

The Grenoble Hybrid Magnet Reached 42 T as a First Step

Pierre Pugat¹, Hocine Abir¹, Romain Barbier¹, Christophe Berriaud², François Debray¹, Cédric Grandclément¹, Bertrand Hervieu², François-Paul Juster², Steffen Krämer¹, Yuriy Krupko¹, Frédéric Molinié², Kevin Paillot¹, Rolf Pfister¹, and Luc Ronayette¹

¹ LNCMI, EMFL, CNRS & Univ. Grenoble-Alpes, France

² CEA Paris-Saclay, France

E-mail: pierre.pugat@lncmi.cnrs.fr

Abstract—A CNRS-CEA French collaboration has developed and built a new modular hybrid magnet at LNCMI-Grenoble to provide intense magnetic fields and fluxes. It was designed to reach in its main configuration at least 43 T in a 34 mm warm bore aperture with 24 MW of electrical power. This can be achieved by combining water cooled resistive inserts, including Cu-alloy polyhelix (25.5 T) and Bitter coils (9 T), with a large bore superconducting coil (1100 mm) based on a new specifically developed Nb-Ti/Cu Rutherford cable-on-conduit conductor (RCOCC) cooled down to 1.8 K by pressurized superfluid He. During the commissioning phase, the superconducting coil alone reached the nominal field of 8.5 T eleven times in total without quench. During the combined tests with Bitter coils, an unexpected quench appeared at 17.43 T very close to the nominal field of this configuration equal to 17.5 T. It was not far from a stagnant quench, difficult to detect, and also known as a “silent magnet killer” with a slow propagation velocity of about 10 cm/s. Both magnet protection systems, i.e. the main and the redundant ones, reacted as expected and the hot-spot temperature was limited to about 85 K validating their efficiency in one of the worst case scenarios. For the combined tests between superconducting and polyhelix coils, a magnetic field of 34 T was reached, but during the current ramp-down, the power converter of the superconducting coil overheated and lost communication with the PLC causing a fast energy discharge. No damage to the superconducting coil neither resistive inserts were detected. Investigations revealed a malfunctioning of the power converter with one of the protection crowbars that was switched on before reaching the triggering voltage threshold. A few components of the power converter were changed and mitigation actions were implemented to avoid the occurrence of such a problem, before continuing the commissioning tests. Finally, the Grenoble hybrid magnet reached 42 T, as a first step. Focus will be given to the problems encountered and solved during this successful initial commissioning phase. The potential to achieve higher magnetic fields is discussed in the invited presentation.

Keywords (Index Terms)— Exceptionally High DC Magnetic Fields, High Magnetic Field Facilities, Hybrid Superconducting-Resistive Magnets, Toward Environmental Footprint Reduction

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