Coordinating Flexibility under Uncertainty in Multi-Area AC and DC Grids

In the future, mixed AC and DC grids, spanning multiple areas operated by different transmission system operators (TSO), are expected to offer the necessary controllability for integrating large amounts of intermittent renewable generation. This is facilitated by high voltage direct current transmission based on voltage source converter technology that can offer recourse actions in the form of preventive and corrective control of both active and reactive power. Market-clearing procedures, based on optimal power flow algorithms, need to be revised to account for DC transmission, flexibility and privacy requirements. To this end, we propose a decentralized two-stage stochastic market-clearing algorithm that incorporates meshed DC grids and allows the sharing of flexibility resources between areas. The benefit of this approach lies in its pricing mechanism, used for coordinating the different area subproblems and requiring only a moderate exchange of information while ensuring system-wide optimality. Case studies are presented to illustrate the methodology and to demonstrated the benefits of additional controllability provided by DC grids.

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