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AN INNOVATION WAY OF ENERGY-SAVING

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Today the quality of electric power, efficiency of its development and power savings during distribution and use are the main directions in electric power industry. To make it is possible only with introduction of new electrotechnical devices based on high technologies using the effect of superconductivity.

In this area real work has begun after opening intermetallic connections. It was the time of low-temperature superconductivity and a coolant could be only a liquid helium. It was a main obstacle for wide application of superconductors.

New possibilities for the developers of superconducting electrotechnical devices have appeared with opening of high-temperature superconducting materials. Using in a system of cooling the liquid nitrogen instead of helium has allowed to design and create efficient superconducting devices. Now there are two kinds of superconducting materials: ceramic compounds on the basis of bismuth and yttrium. There are prominent features in high-temperature superconductors:

1. Very small losses with big density of current;
2. Transition from almost zero resistance to a high one when current can exceed a certain value (a so-called critical current).

Today in the world active researches and engineering designs of various electric equipments on the basis of high-temperature superconductors are carried out: transformers, power cables, and electric motors. The most considerable successes are made in creation of power cables. We`ll consider them now.

Increasing the transmission of power by means of power cables from traditional materials (copper, aluminum) are made today due to increasing voltage and decreasing rated density of current. Maximum possible values of voltage are from 500 κV till 800 κV for new projects. It limits transmitting power in the range of 500 – 1500 MW. It`s necessary to have special conditions of cable laying. And there is a number of environmental problems: stray currents, electromagnetic, radiations warming up the soil, and contamination of it by oils near the substation or places with the defects of cables. Besides, it is necessary to supply compensators of reactive power. And the length of a cable line is limited on several tens of kilometers.

The most effective way for considerable (in 3 … 8 times) increasing the power of distributive networks can be reached by using superconducting cables. The main advantages are high current load, small losses in a superconductor, ecological purity (absence of oils, minimum electromagnetic thermal environmental effects), a high level of fire safety.

First of all the using of high-current superconducting cable lines allows to change and simplify the structure of a network. It is the result of their integrated characteristics. They are considerably more close to generators, than other systems transferring of the electric power. Due to superconductors it isn`t necessary to use step-up or step-down substations and overhead transmission lines. In some cases they can be replaced by a superconducting cable line transferring all electric power developed by a generator without its transformation. Such scheme is especially effective for large power consumers, such as: big cities, metallurgical and chemical enterprises etc.

Now there are about ten large-scale projects on the basis of high-temperature superconductors. They are spent in different countries and companies. One of them was in Albany in 2006. Two companies (Sumitomo and Super Power) switched on a cable. Its length was 350 meters. The working current – 800 A. The type of it was «three in one» (there are three phases of a cable in one cryostat). There was a short during the working. And there were no troubles unit. And after checking it put into operation again.

The most known project of a power cable was a project called LIPA . In New York power supply system 600 meter cable was installed in Long Island. The working current was 2400, at the voltage - 138 κV. Its transferred power was very large. Three phases of a cable were placed in separate cryostats. Now the cable is served in real city conditions.

In Russia there are some projects on the basis of high-temperature superconductors. Three-phase cable has been developed. Its length is thirty and two hundred metres. Its working current is 2 kA. The cable has shown full conservation of superconducting properties after passing all technological path. The cable is capable to work by overloading in 30 % from rated current and above it. The cable has withstood multiple overloads without faults.

Nowadays other large-scale projects are being developed:

- Cable line of 1,5 km in a New Orleans power supply system;
- Further development of project LIPA;
- The creation of a 5 km line in Tokyo;
- The creation of a superconducting ring in Seoul power system with a total length more than 20 km.

In 2010 in December V.V.Putin has signed a document for the realization of a project called «Superconducting industry». Our government finances Rosatom with 765 mll. roubles. All means will be included in an authorized fund of a public corporation "Russian superconductor". The money will go for the formation of experimental and skilled-industrial base, including specialized equipment.

In Tomsk technological center a group of companies "Sibelektromotor" have started to design an asynchronous electric motor on the basis of high-temperature superconductors of the 2nd generations. The wire from manufacturer Super Power is put to Tomsk by corporation «Russian Superconductor». The motor is planned to put into operation at the end of this year.

The Ministor of economical development of Russian Federation Elvira Nabiullina has declared that manufacture of devices on the basis of superconductivity is planned to develop in Russia by 2012. The project on high-temperature superconductivity in cost of 4 billion roubles, is already started. The Center of applied superconductivity formed on the basis of "Kurchatovsky institute" will be engaged for creating the experimental models of superconducting devices.

The progress in this area allows to create economical superconducting electrotechnical devices. Today's level of such developments has already shown their profitable advantages. It allows really evaluate to their characteristics and start working out and realization of commercial projects.