APP4-8

Heat leak measurement of the cryogenic pipe for the superconducting power transmission at different surface temperatures

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Heat leak of the cryogenic pipe constituting a transmission line of the superconducting power transmission is one of the key characteristics, because it affects the efficiency of the transmission strongly. Since the heat leak is mainly caused by the radiative and conductive heat transfers, it depends on the surface temperature of the cryogenic pipe, which can vary with the changes of atmospheric temperature, weather, and direct sunlight hours. Thus, the heat leak can depend on the environmental conditions, where the transmission lines are installed.

We have measured the heat leak of the cryogenic pipes for the superconducting power transmission in the wide range of their surface temperatures to investigate the effect of the temperature variation and to obtain data for the installations of cables in different places with different environmental conditions. The cryogenic pipe used for the measurement was a 12 m long test pipe, which was the same type of the cryogenic pipe used in the Ishikari project [1]. This cryogenic pipe contains two inner pipes within an outer pipe. One of two inner pipes is for the installation of the cable and another is used to return the liquid nitrogen for circulation. The measurement was performed with the boil-off method. The obtained data was compared with the results obtained during the cooling tests of the actual transmission lines in the Ishikari project [2,3,4]. The heat leak characteristics of the cryogenic pipe will be discussed based on the results.

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