

§29. Power Supply for Poloidal Coils

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Power supply for poloidal coils of the Large Helical Device(LHD) is under construction. This is a steady power supply that drive poloidal field coils for steady operation in the phase I of the LHD project. The power supply is consist of three power supply units which correspond to three pairs of poloidal coils(OV,IS,IV) as is shown in Figure 1. Specifications of these power supply units are shown in Table 1. The rated currents shown in the table are the maximum currents in the all operation modes at the phase 1 of the LHD project.

Each unit is consist of a parallel connected double-star thyristor rectifiers, a DC filter and a coil protection system. It means 12 phase rectification. The ripple frequency is 720 Hz. These supply units can provide positive currents and positive/negative voltages.

A ripple voltage is suppressed to 1%(rms) of the rated output voltage by use of a DC filter which is critical damped low pass LC filter. Rise or fall times of coil currents are less than 30 minutes.

Operation mode can be changed within 5 minutes in the all transition except the case shown in Table 2. Furthermore, it is necessary to change polarity connection between the IS coil and IS power supply unit because that current direction of IS coil is opposite only in #1a mode. The transition times in the case of which transition times exceed 5 minutes are shown in Table 2.

The coil protection system can dump coil storage energy to dump resistor at the case of coil quench with a time constant within 20 sec. The protection system is consist of a dump resistor and DC current breaker which is newly developed in our institute. Rated value of the dump resistor is shown in Table 3.

Current control precision of the power supply unit is 0.04%+6A for the demanded value in the all current region by use of a current measuring equipment of which capability is shown in Table 3.

There are two control types which are current control and voltage control in the power supply unit. A phase control in the thyristor control unit is instantaneous response type which is able to minimize a time delay of phase control signal from demand signal. A linearizer is also adopted in order to compensate non-linearity in the phase control unit.

Supporting equipments for this power supply are a cooling system for the thyristors and bus conductors, and AC filter which prevent to flow higher harmonic current to the power line.

Table 1. Specification of the poloidal power supply units

Name of unit	OV	IS	IV
Rated voltage (V)	33	33	33
Rated current (kA)	23.5	16.3	15.7

Table 2 Transitions of which times exceed 5 minutes(from/to #1b mode)

#10	#1d	#2b	#3b	#2a	#4a
5m41s	6m58s	5m14s	7m35s	6m13s	6m58s

Table 3. Ratings of the dump resistors

Name of unit	OV	IS	IV
Resistance(mΩ)	62.0	82.4	80.3
Heat capacity(MJ)	186	76	84

Table 4. Capability of the current measuring equipment

Precision	0.03%+4.5A (of reading value)
Linearity	0.01%/FS
Thermal drift	10ppm/degree in C
Stability	0.02%+3A/2h

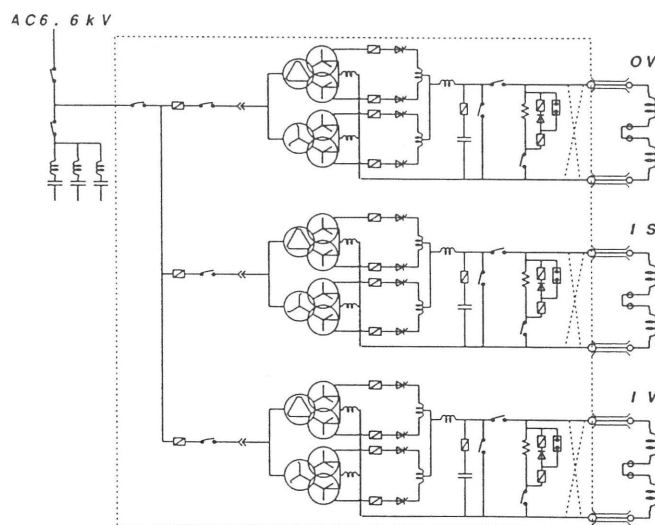


Fig. 1 Skeleton diagram of the poloidal power supply