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Experimental test and characteristic analysis of a real scale HTS coil for 10 MW HTS generator using performance evaluation system

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Large-scale high temperature superconducting (HTS) wind power generators suffer from the high electromagnetic force and high torque due to their high current density and low rotational speed. Therefore, to maintain the mechanical strength of the HTS coil, the torque and Lorentz force of the HTS wind power generator must be carefully investigated. This paper deals with the experimental test and characteristic analysis results of a real scale HTS coil for a 10 MW HTS generator using a performance evaluation system (PES). We have proposed a method to evaluate the characteristics of large-scale HTS wind turbine generators using a PES. The PES is designed and manufactured to examine the electromagnetic properties, stability and cooling performance of a full-scale 10 MW HTS coil. Three HTS coils and corresponding armature modules were designed and manufactured to confirm the characteristics of a real-scale generator using the PES. The system was assembled to withstand the force equivalent to one pole of a 10 MW HTS wind turbine under load conditions. The HTS coil was cooled to 30 K through a neon helium cooling system. The HTS coil operates at a rated field current of 221 A, and generates the same force by flowing a DC current through the armature, which corresponds to the rated armature current of a 10MW generator. As a result, the no-load temperature of the HTS coil operating at 221 A increased by about 2 K. The force on one pole of the wind turbine was measured with a strain gauge attached to the HTS coil under the condition of applying the load current to the three-phase armature coil, and through this, the magnetic field stability, mechanical strength, and thermal conditions of the HTS coil of a 10 MW class wind turbine were able to confirm.

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