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Conceptual Design and AC Loss Analysis of an HTS Central Solenoid Winding Pack for the EU-DEMO Fusion Reactor

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The construction of European demonstration power plant (DEMO) aims to employ high temperature superconductors (HTS) as the main magnets to avoid the requirement of large amounts of helium for the cooling system. The central solenoid coils which is transported with AC current in the reactor should be ensured of their operation condition to avoid quench phenomenon under a high temperature environment. In this case, an HTS central solenoid winding pack which consists of (RE)BCO coated conductors has been designed. AC loss characteristics of the winding pack have been analyzed by using the finite element method which is based on the T-A formulation and the integration approach J-model. Outcomes calculated by the two methods show a better consistency. The results also indicate that eddy-current loss in the silver layers and copper layers of coated conductors in the winding pack has exceeded the hysteresis loss in superconducting tapes, which is of great significance to the design of HTS central solenoid coils for the EU-DEMO fusion reactor.

Keywords: AC Loss, CS winding pack, fusion magnets, HTS modelling

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