Operation Scenario of Mobile SMES for On-Site Eigenvalue Measurement of Electric Power System

Friday, 19 November 2021 10:15 (15 minutes)

Renewable energy and electric power liberalization have become important watchwords for present electric power system. However, the stability of electric power systems is also a serious concern because of the lack of inertial energy of conventional synchronous generators. Since a low system stability may cause an unexpected power oscillation with the natural frequency of an electric power system, power system operation requires an excessive margin to maintain a high system stability. To enhance the resilience of the electric power system, the authors discussed the feasibility of using a superconducting magnetic energy storage (SMES) system for the direct measurement of eigenvalues that express the oscillation modes of a power system. The authors carried out a design study on a 1MJ-class mobile SMES system using MgB2 Rutherford cables whose components such as SMES coils, cooling systems, and power converters are installed in a 40 feet dry container. From the design flexibility depending on the power system conditions, the output power of the SMES system can be adjusted from 1 MW to 4 MW by selecting a cooling temperature. The operating current variations of the SMES coil were estimated as 1800 A at 2.0 T for 20 K, and 2700 A at 3.0 T for 10 K. The SMES coil can be cooled using 3 or 4 sets of conventional cryocoolers, including the cooling system for the 80 K thermal shield even when the cooling temperature is 10 K. In this work, the authors investigate the effective installation sites for eigenvalue measurement and evaluate the re-cooling time interval and optimization of the cooling scenario to achieve full mobility of the SMES system using cryocoolers.

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Session Classification: FRI-OR7-502 SMES, Superconducting Transformers, Cables and Bulks