DESIGN DEVELOPMENT OF A RAPID CYCLING "QUICK COOL" 55-T PULSED MAGNET

C.A. Swenson, W.S. Marshall, A.V. Gavrilin, (NHMFL-FSU);
J.R. Sims, (LANL ESA-WDS); J.S. Schillig (NHMFL Pulsed Field Facility)

Introduction

We present a conceptual design for a rapid cycling pulsed magnet to upgrade the 50T 24-mm bore pulsed magnet system in production since 1998. The design is a fusion of insert fabrication technology with earlier conceptual & prototyping work. The performance targets set for this magnet system are:

1) Peak operating field of 55-T in a 24-mm bore.
2) A cycle time of 5 min. between full field shots.
3) A rise time > 9 ms in the pulsed wave-form (See Fig. 2)

The assembly is comprised of nine free standing coils with cooling gaps between each winding to allow access cryogen for cooling. The cooling manifolds are connected to radial flow channels located on the end spools. Each winding is free-standing and constructed using the poly-layer fabrication techniques. The implicit design strategy is that each winding is self supporting with its own internal MP35N and zylon composite reinforcement shells.

We have completed the mechanical stress analysis, preliminary layout and power-feed model (See Fig. 1), and a thermal analysis (See Fig. 3). Energized stress levels in the zylon fiber reinforcement are less than 2.2 GPa. The thermal analysis has allowed us adjust the reinforcement design to ensure that every winding in the assembly meets the 5 min. cool-down time in the initial design specification.

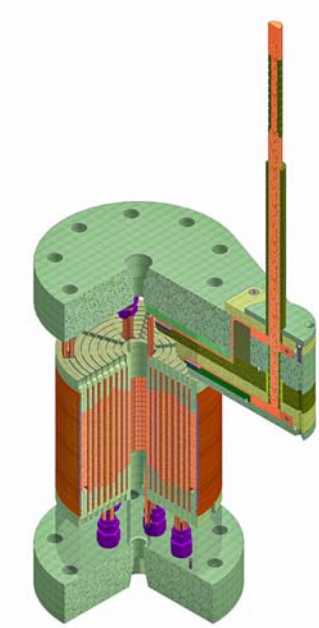

Figure 1. "Quick Cool" assembly.

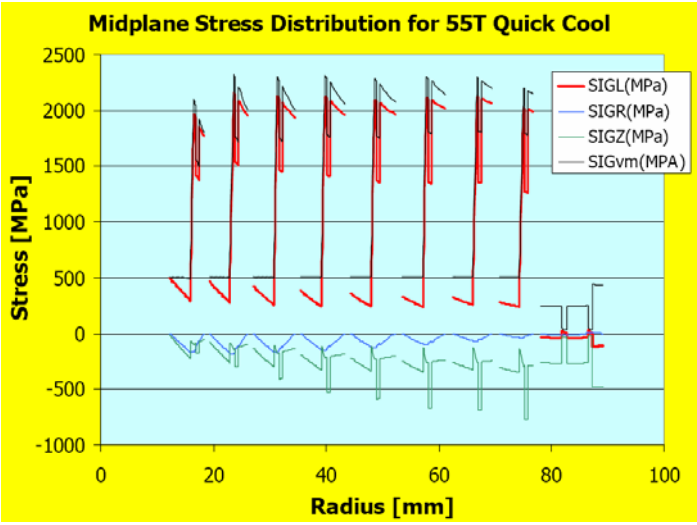

Figure 2. Mid-plane stress analysis for 55T upgrade design.

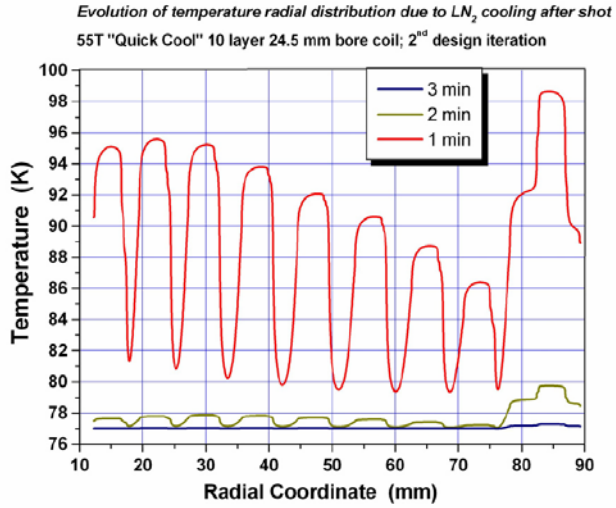

Figure 3. Cool-down analysis for "Quick Cool" assembly.

Summary

We have accomplished the preliminary design work required to define the planned upgrade. The principal development task is the application of the poly-layer assembly process to produce free-standing internally reinforced windings. Implementation of this upgrade will coincide with upgrades to the capacitor bank at the NHMFL Pulsed Field Science Facility.