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Compensating for reactive power and improving the quality of electricity

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ABSTRACT. Increases the reliability of power supply systems and reduces losses during energy transportation. This improves the quality of the transporter and increases the efficiency of Energy Transfer by releasing inductive or reactive energy into the system. Based on the above: a system based on advanced electronics (and other elements) that provide control over one or more parameters of the power transmission system to increase control and improve conductivity [1,2].

KEY WORDS: Transportation of electricity, energy adjustment, reliable transfer of energy, efficiency, energy waste, arrangement of the monitoring system

I. INTRODUCTION

Longitudinal compensation (cow) – used to increase the power coefficient. Since the power line adopts longitudinal inductive resistance, the power coefficient is reduced by the action of current in the inductance behind the voltage. For compensation, the capacitance is connected to the line in a longitudinal direction, which creates an alternating current before the source voltage. Compensation (inductance)- this method can be used both in the charging current of the line (when there is no load) and at a very low load on the receiving side. Due to too little loading or lack of loading, very little current flows through the line. The capacitance of the long line causes an increase in voltage on the receiving side. Shunt reactors connect to the line for compensation [3,4].

Table 1. **Loss values depending on the consumed load in the networks of the Zarafshan-Uchkuduk power plant for 2018-2022.**

Year	2018y.	2019y.	2020y.	2021y.	2022y.
The maximum power consumption for power lines is 220kV, MW	437	451	442	460	466
The maximum power consumption for substations is 220 kV,MW	386	393	396	414	418
Loss of active power, MW	51	58	46	46	48

The results of the calculation of the 220 kv grid mode of the Zarafshan-Uchkuduk power plant are shown. The data is given by the following parameters: active loading at the beginning and end of the line, active power losses, reactive power at the beginning and end of the line, shunted reactive power of the line, reactive power losses, voltage levels at the beginning and end of the line, voltage drop as a percentage figure 1.

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Figure 1. The magnetic part of the control shunt reactor transformer

II. RESULTS AND DISCUSSIONS

Voltage regulation on 220 KV tires is carried out in automatic mode by smoothly changing the power consumption of reactive watt sources in accordance with the mismatch signal detected by the automatic control system. To regulate voltage, the three-phase average voltage of a 220 kV transformer mounted on a Bess pan control panel at the connection point of the reactive watt source is used as the feedback circuit, and the current consumption of the reactive watt sources varies with the degree of magnetization of the magnetic system with the rectified current released by the magnetization regulator [5].

Analyzing the data, the following conclusions can be drawn that voltage levels increased after the introduction of reactive power sources. For example, at the end of the longest L-Bess pan line, the voltage increased from 206 kV to 220 kV, by 6.4%. And in the network, the average voltage increased by 5.6%.High power grid monitoring systems provide additional functions to increase power transmission efficiency and reduce losses. Monitoring not only increases the reliability of electricity transmission, but also the localization of emergency situations, as well as in the direction figure 2.

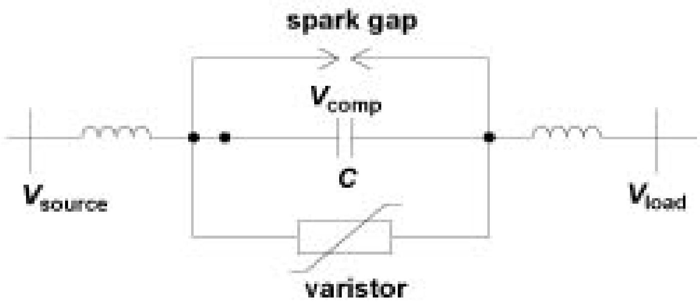

Figure 2. Longitudinal compensation of reactive power

Each phase of the network wrap is carried out parallel to the entry into the middle and wraps over the secondary grooves that cover both halves. The ends of the bulbs are connected to the star with a neutral one. Connected to the part of the substation of the gutters or to the lines [6]. The compensation winding has a voltage of 10 kV, which is connected by a triangle and serves to perform the following functions:

- It excludes harmonics from the network that are multiples of three;
- It is necessary to provide power to the main transformer using a converter that provides magnetization of the magnetic circuit by means of a control winding.

The main and backup thyristors are controlled by an automatic control system under a special program that provides voltage stabilization or maintenance of the level of reactive power consumed Figure 3.

