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Stability Analysis of ITER Central Solenoid During Plasma Scenario

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For large scale fusion magnets of the ITER tokamak, wound with cable-in-conduit conductors, the application of sophisticated numerical models able to analyse the thermal-hydraulic behaviour during plasma scenario is of paramount importance to guarantee adequate stability margin during the operating conditions. The SuperMagnet code has been developed by CryoSoft with the intent to simulate simultaneously electrical, thermal and hydraulic aspects during the operation of superconducting coils.
In this work, the SuperMagnet code is applied to analyse the thermal-hydraulic behaviour of the Central Solenoid of the ITER tokamak under the plasma scenario. The CS magnet system is composed of six modules for a total amount of 240 pancakes. The software is able to tackle the complex structure of the CS and its cryogenic closed loop. In the present work, the circulation pump operation and the heat transfer to helium bath are investigated. The results presented here show the temperature evolution of the magnet and of the supercritical helium during plasma scenario, which allows determining the operation margin of the CS. The stability is further investigated by analysing the quench initiation and propagation in the most critical locations of the system.

Category

Multi-scale and multi physics design methods

Keywords

Cable-in-conduit conductor (CICC), Central Solenoid (CS), ITER, Thermal-hydraulics, SuperMagnet, Plasma Scenario.

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