MT 26
International Conference
on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **799** Type: **Contributed Oral Presentation**

Fri-Mo-Or27-04: MI HTS Insert for Very High Field Magnet

Friday, 27 September 2019 08:45 (15 minutes)

Because nowadays high temperature superconductors (HTS) can carry very strong currents under a high strength magnetic induction at a low temperature, the generation of continuous magnetic fields in the 25 to 50 T range, unattainable with conventional superconductors, is becoming reality.
However, HTS magnets must be effectively protected against transition to the normal state (quench), currently one of the major bottleneck in their use.
Among the possible strategies, the metal-as-insulation (MI) winding technique allows managing the quench of the insert in such manner it will not lead to destruction. The co-winding of a superconductor with a metal ribbon, without isolation nor impregnation, allows the current to redistribute in the event of a local defect, conferring on the insert a self-protected character in case of quench. This self-protected character is shared with the uninsulated coil concept, but the additional turn-to-turn resistance brought by the metal co-wound ribbon reduces drastically the important time constant observed in uninsulated coils. Moreover, in addition to thermal protection, the metal ribbon participates to the mechanical strength of the coil.
The MI concept was tested convincingly with a two double pancake assembly up to a 20 T background field in a LNCMI resistive magnet. It produced a total magnetic field of 26.9 T with mechanical constrain above 800 MPa. Based on this work, a 10 T MI HTS insert was built. This assembly of 9 MI HTS double pancake has produced stably an additional 12 T for 45 mn in a background field of 8 T. We report on further tests up to 20 T of background field to generate a total magnetic field of 30 T.

ACKNOWLEDGMENTS: The authors acknowledge the support of the LNCMI-CNRS, member of the European Magnetic Field Laboratory (EMFL), and of the French National Research Agency (ANR) through the contracts ANR-10-LABX-51-01 (Labex LANEF) and ANR-14-CE05-0005 (NOUGAT project).

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Session Classification: Fri-Mo-Or27 - No-Insulation and Insulated REBCO Magnet Technology