Contribution ID: **723** Contribution code: **TUE-PO1-606-02** Type: **Invited Poster**

[Invited] CORC® cables with superior tensile strain performance : FEM and experiments

Tuesday, 16 November 2021 13:15 (20 minutes)

High current superconducting CORC® cable or wire is composed of spiraled HTS REBCO tapes in multiple layers. Multilayered CORC® wires can carry very high currents in background magnetic fields up to 20 T. The cable combines isotropic flexibility and high resilience to electromagnetic and thermal loads. The flexibility of the cable is limited by the critical strain value damaging the REBCO layer in the tape. Mechanical stresses during operation can result in irreversible degradation in the CORC® wires/cables' performance. Different mechanical loads acting on CORC® cable during production, winding, assembly, and electromagnetic operation are bending, axial and transverse loads. The tape's helical shape around the central core allows tapes to experience only a fraction of the total axial strain applied to the entire cable in the case of tensile loads. The winding angle is the main cabling parameter that influences the tensile strain limit of the CORC® cable. The radial contraction of the tape depends on Poisson's ratio of the central core and winding angle. An analytical model is proposed to estimate the tensile strain in CORC® wires and cables. With optimized cabling parameters, the irreversible strain limit of CORC® cables and wires can be as high as 7%, which is 10 to 12 times higher than the irreversible strain limit of single REBCO tapes. The axile strain tolerance of optimized CORC® cables and wires far exceeds that of highest performing single NbTi strands.

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Session Classification: TUE-PO1-606 High Tc Wires and Cables III