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

Contribution ID: **651** Type: **Contributed Oral Presentation**

Thu-Af-Or20-02: Modeling and Experimental Validation of Quench Protection Concepts for Canted-Cosine-Theta Type High-Field Magnets

Thursday, 26 September 2019 14:30 (15 minutes)

An innovative high-field superconducting magnet of Canted-Cosine-Theta (CCT) type has been proposed for Future Circular Collider (FCC) 16-T dipole magnet design. The unique mechanical structure intercepts the accumulated forces lowering the stress on the windings: intrinsic stress management in high-field Nb3Sn accelerator magnets. Nevertheless, the former itself also becomes a barrier for heat to quickly propagate in case of a quench. To succeed in the CCT-type magnet design and construction, the quench protection is a challenging task which requires detailed investigation of the electrothermal behavior of this magnet. In this paper, the potential detection and protection concepts are studied on both aspects of multiphysics simulations and experiments on a two-layer short model built at Paul Scherrer Institut (PSI). The 2D User-Defined Elements (UDEs) developed by LBNL in ANSYS Mechanical APDL, which support the multi-dependence material properties and include the effect of cable-eddy currents, are adapted and used in the coupled electrothermal, electrodynamic and electric circuits calculations for two-layer CCT-type magnets with different protection methods, such as Coupling-Loss Induced Quench (CLIQ) and Energy Extraction (EE) system. The simulation predictions and the experimental results are the first steps of the conceptual design and feasibility validation of the construction of a fast and efficient quench protection system of CCT-type magnets for accelerators.

Primary author: GAO, Jiani (Paul Scherrer Institut)

Co-authors: GABARD, Alexander (Paul Scherrer Institut); AUCHMANN, Bernhard (CERN); ZOLLER, Carolin (Paul Scherrer Institut); CALZOLAIO, Ciro (Paul Scherrer Institut); MONTENERO, Giuseppe (Paul Scherrer Institut); BROUWER, Lucas (Lawrence Berkeley National Laboratory); LERCH, Philippe (Paul Scherrer Institut); SANFILIPPO, Stephane (Paul Scherrer Institut)

Presenter: GAO, Jiani (Paul Scherrer Institut)

Session Classification: Thu-Af-Or20 - Quench Detection and Protection Systems III