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MILP-based optimization models for UFLS feeder selection

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Abstract-

This paper addresses the problem of feeder selection in conventional under-frequency Load-Shedding (UFLS) schemes, which remain the predominant choice in large power systems due to their simplicity. These schemes rely on local under-frequency relays to disconnect feeders when predefined frequency thresholds are reached. However, the increasing integration of distributed generation (DG) and changing consumption patterns complicate the feeder selection process, leading to higher deviations from the designed load-shedding targets. Moreover, feeder selection modeling for UFLS schemes remains underdeveloped in the literature. To address these challenges, three different mixed-integer linear programming (MILP) models are proposed for feeder selection across all frequency steps. In addition, a time series aggregation (TSA)-based approach is introduced to reduce computational complexity while preserving the quality of the results. The proposed models are evaluated and compared in terms of result quality and computational performance using the key performance indicators (KPIs) introduced in this work.

Index Terms- Feeder selection and allocation; Under-frequency load shedding; Optimization techniques; Distributed generation

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