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Wed-Af-Or14-06: The effect of transverse loads on Nb3Sn Rutherford cables for accelerator magnets

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Rutherford cables based on high critical current density Jc Nb3Sn wires are considered for next generation accelerator dipole and quadrupole magnets. The operating magnetic field of these magnets is expected to be significantly larger than that of the Nb3Sn magnets developed for the High Luminosity –Large Hadron Collider (HL-LHC) project, which is about 12 T. In particular the present designs for the main dipoles of the Future Circular Collider project consider an operating field of 16 T. At these large fields, the Lorentz forces induce a transverse load on the Rutherford cable that can exceed 150 MPa. Experimental results at CERN, Twente and Geneva Universities have recently shown that with transverse load of 150 MPa, the reversible reduction of the critical current is significant (more than 30 % at 1.9 K and 16 T) and it has to be taken into account to design the magnets and properly derive their enthalpy margins. CERN also developed a scaling law for describing the dependence of the Nb3Sn Jc on its strain state; this scaling law, coupled with finite element models, allowed to successfully simulate the reversible reduction of the Jc once a transverse load is applied on the conductor. In this paper, an overview of the present understanding of these phenomena is presented and the impact that these discoveries will have on the design of next generation Nb3Sn accelerator magnets is discussed.

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