

## §8. Reliability Test of Quench Protection Circuit of Poloidal Power Supplies

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All of power supplies to excite superconducting magnets of LHD uses a novel dc circuit breaker using a vacuum circuit breaker and power fuses, in their quench protect circuit. In these two years, experiments to confirm operation of actual quench protection circuits in poloidal power supplies are executed.

In the LHD operation, the superconducting magnets have the large stored energy and coil current is not so changes until dump resistor is connected to the coil. In the experiments, coil current should be kept during quench protection sequence is running. For this purpose, a liquid nitrogen cooled copper coil is used as a dummy load coil. Figure 1 shows a diagram of test circuit.

In the first design of quench protection circuit, the power supply is set to generate full negative voltage immediately when quench is detected. In this operation sequence, the condenser in the dc filter is charged negative and it is short when DS2 close. This rush current damages the contacts of DS2 and the life cycle of DS2 becomes shorter.

To remove this problem, operation sequence was modified. Figure 2 shows an example of current and voltage waveforms in quench protection. In this figure, any rash current is not observed and the sequence modification success. Fig. 3 shows the opening delay and fuse melt time of OV power supply. The fuse melt time increase with operation current become small. But the opening delay is almost constant when operating current is larger than 50% of rating.

Now, 200 shot of experiments are finished for OV power supply and 100 shot is finished for IS and IV power supplies without any operation failure.

Power Supply for OV Coil

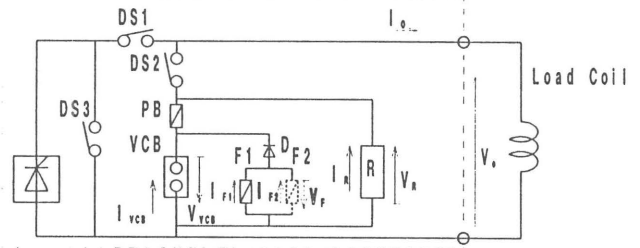


Fig. 1. Diagram of Test Circuit for Quench Protection

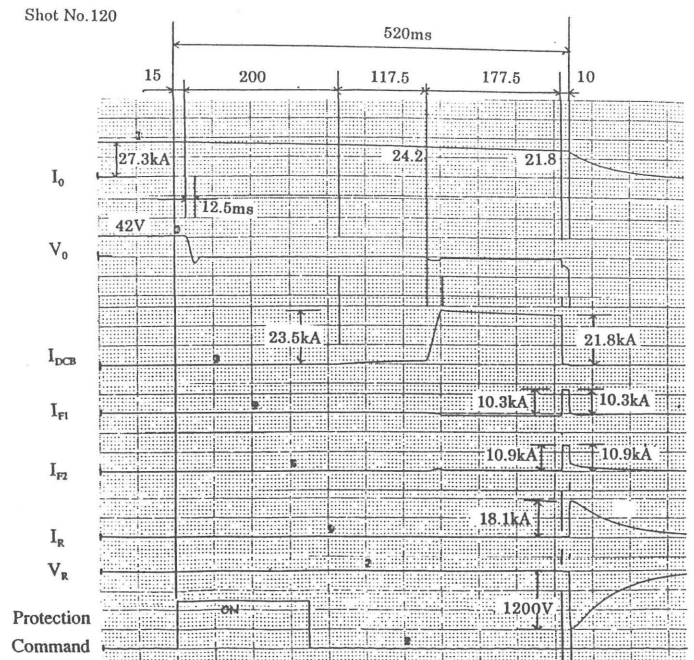


Fig. 2. Waveforms of Quench Protection

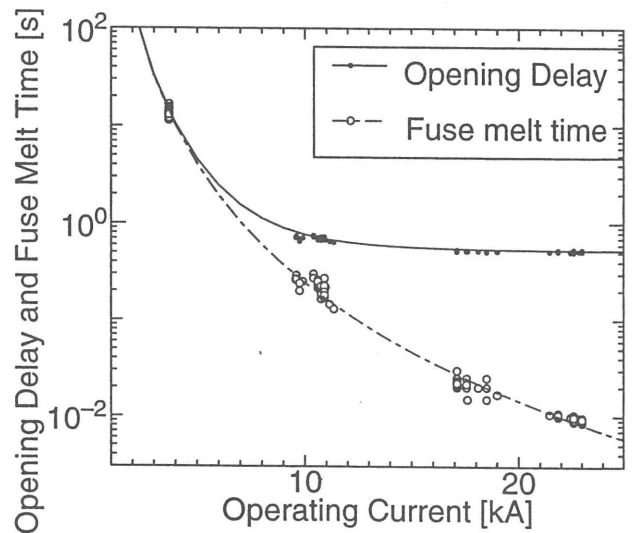


Fig. 3. Operation Delay of OV Protection Circuit