

Control System for Beam Commissioning of the SPring-8 Synchrotron

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Abstract

The construction of the SPring-8 booster synchrotron is finished successfully at September 1996 [1]. The computer control system of the synchrotron was almost completed. All equipments of the synchrotron and the beam transport from the synchrotron to the storage ring can be operated with operation windows on displays of workstations. We show the function of the windows in this article.

1 Introduction

The synchrotron accelerates an electron beam from the beam energy of 1 GeV to that of 8 GeV. The beam operation-modes of the synchrotron are the multi-bunch and the single-bunch mode of electron and positron beams. The control system is required to manage these operation modes.

The control system of the synchrotron is consisted of two parts, one is device controllers with VME systems and the other is operation consoles which are consisted of five workstations. One of the workstations is the engineering workstation "DEC4000-710" (we call the synchrotron computer) and this is filling the role of the central operation of the control system [2]. Two engineering workstations "DEC3000" and two engineering workstations "Alpha Station" are used for the operator's consoles.

The operating system of these engineering workstations is OpenVMS. There are 14 VME systems in which the OS-9 is used for the operating system. The communication protocol between the workstations and the VME systems are TCP/IP.

When the communication of the synchrotron computer and the VME is cut off, the synchrotron computer carries out the connection processing. If any messages from the synchrotron computer are not sent at 1 minutes period to the VME, keep-arrive messages are sent to keep on the link between the synchrotron computer and the VME. If the synchrotron computer does not receive any message from the VME for 3 minutes, the link is considered to be failed and the synchrotron computer retry to recover the link. The synchrotron computer is watching the status of each equipments with an interval of 5 seconds. When the status is changed to new status, the VME sends information to the synchrotron computer. Every one second, the synchrotron

computer is monitoring the measured values in the window which is opened for the operation. The correct condition is always stored in the shared memory data. The status of each equipment is displayed in the window from the shared memory at 5 seconds period, and the measured value are displayed every 2 seconds.

We applied an appreciation interface (API) to access the data at the shared memory easily in the synchrotron computer. API is used as an argument of the program which makes the windows.

The window was written to use Motif based on GUI developing tool of EASYWIN made by DEC. And, the each windows are possible to open by the topdown from the main window called the over-view window, as shown in Figure 1.

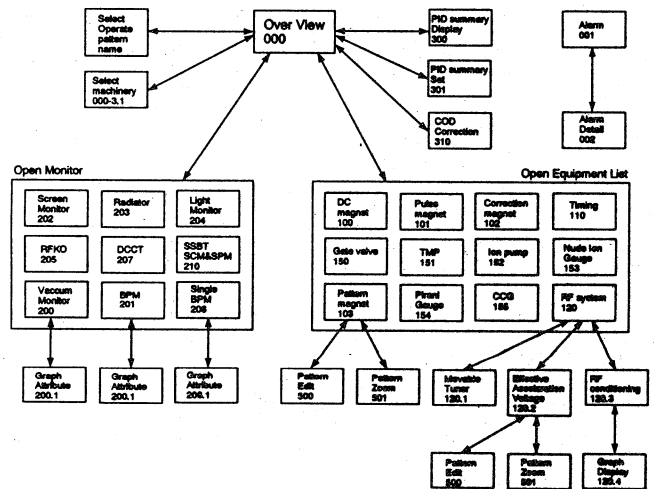


Fig. 1 The relationship between the Over-View window and the individual window.

The operation of the synchrotron is generally carried out for all equipments at the same time from an over-view window. But in the beam commissioning, the operation is carried out by using the individual windows which are selected from the equipments list on the over-view window.

2 Over-View window

The over-view window is shown in Figure 2. The over-view window has the function of the operating information and operation of the synchrotron. The operating information consists of the operation mode, the operation data-file and the condition of the machines.

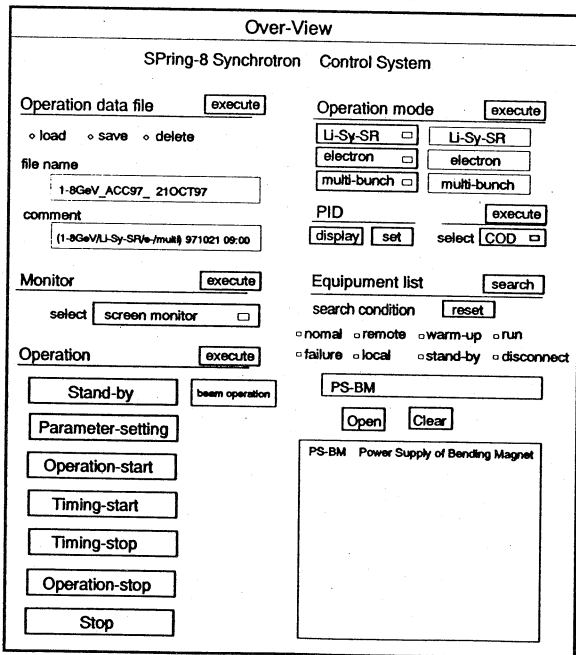


Fig. 2 Over-View window. The original window is written in Japanese.

The operation of the synchrotron is prepared with seven buttons for changing the status of all the equipments. These buttons are stand-by, parameter-setting, operation-start, timing-start, timing-stop, operation-stop and stop. The "stand-by" button is used to change the status of the stop to that of the stand-by. The "parameter-setting" button is used to set the operation data for all the equipments. The "operation-start" button is used to change the stand-by to the run. The "timing-start" button is used to send the trigger signal from the timing system to the equipments in a cycle of 1 second. After this, the beam is injected from the linac to the synchrotron by pushing the beam switch. The "timing-stop" button is used to stop the trigger signal. The "operation-stop" button is used to change the run to the stand-by. The "stop" button is used to stop all the power supplies.

