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Wed-Mo-Po3.06-05 [41]: Design and Numerical Analysis of 10 MW-class Fully-Superconducting Synchronous Generators Installing the New Casing Structure for Turboelectric Propulsion System

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Nowadays, feasibility study of fully turboelectric propulsion systems for electric aircrafts are being conducted. Fully superconducting rotating machine is one of the solutions to realize fully turboelectric propulsion systems with lightweight and high power density. In our previous studies, we reported the high output power density over 20 kW/kg for the 10-MW-class fully superconducting generators. In the previous model it was assumed that the rotor is installed at the space filled with helium gas and the stator is cooled by sub-cooled liquid nitrogen at 65 K or liquid hydrogen at 20 K. The helium gas is cooled by the inner wall of the stator case. Therefore, the operating temperature for the field windings in the rotor was restricted to the liquid refrigerant temperature. In this study, we studied on the new model where the field winding is installed into another vacuum chamber and independently cooled by the other gas/liquid refrigerant. It composes a rotor. In this case it is possible to make the operating temperature of the field windings different from that for the armature windings. In this paper, various kinds of properties of the fully-superconducting generators with this new structure. The operating temperature of the field winding, Tf-op, are set to 20-65 K as a parameter. The dependences of the Tf-op on the AC loss, efficiency, dry weight, output power density were investigated and compared. In addition, the numerical analysis of the thermal stability was performed.

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