Construction and Persistent-mode Operation of a 0.5-T/240-mm Cold Bore MgB_2 MRI Magnet at 10-15 K

Jiayin Ling, John P. Voccio, Seungyong Hahn, Youngjae Kim, Kazuhiro Kajikawa, Jungbin Song, Juan Bascuñán, and Yukikazu Iwasa

Francis Bitter Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, MA, 02139, US

E-mail: jling@mit.edu

Abstract—This paper presents construction and persistent-mode operation results of a 0.5-T/240-mm cold-bore MgB_2 MRI magnet, wound with monofilament MgB_2 wire, at the MIT Francis Bitter Magnet Laboratory. The magnet, of respective inner and outer diameters of 276 and 290 mm and a total height of 460 mm, has computed pre-shim field homogeneity of 200 ppm over a 12-cm Diameter Spherical Volume (DSV). The magnet results presented include: 1) construction details; 2) electromagnetic and cryogenic performances; and 3) protection technique deployed. To limit the continuous length of Hyper Tech supplied MgB_2 monofilament wire to <300 m, the magnet was divided into 8 series-connected coils, each equipped with its own persistent current switch (PCS) and superconducting joints. Before assembled into the magnet, each coil was tested in the temperature range 10-15 K, cooled by the affluent helium vapor emanating from a pool of liquid helium below. Each coil, in self-field, carried a minimum of >100-A superconducting current at 15 K and a peak field of 0.5 T. The magnet, designed for liquid-helium-free operation, was immersed in solid nitrogen, an excellent thermal mass enhancer in the operating temperature range 10 - 15 K. In the magnet energizing mode, with adjacent coils solder-connected, the 8 coils were charged simultaneously with all 8 PCSs “opened.” In persistent-mode operation, all PCSs were “closed.”