

§30. Transient Stability Analysis of Large Current Aluminium Stabilized Superconductors

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In the case of the transient stability analysis of large superconductors stabilized aluminium which 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 phenomenon called "traveling normal zone", we have been developing a computer code based on finite element method analysis of the transient thermal and electromagnetic behaviors of large aluminium stabilized superconductors. We adopted one-dimensional analysis in longitudinal direction of the conductor for thermal diffusion and two-dimensional analysis in cross-sectional direction for current diffusion. We accomplished the simulation with the our computer code concerning with the experiments taken place at NIFS for measuring of the normal transition and propagation with short conductor samples. The background magnetic field is 7T and the transport current is 15kA. The voltage traces according to the normal transition measured by the voltage taps attached to the conductor is shown in Fig.1. It can be considered that the Fig.1 is the voltage traces which is dependent of the influences of the current diffusion in normal propagation. The analysis results is shown in Fig.2. The analysis is carried out under the same condition (operating temperature, location of the taps and the heating pulse of the heater) of the experiments. The analytical result is agreed well with the voltage traces of the experimental results. The summary of the results of the simulation with the computer code is as following.

1. The current diffusion has to be taken account.
2. The possibility of generatiing of "traveling normal zone" is shown.
3. The availability of aluminium matrix could be confirmed.

In the transtiental discussion, it is understood that the normal zone is possible to propagate in the lower current value than recovery current. The recovery current is the current value which recovers superconducting state because the cooling effect by helium is larger than the magnitude of joule heat generation at the end of the current diffusion. And nevertheless the coil did not reach the quench, the loss of the joule heat due to the generating of "traveling normal zone" presented in this results might be serious, supposing that the value of the transport current is kA orders. Therefore, in the future, it is necessary to investigated the behaviors in coil quenching included the generating of "traveling normal zone".

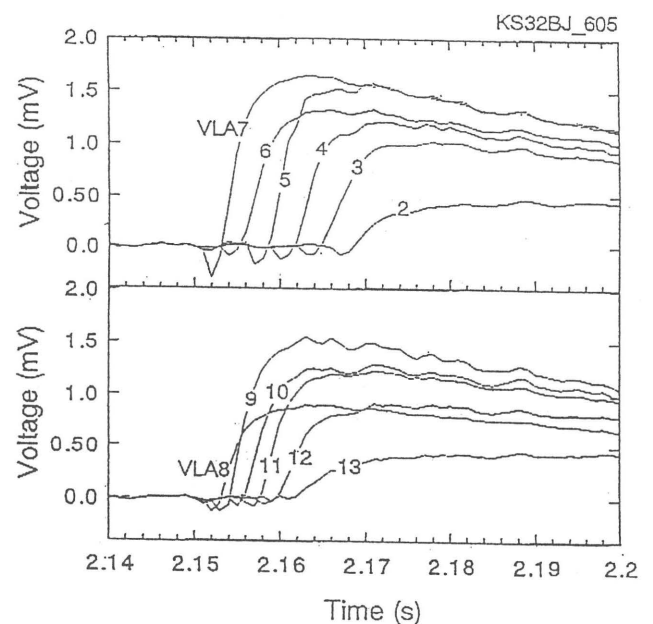


Fig. 1. The voltage traces according to the normal transition with a trnasport current 15kA, magnetic field 7T (experimental result).

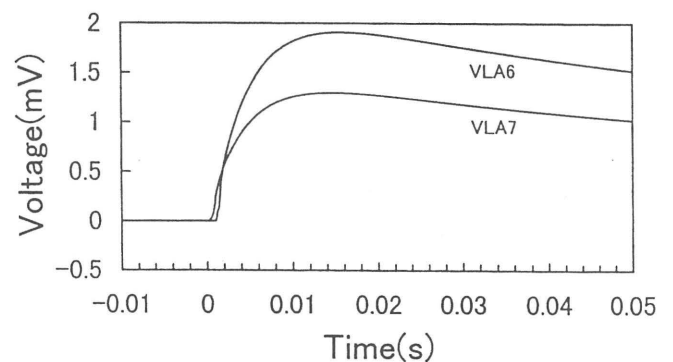


Fig. 2. Calculated voltage traces according to the normal transition with the same condition of Fig.1.