Scale-up of Pre stressed Zylon Composite Technology for NHMFL 100T Outsert

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Introduction

The NHMFL Pulsed Field Facility is engaged in the upgrade and replacement of 100T outsert coils 1-4. The 100 T outsert is a generator powered magnet assembly. Coils 1-4 utilize metallic reinforcement shells comprised of ultra high yield 301:SS sheet wound onto Nitronic 40 bobbins. The first production coils had their spiral 301:SS sheet wrappings terminated with spot and fusion welds. These welds failed during the first 6 months of outsert operation in the two innermost coils. (#1 & #2) The weld failures resulted in the permanent damage of coil #2. Coils 3, & 4 were not damaged. After extensive modeling, and a systematic NHMFL review the external Shell reinforcement was redesigned to incorporate a 3 mm Zylon composite closure on the OD of the 301:SS spiral shells. Outsert coils #3, and #4 were refurbished and coils #1 & #2 were replaced. The Zylon composite technology employed was a scale-up of the wet-layup reinforcement technology used in smaller capacitor driven pulsed magnets at NHMFL. The new composites were 3X larger than those developed previously. The processing of larger coils in industry required process adaptation to utilize larger fiber yarns, and a new epoxy system modified for a longer gel time.

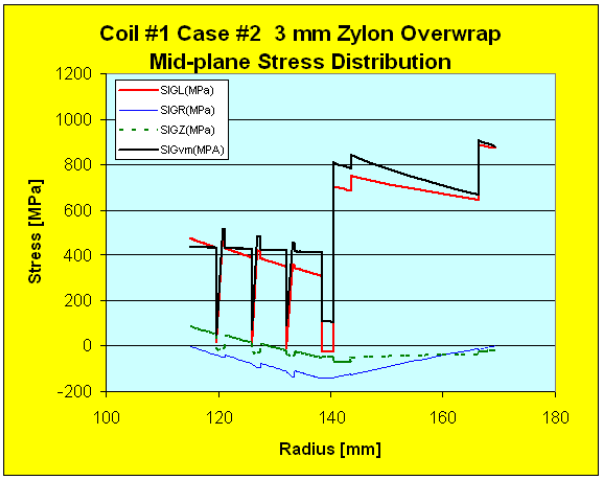

Figure 1 Mid-plain stress analysis of 100 T outsert coil #1 modeled with 3 mm Zylon composite closure. Outsert assembly is energized to 37 T. Zylon closure reduces stress on 301:SS over-wrap by ~ 200 MPa.

Figure 2 Image of 100T outsert coil #3 during rework at industrial site. Coil image is curing of Zylon composite closure. Technician is removing release tape from OD of composite shell.

Status of the Work

Outsert coils #3 & #4 are now refurbished. Outsert coils 1&2 were replaced. The 100T outsert will resume operations in March 2009. The modified assembly will deliver the 37T background field previously delivered. The scale up of the Zylon composite technology was successful. The fiber worked well with existing industrial tooling presenting few challenges to the manufacturing.

Acknowledgements

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References

[1] Walsh, R.P., *et al.*, IEEE Trans. Appl. Supercond., **16 (2)**, 1761-1764 (2006)