World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:8, No:10, 2014

Feasibility Study on a Conductive-Type Cooling System for an Axial Flux Permanent Magnet Generator

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Abstract : For the sustainable development of wind energy, energy industries have invested in the development of highly efficient wind turbines such as an axial flux permanent magnet (AFPM) generator. The AFPM generator, however, has a history of overheating on the surface of the stator, so that power production decreases significantly. A proper cooling system, therefore, is needed. Although a convective-type cooling system has been developed, the size of the air blower must be increased when the generator's capacity exceeds 2.5 MW. In this paper, we proposed a newly developed conductive-type cooling system using a heat pipe wound to the stator of a 2.5 MW AFPM generator installed on an offshore wind turbine. The numerical results showed that the temperatures on the stator surface using convective-type cooling system and the proposed conductive-type cooling system at thermal saturation were 60 and 76°C, respectively, which met the requirements for power production. The temperatures of the permanent magnet cased by the radiant heating from the stator surface were 53°C and 66°C, respectively, in each case. As a result, the permanent magnet did not reach the malfunction temperature. Although the cooling temperatures in the case of the conductive-type cooling system were higher than that of the convective-type cooling system, the relatively small size of the water pump and radiators make a light-weight design of the AFPM generator possible.

Keywords : wind turbine, axial flux permanent magnet (AFPM) generator, conductive-type cooling system
Conference Title : ICTE 2014 : International Conference on Thermal Engineering
Conference Location : Barcelona, Spain
Conference Dates : October 27-28, 2014