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Quench Protection and Cyclic Fatigue Test Results for MTI Coils in the 40T All-superconducting Magnet Project at the NHMFL

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The high-strength substrate within REBCO contributes to its selection for use in the NHMFL 40 T all-superconducting magnet. To confidently scale up to a 40 T user magnet, both quench protection and cyclic fatigue are among the technologies that require successful demonstration. Here, numerous test and simulation results from two-in-hand wound, double-pancake stacked, insulated mid-scale test coils are shared and discussed. The two-in-hand winding method is known to provide resilience against single tape defects via the parallel superconducting paths, hence the technology descriptor - multitape insulated, or MTI. These MTI mid-scale coils were wound with >1.2 km of conductor and generated an additional ~15 T inside of 12 T LTS magnets. Designed to reach very high hoop strains (>0.5 %), the test coils were cycled (~1 kcycle) to evaluate the longevity of the various magnet components, as well as the REBCO tapes. Additionally, the test coil designs balance compact size against the amount of stabilizing conductive material, albeit resistive, available for energy extraction in the event of a protected quench. Here we demonstrate the feasibility of safely protecting a REBCO-tape wound, insulated coil with a designed J_{cu} of about 700 A/mm².

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