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Optimal coordinated design of under-frequency load shedding and energy storage systems

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Abstract-

Under-frequency load shedding (UFLS) is considered a fundamental protection tool against power imbalances in electrical grids, particularly in small island systems. However, load shedding entails a delicate compromise between guaranteeing the stability of the system and disconnecting the lowest amount of load to achieve it. Fast-responding converter-interfaced energy storage systems (ESSs) can help improve such a compromise. In this regard, this paper proposes a methodology for the coordinated design of under-frequency load shedding (UFLS) and fast-responding converter-interfaced energy storage systems (ESSs). UFLS parameters include thresholds for frequency and its rate-of-change, and time settings of each step. ESS control parameters comprise, among others, the emulated inertia and the droop. The proposed coordinated methodology is applied to a real Spanish island power system with a 4 MW/5.6 kWh ultracapacitor (UC). Results show that the proposed methodology is able to significantly reduce the total amount of load shed with respect to the currently implemented UFLS settings and UC control parameters.

Index Terms- Frequency stability; Under-frequency load shedding; Energy storage systems; Ultracapacitors; Island grids

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