## §1. Update of Control System of DC Power System for LHD Superconducting Magnet

## Chikaraishi, H.

LHD has six dc power supplies and a control system to excite its superconducting magnet. The control devices for power system that are programmable logic controller (PLC) installed in thyristor rectifier (Fig. 1), control circuit installed in the thyristor rectifiers (Fig. 2) and computer system (Fig. 3) have been continuously used after construction. Although this power system operates 20 years without sever problem, some components became overage and it became difficult to maintain. Therefore update program of the power system is running from 2013.



Fig. 1: PLC configuration installed in power supply



Fig. 2: Block diagram of local control module installed in power supply



Fig. 3: Computer system for the power supplies.

The PLC were replaced with next-generation model of same manufacturer. Then the program used in the old PLC can be transferred with minor modifications such as remapping of IO address or timers. The main specifications of old and new PLC are listed in Table I.

 
 Table I: Main specifications of old and new Programmable Logic Controller

	Old system	New system
	Mitsubishi elec.	Mitsubishi elec.
CPU Model	A2A	G02U
Program ROM	16 k byte	80 k byte
RAM	32  k byte	$128 \mathrm{\ k}$ byte
Processing speed	$0.2 - 0.4 \ \mu s/step$	40 - 80  ns/step

The local control unit shown in Figure 2 will be rebuilt with new devices. The detail design will start at beginning of 2015.

The configuration of new computer system is same with the old computer system to minimize the modification. The main specifications are shown in Table II. The real time computers are changed from VME bus system to Compact PCI system and the supervisor computer is changed from Sun workstation to a Linux based workstation to reduce the cost. At the same time, the data link with optical interface and LAN are upgraded to higher speed models as shown in Table II.

Table II: Main component of computer system

	Old system	New system	
Real-time computer			
Computer			
Flame	VME	Compact PCI	
	MIPS $R4600$	Power PC	
CPU	(150  MHz)	(1.4  G Hz)	
Main memory	$128 \mathrm{~M}$ byte	1 G byte	
OS	VxWorks	VxWorks	
LAN	10 base	1000 base	
Supervisor computer			
CPU	Ultra SPARC	Intel i7	
OS	Sun OS	Linux	
Main Memory	$512 \mathrm{~M}$ byte	16 G byte	
Main Storage	40  G HDD	500  G SSD	
LAN	100 base	1000 base	
Remote terminal			
CPU	Ultra SPARC	Intel i7	
OS	Sun OS	Linux	
Main Memory	$512 \mathrm{~M}$ byte	16 G byte	
Main Storage	40 G HDD	500  G SSD	
LAN	100 base	1000 base	
	Reflective mem.	Reflective mem.	
Data connection	$600 \mathrm{~M} \mathrm{~bps}$	4.2  G bps	