

Development of Superconducting Cable with Energy Storage Function for Mass Utilization Society of Renewable Energy

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Abstract—Mass utilization of renewable energy is essential to realize a sustainable society, but to achieve this, measures must be taken to compensate severe output fluctuations caused by solar and wind power generations which will be representative of such energy. On the other hand, conventional variable power sources are unable to absorb such fluctuations, and such power sources are decreasing with the introduction of renewable energy. Therefore, a new energy infrastructure should be considered to accommodate the mass utilization of renewable energy. We have been addressing this issue by proposing a superconducting cable with energy storage function and a power system using this cable [1], [2]. According to this concept, the power system itself can absorb sudden output fluctuations of renewable energy that cannot be absorbed by conventional technologies, and even the efficiency of energy use can be greatly improved by minimizing energy conversion. In this study, we will report development results by a Japanese five-year program: (i) conceptual design of superconducting cables with energy storage function, (ii) fabrication of model cables, (iii) experimental demonstration by hardware-in-the-loop simulation, and (iv) evaluation of the improvement of energy utilization efficiency.

Keywords (Index Terms)—Superconducting cable, energy storage, renewable energy, microgrid

[1] K. Higashikawa et al., “Novel Power System with Superconducting Cable with Energy Storage Function for Large-Scale Introduction of Renewable Energies,” IEEE Transactions on Applied Superconductivity, vol. 29, no. 5, ArtID. 5402204, August 2019.

[2] K. Higashikawa et al., “Development of Superconducting Cable with Energy Storage Function and Evaluation of its Functionality in DC Microgrid With Renewable Energy Sources,” IEEE Transactions on Applied Superconductivity, vol. 33, no. 5, ArtID. 5400405, August 2023.

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