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P3.082 Thermal-Hydraulic and Quench Analysis of the DEMO CS coil

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The Central Solenoid (CS) coil of the European DEMO tokamak will consist of five modules, namely CSU3, CSU2, CS1, CSL2 and CSL3, located vertically one above the other. The central CS1 module will be subjected to the most demanding operating conditions (the highest magnetic field and mechanical loads). The design concept of the CS1 winding pack with superconductor and stainless steel grading is developed by EPFL-SPC, PSI Villigen. The proposed design is based on 10 layer-wound sub-coils using HTS, wind & react Nb₃Sn and NbTi conductors in the high, medium and low field sections, respectively. The proposed design undergoes comprehensive electromagnetic, mechanical and thermal-hydraulic analyses aimed at verification if it fulfils the design performance criteria. Our present work is focused on the quench analysis of all the CS1 conductors, aimed at the assessment of the maximum hot spot temperature. The analysis, based on the most recent iteration of the design proposed in 2017, is performed using the THEA CryoSoft code. We take into account the realistic magnetic field distribution along each conductor, heat transfer between neighbouring turns, and heat generation due to AC losses. A special attention is given to establishing the reliable quench simulation procedure for innovative HTS conductors. The obtained results should provide information for further improvement and optimization of the winding pack design.

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