

## Feasibility Study on Hybrid Multi-Stage Direct-Drive Generator for Large-Scale Wind Turbine

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**Abstract :** Direct-drive generators for large-scale wind turbine, which are divided into AFPM(Axial Flux Permanent Magnet) and RFPM(Radial Flux Permanent Magnet) type machine, have attracted interest because of a higher energy density in comparison with gear train type generators. Each type of the machines provides distinguishable geometrical features such as narrow width with a large diameter for the AFPM-type machine and wide width with a certain diameter for the RFPM-type machine. When the AFPM-type machine is applied, an increase of electric power production through a multi-stage arrangement in axial direction is easily achieved. On the other hand, the RFPM-type machine can be applied by using its geometric feature of wide width. In this study, a hybrid two-stage direct-drive generator for 6.2MW class wind turbine was proposed, in which the two-stage AFPM-type machine for 5 MW was composed of two models arranged in axial direction with a hollow shape topology of the rotor with annular disc, the stator and the main shaft mounted on coupled slew bearings. In addition, the RFPM-type machine for 1.2MW was installed at the empty space of the rotor. Analytic results obtained from an electro-magnetic and structural interaction analysis showed that the structural weight of the proposed hybrid two-stage direct-drive generator can be achieved as 155tonf in a condition satisfying the requirements of structural behaviors such as allowable air-gap clearance and strength. Therefore, it was sure that the 6.2MW hybrid two-stage direct-drive generator is competitive than conventional generators. (NRF grant funded by the Korea government MEST, No. 2017R1A2B4005405).

**Keywords :** AFPM-type machine, direct-drive generator, electro-magnetic analysis, large-scale wind turbine, RFPM-type machine

**Conference Title :** ICMIMT 2017 : International Conference on Mechanical, Industrial and Manufacturing Technology

**Conference Location :** San Francisco, United States

**Conference Dates :** September 28-29, 2017