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Electrical Characterization of CFD CORC® Cables Between 65 and 77 K

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***Abstract*—In the quest to develop all-electrical hydrogen powered aircrafts, superconducting powertrains are interesting due to their compactness and low loss to power ratio. Superconducting cables based on second-generation high-temperature superconductors (or REBCO tapes) are now commercially available with different cabling geometries. One promising cabling configuration is the concept of cables with REBCO tapes helically around a metallic cylindrical former, for example the Conductor on Round Core (CORC®) [1]. It has been demonstrated that such superconducting cables are particularly interesting in applications such as superconducting powertrains [2]. Additionally, integrating fault current limitation capabilities in a superconducting cable would allow to increase the resilience of the electrical network without any additional components.**

To implement high-performance fault current limitation capabilities, the cable should have, in the normal conducting state, the highest resistance possible. Furthermore, it should behave as an ideal binary device, either fully superconducting or normal. However, in practice, because of local critical current inhomogeneities along their length combined with a low normal zone propagation velocity (NZPV), REBCO tapes can be partially quenched, which is very dangerous for the integrity of the tape since the current remains high.

A promising approach is to enhance the NZPV of REBCO tapes using the current flow diverter (CFD) concept [3]. This work presents the advancements achieved in integrating for the first time the CFD architecture in a CORC® cable configuration [4].

Twelve one-meter long CFD REBCO tapes were produced using a reel-to-reel CFD process to fabricate two 23 cm long CFD CORC® cables having 2 layers and 3 tapes per layer. A 23 cm long CORC® cable made solely of commercial unmodified SuperPower REBCO tapes was also fabricated (called regular CORC® cable). Critical current and NZPV measurements were performed in a liquid nitrogen bath between 65 K and 77 K (self-field). A critical current of 1044

A was found at 67.2 K. For the whole temperature range, the NZPV was increased by a factor of 4.5 in the case of the CFD CORC® cable in comparison with the regular CORC® cable.

***Keywords (Index Terms)*— Current Flow Diverter, coated conductors, CORC cable, quench, normal zone propagation velocity**

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