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Sun-Mo-Or1-07: AC Loss Experiments at the SULTAN Facility on Aluminum Slotted-Core HTS REBCO Conductors for Fusion Applications

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High-Temperature Superconductors (HTS) technology offers significant advantages in reactor design, representing a key step toward commercial fusion power plants. These advancements have driven extensive R&D efforts on HTS conductors for fusion magnets based on Rare Earth-Barium-Copper-Oxide (REBCO) tapes.
The aluminum slotted-core cable concept developed by ENEA features stacks of HTS tapes embedded in slots within an extruded aluminum stabilizer, which acts as both electrical and thermal stabilizer. In this design, the HTS stacks are not soldered but compacted during the jacketing process with an external aluminum tube. This configuration enhances the cable's mechanical behavior, providing good tolerance to bending loads, as previously demonstrated. However, the AC losses in such cables with non-soldered tape stacks remain unexplored under conditions relevant to fusion applications.
This contribution presents recent AC loss experiments conducted at the SULTAN test facility on aluminum slotted-core conductors. The SULTAN samples consist of two 3.6 m long Al slotted-core conductors in a hairpin configuration, electrically connected by a joint at the bottom and linked to the facility current leads at the top. AC loss tests were performed as part of the EUROfusion Quench Experiment campaign. Cryogenic tests at 6 K employed the gas flow calorimetric method, applying sinusoidal AC external fields (ranging from ±0.1-0.4 T) with frequencies from 0.1 Hz to 5 Hz, superimposed on a 2 T DC background field and with zero operating currents.
The AC loss analysis focused on quantifying contributions from magnetization and coupling/eddy current losses. Electromagnetic analytical methods and Finite Element simulations were used to interpret experimental data. These findings provide critical insights into minimizing coupling and eddy current losses in future cable designs, with the goal of optimizing HTS conductor performance for fusion applications.

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