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Basic study on coil structure for high-temperature superconducting cable termination applying a wireless power transmission system

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A floating offshore wind power generation has been investigated to reduce the greenhouse gas emissions in Japan. When the floating offshore wind farm transmits AC electric power to the commercial power system on the land using a copper cable, it is necessary to increase the voltage by an offshore transformer facility in order to reduce the transmission loss of the copper cable. However, it is difficult to install the offshore transformer facility because the seabed around Japan is deep. Thus, a high-temperature superconducting (HTS) cable with the high capacity and the low loss has been investigated. On the other hand, the HTS cable termination has a mechanical connection between the HTS wire and the copper wire. Therefore, there are some problems with the HTS cable termination: the mechanical degradation due to heat intrusion from the normal temperature part, heat generation by the contact resistance, and heat shrinkage. We devised a coil structure for the HTS cable termination applying a wireless power transmission system, and mechanically separated the HTS cable (low temperature part) from the copper cable (normal temperature part). In this study, we investigated the coil structure suitable for the HTS cable termination from the experiments and the electromagnetic field analysis using finite element method. As a result, we found that the coil structure for the HTS cable termination is more suitable for a solenoid coil structure than a spiral coil structure. This is because the coupling coefficient between the HTS solenoid coil and the copper solenoid coil was higher than that fabricated with the spiral coil structure. Also, we found that the high-efficiency HTS cable termination is possible by providing a larger inductance of the HTS coil side than that of the copper coil side.

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