

Resilience-Oriented DG Siting and Sizing Considering Energy Vulnerability Constraint

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Low-income customers are more vulnerable to power outages because they live in areas with poorly equipped distribution systems. However, existing approaches to improve grid resilience focus on the overall system condition and ignore the outage experiences of low-income customers, which leads to significant energy inequities in resilience. Therefore, this paper explores a new resilience-oriented planning method for distributed generator (DG) siting and sizing, by embedding an additional energy vulnerability constraint (EVC). First, the expected load shedding index (ELSI) is defined as the ratio of the load shedding to the original load, which quantifies the resilience-oriented energy vulnerability. Then, the DG siting and sizing problem is formulated as a two-stage stochastic programming with the EVC. The first stage determines the optimal sites and sizes of DG units under investment constraints and EVCs, while the second stage optimizes expected costs of unserved load. A violation variable is introduced to ensure the model's solvability. Finally, numerical studies are performed on the IEEE 33-bus and 123-bus systems to verify the effectiveness of the proposed DG planning model in reducing energy vulnerability. Three observations are presented as future guidelines for resilience-oriented DG planning.