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ANALYSIS OF METHODS FOR REACTIVE POWER COMPENSATION IN ELECTRICAL NETWORKS

One of the main aspects related to improving the quality of electricity in industrial networks, both at the design stage and at the operation stage, is the issue of reactive power compensation. It covers the selection of the most effective compensation sources, the calculation and management of their capacity, and the determination of placements in the network.

Effective reactive power compensation in industrial networks includes various aspects aimed at increasing the economic efficiency of electrical equipment and improving the quality of consumed electricity. This includes the selection and calculation of compensation devices taking into account the specifics of the network.

Active and reactive power represent significant differences in terms of electricity generation and consumption. Basically, electrical receivers consume active power, and losses in the network and equipment lead to small losses of active power. However, reactive power losses in the network can be comparable to the reactive power consumed by electrical receivers.

Synchronous generators in power plants play an important role in balancing reactive power in electrical networks. However, if the active power production decreases, there is a need to increase the reactive power production. This may lead to the transfer of some generators to operate at a reduced power factor.

To reduce the consumption of reactive power from the network, reactive power compensators are used, such as capacitor banks, synchronous compensators, motors and static reactive power sources.

At an enterprise, reducing reactive power consumption is achieved by various methods. These may include natural approaches, such as regulating the operation of electrical receivers to reduce the impact on the electrical network, as well as special compensating devices installed at certain points in the electrical supply system.

The widespread use of valve converters in industry requires solving the problem of limiting their influence on the power grid, primarily the issues of reactive power compensation.

The use of valve converters in industry is widespread, but this raises the need to solve problems associated with their impact on the electrical network. One of the key tasks is reactive power compensation.

It is especially difficult to cope with this task in networks with a high content of higher harmonics generated by nonlinear loads. Traditional reactive power compensation methods designed for sinusoidal currents and voltages may encounter technical difficulties in such conditions.

Studying the operation of capacitor units in the presence of higher harmonics is important for assessing the possibility of their use in industrial electrical systems. Practice shows that capacitor banks operating at a non-sinusoidal voltage can fail due to overload with higher harmonic currents. Connecting capacitor banks to the busbars of a substation that supplies power to a powerful valve load can lead to resonance with the network inductance, which also negatively affects their operation.

Currently, static reactive power compensators are being actively introduced, which are an effective means for compensating reactive power in power systems. These devices have several advantages, such as speed, reliability, and the ability to control reactive power without the use of rotating parts.

One of the key advantages of static compensators is their ability to compensate for reactive power without delay, which allows for more accurate and efficient control of energy processes. This is especially important in networks with rapidly changing load or high levels of unbalance.

In addition, static compensators ensure voltage stability in the electrical network, which helps to increase the efficiency of electrical installations and improve the quality of electricity. These devices can also perform the function of filtering higher harmonics and reducing voltage asymmetry in the network.

Due to their advantages, static reactive power compensators are actively used in various industries and energy sectors to optimize the operation of electrical networks and increase their reliability.