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Summary:

As power systems strive towards enhancing resilience and reliability, the focus shifts to implementing adaptive and decentralized control mechanisms. This research delineates a robust framework which pivots on a dynamic restructuring of networked microgrids (NMGs), fundamentally anchored on real-time fault detection and swift response strategies.

In the initial stage, the framework identifies real-time faults in the network, triggering a dynamic reconfiguration of microgrids (MGs). Utilizing dynamic switches, new MGs formations are created, fostering potential connections with neighbouring MGs to form a cohesive cluster. This mechanism, aimed at mitigating the repercussions of High Impact Low Probability (HILP) events, enables power sharing amongst the clusters, thereby enhancing the overall resilience and reliability of the system.

Transitioning to the second stage, each MG, operating in a stand-alone mode, deploys a Linearized AC OPF algorithm to calculate the power surplus or shortage within the current time interval. Significantly, only signals corresponding to a single time step progress to the next stage, facilitating precise power exchange calculations. Accommodating the inherent uncertainties associated with renewable energy resources and fluctuating load profiles, the framework integrates Stochastic Programming, Monte Carlo simulation techniques, and employs a bottom-up approach of Agglomerative Hierarchical Clustering.

As it progresses to the third stage, a consensus-based algorithm is employed to optimize power sharing results among the interconnected MGs, striving to minimize power mismatches and streamline the power exchange processes using initial values derived from the second stage.

Lastly, the fourth stage introduces a detailed non-linear AC OPF algorithm to scrutinize the solutions meticulously. This step affirms the viability of the final optimization results while adhering to stringent technical guidelines encompassing voltage, angle, and power losses, thus ensuring a stable and resilient network, especially under extreme events that challenge the stability thresholds of MG operations.

This innovative approach promises to be a cornerstone in fostering a future of power systems marked by heightened resilience, reliability, and adaptive capability, paving the path for a dynamically responsive and resilient energy landscape.