Adaptive Robust Load Restoration via Coordinating Distribution Network Reconfiguration and Mobile Energy Storage

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In recent years, the power outages caused by catastrophic weather events have become an imperative issue in power system research. Mutual impacts of pre- and post-event operation, uncertainties during system recovery, as well as binary decision variables are still challenging. To address these issues, this paper proposes an adaptive robust load restoration method for active distribution networks which coordinates network reconfiguration, mobile energy storage systems (MESSs) and repair crews (RCs). In the pre-event stage, pre-positioning of MESSs and proactive network reconfiguration are conducted to enhance system survivability. In the post-event stage, dynamic network reconfiguration is coordinated with scheduling MESSs and RCs, to restore all loads under uncertainties. A mixed integer second-order conic programming model which also contains practical voltage dependent loads is formulated. Further, a two-stage robust optimization method is applied to guarantee solution robustness against multiple uncertainties including fault locations. To optimize the binary recourse variables in the post-event stage, a feasibility pump based solution algorithm is developed. Numerical simulations conducted on a 33-bus system demonstrate effectiveness of the proposed load restoration method, high efficiency of the solution algorithm and high solution robustness.

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