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Analysis of Minimum Quench Energy of ITER NbTi and Nb3Sn CICCs

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The Cable-In-Conduit Conductors (CICCs) for the ITER magnets are subjected to fast changing magnetic fields during the plasma-operating scenario. In order to anticipate to the limitations of the conductors under the foreseen operating conditions, it is essential to have a better understanding of the stability margin of the magnets. In the last decade ITER has launched a campaign for characterization of several types of NbTi and Nb3Sn CICCs comprising quench tests. The conductors are subjected to a singular sine-wave fast magnetic field pulse and relatively small amplitude with respect to the ITER plasma operating scenario. The Minimum Quench Energy (MQE) tests, performed in the SULTAN facility, were reproduced and analyzed using JackPot-ACDC, an electromagnetic-thermal model for CICCs, developed at the University of Twente and THEA (Thermal, Hydraulic and Electric Analysis of Superconducting Cables). The experimental results were used to calibrate the numerical models and to reproduce the energy deposited in the cable during the MQE stability tests. The agreement between experiments and models shows a good comprehension of the various CICCs thermal and electromagnetic phenomena. The results provide a good basis for further investigation of conductor stability and extrapolative scaling for different magnetic field pulses with lower ramp rate and higher amplitude.
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