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Battery Energy Storage System Economic Benefits Assessment on a Network Frequency Control

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Abstract : Here a methodology is considered aiming at evaluating the economic benefit of the provision of a primary frequency control unit using a Battery Energy Storage System (BESS). In this methodology, two control types (basic and hysteresis) are implemented and the corresponding minimum energy storage system power allowing to maintain the frequency drop inside a given threshold under a given contingency is identified and compared using DigSilent’s PowerFactory software. Following this step, the corresponding energy storage capacity (in MWh) is calculated. As PowerFactory is dedicated to dynamic simulation for transient analysis, a first order model related to the IEEE 9 bus grid used for the analysis under PowerFactory is characterized and implemented on MATLAB-Simulink. Primary frequency control is simulated using the two control types over one-month grid's frequency deviation data on this Simulink model. This simulation results in the energy throughput both basic and hysteresis BESSs. It emerges that the 15 minutes operation band of the battery capacity allocated to frequency control is sufficient under the considered disturbances. A sensitivity analysis on the width of the control deadband is then performed for the two control types. The deadband width variation leads to an identical sizing with the hysteresis control showing a better frequency control at the cost of a higher delivered throughput compared to the basic control. An economic analysis comparing the cost of the sized BESS to the potential revenues is then performed.

Keywords : battery energy storage system, electrical network frequency stability, frequency control unit, PowerFactor
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