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The uniqueness of power consumption of reactivity of electricity consumers in industrial enterprises

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ABSTRACT: Reactive power consumption in the power supply system of industrial enterprises exists in power grid lines and all electrical devices, so it is very important to manage and save reactive power consumption. Reactive power compensators are designed using capacitive elements to control the reactive power consumption, and the reactive power consumption is saved and the main facts affecting the reduction of the power factor and the result of its obvious consequences, which together with the low is parsed to result in pointer values. This article provides a broad overview of power factor compensation methods in industrial projects.

KEYWORDS:reactive power, active power, compensation, static capacitor, synchronous motor, reactive load, power factor.

I. INTRODUCTION

Economical use of all types of energy, including electricity, issues of improving the efficiency of electrical devices are important. In recent years, a lot of attention has been paid to improving the quality of electricity. The quality of electricity can significantly affect the consumption of electricity, the reliability of power supply systems and the technological process of production. Rational reactive power compensation reduces energy losses due to reactive power flows, ensures the quality of consumed electricity by regulating and stabilizing the voltage level in power networks, and achieves high technical and economic performance of electrical devices.

The problem of reactive power compensation in the country's electrical systems is of great importance for the following reasons:

1. In industrial production, the consumption of reactive power compared to active power has increased significantly;

2. Due to the increase in household loads, the consumption of reactive power in the city's electric networks has increased;

3. Reactive power consumption in agricultural power networks is increasing.

Reactive power compensators are used to reduce reactive power. Reactive power compensation is used to save energy. This issue is more relevant in large industrial enterprises. The use of reactive power compensating devices (RQKQ) is the most effective and efficient way to reduce the power consumed from the network.

Reactive power compensation enables efficient use of electrical energy and consists of three main loads: increased capacity of power transformers, power transmission lines, and reduced active energy loss ensures normalization of voltage. The process of reactive power compensation, technical and economic problems is solved with the help of reactive power sources, and its efficiency creates the possibility of rational use of electricity.

We can divide the measures taken to compensate reactive power into the following 3 groups:

- Use of those that do not require compensation devices;
- Those who use compensation devices;
- Allowed as an exception;

Activities in the use of compensation devices:

- Installation of static condensers.
- Use of synchronous motors as a compensator.
- Application of static sources of reactive power.
- Application of several parallel devices for compensation network

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The electrical part of the energy system consists of distribution networks consuming electricity sources and electricity consumers. The distribution of magnetic field and electric distribution in networks is usually not realized uniformly. They are unevenly distributed along the chain.

In some parts of the circuit, for example, the inductance has a magnetic field, in other parts, for example, in the capacitors, the electric field dominates, and the main reason is the result of the change in the electric field. Due to this, reactive power distribution and consumption occurs.

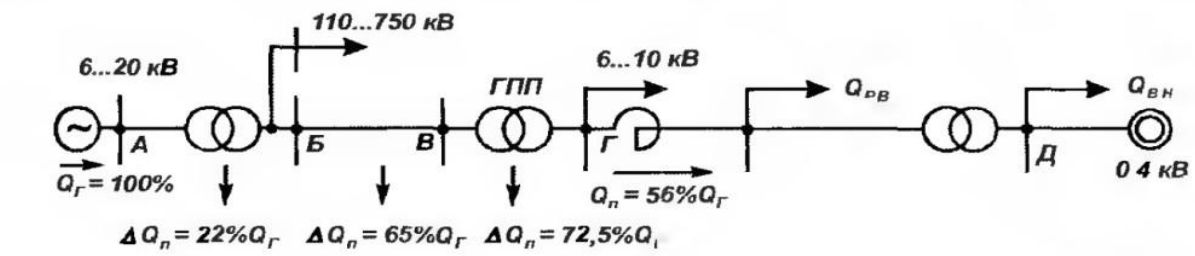
Table 1 presents the most loaded winter days of the structure of electricity consumers in the power supply systems of the enterprise during the maximum load hours of the energy system.

Table 1. The composition of electricity consumers in the enterprise's electricity supply system

Types of electricity consumers	Energy system of electricity consumers installed capacity, %.	
	Active	Reactive
Asynchronouselectricityengines	30	33
Synchronousmotors	23	0
Valveswitches	18	10
Electricovendevices	12	8
The power plant is private desire	5	2
Waste in electrical networks	5	42

Form of DQ waste, their share of reactive power of the system corresponds to 42%. Out of 100% of the reactive power produced by the power system, 22% is in step-up transformers and step-up autotransformers at power stations. 110-500kV energy is lost in system substations, 6.5% in district lines in grid systems, 13.5% in step-down transformers, and only 58% of all generated reactive power goes to 6-10kV consumer buses. Figure 1 shows the distribution of reactive power dissipation in the equivalent power transmission of the station - consumer and the vector diagram of the currents and voltages for these transmission nodes. Even when cosph = 0.97, all power transmission nodes in consumers (φ=22º) are heavily loaded with reactive power; 1000 kW of active power from the power plant is required to transmit 800 kVAr of reactive power at the beginning of transmission and 400 kVAr at the end. This leads to an increase in current loads in the network and, as a result, an increase in the cost of network construction, an increase in electrical energy wastage, and a deterioration in voltage quality due to wastage in network elements. It is possible to load power stations with large reactive power, to overload generators in terms of current, to use them for the production of special reactive power, and to turn off a part of generators in reserve according to active load from active load hours.

a) Reactive power flow change.



