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Conductor for MRI magnets beyond NbTi

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Magnetic Resonance Imaging, MRI, is a powerful medical diagnostic tool and the largest commercial application of superconductivity. MRI magnet design is determined by competing requirements including functional performance, patient comfort, ease of siting in a hospital, minimum acquisition and lifecycle cost. The increased center field, maximized uniformity volume, minimized field decay and stray field, magnet compactness, optimized refrigeration, improved manufacturability, reliability and serviceability drive the magnet requirements. We consider the conductor requirements for commercial MRI magnets beyond traditional NbTi conductor while avoiding links to a specific magnet configuration. MgB2, ReBCO and BSCCO conductors are evaluated. From a technical point of view, none of the HTS or MgB2 conductors meet all of the requirements to commercial MRI magnets at the moment. The following conductor features shall be developed or improved: (1) Conductors specifically designed for MRI applications, with form-fit-and-function which can be readily integrated into present MRI topology with minimum modifications; (2) Conductors with improved quench characteristics, i.e. the conductor ability to carry significant currents without damage in the resistive state; (3) Insulation which is compatible with manufacturing and refrigeration technologies; (4) A dramatic increase in production and long-length quality control, including large-volume conductor manufacturing technology. The in-situ MgB2 conductor is, perhaps, the closest to commercial requirements. This conductor still needs significant and lengthy developments including but not limited to development of a stabilized conductor, conductor that does not require processing after winding, reliable long-length conductor. Conductor technology is not the only issue in introduction of HTS / MgB2 conductor in commercial MRI magnets. Volume-production technologies shall be developed including efficient winding, reliable quench protection, superconducting joints, thermal switches that are compatible with HTS / MgB2 and can operate at elevated temperature, refrigeration technologies.

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