§6. Estimation of Induced Current of LHD Using Pulse Power Supplies

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For the dynamic current control of the LHD super conducting coils, the pulse power supplies for IS and IV coils were constructed. When the magnetic field is swept with these power supplies, some induced current flows in the structural material. This current makes some loss and an error field, so the estimation of it is necessary.

We estimate a ac losses and a circuit resistance coupled to coils with this overshoot component using equivalent circuit model shown in Fig. 1. In this model, each brunch current is modeled as shown in Fig. 2 when rectangular voltage is induced, and the induced current is observed as a surplus component in the coil current. To simplify the phenomena, we use under following conditions.

A Only IV coil current is swept and the other coil currents are kept constant.

B Only IV coil is driven with high voltage and the other coils voltage are kept zero.

In the case A, there are some voltage are induced in other coils and some power flow are occurred, but case B operation , there are no power flow. Fig. 3 and 4 show the detail of current waveforms and i_r described in Fig. 1. With these figures, the resistive current is constant as shown in Fig. 2, but case B shows lamp up the resistive current. It may suggest the equivalent coupled resistance is changed by time in this situation. With these results, the coupled equivalent resistance for IV coil and time constant are as follows.

Plasma axis control Rp for IV coil is about 8-10 Ω, and the time constant is 0.1 s.

A Rp is 6.2 Ω and the time constant is 0.16s.

B Rp was changed from 5 to 2 Ω but time constant is 0.16 s and is not changed so much.

The result of case A had agreement with the result for the axis control, but the result of case B had big difference. In the next LHD experiment, more detail will be tested by the pulse power supplies.

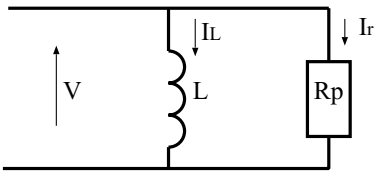


Fig. 1: Equivalent circuit of coupled structure.

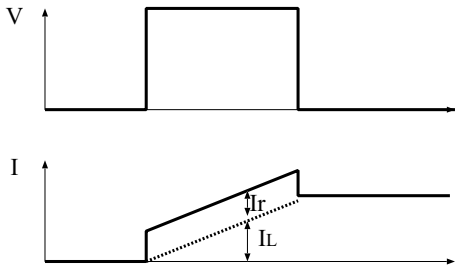
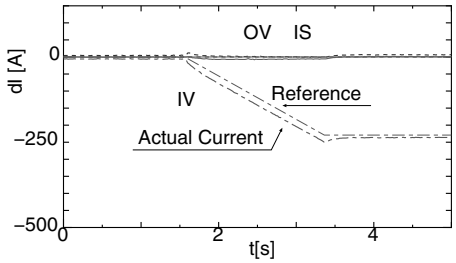
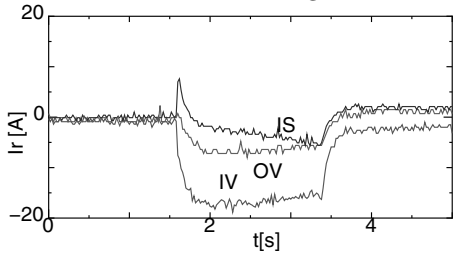


Fig. 2: Resistive current and inductive current flowing the SC coil.

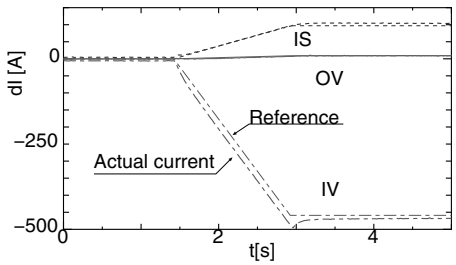


a. Current change.

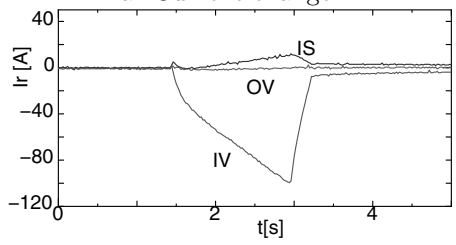


b. Resistive current ir.

Fig. 3: Coil current for case A experiment.



a. Current change.



b. Resistive current ir.

Fig. 4: Coil current for case B experiment.