COMPENSATION CHOKES

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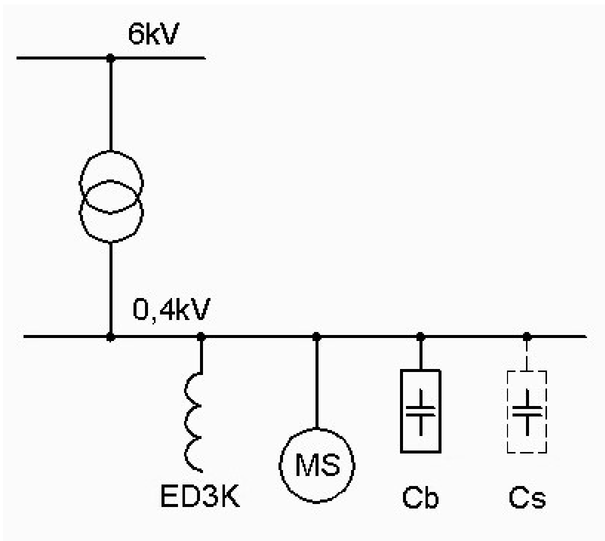
In the last few years, the significance of reactive power compensation has increased considerably. This results from the growth in payments calculated by power engineering plants for the reactive power, either given off, or taken from the network and for failing to maintain the value of tgφ ratio. The ELHAND TRANSFORMATORY from Lubliniec manufactures the chokes of type ED3K, assigned for compensating capacitive reactive power.

The role of compensation chokes in electromagnetic network

Most electric energy receivers in industry are inductive in character. They consume the inductive reactive power from the network, necessary to produce an electromagnetic field. This field is a condition for the operation of the machines. In the light of deficiency in the inductive rated power in the plant electric network, it is taken by the terminals from the electrical power system. It is the electric power lines, condensers batteries in HV stations, and generators in power plants that are the sources of the inductive rated power. Its transmission from the generator to the receivers in the plant results in an increase in power losses and active energy, increase of voltage drops in the feeding lines and transformers. Moreover, it is necessary to install devices with higher powers and rated currents, as well as to limit transmission capabilities of electric and power lines.
The best solution is the production of the inductive rated power in the plant (compensation) as close as possible to the receivers. The inductive rated power is most frequently compensated by installing condensers batteries or by using synchronic compensators. In large industrial plants, where - apart from inductive receivers (transformers, motors) – synchronic drives operate, it is possible to execute partial compensation of rated power by changing the configuration of the plant's internal electro and power network. By making suitable combination operations in the switching stations, it is possible to create natural compensation. However, this solution is very often difficult to implement owing to technical and technological limitations.
In case of excess in capacitive rated power in the plant network, this power will be given off through terminals to the electric and power systems. Similarly, with the consumption of inductive rated power, this phenomenon is also disadvantageous, since electric power engineering plants calculate additional charges for rated power, both consumed and given off to the system. Furthermore, the capacitive rated power transmission has analogous consequences to the inductive rated power transport.
The compensation chokes of the ED3K are assigned for compensating the inductive rated power, resulting from the synchronic machines operation and widespread low- and medium-voltage cable networks with their insufficient load (drawing 1).



Drawing 1 Fragment of diagram for the electric and power network with the compensation of the capacitive rated power. ED3K – compensation choke, MS – synchronic machine, Cb – capacity of condensers batteries, Cs – electric network and cable lines capacity.

It is the rated power produced that is the basic operational parameter of the compensation chokes as determined by the following equation (1).

$$Q_{ED3K} = I_n^2 \left(2pf_n L_{ED3K} \right), (1).$$

where: I_n – rated effective value of the sinusoidal alternating current; f_n – rated frequency; L_{ED3K} – choke inductance [2].

The compensation choke's power is frequently selected on the basis of the measurements carried out in the plants. During load intervals, the condenser's static batteries usually cause the network overcompensation. It is possible to protect the electric network against periodical "overproduction" of the capacitive rated power by applying the ED3K compensation choke to be switched on when the electric network is being underloaded. However, the choke power should be compliant with the power value of the network compensation in the production intervals.
The compensation chokes are connected into batteries that, depending on the nature of the change in the rated power in the electric and power network of the plant, are manufactured in the static and regulated version. The choke batteries often work with the automatic regulator cosφ and thus they enable more effective follow-up compensation of the capacitive rated power, preventing the network from overcompensation. When suitably selected, the ED3K, or a choke battery, improve the tgφ ratio, and the payments for power and electric energy are thereby reduced.
The core chokes are also applied in the inductive rated power compensation systems. The most frequently used system is the classic condenser multi-grade battery system, whose grades are switched on or off, depending on the rated power intake.
In order to limit the current (whose value may reach 150xI_n), it is the suppressing chokes that are used in the transient states and are installed between the protections and contactors switching on the respective elements of a battery [2].

The ED3K compensation chokes structure.

The ED3K three-phase chokes are manufactured in land and ship versions. The chokes are usually devices of significant power. It is the induction and rated current that are the compensation choke parameters. These dimensions are dependant on the operational system and rated power to be produced by the choke.
The choke core is manufactured from electromagnetic silicon sheet, of a thickness ranging from 0.25 to 0.5 mm. The windings, made of wound wire, usually roll formed, are placed at the core columns. The chokes are then subject to vacuous impregnation which effective protects and ensures reliability of the chokes operating in harsh environmental conditions. In the next stage, the chokes are equipped in terminals and cable tips, as well as mechanical instrumentation facilitating transport. The final production stage consists of the tests, carried out at the electrical test station on the basis of the norms currently in force. The objective of the final tests is to eliminate all possible defects in the product prior to delivery to the customer.
All work connected with manufacturing and preparing the production in the ELHAND TRANSFORMATORY Company is executed in accordance with the quality assurance system ISO-9002. This permits the highest quality and repeatability of the technical parameters in the transformers, chokes and power supplies produced.

Bibliography

[1] Bełdowski T., Markiewicz H. *Stacje i urządzenia elektroenergetyczne.* WNT W-wa 1995

[2] Nartowski Z. *Baterie kondensatorów do kompensacji mo cy biernej.* WNT W-wa 1967

[3] Plamitzer A.M. *Maszyny elektryczne.* WNT W-wa 1986

[4] *Poradnik inżyniera elektryka tom3* WNT W-wa 1997

[5] Jezierski E., *Transformatory* WNT W-wa 1965