27th International Conference on Magnet Technology (MT27)
Fukuoka, Japan / 2021

Contribution ID: **664** Contribution code: **FRI-OR6-101-01** Type: **Invited Oral**

[Invited] Main results and lessons learned from the MDPCT1 R&D program

Friday 19 November 2021 07:30 (15 minutes)

In the framework of the US Magnet Development Program (MDP), Fermilab has developed and tested a high-field Nb3Sn dipole demonstrator MDPCT1 for a post-LHC Hadron Collider with the goal to achieve the field of 15 T in the aperture. The magnet design is based on 60-mm aperture 4-layer shell-type coils, graded between the inner and outer layers to maximize the magnet performance. An innovative mechanical structure with aluminum clamps and a thick stainless-steel skin was developed to pre-load brittle Nb3Sn coils and support large Lorentz forces at high fields. The coil axial motion under Lorentz forces is controlled by thick stainless-steel end plates connected by eight stainless steel rods. MDPCT1 was tested in three test runs. The magnet reached record fields for accelerator magnets of 14.1 T at 4.5 K in the first test and 14.5 T at 1.9 K in the second test and then showed large degradation of its quench performance. After tests the magnet was disassembled to the level of individual coils, and all the key structural components and the coils were inspected, and results were analyzed. The most important results and lessons learned from the MDPCT1 R&D program are presented and discussed in the paper.

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Session Classification: FRI-OR6-101 Accelerator Magnets I: HFM and others applications