Design and Real-Time Implementation of a Centralized Microgrid Control System With Rule-Based Dispatch and Seamless Transition Function

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Abstract: With reference to the newly released microgrid standards, design and real-time implementation of a centralized microgrid control system is presented in this article. In the grid-connected mode, the utility grid will provide the voltage and frequency reference at the point of connection. The assets within the microgrid will follow power command references provided by the control system. In the islanded mode, the energy storage system (ESS) can provide the voltage and frequency reference to all other generators. Based on the state-of-charge of the ESS, a rule-based dispatch is proposed, with priority given to diesel generator and then the storage in the middle state of charge range. To alleviate power fluctuations, meet smooth planned islanding requirement, and compensate for the feeder losses ignored in dispatch algorithm, a supplementary slack-bus power control based on closed-loop feedback and first-order filter is proposed. The potential of the storage system in firming short-time power fluctuation and providing long-term load shifting capabilities is exploited. An emergency dispatch function for unplanned islanding considering the speed of response limitation of a diesel generator is also proposed. The proposed control strategy is implemented and tested on a controller hardware-in-the-loop test bench. It demonstrates the capability of the control system to reduce load shedding and renewable curtailment, and to implement power management at the point of interconnection.