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Feasibility study of novel rapid ramp-down procedure in MgB2 MRI magnet using persistent current switch with high off-resistivity

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Dry magnets using MgB2 wires are one of effective options to eliminate dependence on liquid helium in MRI scanners. In the dry magnets, however, lack of thermal mass of cryogen makes a controlled quench difficult and extends time for restarting the magnets after the quench. In this study, a novel rapid ramp-down procedure, which can be substituted for the controlled quench in emergency rundown, is proposed, and its feasibility is proven for a 1.5 T whole-body MgB2 MRI magnet. In this procedure, a power supply receives current from a persistent current switch (PCS), the PCS is turned off by heating, the power supply is interrupted by a breaker, and the stored energy in the magnet is mostly consumed at an external resistor. Owing to the large energy margin of MgB2 wires, the AC loss during the ramp-down does not bring a quench of the MgB2 coils. A niobium-titanium sheathed MgB2 wire 0.60 mm in diameter is made, and a PCS with high off-resistivity is designed using this wire. The shunt current during the ramp-down does not bring the burnout of the PCS when the wire length is sufficiently long, typically hundreds of meters. Because heat generation inside the cryostat during the ramp-down is a few percent of the stored energy in the magnet, the magnet is not heated excessively. As a result, the proposed ramp-down procedure should shorten the downtime of MRI scanners.

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