

DETERMINATION OF PARAMETERS OF SHUNT REACTIVE POWER COMPENSATION SYSTEMS FOR 6-35 KV NETWORKS

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Relevance of the Research

In the context of energy resource shortages, rising electricity costs, and increasing reliability requirements for power supply, there is a growing need to implement modern energy-saving systems and improve power quality. One of the effective methods to enhance energy efficiency is the use of shunt compensation systems, which reduce energy losses, stabilize network operation modes, improve voltage regulation, and lower the levels of harmonics.

A review of literature and practical experience indicates that mostly research in this field is focused on low-voltage networks, while the improvement of shunt compensation system parameters for medium voltage (6–35 kV) remains insufficiently studied. One of the pressing issues is the increasing levels of harmonics caused by the operation of modern power equipment. Capacitor banks remain the most cost-effective and easy-to-operate source of reactive power. However, existing design methodologies often do not consider the impact of harmonics on system efficiency and the potential for resonance phenomena, which reduces the stability of power supply and shortens equipment lifespan.

Research Objectives and Tasks

The *aim* of this study is to develop and improve the parameters of shunt reactive power compensation systems for medium-voltage networks, taking into account real operating conditions. To achieve this goal, the following tasks are planned:

- Analysis of the impact of higher harmonic components on the efficiency of compensation devices;
- Determination of optimal compensation system parameters considering possible resonance phenomena;
- Use of computer modeling to assess the effectiveness of the proposed solutions;
- Development of recommendations for implementing improved compensation systems in distribution networks.

Research Methodology

To achieve the set goal, methods of computer modeling, analytical, and experimental studies have been used. The primary tool is the MATLAB Simulink software environment, which allows for evaluating the impact of compensation system parameters on power network operation modes.

Experimental studies employ advanced instruments for measuring power quality parameters. Several enterprises with both positive and negative experiences in implementing reactive power compensation devices have been examined, accumulating empirical data on the effectiveness of such systems. Work is currently underway on systematizing the obtained results, conducting additional experiments, and developing a comprehensive calculation methodology.

Key Results

The proposed solutions enable:

- Reduction of power losses in distribution networks;
- Improvement of the efficiency of reactive power compensation systems;
- Avoidance of resonance phenomena in the design of reactive power compensation systems;
- Optimization of compensation device parameters to ensure maximum energy efficiency and power supply reliability.

Conclusions and Future Research Prospects

The study results represent a significant contribution to the field of energy saving and power quality improvement. The proposed analysis and modeling methods can be used for designing new and improving existing reactive power compensation systems. Future research will focus on exploring the possibilities of adaptive control of compensation devices under variable load and harmonic conditions, as well as developing algorithms for automatic optimization of compensation system parameters.

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