

Parametric study on CORC cable bending, experiments and modeling

A. Nijhuis^a, V.A. Anvar^{a,b}, M.S.A. Hossain^b, D.C. van der Laan^c, J. Weiss^c, T.J. Haugan^d

^a *University of Twente, Faculty of Science & Technology, 7522 NB Enschede, The Netherlands*

^b *University of Wollongong, Wollongong, Australia*

^c *Advanced Conductor Technologies and University of Colorado, Boulder CO 80301, USA*

^d *US Air Force Research Laboratory, Wright Patterson AFB, OH 45433, USA*

**Corresponding author: a.nijhuis@utwente.nl*

The CORC cable is composed of several layers of helically wound HTS tapes on a round core with the winding direction reversed in each successive layer. The cable is flexible but the flexibility is limited by the critical strain value when causing breakage of the HTS layer. The cables for magnets in fusion reactors experience large mechanical and electromagnetic loads arising from cabled conductor and coil manufacturing to cooling and operation of the magnet. In order to optimize the manufacture and operating conditions, the mechanical behavior of CORC cable must be understood for different relevant manufacturing and loading conditions. The complex configuration with many contact interactions between tapes and the non-linear behavior of the materials during the production and operation conditions requires the use of finite element (FE) modeling. The FE modeling will allow an accurate calculation of the stress-strain state of the cable components under various loads and importantly; avoiding large-scale and expensive experimental optimization studies.

This work presents the results of experimental tests and detailed FE modeling of the 3D stress-strain state in a CORC cable under bending load, taking the temperature dependence and the elastic-plastic properties of the individual tape materials into account, starting from the initial tape processing conditions during its manufacture up to magnet operating conditions [1]. Furthermore a comparison of the simulations with experiments is presented with special attention for the critical force, the threshold where the individual tape performance becomes irreversibly degraded.

The FE model appears to describe the bending test of the CORC cable adequately and can be used to study other types of loads, parametric research of dependent variables and optimization of the CORC cable design.

[1] K. Ilin, K.A. Yagotintsev, C. Zhou, P. Gao, J. Kosse, S.J. Otten, W.A.J. Wessel, T.J. Haugan, D.C. van der Laan, A. Nijhuis, "Experiments and FE modeling of stress-strain state in ReBCO tape under tensile, torsional and transverse load", *Supercond. Sci. Technol.* 28 (2015) doi:10.1088/0953-2048/28/5/055006