**Analysis of the energy efficiency of 110/6 kV distribution network in an oil producing enterprise in Kazakhstan**

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**Introduction.** In connection with the adoption of the Law “On Energy Saving and Improving Energy Efficiency” on January 13, 2012, improving the energy efficiency of power supply systems and electrical equipment is one of the most important strategic objectives of the Republic of Kazakhstan.

The largest share of irrational electricity consumption occurs precisely at industrial enterprises in Kazakhstan. This is due to the fact that a large number of electric motors, transformers and light sources continuously work at industrial enterprises of Kazakhstan. Often, underloading or overloading of electrical equipment and distribution networks is the result of inefficient operation of the power supply system and power consumption. This leads to an increase in the share of losses in transformers, electric motors, a decrease in the power factor in the power supply system, a decrease in the service life, an increase in accident rate, etc. Therefore, the introduction of energy-efficient electrical equipment is the main task of production.

In this connection, optimization of equipment operation modes and reduction of losses in the system of transformation, distribution and transformation (transformers, distribution networks, electric motors) is one of the methods of saving energy consumed by an enterprise. In this article, a simulation of a 110 kV distribution network of an oil producing enterprise was done in order to determine the most effective mode of operation of the network.

**Methodology.** The analysis was carried out using the software Power factory DigSilent [1]. This software product is the leading integrated software for the analysis of power systems, which covers the entire spectrum of functionality from standard functions to high-tech and advanced applications. Through this program, a 110 kV distribution network was modeled, consisting of 26 transformers and more than 100 consumers (Fig. 1). The following factors were taken into account in the simulation:

- Power supply source;

- Passport data of transformers and cables;

- Daily schedules of loads of the electric power consumers for the winter period of time.

Table 1 presents the simulated options for network modes.

Table 1 – Simulated options for network modes

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| --- | --- |
| Options | Description |
| А | Initial network mode |
| B | Network operation mode when disconnecting an underloaded transformer |
| С | Connection of an additional power source in the form of solar power stations |



Figure 1 – Model of 110kV distribution network of an oil producing enterprise

**Results.** Due to the fact that in Kazakhstan there is no manual for energy-efficient analysis of electrical equipment, this analysis was conducted on the basis of a reference document on the best available methods for improving energy efficiency in the European Union [2].

According to the results of the analysis carried out on option A, many underused transformers were identified. It would seem that under-utilization for transformers is a positive effect, which leads to an increase in the service life of equipment, however, as shown by field tests of the European Union, under-utilization of electrical equipment is negative in terms of energy efficiency. In this case, the European Union proposes to hold a series of events to improve the energy efficiency of the mode of operation of distribution networks. These measures were considered in options B and C, the results of which lead to energy and money savings.

**References**

1. <https://www.digsilent.de/en/>
2. Reference document on best available techniques for Energy Efficiency, European commission, February 2009.