Realization and First Tests of the EuCARD 5.4-T REBCO Dipole Magnet

Maria Durante¹, Franck Borgnolutti², Denis Bouzias², Philippe Fazilleau², Jean-Marc Gheller², Frédéric Molinié², Philippe De Antoni²

1. DRF/IRFU/DACM 2. DRF/IRFU/DIS

Wed-Al-Po3.03-05 [31]

FRAMEWORK – EuCARD High Field Magnet

The design of the HTS dipole magnet began within the framework of the European Coordination for Accelerator Research and Development (EuCARD), in collaboration with CNRS of Grenoble, INFN of Milan, University of Tampere and CERN. It has been pursued and completed under the first collaboration agreement between CEA-Saclay and CERN on research and development for future LHC superconducting magnets.

Magnet Design

- 3 double layers coils
  - Layer 1 : 30 turns
  - Layer 2 : 24 turns
  - Layer 3 : 10 turns

- Current density : 2000 A/mm²
- Temperature : 4.52 T
- Magnetic field at the centre : 10 T

- Background field : 0 T
- Magnetic field at the centre (no persistent currents) : 5.38 T
- Expected field at the centre (with persist. currents) : 4.67 T
- Temperature : 4.2 K
- Winding current density @ L : 250 A/mm²
- Magnetic force F_L (one quadrant) * : 210 kN/m
- Self-induced energy : 10.4 kJ
- Self-inductance : 2.7 mH
- Estimated temperature margin : 28 K
- Estimated margin on the load line : 12 K

- Magnet protection

OBJECTIVE – REBCO Tape Stacks

This dipole prototype is the first step towards the use of HTS for accelerator magnets. Its objective is to demonstrate the possibility of using a REBCO type HTS ceramic tape to generate 5-T field in the 13-T field of the Nb₃Sn FRESCA2 dipole, for a total field of 18 T.

Coil Manufacturing

- External coil winding
  - No hard way bending in layer jump
- Central coil winding
  - Tape transposition on midplane (layer-jump zone)

Magnet Assembly in Standalone Configuration (demountable mechanical structure) and Tests

Assembly of the magnet in standalone configuration:
- 316L pads
- 316L demountable mechanical structure

Demountable inter-coil connections:
- 160-mm long SnIn splices

Test facility at CEA Saclay (GN₁ & LN₂ 77K, GHe 4-10K, LHe 4K)

First powering tests (standalone)

This work received funding from the European Commission under FP7 project EuCARD, grant agreement no. 227579, WP7, and continues in the framework of a collaboration agreement between CEA and CERN on research and development for future LHC superconducting magnets, no. KE2275/TE, WP5