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M2Po2B-05: CLIQ Quench Protection System for a MgB₂ Segment Coil for MRI Applications

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In this work, we performed studies of quench protection relevant to MgB₂ based 3T conduction cooled magnetic resonance imaging (MRI) machine. We modelled a conduction cooled MgB₂ whole body, segmented coil MRI design. The overall design had 3T in the bore, with 10 ppm homogeneity in a 49 cm DSV, total magnet length = 1.37m, total conductor length = 121km, operating current $I_{op} = 287$ A, critical current $I_c = 383$ A, and $I/I_c = 0.75$. We first applied the CLIQ scheme to one coil, with OD 901 mm and winding pack 44 mm thick×50.6 mm high, conduction-cooled, react-and-wind, with 1.7 km of MgB₂ strand. The results of coil temperature and current are presented for various protection conditions. These results are compared to those using a quench heater approach (with external dump resistor). A scheme for scaling this approach up to protect the full magnet is then described, and the simulation results presented. An oscillating 100A and 75Hz exciting current generated by a charged 40mF, 0.2μF and 500V capacitor in CLIQ units induces a transition to the normal state of the entire coil winding pack within 7 seconds.

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