Integration of the Synchrotron Control System to the SPring-8 Control System

Naoyasu HOSODA, Tsuyoshi AOKI, Kenji FUKAMI, Toru FUKUI, Masahiko KODERA,
Takemasa MASUDA, Takashi OHSHIMA, Hiromitsu SUZUKI, Masaru TAKAO,
Ryotaro TANAKA, Norio TANI, Akihiro YAMASHITA and Hiroto YONEHARA

SPring-8/JASRI

1. Introduction

At the SPring-8 accelerator complex, control systems of the linac, the booster synchrotron and the storage ring were designed and constructed independently. Since December 1996, the synchrotron started its operation and its control system was useful enough in the commissioning phase and the steady operation [1, 2] . However, more tight combination to the storage ring control system was required for future development and transparent operation of accelerators. It was decided to integrate the present control system of the synchrotron to the SPring-8 standard control system. We gave attention not to interrupt SR user experiments, when we developed and tested the system.

2. Hardware System

To control the synchrotron, we use 14 VMEbus systems. The network system which connect VMEbus systems and operator consoles were replaced from coaxial cable (yellow cable) to system using optical fiber Ethernet and switching hub. And new hub port are prepared beside each VMEbus. The CPU boards of VME system were changed from MVME147SA-1 to HP9000/743rt. All other VME I/O boards such as DI, DO and AI were remained. The Operator console were also changed from Digital workstations to HP9000/700 series. The thing that hardware replacements were minimized was one reason of success of this integration.

3. Software System

The software system was replaced to the one that developed at the storage ring control [3] . This brings seamless equipments control and data analysis between the synchrotron and the storage ring. The software is divided into the framework (core) parts and the equipment parts. The former is already made, and it was necessary for us to create VME front-end control software (EM) [4] and operation window software (GUI) .

The developments of device driver for HP-RT were newly needed, because we remained all VME I/O boards. Followings are available now: AVME9350, DVME-DOUT3, DVME-DIN3, FDO, NIO, MTC, PMEM and 743rt RS232C port.

3-1 Construction

First, the synchrotron equipment group listed up operation commands and monitoring points for all equipments. And we designed new operation windows. The machine operator had some difficulty in operation with the old system, so this was a good chance to modify the window to more user friendly. Along with the new software architecture, the determination of SVOC command list [4] was proceeded. We repeated development and test the software.

Early time of developments, software test using real equipment was done during machine suspend period from Friday evening to Tuesday noon every three week. But after, for bug fixing and stable control, more test time was needed. Fortunately we usually inject to the storage ring once a day. We can devote the rest time to test the new control system. The exchanges from old control system to new one and vice versa were easy because its only exchanges the VME CPU boards. This allowed us to use these time every day just before winter shutdown. The power supply for main magnets are operated by a 1 Hz acceleration pattern. To set the current and the voltage pattern at the same time, EM was modified to access to multi I/O boards. The ramping pattern of main magnets with the new system must be match to the pattern created by old system, because it strongly influences on electron beam.

To control RF cavity voltage, we have used an EMA process [5] . This process works to increase or to decrease klystron input power and anode voltage by watching cavity vacuum, reflection power and collector loss every 500 msec. Fig. 1 shows cavity voltage and vacuum monitor window. At this time, cavity voltage was increased from 1 MV to 2.35 MV. Compared with klystron 2, cavity voltage of klystron 1 was delayed. This is because corresponding cavity vacuum was reached upper limit of 7.0 x 10^{-6} Pa, the EMA process was waiting for the

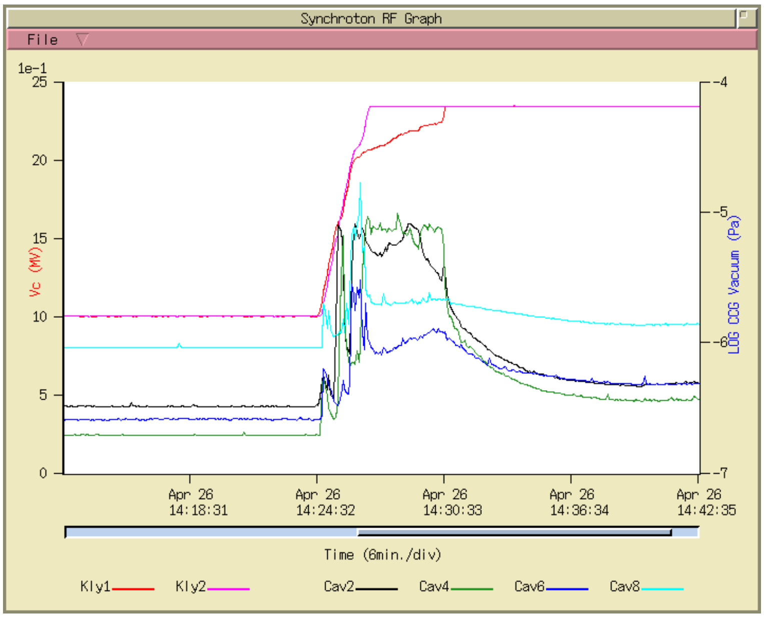

Fig. 1 RF cavity voltage and vacuum monitor window.

vacuum of the cavities to recover.

