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Designing and Manufacturing of REBCO-based Al-slotted core Cable-In–Conduit Conductors for quench experiments

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High current Rare-Earth Barium-Copper Oxides High Temperature Superconductor (HTS) Cable-In-Conduit (CIC) Conductor conceived for large fusion magnet applications based on aluminum slotted-core incorporating HTS tape stacks has been successfully proposed in the last years [1]. In this work, the activity carried out for designing and manufacturing CIC samples aimed at the investigations of thermal stability and quench behavior under fusion relevant conditions to be performed at the SULTAN facility (Swiss Plasma Center) is presented. The sample, based on the 6-slot core with straight slot configuration, will consist of two 3.6 m long conductors electrically connected by a joint at the bottom and connected to the facility current lead at the top. The sample layout and the HTS tape arrangement have been defined with the support of the simulation codes implemented for the electromagnetic performances and a thermal-hydraulic conductor model of the CIC sample for the analysis of the quench phenomena [2, 3]. Based on the single tape performances, this choice will assure a conductor critical current slightly in excess of 15 kA at 5 K, 11 T in agreement with the experimental facility requirements. The HTS conductor quench behavior will be monitored by voltage taps and temperature sensors arranged along the conductor length either on the external jacket along the conductor length or embedded within the conductor cross-section to monitor the occurrence of the temperature gradients across the conductor cross-section as predicted by thermal-hydraulic simulation.
The sample designing and manufacturing details as well as the expected performances based on simulation analyses will be presented and discussed in view of the applications of this CIC conductor concept in actual fusion reactor magnetic systems.

[1] G. Celentano, et al.,IEEE TAS 24 2014, 4601805
[2] G. De Marzi, et al.,SuST 34 2021, 035016
[3] A. Zappatore, et al.,IEEE TAS 30 2020, 4603307

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