Contribution ID: **239** Type: **not specified**

Mechanical stress analysis during quench

Wednesday 11 April 2018 09:30 (15 minutes)

Within the FCC project, the EuroCirCol Work Package 5 is dedicated to the design of 16 T Nb3Sn superconducting dipole magnets. Three main aspects are considered during the design phase, i.e. the optimization of the electromagnetic performance of the dipole magnets, their mechanical structure and quench protection design. Various numerical models have been built for their analysis, employing dedicated commercial and in-house simulation tools, according to the different physics laws involved. As an example, COMSOL is considered to simulate the protection effectiveness of the Coupling-Loss Induced Quench (CLIQ) system during a quench while ANSYS APDL language is employed in the mechanical models.
In this contribution, two of these aspects are considered together to analyze the development of mechanical stress during quench. Magneto-thermal COMSOL and mechanical ANSYS models are coupled via MpCCI, a software that allows for mesh-based interpolation, so that Lorentz forces and temperatures developed during quench can be employed for the mechanical analysis. Different hot-spot locations are considered and their effect on the peak stresses is shown. This analysis may provide useful feedback to the mechanical design, which in a first phase considers nominal operating conditions.

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Session Classification: Magnets

Track Classification: EuroCirCol