simulink then, a mathematical model is used to determine the optimal size of the BESS that minimizes the total operational cost of the MG. The performance of the two configurations would be tested with simulations. The two configurations are expected to reduce DC bus voltage fluctuations, but in the cases of voltage stability and optimal cost, the best configuration performance will be determined at the end of the research. The work is in progress, and the result would help MG designers and operators to make the best decision on the use of BESS for DCMG configurations.

Keywords : aggregated energy storage system, DC bus voltage, DC microgrid, distributed battery energy storage, stability
Conference Title : ICEASG 2018 : International Conference on Energy Automation and Smart Grid
Conference Location : Sydney, Australia
Conference Dates : December 03-04, 2018