Real-time Trading Strategies for Proactive Distribution Company with Distributed Generation and Demand Response.

Distributed energy resources (DERs), such as distributed generation (DG) and demand response (DR), have been recognized worldwide as valuable resources. High integration of DG and DR in the distribution network inspires a potential deregulated environment for the distribution company (DISCO) directly procuring capacities from local DG and DR. In this situation, a hierarchical market structure is achieved comprising the transmission-level (TL) and distribution-level (DL) markets. Focusing on the real-time process, as the interface actor, the DISCO's behavior covers downwardly procuring DL DG and DR resources, and upwardly trading in the TL real-time market, resulting in a proactive manner.

The DL aggregator (DA) is defined to manage these small-scale and dispersed DGs and DRs. A methodology is proposed in this thesis for a proactive DISCO (PDISCO) to strategically trade with DAs in the presented DL market and transact with TL real-time market. A one-leader multi-follower-type bi-level model is proposed to indicate the PDISCO's trading strategies. To participate in the TL real-time market, a methodology is presented to derive continuous bidding/offering strategies for a PDISCO. A bi-level model is proposed to elaborate the interactions between the PDISCO's bids/offers and the TL market's outcomes. The PDISCO's trading performance features in a bidirectional transaction. In this thesis, replacing the lower-level problems with the primal-dual approach, each proposed bi-level model is transformed into a solvable single-level mathematical program with equilibrium constraints (MPEC).

The effectiveness of the proposed models are verified by individual case studies.