MT 26
International Conference
on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **835** Type: **Poster Presentation**

Wed-Mo-Po3.06-06 [42]: Design and Analysis of a 10-MW-Class HTS Generator considering Various Winding Insulation Techniques for HTS Rotor-Field Poles

Wednesday, 25 September 2019 09:30 (1h 45m)

This paper presents the results of the electromagnetic design and numerical analysis for a 10-MW-Class second generation high-temperature superconducting generator (2G HTSG). Since the offshore wind power has the technical and economic difficulties in a regular maintenance due to geographical conditions that are difficult to access, the operation reliability of 2G HTS coil for the rotor-field poles should be technically guaranteed to realize the feasible application and, by extension, commercialization of the 10-MW-Class HTSG on offshore wind power. In this study, three winding insulation techniques (WITs) for HTS field coils (FC), such as no-insulation, metal insulation, and metal-insulator transition insulation, are considered to give a definite report the operation reliability of the 10-MW-Class HTSG in offshore environment. Using the time-transient solver of the three-dimensional electromagnetic finite element analysis (3-D EM FEA), EM characteristics of HTSG with three WITs are investigated and compared in terms of the performances of HTSG's electrical output and HTS FC's critical current. Then, in order to analyze the charging and discharging characteristics in steady-state operation as well as the electrical and thermal characteristics in transient-state operation of HTS FCs with three WITs, electric equivalent circuit models are built with key parameters based on EM FEA result. Finally, the performances of HTS FCs are discussed and evaluated in electromagnetic response time and stability characteristics.

Acknowledgement: This work was supported in part by the 2019 scientific promotion program funded by Jeju National University, and in part by Korea Electric Power Corporation (No. R18XA03)

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Session Classification: Wed-Mo-Po3.06 - Generators II