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Analysis of stresses in a 16-T superconducting dipole during a quench

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The copper current density plays important role in the quench protection of superconducting magnets. In non-graded magnets the worst case hot spot is typically at the location of the highest magnetic field and with active quench protection the temperature of the rest of the magnet is kept relatively isothermal. Graded superconducting magnets pose new challenges to the quench protection because the maximum copper current density is cable dependent. The worst case hot spot is not anymore typically at the location exposed to the highest magnetic field. At the same time significant temperature gradients may occur at the interface between different cables. This means that the quench protection becomes also a mechanical issue. In this paper we study the quench protection of a 16-T EuroCirCol FCC dipole design from mechanical point of view. We use finite element analysis to study the worst case stresses in the magnet assembly during its entire use cycle: pre-loading, cool down, energising and quench event. In addition, we study stresses caused by different quench events to find limiting conditions for magnet and quench protection system design.

Primary author: ZHAO, Junjie (Lanzhou University (CN) and TUT (FI))

Co-authors: STENVALL, Antti Aleksis; LORIN, Clement (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR)); SALMI, Tiina-Mari (Tampere University of Technology, Finland)

Presenter: ZHAO, Junjie (Lanzhou University (CN) and TUT (FI))

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