§6. Transient Stability of Large Current Aluminum Stabilized Superconductors

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In the case of the transient stability analysis of large superconductors stabilized aluminum whose electrical resistivity is much lower than that of copper, it is pointed out that the effect of current diffusion in the cross-sectional direction of the conductor can't be ignored. To investigate the transient stability, we have been developing computer code based on finite element method analysis of the transient thermal and electromagnetic behaviors of large aluminum stabilized superconductors. We adopted two-dimensional analysis in longitudinal direction of the conductor for thermal and current diffusion. And Cu-2%Ni clad with high electrical resistivity and low thermal conductivity, which is placed around the aluminum stabilizer to restrain the Hall current generation, affects the characteristic of normal-zone propagation.

We have been investigating the maximum recovery current and the minimum propagation current. Before, we assumed that the heat transfer of lq.He was 3000 W/m^{2}K and the Hall current generation could be ignored. However, it is necessary to take into account the nonlinearity of the heat transfer of lq.He and the Hall current generation. Therefore, the experimental data of the heat transfer of lq.He, which is shown in Fig.1, is considered in analysis. For 2D Analysis, the Hall current generation cannot be taken into account. So the virtual resistivity of the conductor, which is obtained by the short sample testing (Fig.2), is assumed instead of the Hall current generation. On these assumptions, Fig.3 shows the maximum recovery current and minimum propagation current as a function of stabilizer/superconducting strands region (Al/SC) cross-sectional area ratio under 7T external Magnetic field. The Al/SC ratio of the LHD conductor is about 1.86.

The recovery current and the minimum propagation current is reduced by considering the assumption of the Hall current generation. Because the resistivity by assuming the Hall current generation is larger than that by ignoring the Hall current generation. However, the minimum propagation current is increasing by considering the assumption of the experimental heat transfer. Because the experimental heat transfer is larger

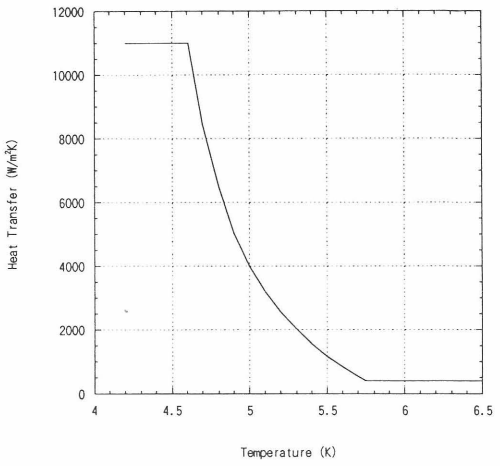

Fig.1 Heat transfer of Lq.He in experiment.

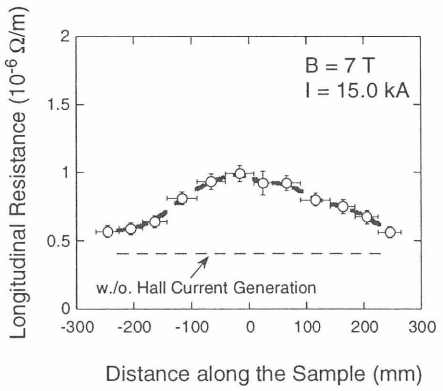

Fig.2 Longitudinal resistance of conductor in experiment.

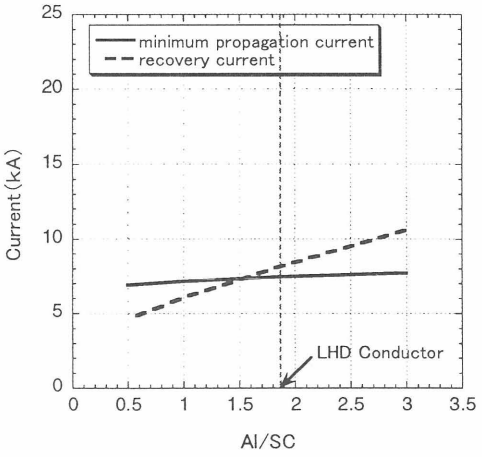

Fig.3 Recovery and minimum propagation current.

than the value, which was assumed to be 3000 W/m^{2}K, at 4.2K. So the initial rise of heat is prevented and the minimum propagation current is increasing.

This analysis was not considering the amount and the length of initial heat. So we will investigate the effect of the amount and the length of initial heat affects to the recovery current and the minimum propagation current.