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Reactive power compensation in electrical networks

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ABSTRACT.

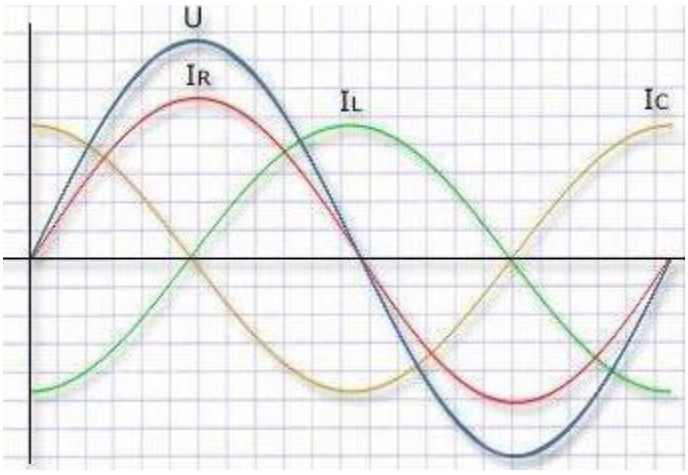
The paper outlines methods of compensating reactive power in electric lines. To reach the aim the two types of compensation devices are used including synchronous compensators and battery capacitors.

INTRODUCTION.

Reactive power is one of the main indicators characterizing the operation of the electrical system. The term "reactive power" is introduced in relation to the established modes of symmetric circuits with sinusoidal alternating current and voltage. In case of sinusoidal power transmission the positive half-wave is characterized by power transmission from the source to the consumer. Energy return occurs in the event of negative half-wave. The aggregate total power characterizing flows within power system is divided into active and reactive components.

The appearance of reactive power (RP) is associated with the presence of elements in the system that are able to accumulate and transfer electricity. These elements are: long lines of high and ultra-high voltage, coupling capacitors, cable lines, shunt capacitors having a large capacity. Other consumers have on the contrary inductive type of load, such elements include: asynchronous motors, induction heating furnaces, transformers, reactors. RP in the resulting system is equal to zero, so the costs of its production do not occur.

Application of static reactive power sources (RPS) in load nodes, helps to solve a number of problems associated with economic mode of the power system and the consumer. Also the use of the RPS has a positive effect on the quality and efficiency of power supply design objects.



Generation of active component is associated with the consumption of power load and performing useful work. Generation of active power needs a certain amount of primary energy in power plants. The second component is related to the exchange of energy between the system and the source.

The main criterion of active power balance in the system is the frequency. When under load consumption and power generation power line frequency is maintained constant at the level of 50 Hz.

At loss of synchronism of the system, the remaining generators in the power take the power from generators that are not able to cope with, the frequency of their rotation falls and as a result the system frequency also falls. Indicator of production consumption balance in the RP system is voltage.

Moreover, the figure for the RP is not a system, as a balance must be maintained in each node where the voltage level is controlled. Despite the overall compliance between production and consumption of the reactive power, the balance in the individual nodes can not be. Therefore it is very important to observe the availability of RP where there intake.

Synchronous compensator

Synchronous compensator (SC) is a synchronous motor running in an idle mode. Effectiveness of compensation reactive sources depends not only on the power equipment, but also on the regulatory systems that control these sources. So, for the SC regulatory effect increases significantly when using automatic voltage regulation (AVR). Such systems provide excitation control not only when supervised parameter deviations, but when you reject modes of the compensator and power system as a whole.

However, the possibilities of AVR are limited by inertia windings of synchronous machines. This problem can be solved by rapidly changing magnetic flux due to the saturation of individual sections of the artificial magnetic circuit with its special magnetizing windings.

Synchronous compensator (SC) in underexcitation mode consumes from the system current with inductive component, the inductive component, the more, the more underexcitation . With overdrive SC consumes network of capacitive current, loading line with reactive power and thereby reducing the voltage at the node. At a current equal to the excitation current idling compensator network of active current is consumed due to losses in the windings of the equipment.

Capacitor batteries

Along with the SC, capacitor batteries have become widespread for the purpose of RP compensation. They got a lot of popularity for cheapness and ease of operation . Introduction of new technologies and materials for manufacturing these sources RP has allowed to reduce the specific volumes, increase the service life, reduce power losses in capacitors, leading to cheaper equipment. BC to an applied sinusoidal AC give the network outpacing capacitive current thereby relieving power lines to transport RM. Voltage in this node increases.

Voltage regulation using the capacitor takes place stepwise, when connecting or disconnecting of additional capacitors. Gradual control is one of the most significant shortcomings of the SRP.

CONCLUSION.

In comparison with the voltage regulation capacitors a compensator has considerable advantage. Since regulation is smooth and combined with the latest systems of AVR compensators regulation occurs continuously, constantly maintaining high static stability. When designing electricity supply system the choice of a means of compensation have to be evaluated. Investments to install SC and BC vary considerably, however, and their effectiveness varies.

References:

1. http://forum220.ru/reactive-power-compensation.php.
2. http://electrolibrary.narod.ru/9/99.htm.

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Water as reactor coolant

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The coolant is a liquid or gaseous substance which is used for the removal of heat from the core. This heat is released in the process of nuclear fission.