The test results of superconducting AC and DC cables in Russia.

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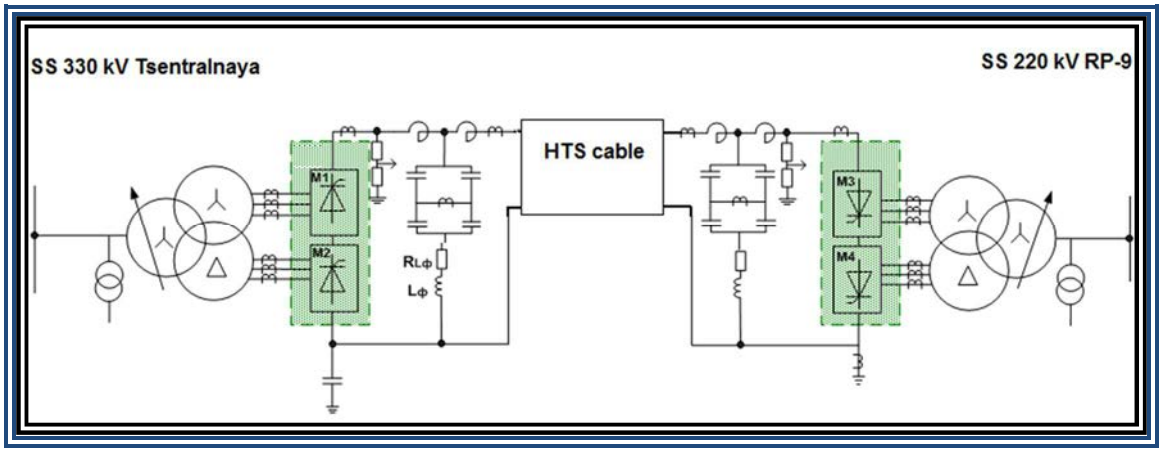
Superconducting cables have evident benefits when transmitting large power flows through electrical networks in comparison with traditional ones. The Russian R&D program for superconducting HTS power devices includes the creation of HTS AC and DC cable lines. Two cable lines on the transmitted power of 50 MVA/MW at 20 kV were produced and tested in the framework of the program.

Demonstration AC cable line length of 200 meters is designed for installation on one of the substation in Moscow. The cable nominal rating is 20 kV – 1500 A with possible 30% overload, i.e., 2000 A at 20 kV. This means 50 MVA to 70 MVA of transmitted power. Cable line consists of three separate phases placed in three different cryostats. Cable phase design include central spiral, copper former, two layers superconducting cable core, high voltage insulation, one layer superconducting screen, copper protection layer and flexible cryostat.

DC cable line will be installed in the electrical network of St. Petersburg to connect the two powerful substations on the medium voltage. As a basic design was chosen a unipolar cable with the reverse conductor in one cable. The cable consists of concentric layers containing the following elements:
former and stabilizing element, superconducting central wire playing a role of the forward conductor,
high voltage insulation, superconducting reverse conductor, external stabilizer, external (screening) insulation, electric (non- superconducting) screen, cryostat with protecting layer. Wiring diagram of DC cable line connection to the electrical network shown in the figure below.



Special cryogenic test facility with attached electrical capacity of 120 MVA has been developed to test different HTS electrical power devices in R&D center @ Federal Grid Company, Moscow. It was tested several sections of AC and DC cable lines length of 30, 60, 200, and 860 meters. The critical cables dependence upon temperature for both cables were measured. All cables underwent high voltage and short circuit current test successfully. Current leads and joints have been developed and tested in a wide range of currents and voltages. Detailed test results will be shown in the report.

The successful introduction of this HTS cable lines into electric grids will allow checking up the basic technical solutions for this technology and get an experience for the commercial application. This will be the first step to broader implementation of HTS technology in the electrical network of megalopolises.