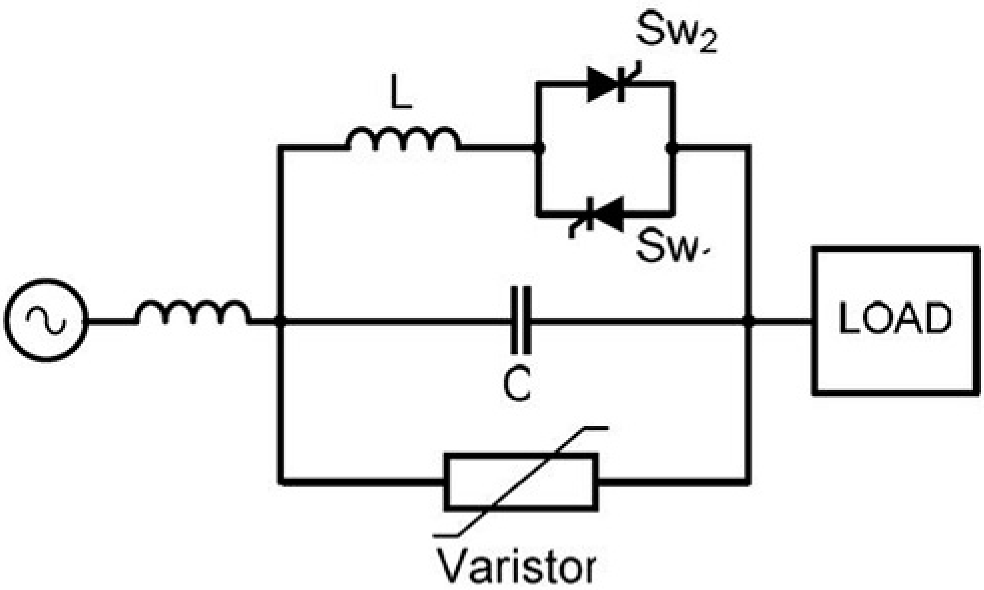

Figure 3. Modern methods of reactive power compensation

Load losses of active power formulae 1

$$\Delta P_2 = \frac{P^2+Q^2}{U^2} * R \quad (1)$$

Voltage drop formulae 2

$$\Delta U = \frac{PR+QX}{U} + j\frac{PX-QR}{U} \quad (2)$$

1. The quality of electricity is very important in any power grid, especially for electricity consumers. The quality of electricity includes the presence of a power source, the frequency and magnitude of the voltage, as well as the characteristics of the signal form of the power source.

2. The consequences of problems with the quality of electricity are inefficiency, overheating and reducing the service life of the equipment, data loss, interruption of the process, dependence on the violation of isolation. Although it is not possible to completely eliminate the causes, the quality of the power supply can be improved, and the remaining effect on the power supply can be mitigated. Using devices that improve the quality of electricity means using a filter to block the harmonica [7]. Increase in reactive power consumption or decrease in power factor P = const Figure 4.

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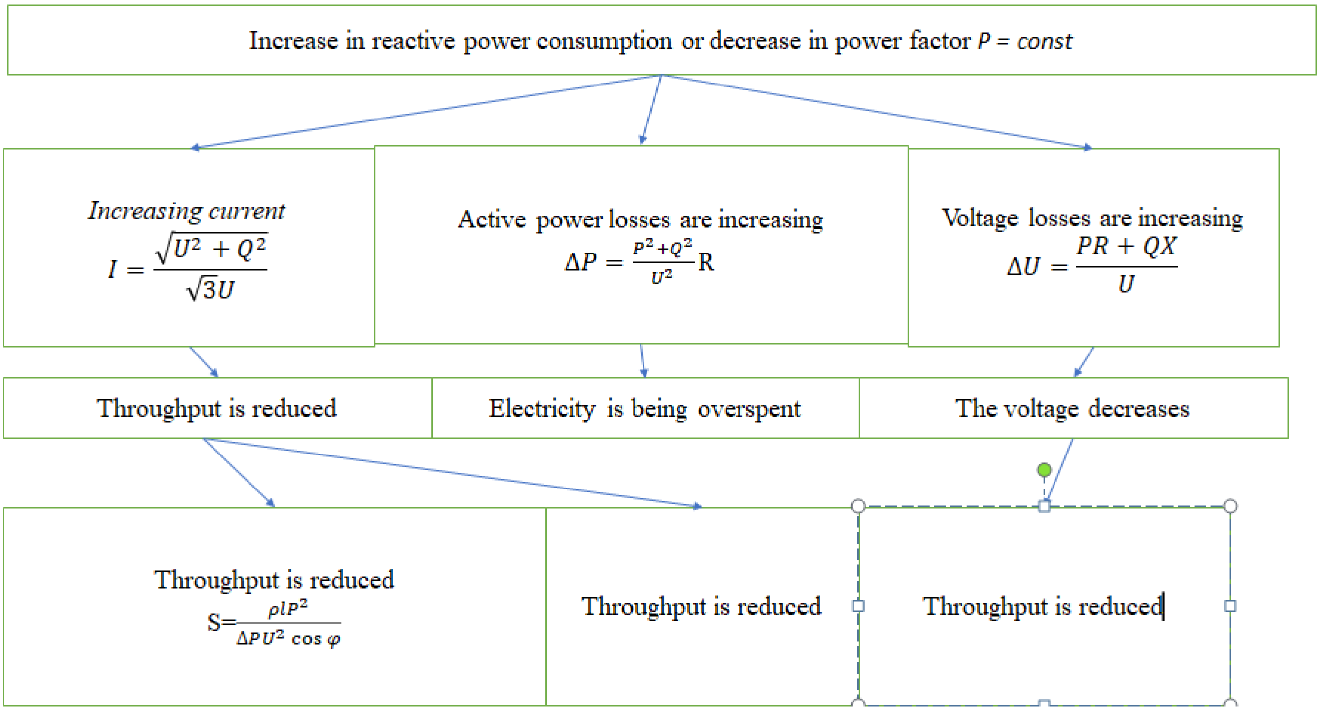

Figure 4. Increase in reactive power consumption or decrease in power factor P = const

III. CONCLUSION

By solving the problem of compensation of reactive power, it is an important task to reduce the loss of active power in the power lines of modern power supply systems. The effectiveness of compensation depends on the choice of possibilities and the placement of compensation blocks in the network nodes. The problem under consideration is a multi-objective and multi-factor optimization problem, and the time required to solve it increases exponentially as the dimensionality of this problem increases. In such conditions, it is advisable to use methods of optimization of evolution and swarm. two method analysis algorithms have been used: special attention has been paid to putting the algorithms into practice, in this case solving the problem of optimal placement of reactive power sources. Using a specially designed interface between an optimization algorithm and an optimization problem model has been shown to allow researchers to apply optimization algorithms quickly. In addition, the influence of the parameters of heuristic algorithms on their effectiveness was studied. It has been shown that reactive kVt compensation can reduce the loss of active power in the power supply system by up to 20%, and the payment period for the installation of the necessary equipment is from 2 to 4 years.

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