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ADVANTAGES AND DISADVANTAGES OF AUTOTRANSFORMERS

Although the advantages of autotransformers have long been known, for a long time they were used only as auxiliary devices for starting asynchronous motors, voltage regulation in laboratory conditions, etc. However, last century, autotransformers were produced as high power and high voltage units and even in some cases replaces transformers in their traditional positions. This is explained by the fact that with the growth of the produced electrical energy and the increase in the voltage of power lines, the use of autotransformers has become more desirable, and sometimes simply necessary, since with the same throughput power, the autotransformer has smaller dimensions and higher efficiency than the transformer. At very high powers and ultra-high voltages this becomes especially important, since only the autotransformer connection allows the construction of transportable units.

The use of autotransformers became possible because ways were found to overcome or, in any case, mitigate the shortcomings of autotransformers that previously blocked their path to large-scale energy. In some cases, however, the disadvantages of autotransformers outweigh their advantages and then transformers are used. Now let us consider the advantages and disadvantages of autotransformers.

For advantages it is a good idea to compare units of the same throughput power.

The production of an autotransformer requires fewer materials (copper, steel, insulating materials, etc.) and is therefore cheaper.

Losses in the autotransformer are lower and therefore its efficiency is higher.

The change in voltage in the autotransformer is less because the short circuit voltage is less.

With the same steel grade and rated induction, the magnetizing current in the autotransformer is less.

The overall dimensions of the autotransformer are smaller, which allows the production of transportable units of higher power throughput.

All these advantages of autotransformers become more apparent, the smaller the difference between the primary and secondary voltages is. Usually in power autotransformers transformation ratio is $k<2$.

Along with the advantages listed above, autotransformers have several disadvantages that limit their use.

The electrical connection between the high and low voltage sides leads to the fact that any violation of the regime or an accident on one side leads to a violation of the regime on the other. When one of the high voltage lines is shorted to ground, the low voltage line voltage receives the potential U2, with respect to ground. As a result, not only the low voltage winding of the autotransformer, but also all the equipment on this side, including the generator, are under increased voltage with respect to ground. The more this voltage exceeds the nominal voltage, the greater the ratio of secondary to primary voltage is (U2/U1).

Of greatest interest are the issues of overvoltage in three-phase autotransformers. These issues will be discussed in detail below. The second disadvantage of the autotransformer is the low short-circuit voltage and associated high short-circuit currents and mechanical forces. Since power transformers are usually designed without a large margin of mechanical safety, and the forces acting on their windings at given line-to-line voltages are inversely proportional to the square of the short-circuit voltage, an autotransformer designed like a transformer can be destroyed during a short circuit. An autotransformer with a transformation ratio close to 1 may not be mechanically strong enough if the short circuit currents of the autotransformer are not limited by the resistance of other elements of the system. This must be considered when calculating the mechanical strength of autotransformers. In some cases, it is necessary to increase the leakage resistance of an autotransformer by increasing its stray fields, for example, by reducing the diameter of the rod, increasing the width of the gap between the windings, etc. An increase in stray fields in an autotransformer is, of course, undesirable, since it leads to an increase in losses, local overheating, and increased voltage fluctuations.

Some complications are encountered in solving the problem of voltage regulation under load of power autotransformers.

An autotransformer is a convenient and economical way to transform voltage, but due to its shortcomings, it cannot completely replace simple transformers. But it has firmly occupied its niche, and it has a future. To date, every third product of a transformer is an autotransformer.