Nb_3Sn High Field Magnets for the High Luminosity LHC Upgrade Project

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Abstract — The High Luminosity upgrade of the Large Hadron Collider at CERN requires a new generation of high field superconducting magnets. High field large aperture quadrupoles (MQXF) are needed for the low-beta triplets close to the ATLAS and CMS detectors, and high field two-in-one dipoles (11 T dipoles) are needed to make room for additional collimation. The MQXF quadrupoles, with a field gradient of 140 T/m in 150 mm aperture, have a peak coil field of 12.1 T at nominal current. The 11 T dipoles, with an aperture of 60 mm, have a peak coil field of 11.6 T at nominal current. Both magnets require Nb_3Sn conductor and are the first applications of this superconductor to actual accelerator magnets.

Collaboration between the US LARP (LHC Accelerator Research Program) and CERN is developing the MQXF magnets, whereas the 11 T dipole magnets are being developed by CERN and Fermilab. This paper reviews the status of Nb_3Sn technology for accelerator magnets, discusses its main challenges, and discusses how the MQXF and 11 T designs are addressing them.

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