Optimal coordinated expansion planning of transmission and electrical energy storage systems under physical intentional attacks

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Abstract-

In this paper, a new model for “coordinated expansion planning of transmission and electrical energy storage systems (CEP)” to decrease the vulnerability against physical intentional attacks (PIAs) is proposed. In this model, generators and the amount of load at the planning horizon year are assumed to be known and load variations during four sample days are considered as the representatives of daily load variations in different seasons. To consider PIAs and their impacts on the power system, a scenario-based method is used in which credible PIA scenarios during the horizon year are obtained. Using the obtained scenarios, the problem of CEP is modeled as a mixed integer linear programming problem. The model is implemented on a modified IEEE 30-bus test system and numerical results are presented for numerous case studies. Using numerical results, the proposed model is verified by comparison with the models suggested in literature. Also, the sensitivity analysis of the results is presented.

Index Terms- Energy storage systems, intentional attacks, mixed integer linear programming, transmission expansion planning (TEP).