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Design and analysis of the quench protection system for the MICE coupling coils

Author Block

: **B.A. Smith**¹, S. Prestemon², H. Pan³;

¹Massachusetts Institute of Technology, Cambridge, MA, USA, ²Lawrence Berkeley National Laboratory, Berkeley, CA, USA,

³Lawrence Berkeley National Laboratory, Berkeley, CA, USA.

Abstract:

The two identical MICE coupling coils have the largest diameter and stored energy, at 13 MJ each, of any of the coils in the MICE experiment. The coils have an inner diameter of 1.5 m and radial and axial builds of 102.5 mm and 285 mm, respectively. The coils contain approximately 15,936 turns and are wound with a single rectangular NbTi strand with a copper-to-superconductor ratio of 3.9:1. Each coil is conduction cooled using 3 cryocoolers, which maintain an operating temperature at about 4.5 K. Each coil is powered through a pair of series-connected copper and 500 A HTS current leads. The quench protection analyses described here show that subdividing the winding into 4 or more cold diode protected subsections maintain hot spot temperatures below 150 K, and internal winding voltages below 300 V. The superconducting subdivision interconnect loops are protected by heat sinking them to the aluminum winding housing. Stabilizing the superconducting to HTS current leads minimizes the likelihood of lead quench.

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