## §64. Reduction of AC Loss of Cable Superconductor by Short-circuiting the Cable Periodically

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We are developing a technique to enhance stability of a cable-in-conduit superconductor by short-circuiting the cable periodically and have demonstrated effectiveness of this technique experimentally and analytically[1]. However, it is pointed out that the effectiveness may be deteriorated when a disturbance occurs near to a short-circuiting part and that inhomogeneous current distribution is caused among strands when the cable is subject to changing external field and pitch of the short-circuit is not *n* times of the cable twist pitch (*n* : integer). The inhomogeneous current distribution causes extra AC Losses.

In this fiscal year, we analyzed dependence of the stability of the cable on position of the disturbance and relation between the in homogeneity of the current distribution and the pitch of short-circuiting part.

i) Dependence of stability on position of distribution

Fig.1 is an analytical result comparing the MQE's of a triplex cable with short-circuiting elements shown in Fig.2 when disturbances occur at $L/2$ and $L/3$ a part from the short-circuiting part, where L is the pitch of the short-circuiting and I and Ic are transport and critical currents of the cable respectively.

Other parameters of the analyzed cable are shown in the reference 1. It is shown by the analysis that the stability is deteriorated when a disturbance occurs near to the short-circuiting part. When a disturbance occurs at the short-circuiting part, our technique is ineffective. We are considering a method coping with this problem.

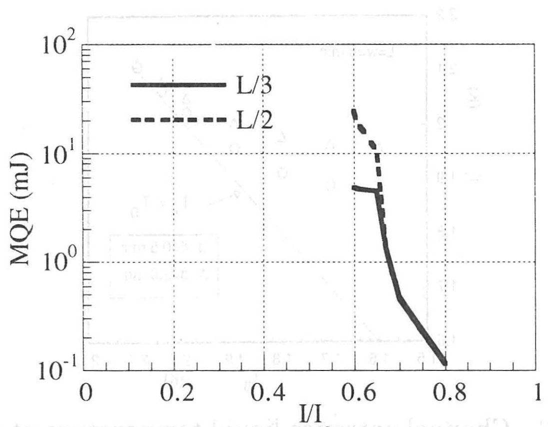
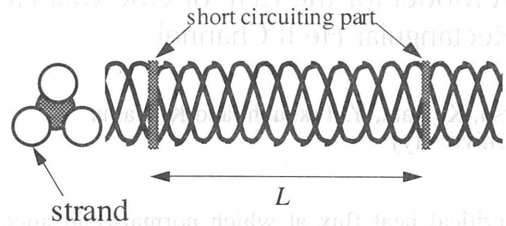



Fig.1 Dependence of MQE on position of disturbance




$l_p$ : 0.2mm $l_p$ : Twist pitch of Cable $L$: 4 ~ 5 $l_p$
Ramp rate of external field: 1T/sec
Short circuiting resistance: $10^{-6}\Omega$
Strand critical current: 98A

Fig. 2 Analytical model of triplex with short-circuiting parts

ii) Inhomogeneity of current distribution among strands.

When the pitch of the short-circuiting part $L$ is not $n$ times of the twist pitch of the cable $l_p$, in homogeneous current distribution is caused among the strands of the cable subject to changing external field, because electro-motive force is induced in the strands between the short-circuiting parts.

Fig.3 shows the magnitude of the biased current in a strand of the triplex shown in Fig.2, where $L$ =4~5$l_p$. The magnitude is the value at 1 sec after the start of the changing external field of constant ramp rate. The bias current is maximum when $L$=4.05$l_p$. When the short-circuiting resistance is properly chosen, the bias current is not significant.

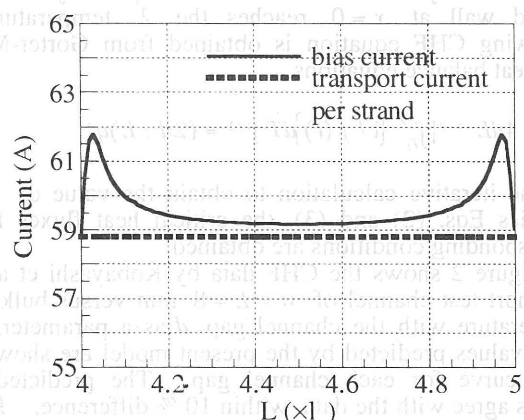



Fig.3 Magnitude of bias current vs. L

Reference

1) O. Tsukamoto, T. Sasaki, S. Fukui, M. Yamaguchi, M. Ono,"Enhancement of stability of Cable Superconductor by Normal Metal Elements Placed Periodically to Short Cable Strands", Presented at MT-15 (1997) PD.39