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Effect of thermal contact between gas-cooled REBCO conductors on hot-spot temperature in fusion magnets

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A thermal and hydraulic analysis is presented to highlight the importance of thermal contact between gas-cooled REBCO conductors in cryogenic stability. For compact and efficient HTS fusion magnets, a variety of conductors are under development to stack REBCO tapes in a rigid jacket. In accordance with the leading group, the conductors are cooled by forced-flow of gaseous helium around at 20-30 K. One-dimensional distribution of gas temperature and pressure is rigorous calculated along an entire cooling loop of double-pancake winding in toroidal-field magnet, by taking into account the thermal interaction between adjacent conductors. The key parameters in this analysis are taken from the preliminary model of a KSTAR winding pack. It is clearly verified that the thermal contact plays a crucial role in the location and temperature level of internal hot spot. Thermal insulation by minimizing the axial contact between double-pancake windings is proposed as an effective method to protect the REBCO conductors from an excessively high temperature at inner layers. Details of gas-cooling schemes are discussed for the application to the winding pack design of high-field HTS magnets.

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