2. Control System

1. Status

In FY2021, we continued to improve the control system for SPring-8 and SACLA. Several components of the control system were replaced:

· The Online Database server for SPring-8 was upgraded with a 48-node server system with the Cassandra 3.1 database management software during the summer shutdown period. This system can keep online data for more than one year.

· Because of the deterioration of the Online and Archive Database servers, the MQTT broker for SCSS+ was replaced. The Online Database server consists of the 24-node system with the Cassandra 3.1 database management software. The Archive Database server has 2.6 TB (RAID1+0) of SSD storage with the MariaDB 10.3 software.

· The file server for a waveform and image data files was upgraded with 120 TB storage. This server is separated from the main file server to avoid consuming disk space.

· The network switch of the SACLA klystron gallery was replaced with a full gigabit Ethernet switch. It aimed to avoid the deterioration and upgrade the bandwidth from 100 Mbps to 1 Gbps.

2. Development of framework for accelerator control system

The control system is working well, but several tasks need further modification [1]:

· brushing up of a user interface for the management of the signal registration,

· management of a parameter for an accelerator with the parameter database, and

· release of the RestAPI frame to access the database.

Last year, we released a web application to manage the signal registration of the parameter database for operators. The functions of the web application are continuously updated to manage the signal registration workflow to take into account operators' feedback. New functions were added as follows:

1. new signal type (image data and priority control of data acquisition),
2. account control list with privileged account,
3. improvement of 'SVOC Check Result' presentation (Fig. 1(a)) and logging, and
4. improvement of user interface of backup and restore (Figs. 1(b) and 1(c)). In addition, we implemented a function of manual backup.

We released a web application to manage parameters, such as a parameter of an operation and calibration constant, for accelerator operators (Fig. 2). We executed a method of updating the parameter on the test environment first and then checking the result. Finally, we executed a method for an accelerator control environment. The web interface is used similarly to manage the signal registration.

We released the RestAPI used to access data and manipulate figures for operators and researchers. For safety and the device interlock system, we use the programmable logic controller (PLC) manufactured by Mitsubishi Electric. To control the PLC, we developed a software program for the C Controller Module with Lineo uLinux. It can control the PLC in the same way as VME or the MTCA.4 system with the accelerator control framework.

