Contribution ID: **194** Type: **Poster presentation (105min)**

Conceptual Design of the Cooling System for a Superconducting Wind Turbine Generator

Tuesday, 8 July 2014 14:15 (1h 45m)

The wind energy sector is one of the main energy sources concerned with environment and energy. However a particular trend is increasing turbine ratings, this trend causes the increase of the nacelle weigh. To solve this problem, superconducting wind turbine generators have the potential to provide a compact and light weight drive train. Nevertheless of these advantages, the cryogenic system has some problems. Because the use of a stationary refrigerator requires that a means be provided for the transfer of cooled helium gas from the stationary supply to the rotating field winding and for return of the gas from the rotor to a stationary reference frame. It was possible by using the centrifugal force due to high speed rotation, so-called self - pumping effect that causes the refrigerant circulation. However, the wind turbine speed is lower by two orders of magnitude than in normal generators or motors, the superconductors of the rotor must be force-cooled by cooling channel. Moreover, it is necessary to supply a high pressure helium gas. However, the sealing technology of high pressure cryogenic refrigerant has not been established yet. Therefore, we propose a method of supplying a coolant in the cooling channel of the superconducting rotor by circulation pumps built in the rotor and a rotating-stationary heat exchanger placed in the rotor to separate the refrigerant of the stationary system and the rotational one.

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Session Classification: Tue-Af-Posters Session 1.3

Track Classification: C-11: Cryogenics for power applications and transportation