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Towards the Power Synergy Hub (PSHub): coordinating the energy dispatch of super grid by modified Benders decomposition

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Abstract— The challenge of operating ultra-large-scale power system or super grid is addressed in this paper. We set up the concept of power synergy hub (PSHub) serving as the operation hub coordinating the energy dispatch of multiple nations or regions across the continent to achieve global optimal targets. An eficient mechanism based on the modified Benders decomposition (BD) is proposed to coordinate the operations of national or regional power networks. The key contribution is that we take the total power outputs of regional power networks as the complicating variables to formulate the master problem and subproblems in the modified BD. Instead of using DC optimal power ow model (DC OPF), we propose to use convex AC optimalpower ow model based on second-order cone programming (SOC-ACOPF) to operate the super grid. A comprehensive investigation proves that the SOC-ACOPF outperforms DC OPF in terms of accuracy. Numerical evaluations also show that our SOC-ACOPF model has stronger convergence capability and computational eficiency over other considered SOC-ACOPF models. The convergence of the modified BD is guaranteed by the convexity of SOC-ACOPF. A parallel computation framework in GAMS is proposed to assist real-time operation of the super grid. Compared with operating super grid in a centralized way, the modified BD approach shows stronger convergence capability, computational eficiency and robustness.

Index Terms— Super Grid, Power Synergy Hub, Energy Dispatch, Optimal Power Flow, Modi ed Benders Decomposition, Parallel Computation.

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