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Quench Characteristics of Conduction-cooled 6T NbTi Magnet System

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One of the important features of any conduction-cooled LTS coil is to achieve thermal stability against any thermal disturbances as the minimum quench energy of a NbTi coil is very minimal.The thermal stability of the conduction-cooled magnet system will be governed by the energy balance at the NbTi coil. The cryogen-free magnets are cooled using cryocooler alone through the conductive thermal links which makes more prone to quench and limits the sweep rates. We have developed a 6T NbTi cryogen-free magnet system (CFMS) with warm bore. The maxium sweep rate for the 6T CFMS is found to be 6 A/min. The dynamic heat generation (e.g AC loss) of coil limits the sweep rate. The maximum temperature of coil went to 53.25K when quench at 101.1A during training of the coil.The temperature of the 2nd stage cold head of the crycooler went to 15.87K. We have done some intentional quench at higher sweep rate of 8 A/min and 20 A/min to study the quench charateristics. Quench of the 6T NbTi coil due to the cooling failure has also been experimentally studied. This paper briefly discusses the different types of quench charatcteristics for the conduction-cooled 6T NbTi magnet system. We have done FEA analysis of the 6T NbTi coil to simulate the maximum hot-spot temperatutre and its resistance growth during a quench. The experimental measurement has been compared with the FEM analysis. This paper also discusses the post-quench distribution of the dumped energy in different components of the magnet system.

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