TRAINING PERFORMANCE OF 75 T PROTOTYPE PULSED MAGNET

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Introduction

A new 75 T pulsed magnet design is now undergoing operational evaluation at the NHMFL Pulsed Field Science Facility (See Fig. 1). The magnet design incorporates improvements to the engineering template developed for the 65 T pulsed user magnets. The development of the 75T magnet is part of the NSF effort to develop insert magnets for the DOE 100T multi-shot (MS) magnet program. An important objective of the 75T project is to gain experience operating insert-like coils in the same temperature, stress, and strain range encountered at 100 T. The 75T magnet assembly is comprised of two solenoid coils nested together. The inner "A" coil is constructed with materials & techniques identical to those planned for the 100T inserts.

The 75T testing protocol entails three phases of operation: 1) Training and operation at 75T. 2) Magnet operation at 70 T to baseline reliability performance at 90T operational stress. 3) Demonstration of cryogen free operation at 70T. We report the results of phase 1 in this article. This experimental activity is critical for insert design validation.

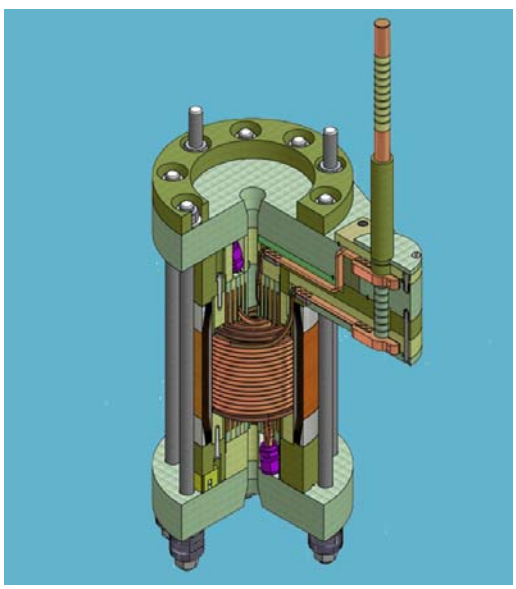

Figure 1. Section view of 75T with windings.

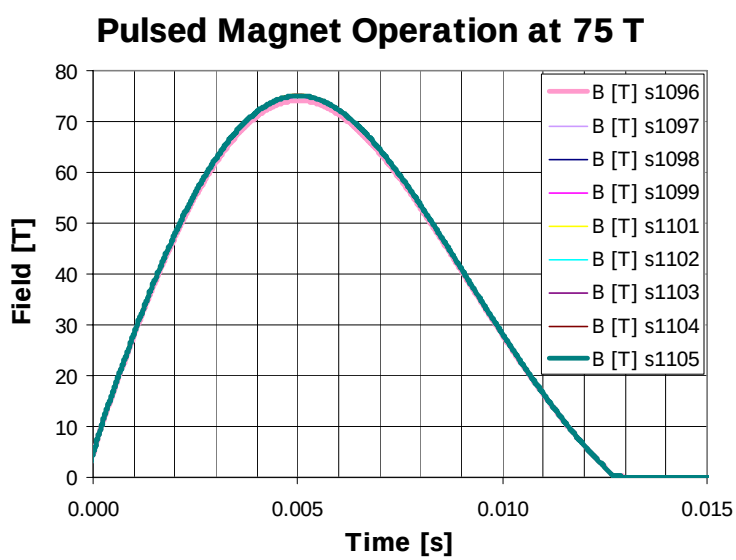

Figure 2. Pulsed field waveforms integrated from B-Dot signal.

Experimental Results

The 100T capacitor bank is configured to 15.2 mF for high-energy pulsed operations with the 75T magnet. We successfully trained the 75T prototype to full field over 21 pulses of increasing intensity. The capacitor bank energy for a 75T pulse is 1.44 MJ. We energized the magnet ten times to 75 T in accordance with the test protocol (See Fig. 2). The "100T Intensity" phase of the testing protocol was completed on November 18th. The 75T testing protocol will entail 100-200 pulses at 70 T to validate reliability at stress levels comparable to the MS Insert at 90 T and cryogen free operation.

Summary

Magnet performance closely followed design predictions. The drive voltage calculation was within 50 volts of the measured experimental value. The 75T prototype and the insert capacitor bank both operated together according to specification. The 100T insert capacitor bank functioned flawlessly throughout training. We are optimistic and encouraged by the technical results obtained thus far.