The ITER PF1 coil electrical joint test results

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One of the tasks of the Russian Federation in the ITER project is to supply one of six poloidal coils - PF1 coil, which contains 16 electrical joints to connect adjacent layers in one single electrical and hydraulic circuit. The active resistance of the joints is one of the critical parameters in the load part of the cryogenic system and the stability margin of the superconducting cable. Based on the requirements, the International Team of ITER has updated the structure of the compounds in the partialized materials. (Up to 55 kA) and magnetic fields (up to 5 tons), the active resistance should be <5 nOhm, and the connection loss should be <50 J for a transverse field of ± 0.2 T.

This work describes selected materials and developed technologies and equipment used during manufacturing of termination boxes, preparation of a superconducting cable for subsequent electroplating and inserting in the termination box. Also, these technologies are used for soldering the superconducting cable and the copper sole of the termination box and the copper soles of the termination boxes between each other. Features of the selected materials are the provision of the required parameters of the active joint resistance, the mechanical strength of the soldering, and the absence of halogens in the electrolyte for electroplating meets the safety requirements of the international organization of ITER. The peculiarity of the developed technologies is the non-destructive testing of operational control at each stage of manufacturing, ensuring the requirements for losses inside the joint and the temperature control of the superconducting cable during soldering, which did not exceed the critical value of 250 ° C.

Also, in this paper, it is described a prepared test facility on the territory of NIIEFA, where a preliminary joint sample was tested. A feature of the facility is the possibility to investigate large-scale samples at currents up to 25 kA and magnetic fields up to 2 T. The results were verified by testing the ITER PF1 coil qualification joint sample at the SULTAN (Switzerland) test facility.

As the results of this work, the test programs are given, as well as the results of studies of the parameters of the preliminary and ITER PF1 coil qualification joint samples.