Research on Time-of-Use Tariff of New Energy Power System Considering Supply and Demand Uncertainties

This thesis focuses on improving the time-of-use (ToU) tariff policy for electricity pricing in new energy power systems. The main contributions are:

- Peak-Valley Period Division: An improved model is proposed for dividing the peak-valley periods of the load curve using numerical relationships, rather than relying on subjective human judgment. The model incorporates a modified membership function to improve interpretability and effectiveness.
- Addressing Rapid Period Changes: A correction model based on fuzzy subsethood is developed to handle rapid changes in time period types, ensuring more stable and practical period partitioning and better implementation of the ToU policy.
- Optimization Model: A nonlinear programming model for ToU electricity pricing in new energy systems is proposed, incorporating user participation in demand response. A combined solving approach using a hippopotamus optimization algorithm and CPLEX solver transforms the problem into a linear programming problem, making it easier to solve.
- Impact Analysis: The model is analyzed in different scenarios, showing that ToU policies improve system efficiency, peak shaving, and valley filling. However, the effectiveness is weakened by supply-demand uncertainty. More accurate forecasting and robust systems are needed when integrating renewable energy sources like wind and solar power.

In summary, the thesis provides a more practical and efficient approach to dividing peak-valley periods, correcting period changes, and optimizing electricity pricing in the context of supply-demand uncertainty in new energy systems.