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Conceptual Design of a Large Aperture Dipole for Testing of Cables and Insert Coils at High Field

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Advances in the performance of LTS and HTS superconductors enable the development of advanced magnets for a range of applications, including tokamaks for fusion energy, dipoles and quadrupoles for hadron colliders, and solenoids for nuclear magnetic resonance studies. The capability of testing prototype cables and insert coils at high field is critical to these developments. We present here the conceptual design of a test facility dipole with features suitable to support the advanced magnet development efforts of both Fusion and HEP communities. In particular, a background field in the range of 13 to 15 T is provided over a minimum homogeneous length of 700 mm, and the magnet clear bore of approximately 150x100 mm can accommodate large fusion conductors as well as prototype coils for high field dipoles, along with flexible cryogenic and mechanical provisions for sample characterization. Two technical solutions are considered. The first uses a Cable-in-Conduit Conductor and follows the design developed by EFDA for the EDIPO magnet. Preliminary studies show that an increase of the operating field from the original 12.3 T to 13 T is possible by taking advantage of improvements in conductor performance, and further optimizing the cable design. The second approach uses a Rutherford cable and follows a block-coil design similar to the CERN FRESCA2 dipole, and the LBNL HD and LD1 dipoles. Due to increased current density in the coil pack, this approach can provide background fields in the range of 14 to 15 T, depending on the technical features adopted for the magnet and the cryogenics. Following a comparison between the two approaches, we present a baseline design including performance objectives, key parameters, and preliminary magnetic, mechanical and quench protection analysis.

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