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Energy Storage Optimisation in an Electric Power Grid

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Energy storage is an essential part of energy supply to consumer demand from the grid. It plays a strategic role in the future development of flexible and reliable electricity systems. Energy storage systems allow excess of generation from the grid to be stored for later usage therefore ensuring an efficient network, particularly as back-up power support following an outage in the distribution network.

The variability of renewable energy resources are difficult to predict consequently causing several negative impacts on the electric grid. Inconsistency of renewable energy is presently dealt with by ramping conventional reserves up and down based on consumer demand but predominantly by weather forecasts. However, as the penetration level of renewable energy increases, conventional reserve compensation will no longer be appropriate without energy storage units capable of rapidly responding to the power fluctuations within the network to maintain system stability.

This research project demonstrates the potential benefits of optimised positioning of energy storage systems in order to manage the growing deployment of intermittent generation by solving these issues in providing electricity where and when required. A simulation study is presented using OpenDSS interfaced with MATLAB software. The distribution model used in the co-simulation is the '13Bus' circuit from the 'IEEETestCases' examples.

This circuit model was used to demonstrate how singular and multiple batteries based on determined geographical locations can reduce the instability of a PV generator, peak-shave during high-demand hours and smooth the power flow within the network. The results demonstrate the effectiveness of the proposed energy storage positioning strategy in enhancing the stability and reliability of the grid.

Keywords
Energy, Power, Distributed Network, Power Grid, Storage, MATLAB, OpenDSS, Renewable Energy, Coordination.

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