

Doctoral Dissertation

Integrated Microgrid Expansion Planning and Policy Making under Uncertainty in Power Electricity Market

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Abstract

Major power network failures pose safety, security, and financial risks to functions of critical sectors such as medical facilities, data centers, and manufacturing industries. During Hurricane Harvey, there was a power outage in Houston area; however, the microgrid system helps Texas Medical Center and grocery stores continued its operation. This highlights that microgrid can be a good alternative for modernizing our electric grid to ensure access to reliable power. Deploying microgrid in the main grid can not only enhance the resiliency and reliability of the power system, but assist rural electrification, cost-savings, and integration of renewables. To optimize the effectiveness of deploying and designing microgrid in the competitive electricity market, a market-based power planning model is proposed in this thesis to provide appropriate market price signals for power investors including microgrid, conventional generators, and transmission lines owners. To address some uncertainties such as unexpected load growth, component power outage, and renewable power output faced by the power investors, a two-stage stochastic optimization model is developed, and the model is solved using Benders Decomposition.