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Critical Current Degradation Measurements for RRP Nb3Sn Strands Under Applied Transversal Loads

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Superconducting niobium-tin (Nb3Sn) wires have become a key technology for the development of next generation accelerator magnets. These conductors can be described by their high critical current density but also by their remarkable strain-dependent behavior. In presence of mechanical loads, the superconducting lattice is distorted resulting usually in a reversible decrease of the critical current. In addition, the performance of the wire is irreversibly degraded when the applied loads exceed a critical threshold. These two aspects are equally critical in view of the next generation of accelerator magnets based on Nb3Sn conductors, and they need to be accounted for in the proposed solutions for the design studies of the Future Circular Collider (FCC). At University of Geneva, a measurement probe with a geometry similar to a Walters spring is used to investigate the critical current of impregnated Nb3Sn strands under transversal applied forces. This configuration is chosen to simulate the working conditions of a wire in an accelerator magnet. An extensive campaign of measurements has been undertaken to explore the electro-mechanical behavior of the Restacked-Rod-Process (RRP) wire that is being developed for the potential FCC magnets. To approach the conditions experienced in the Rutherford cables of accelerator magnets, the effects of 15 % rolling deformation and of glass fiber sleeving are investigated. The measurements method and the experimental results are presented in detail, yielding essential information for the magnet design.

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