Status and Challenges in the Nb3Sn MQXFB Quadrupoles for HL-LHC

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The inner triplet (or low-β) quadrupole magnets are among the components to be upgraded in LHC interaction regions for the HL-LHC project. The new quadrupole magnets, called MQXF, are based on Nb3Sn superconducting magnet technology, with a conductor peak field of 11.3 T. CERN is in charge of the fabrication of MQXFB, the longest Nb3Sn accelerator magnets designed and manufactured up to now, with a magnetic length of 7.2 m. Two magnets, MQXFBP3 and MQXFB02, reached the required performance for operation in the HL-LHC. Endurance tests in MQXFB02 demonstrated the robustness of the technology. However, they still exhibited a limitation at 4.5 K with a phenomenology similar to the one observed on the first two prototypes. After improvements on the cold mass (longitudinal welding) and magnet assembly (elimination of overstress on the conductor during loading) procedures, a series of modifications were implemented in MQXFB03 at the level of the coil fabrication to address and/or reduce the weaknesses in the windings. The magnet was tested, reaching performance requirements with no signs of conductor limitation at 4.5 K. MQXFB is now in the series production phase, with around half of the coils completed and seven magnets assembled. We provide in this paper an overview of the MQXFB program, with a summary of the main recent achievements and an overall status of the fabrication.