3-2 Operation Windows

The main window of the synchrotron control can be seen at Fig. 2. This is a part of the SPring-8 machine control window hierarchy.

Functions for the ordinary operations are collected in this window. As for operations for RF system, there are 6 procedure. For example, starting up the klystron power supplies (HV on), raising the cavity voltage to a standby value (RF standby) and raising the cavity voltage to a beam operation value (Beam operation) . A11 153 magnet power supply of the synchrotron and SSBT (Synchrotron to Storage ring Beam Transport) are operated together. To change the beam transport to the storage ring or to the synchrotron beam dump is only to select from corresponding two buttons. When single bunch beam is need, RFKO system is turned on.

From this window, all other synchrotron equipment control windows can be opened to a selected operator console. Using these windows, more detail operation are available.

4. Conclusion

Integration of the synchrotron control system to the SPring-8 control system was succeeded. We can control equipments of the synchrotron and the storage ring by same control system. The equipments data such as operation parameter, cyclic acquired data and COD data are logged in the same database system with the storage ring. We can access to the synchrotron and the storage ring data using C functions or WWW browsers by same way. Also this integration decreases man-power and cost for future maintenances and improvements.

References

[1] H. Suzuki *et al.*, SRI'97, (1997).

[2] N. Tani *et al.*, Proc. of the 11th Sympo. on Accel. Sci. and Tech., 467 (1997).

[3] R. Tanaka *et al.*, Proc. of ICALEPCS'97, 1 (1997) .

[4] A. Taketani *et al.*, Proc. of ICALEPCS'95, 625 (1995) .

[5] A. Taketani *et al.*, Proc. of ICALEPCS'97, 486 (1997).

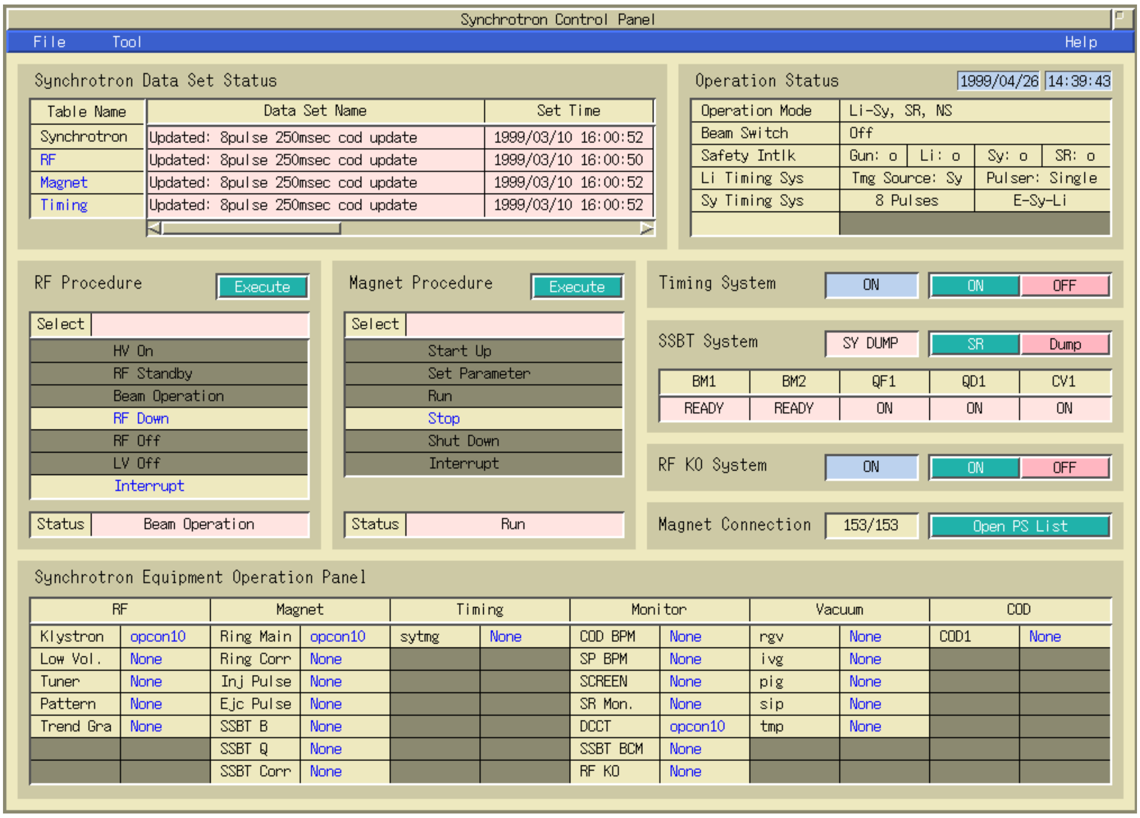

Fig. 2 Synchrotron control main window.