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Development of DC Superconducting Cable with Magnetic Energy Storage Function for Compensating Power Fluctuation from Renewable Energy Sources

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We have been developing DC superconducting cable with magnetic energy storage function. This novel application offers high-speed and high-power charge/discharge operation indispensable for compensating output power fluctuation from renewable energy sources such as photovoltaic, wind turbine, etc. In this paper, we will report its development status under a Japanese national program: (1) conceptual design of the superconducting cable for a 10-MW-class micro-grid, (2) the structure and the control method of the micro-grid, (3) fabrication of a prototype of the superconducting cable, and (4) its operation for compensating output power fluctuation from renewable energy sources. For example, a superconducting cable with a stored energy of 1 GJ was designed by considering the performance of a RE-123 coated conductor, and its small prototype was fabricated and tested by a hardware-in-the-loop (HIL) simulation with Real-Time Digital Simulator (RTDS). As a result, it was successfully demonstrated that very large output power fluctuation with a similar scale as the power capacity of the micro-grid could be compensated completely by the superconducting cable although such an operation is difficult by conventional batteries. We believe that this novel application based on superconducting magnet technology will become a promising solution for large-scale utilization of renewable energies for carbon-neutral society.

This presentation is based on results obtained from a NEDO Feasibility Study Program (Uncharted Territory Challenge 2050).

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