Development of SMES (Superconducting Magnetic Energy Storage) System for Instantaneous Voltage Dip Compensation and Power System Control

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Abstract

We have been developing a superconducting magnetic energy storage (SMES) system, which can output almost all of the stored energy instantaneously and has an advantage of scale, compared with the other energy storage such as batteries. We have already developed a practical SMES system of 10 MW- 10 MJ capacity using low temperature superconducting wires for instantaneous voltage dip compensation, and have been developing SMES coils for power system control using second-generation yttrium-based high temperature superconducting wires of higher performance in critical current and mechanical properties compared with conventional low temperature superconducting wires and first-generation Bismuth-based high temperature superconducting wires, in order to fulfill the requirements for huge capacity and cost reduction of the SMES system.

The SMES system of 100 MVA output power for power system control was conceptually designed using yttrium-based superconducting wires. The target of the stored energy required for the SMES system is 2 GJ class. The designed SMES of a toroid coil type consists of one hundred eighty unit coils of ϕ 2.8 m outer diameter, and each unit coil is connected to each converter of a multi-cell type. This design concept can realize the 2 GJ class SMES system, which have the coil specifications of up to 2 kA rated current, up to 2 kV rated voltage, up to 600 MPa hoop stress tolerance and up to 3 W/m^2 heat flux around 20 K. Current status of the major challenges such as current capacity, dielectric strength, and mechanical strength enhancements in the unit coil development are reported.

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