Development of Enhanced Reliability Low Sample Risk 50 Tesla Pulsed Magnet for Radiological Sample Testing

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Overview

The NHMFL Single Turn Facility also operates a 10 kV 7.2 mF 360 kJ capacitor bank for sample characterization in the ms time scale. The single turn facility requested a 50 T cryogenically cooled pulsed magnet to operate with this capacitor bank in 2009. The magnet will be used to characterize radiological samples. The design requirements were: 1) the magnet deliver a 45 T to 50 T pulse with a 2 ms to 5 ms rise time, 2) the magnet be extremely reliable, and 3) the magnet assembly should allow for enhanced sample safety in the advent of magnet failure.

Design Description of 50T Magnet

The basic magnet structure adopted was that of the poly layer assembly technique developed for the US NSF & US-DOE 100T multi shot magnet program. The magnet geometry has proven reliable and been implemented in NHMFL 65T and 75T user magnets, as well as the in the 90 T insert magnet. The resulting magnet will have a 2.5 ms rise time during a 50T pulse.

NHMFL poly-layer assembled magnets have metallic reinforcement between layers. The metallic reinforcement allows plasma venting during fault without catastrophic structural failure. An insulated Hastelloy liner tube is placed in the central bore to protect the sample cryostat in the advent of electrical fault. There is an annular channel between the windings and the liner tube to allow axial venting of plasma during fault. Hastelloy was selected for the liner tube as the best compromise for shielding while minimizing eddy currents and avoiding structural buckling during operation.

Status and Conclusion

The magnet design incorporates a novel plasma shield and venting technology together with the developed NHMFL poly-layer poly-metal reinforcement technology to enhance reliability and sample survivability for use with radiological samples.

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References