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b) Phase shift of voltage and current in the busbars of the power transmission power station - in the busbars of the receiving substation.

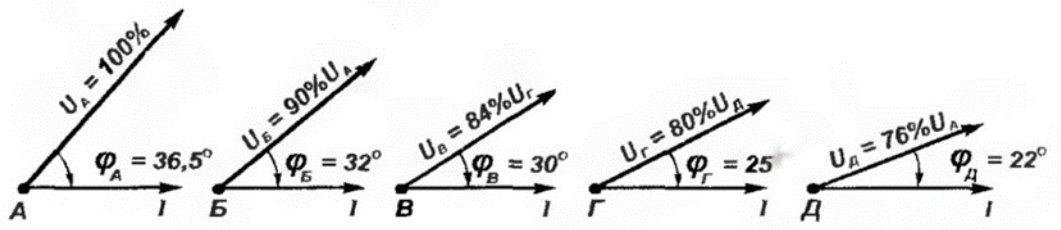

Figure 1.

The composition of reactive power consumers shows that the main part of it is consumed in the form of four types of devices: asynchronous motor - 40%, electric furnace devices - 8%, valve transformers - 10%, all phase transformations of transformers (waste in them) – 35%, power lines (waste in them) – 7%. In each specific number of the energy system, there may be some deviations in the percentage calculation, but the general trend remains the same.

The load of the power supply system is determined by the full power:

$S = \sqrt{P^2 + Q^2}$, the asset organizer of which is consumed is useful and the supply does not return to the source. Reactive organizer for organizing magnetic and electric fields in electrical network elements. It is not actually consumed, but the supply flows from the source (generator) to the consumer of electricity and vice versa.

The problems of power supply system electrical equipment and grid loading due to reactive power are summarized in Figure 2. The mentioned negative factors force the compensation of reactive power to be brought closer to the places of consumption. This relieves electrical equipment of its overcurrents, which has the same effect as power factor gain.

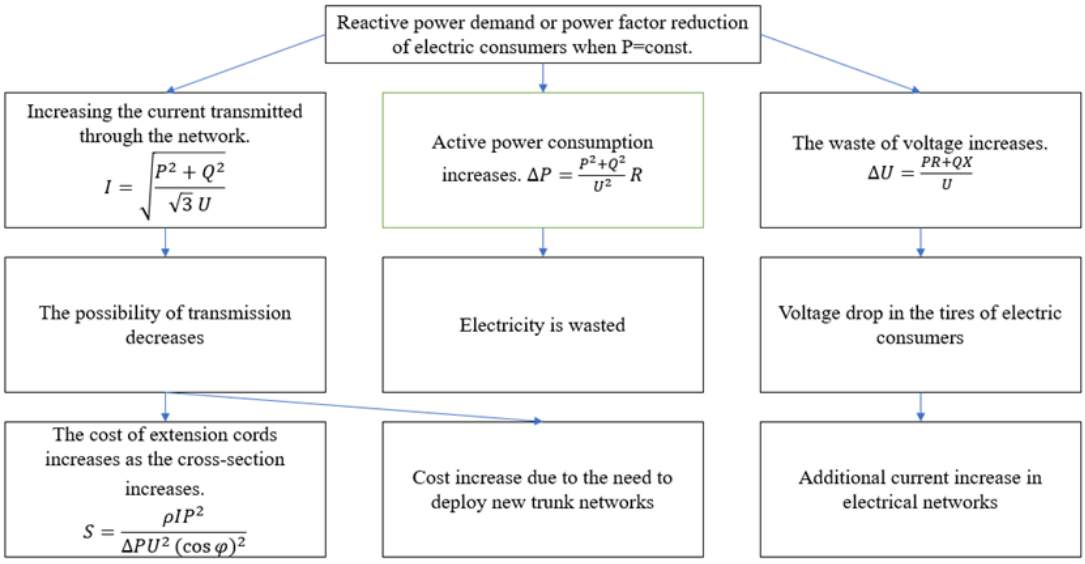

Figure 2.Consumption and transmission of reactive power result of acquisition

Reducing reactive loads in generators and networks there are two complementary ones.

1. Installation of special compensating devices at the enterprise artificial compensation. The following are used as personal reactive power sources in the power supply system of an industrial enterprise:

- Synchronous motor and personal power plant generators;
- Electrical networks, air and cable lines;
- Additional installed compensating structures.

Synchronous compensators, high- and low-voltage capacitor batteries, special adjustable coils.

2. Natural compensation of reduction of reactive power of electricity consumers themselves.

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In short, reactive power is a part of organizational work compensation does not require large material costs and should be carried out in the first place in enterprises.

II.CONCLUSION

The problem of reactive power compensation in an industrial enterprise includes a number of technical and economic issues, including organizational work.

can include:

- organizing organizational work for the implementation of natural compensation to do;
- Selection of types and appearance of compensating structures;
- Placement of compensation devices in networks;
- Optimization of the operating mode of compensating devices;

The choice of the most convenient and effective compensation option, the required power and the type of compensating device should be based on the analysis of the schemes of the power supply system of the industrial enterprise.

The losses in each electrical network line and electrical equipment are different, and we compensate for them using reactive power compensators of different capacities. As a result of the above data and calculations, it was concluded that reactive power losses in networks have been reduced by 50% and losses in electrical devices have been reduced in comparison to the previous %.

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