Control system for the magnet power supplies of the Rare-RI Ring

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We report on the status of the control system of the magnet power supplies of the rare-RI ring. The development of the control system was started at the beginning of 2013, and it has become possible to remotely control the main and trim coils of dipole, septum, and quadrupole magnets since November 2013.

Components to be controlled in the rare-RI ring are classified into two groups: components for operating the rare-RI ring as a storage ring and other components used solely for precise mass measurements. The components belonging to the former group, such as magnets and vacuum systems, are similar to those used in the existing RIBF accelerators. As a first step in implementing the control system for the rare-RI ring, we have started developing the control system for the magnet power supplies that will be first used for magnetic-field measurements of the rare-RI ring. Control systems for vacuum components will be integrated into the control system for the magnet power supplies.

The control system of the rare-RI ring is developed on the basis of Experimental Physics and Industrial Control System (EPICS)[1]. To save construction cost and time, the control system is designed to utilize the software resources developed for the RIBF accelerator control system in the past 10 years. Following recent trends in the control systems of the RIBF accelerators, the programmable logic controllers (PLCs) manufactured by Yokogawa Electric Corporation (hereafter, FA-M3) was chosen as a main controller of the components. The controllers used for the magnet power supplies are summarized in Table 1.

Table 1: Controllers used in the rare-RI ring

Type of Magnet (Number)	Number of magnet power supplies	Type of controller (Number)
Main coil of dipole magnets (24)	1	F3SP66 (1)
Trim coil of dipole magnets (10)	10	Serial-Ethernet Converter (1)
Septum magnet (4)	2	F3SP66 (2)
Kicker magnet (5)	10	Under discussion
Correction coil magnet (24)	6	Under discussion
Quadrupole magnet (10)	10	F3SP66 (5)

Magnet power supplies, except for those exciting the trim coils, were newly developed for the rare-RI ring. F3SP66 is a conventional ladder PLC-CPU for the FA-M3 system, and it is controlled by using netDev, an EPICS device, and driver support for general network devices developed by KEK and RIBF control groups[2]. Old power supplies are reused for the trim coils; these are controlled via serial communication, RS422. We have connected a serial-Ethernet converter to the magnet power supply and controlled it via Ethernet by using StreamDevice, an EPICS device support for devices controlled by sending and receiving strings[3].

For an operator interface (OPI) application, we have selected Control System Studio (CSS).[4] CSS is a user interface framework for control systems based on Eclipse, which has functions of not only a graphical user interface (GUI) but also an alarm system and a data archiving system. It is at the forefront of recent OPIs.

Regarding a network, we have recently installed a local area network (LAN) dedicated to the rare-RI ring (hereafter, rare-RI ring LAN), which will be used in combination with the LAN of the RIKEN Wako campus (hereafter, Wako LAN). Servers and controllers for each component in the rare-RI ring are connected to the rare-RI ring LAN, and client PCs are connected to the Wako LAN. The two networks are connected to each other across a firewall. We can obtain information on the rare-RI ring from every PC on the Wako LAN; however, controlling the components is permitted for only a few dedicated client PCs.

Three types of servers are installed in the rare-RI ring LAN. The first functions as a network file system (NFS) and EPICS-Input/Output Controller (IOC) server and as a firewall and router in the connection of the rare-RI ring LAN and the Wako LAN. As an IOC server, it serves as a soft IOC to control ladder CPUs. The second server is a backup server. The files on the NFS and EPICS-IOC servers' local hard disks are copied to this backup server to avoid loss of files and data. The third server manages a relational database (RDB), in which PostgreSQL is installed to operate the data archiving system and the alarm system of CSS on client PCs. This server also simultaneously executes a data acquisition program to save operation data and a program for operating the GUI of the CSS alarm system.

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References

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