COMPUTATION OF JT-60SA TF COIL TEMPERATURE MARGIN

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Within the so-called Broader Approach signed by the EU and Japanese governments in 2007, the upgrading of the JT-60 tokamak to the JT-60SA superconducting tokamak was decided, as a "satellite" facility to ITER. Among other components, the EU is in charge of supplying the 18 toroidal field (TF) coils, which will be made of NbTi [1].

The TF coils will be subject to different kinds of thermal loads. These include a significant neutron load, coming from DD fusions occurring inside the JT-60SA plasma, whose distribution inside the different coil components was recently studied [2].

The thermal loads enter the calculation of a fundamental parameter of the TF coils, namely the temperature margin ΔT, which is defined as the difference between the current sharing temperature (or quench temperature, in the case of NbTi) and the operating temperature; in the JT-60SA design the minimum allowable value of ΔT is 1.0 K after burn and a disruption event and 1.2 K after nominal burn operation.

So far, the complex problem of assessing ΔT for the different operating scenarios has been addressed by coupling 2D thermal calculations of the coil structures with 1D analysis of the single conductor [3, 4].

In order to verify the accuracy of this approach, we apply here the recently developed 4C thermal-hydraulic code [4] to the calculation of the temperature margin in the JT-60SA TF coils, for nominal burn operation subject to neutron-related heat load. 4C implements a model of compressible 1D supercritical helium flow in the entire winding (and in the case cooling channels, where relevant), coupled with 3D heat conduction in the solid structures and fed by an external cryogenic circuit including valves, pumps, heat exchangers, cryolines, etc.

The results of 4C will be compared with those of previous simplified analyses [5].

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