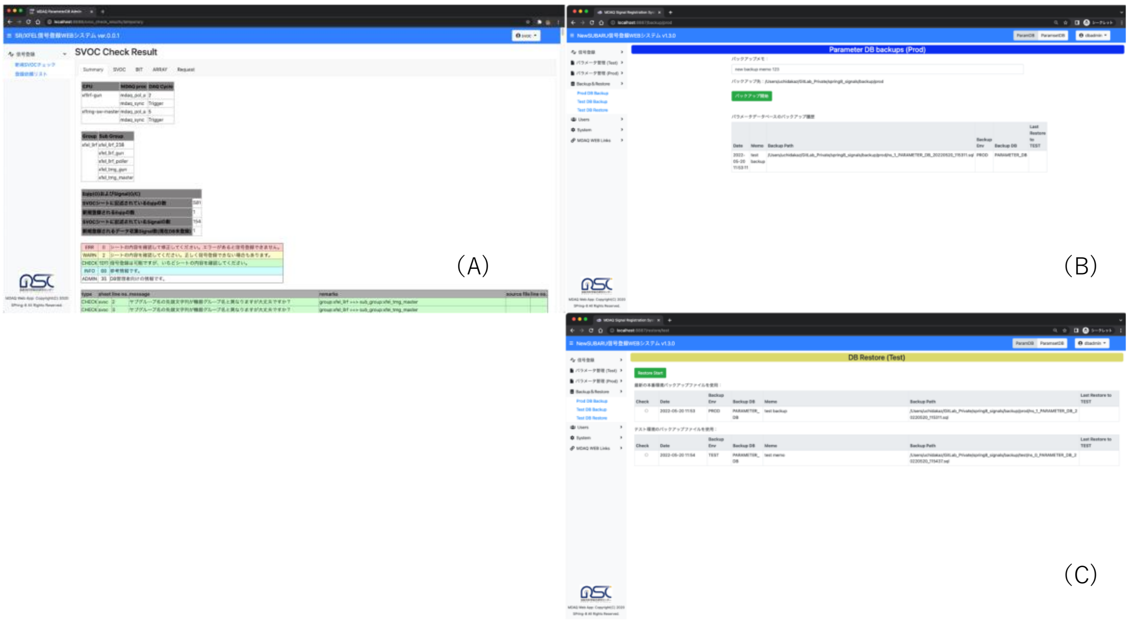

Fig. 1. User interface of a web application to manage the signal registration. (A) SVOC check result page. Results are summarized with the TAB style. (B) Backup page. (C) Restore page.

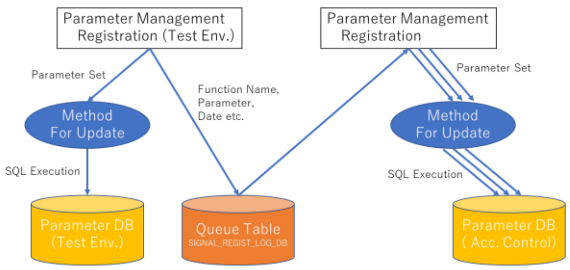

Fig. 2. Schematic of registration for parameter database.

Fig. 3. I/O card with EtherCAT and trigger input.

3. Development of equipment for accelerator control system

We developed an I/O board to control a magnet power supply (Fig. 3). Last year, we designed an iDIO card with the EtherCAT protocol, which is going to be used as a new-generation accelerator control. We added new functions for the shot-by-shot control of a magnet power supply. We use a mezzanine card to input a trigger. The trigger timing chart is shown in Fig. 4. An ADC data is read out at the BUSY signal of the first arrival after the trigger. A DAC data is set with the strobe and the delay timing is controlled between 1 and 200 ms. This card will be tested at SACLA next year.

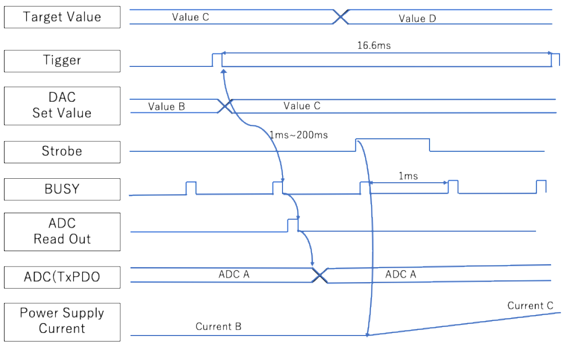

Fig. 4. Trigger sequence of iDIO card.

To reduce radiation damage, a GigE camera is used in the beam study to shutdown power in normal operation mode. We developed a power supply card for the GigE camera system (Fig. 5). The power of the GigE camera is supplied via an auxiliary power port of an image grabber card. The power supply card is controlled by the USB port of the PC server and accessed from the equipment manager of the accelerator control framework.

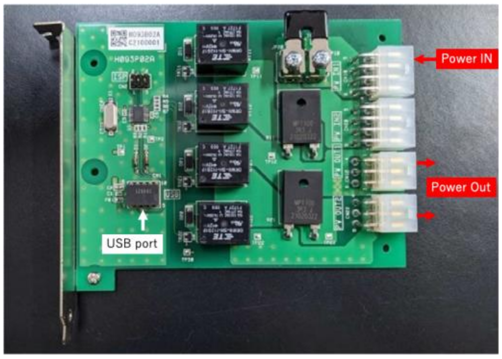

Fig. 5. Power supply card for GigE camera system controlled with USB.

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Reference:

[1] Okada, K. et al., (2021). *Proceedings of the 18th Annual Meeting of Particle Accelerator Society of Japan*.