Contribution ID: **420** Contribution code: **FRI-OR7-303-03** Type: **Oral**

Integration of Bi-2212 and Nb3Sn CCT magnets for a hybrid magnet test

Friday, 19 November 2021 10:30 (15 minutes)

High temperature superconducting (HTS) magnets working as inserts inside low temperature superconducting (LTS) magnets are foreseen to enable >16 T class accelerator dipoles for future particle colliders. Under the U.S. Magnet Development Program (US-MDP), LBNL has been making steady progress towards designing and fabricating practical Bi-2212 and Nb3Sn canted-cosine-theta (CCT) dipoles that have stress management capability to enable high fields. The next step is the integration of the HTS and LTS magnets to work in hybrid configuration. At LBNL, two hybrid magnet tests are planned in the short and mid-terms. The first test consists of a 0.4 m long two-layer Bi-2212 CCT magnet inside a 1 m long two-layer Nb3Sn CCT magnet. The Bi-2212 insert, called BIN5c, has a 30 mm bore and was designed to generate 2.5 T in the bore. It was fabricated at LBNL in collaboration with NHMFL and recently tested. The Nb3Sn magnet, called CCT5, has a 90 mm bore and was also fabricated and tested at LBNL. It produces a bore field of 8 T. The second test consists of a 0.8 m long two-layer Bi-2212 CCT magnet inside a 1.5 m long four-layer Nb3Sn CCT magnet. The Bi-2212 magnet, called BiCCT1, is a 5 T magnet with 40 mm bore. It fits inside the 120 mm bore Nb3Sn magnet, called CCT6, which is designed to produce a background field of 12 T. Both magnets are under fabrication. In this work, we present the detailed magnetic and mechanical analysis of the magnets in hybrid configuration, and an analysis of the challenges and practical considerations including mechanical assembly, stress management and quench detection and protection associated with the hybrid tests.

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Session Classification: FRI-OR7-303 HTS coil II