

Feasibility Study Project to Realize the Merits of 10 MW-class Superconducting Wind Turbine Generators

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Abstract — In the field of wind power generation, there is a general trend of developing wind turbines larger than the present 5 MW size because use of larger capacity turbines can increase the total capacity of a wind farm and reduce the cost of power generation. An extension of the conventional technologies (copper coils or permanent magnets) to build gearless, direct-drive generators may result in an oversize and overweight, and the realization of compact and light-weight superconducting wind turbine generators is desired. We first examined what type of superconducting rotor design is suitable, and from a cost standpoint selected salient-pole type iron-cored rotor design, in which much less amount of expensive high-temperature superconducting (HTS) wires are needed than in an air-cored rotor design. We then proposed and conducted a feasibility study project for over 10 MW-class superconducting wind turbine generators sponsored by NEDO (2013–14), collaborating with Furukawa Electric Co. Ltd., Mayekawa Manufacturing Co. Ltd., Niigata University, Sophia University and University of Tokyo. This study has focused on three key components necessary for the fabrication of an iron-cored HTS wind turbine generator: (1) superconducting coil module, (2) highly reliable Brayton refrigerator (~1 kW@20–40 K, maintenance interval >30,000 h) and (3) cryogenic gas transfer coupling employed for superconducting rotor. Note that each superconducting coil module, consisting of an HTS racetrack coil and a vacuum vessel, is placed around each salient pole and the HTS coils are cooled by cryogenic He gas. Additionally, we have made a general design of a 10 MW-class HTS wind turbine and realized the advantages of HTS wind turbine generators over conventional generators. In this presentation we will report primary results of the NEDO project.

Keywords (Index Terms) — Superconducting wind turbine generator, HTS wires, salient-pole iron-cored rotor, coil module system, turbo-Brayton refrigerator, cryogenic gas transfer coupling.