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Qualification Program of Joints for ITER Coils

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The superconducting coils of the ITER tokamak have hundreds of joints interconnecting conductor unit lengths. The joints operate in magnetic field of up to 4T, field derivatives up to 0.5T/s, and currents up to 70kA. The majority of the joints has a twin-box design, with the exception of the coaxial and splice joints of the Central Solenoid. They are designed differently, to fit into the tight space around the coil periphery and to minimize energy losses under varying field.

The agreed on ground acceptance tests for the coils at 80K (the CS coil to be tested at 4K) creates no possibility to measure the resistance of the joints in the superconducting state. As no reliable NDT method was found to detect a joint failure, the series production of the joints relies on strict adherence to established manufacturing procedures. Furthermore, a periodic test of the joint samples manufactured in parallel with a coil fabrication helps to control the production quality.

To qualify the manufacturing procedures, to establish a series production tools and worker teams, a qualification programme was set up for manufactures of the coils. This programme includes a set of mock-ups and samples to mimic the manufacturing process, submitted to qualification tests. The tests include mechanical testing of materials at room and cryogenic temperature, electrical tests of full size joint samples in the conditions similar to those of the coils, destructive examination of the joint mock-ups, and mechanical test of the full size mock-ups. All tests are carried out in specialised laboratories qualified for this type of work.

The paper describes the main items of the qualification programme, the tests performed and the acceptance criteria. The test results are reported and compared to the criteria.

The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

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