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C1Or3D-02: Novel modular PCS and decoupling control for SMES with coupling superconducting coil

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The high-temperature superconducting magnetic energy storage system (HTS-SMES) utilizes the superconducting coil (SC) to store the electric energy in the magnetic field, which has the advantages of high efficiency, fast response, infinite charge-discharge cycles, etc. Coupling SC (CSC) with two or more SCs made of different HTS materials can improve the utilization rate of HTS tapes, reduce the manufacturing cost, increase the energy storage density of the magnet, and decrease the leakage field. Although the CSC has advantages over conventional SC, the coupling magnetic field makes precise power and current regulation of the individual SC difficult. Moreover, the self-inductances of the individual SCs with different materials are usually different. The induced voltage due to current fluctuation is therefore different, which makes it necessary to design power converters with different power ratings connected to each SC. To solve the difficulties in the application of SMES with CSC, a novel modular power conditioning system (MPCS) and decoupling control for SMES are proposed. With the MPCS, the power rating of individual SC can be flexibly designed by selecting the number of power modules. The power and current of individual SC can be precisely controlled with the decoupling control. Simulation results verified the efficacy of the proposed approaches.

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