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Large-scale energy storage frequency regulation

Overview

This paper studies the frequency regulation strategy of large-scale battery energy storage in the power grid system from the perspectives of battery energy storage, battery energy storage station, and battery energy storage system, respectively.

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Among various grid services, frequency regulation particularly benefits from ESSs due to their rapid response and control capability. This review provides a structured analysis of four representative ESS types and emphasizes the growing importance of hybrid configurations.

The simulation results demonstrate that the proposed strategy enhances primary frequency regulation and transient stability while effectively mitigating oscillations.

The proposed approach integrates a hybrid energy storage systems (HESSs) with load frequency control (LFC) based on a proportional derivative–proportional integral (PD-PI) controller.

Secondary frequency regulation, executed through Automatic Generation Control (AGC), requires continuous adjustments to active power output to maintain system frequency within narrow tolerances (e.g., 50 Hz or 60 Hz ±0.05%).

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