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M1Po2C-01 [36]: Quench, Normal Zone Propagation Velocity, and the Development of an Active Protection Scheme for a Conduction Cooled, R&W, MgB2 MRI Segment Coil

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The development of coils which can survive a quench is a crucial aspect for demonstrating the viability of MgB2-based main magnet coils for MRI. Here we have studied the thermal stability properties of a large (outer diameter: 901 mm; winding pack: 44 mm thick × 50.6 mm high) conduction-cooled, R&W, MgB2 superconducting coil. Minimum quench energy (MQE) values were measured for different coil operational current (Iop) values. During these measurements, normal zone propagation velocities (υp) were also measured using multiple voltage taps placed around the heater zone. The coil was cooled conductively; Ic was 186 A at 15 K. As Iop ranged from 80 A to 175 A, MQE ranged from 152 J to 10 J, and NZP from 1.3 to 5.5 cm/s. Two kinds of heaters were involved in this study: a localized heater ("Test Heater") used to initiate the quench, and a larger "Protection Heater"which was used to protect the coil by distributing the normal zone after a quench was detected. The protection heater was placed on the outside surface of the coil winding. The Test Heater was also placed on the outside surface of the coil at an opening made in the protection heater. We then developed and tested an active protection scheme for the coil. Such active protection modes are of great use for MgB2-based MRI because it allows us to take advantage of the relatively large MQE values of MgB2 in order to reduce the excess stabilizer needed for totally passive protection schemes, increasing winding Je and allowing competitive MgB2 MRI designs. The ability to detect the quench was demonstrated using a difference voltage between two segments of the coil, and the ability to fire a protection heater was demonstrated. A larger energy deposition will be needed for full coil protection, this development is underway.

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