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Analysis of quench data and performance of MDPCT1 –the 15 T Nb₃Sn dipole demonstrator

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MDPCT1 is a four-layer cos-theta Nb₃Sn dipole demonstrator developed and tested at Fermilab in the framework of the U.S. Magnet Development Program. 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. While its inner coils performed exceptionally well with only two quenches up to 14.5 T and no evidence of degradation, the outer coils underperformed and degraded over the course of testing. By adopting new measurement and analysis techniques at FNAL we are discussing in detail what happened. Both success and failure in our diagnostics are discussed. The evolution of techniques over the course of two tests (and three thermal cycles) shows the path we were taking to address challenges brought by the first four-layer magnet tested at FNAL. This paper presents the analysis of quench data along with diagnostic features and complimentary measurements taken in support of the magnet performance analysis.

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