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Use of Battery Energy Storage Systems to Enhance the Frequency Stability of an Islanded Microgrid Based on Hybrid Photovoltaic-Diesel Generation

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Abstract

Primary frequency control in power systems is becoming more difficult as levels of non-synchronous generation grow. This paper explores how implementing a control strategy based on the concept of virtual inertia, supported by the use of battery energy storage systems (BESS), might positively impact frequency stability of the grid. Particularly, this work centers its effort on islanded microgrids based on hybrid generation: photovoltaic and diesel. This paper presents a methodology for representing an islanded-power system equipped with photovoltaic (PV), diesel generators, and BESS, the latter with a

virtual frequency control feature devised to improve the resilience of the system in terms of frequency after a contingency occurs. The proposed methodology is designed as an analysis tool to help in the survey and decision making in the planning and operation of systems with these characteristics. This methodology and its implementation are used to test an electrical power system facing a continuous power imbalance caused by the PV-power intermittence to assess how the frequency varies when the virtual inertia control system based on BESS is enabled or not. Matlab-Simulink is used as a simulation environment. The numerical results achieved with the model show the benefits of implementing the virtual inertia control characteristics in the BESS in terms of both reducing frequency fluctuations and reducing the time-derivative of frequency under normal operating conditions.

Author keywords

Battery energy storage system; Microgrid; Photovoltaic generation; Primary frequency control; Synchronous generation

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