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M2Or1A-02: Critical transverse loading limits of REBCO CORC©-like cables for fusion

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High magnetic fields of up to 20 T in tokamak-type fusion devices, such as in Central Solenoids of European DEMO and the Chinese BEST fusion reactors, require High-Temperature Superconductors (HTS). Among the potential candidates, ReBCO tape has emerged as a promising choice. However, the substantial Lorentz forces in these environments can lead to localized mechanical stress, which can irreversibly degrade the critical current of the superconductor.

In addressing this challenge, the Conductor On Round Core (CORC®) configuration appears as a viable solution to withstand these demanding operating conditions. The design of such cables requires comprehensive electromechanical characterization of ReBCO tapes, CORC® cables, and finite element analysis (FEA). This presentation outlines the work conducted at the University of Twente to investigate these three aspects.

For the mechanical characterization of ReBCO tapes, two experiments were performed to examine the strain sensitivity of the critical current under tensile and compressive strains. Tapes from three different manufacturers were tested, and the results are presented.

The transverse load response of two CORC® cables was also studied using an hydraulic press (Twente-Press). A specially designed sample holder was designed to resemble the loading conditions in real CORC®-CICC. Measurements of the critical currents of individual tapes and contact resistances between tapes as functions of applied load and load cycling are shown.

Finally, results from a 3D FEM model are discussed. After validation against experimental data, the model is used to replicate tests conducted at SULTAN for CORC®-like CICC samples. The model predictions are in agreement with the current-sharing temperature behavior, allowing for conductor optimizations.

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