The excitation current of all the magnets were set to the design values on the bases of the magnetic field measurements [3]. And the other equipments were also set to the preset values. The operating data set is stored in the directory of the synchrotron computer. The data of the individual equipments were saved in the directory of the every equipments. To select the operation data from the

operation data-file with the over view window, these data were copied in the temporary directory. The data setting are carried out with the data of the temporary directory and does not rewrite new data on the original data. The temporary data is saved by rewriting to the original data in the synchrotron computer.

3 Individual window

3.1 Pulse magnets

The fifteen operation windows of pulse magnets are prepared for every power supplies of six septum, five kicker and four bump magnets. These windows consists of operations, setting the charging voltage, monitoring the measured value and the status. The windows for the kicker magnets have a function to select long and short pulse width for operation modes.

3.2 Pattern magnets

The five operation windows of the pattern magnets are prepared for power supplies of bending, focusing quadrupole, defocusing quadrupole, focusing sextupole, defocusing sextupole magnets. These windows consists of the operation, the status and setting and displaying the excitation-current pattern. The windows include two sub-window to set excitation-current pattern. One is for edition of the pattern and the other is for zooming the pattern visually. For example, the operation window of the bending magnet is shown in Figure 3.

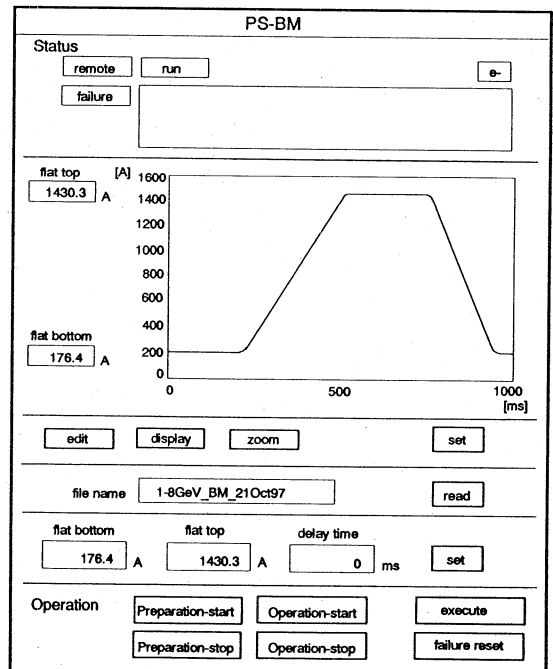


Fig. 3 The operation window of the bending magnet. The original window is written in Japanese.

3.3 Correction magnets

The operation window of the correction magnets are prepared eighty windows for every power supplies of forty horizontal correction magnets and forty vertical ones. These windows consists of the operation, setting excitation currents, monitoring measured values and the status. The excitation currents and the timing data for both of the injection and extraction with the windows are set. We prepared also the window which the excitation currents of all the correction magnets could be set as a whole to correct a closed orbit.

3.4 SSBT magnets

The SSBT is the beam transport line from the synchrotron to the storage ring. Fifty two windows are prepared for every power supplies of six dipole, twenty five quadrupole and twenty one correction magnets. These windows consists of the operation, setting the excitation current, monitoring the measured values and the status. The windows of the dipole and quadrupole magnets have a function to initialize the magnetic fields. This function is carried out by pushing the operation-start button or the initializing-start one.

3.5 rf system

The window of the rf system is the most complicated one. The parameters of the system is prepared for power supplies, transmission lines, cavities and the vacuum system. They are closely related mutually. The rf system has two 1MW klystrons and eight five-cell cavities. The effective accelerating voltage is obtained by adjustment of the phase difference between two klystrons [4]. The rf system is required to make the pattern of the accelerating voltage to accelerate the beam from 1 GeV to 8 GeV. The window of the rf system includes a sub-window to set acceleration-voltage pattern. After the pattern is decided, it is converted to pattern of the phase difference between two klystrons automatically. Both of the two patterns are displayed in the window.

3.6 Timing system

The window of the timing system is used for selecting the channel to be used or not to be used and for setting the delay times. This window displays the status of eighty five trigger signals in the list. The delay times can be set as delay values or counts of the clock [5].

4 Monitor window

4.1 Fluorescent screen monitor

Fourteen fluorescent screen monitors are installed in the synchrotron and sixteen fluorescent screen monitors are

installed in the SSBT. The fluorescent screen monitors were used to observe the beam position and is displayed by the list in the window. This window has functions to select a monitor, to insert it in the beam duct and to turn on light.

4.2 Beam position monitor

The synchrotron has eighty beam position monitors (BPM) [6]. These are used to measure a closed orbit distortion. The window of the BPM consists of displaying the eighty beam position and the timing data for the measurement. The graph can display five closed orbit in the horizontal and vertical directions at the same time to compare them mutually. This window has a sub-window for changing the scale of the graph, setting the gain of the BPM and saving and loading of measured data.

5 Conclusion

The beam commissioning of synchrotron was finished successfully by using this control system. The optimum operation parameters for the multi-bunch and single-bunch modes were acquired and saved in the control system. The performance of the control system was confirmed in the beam commissioning and the some improvements were carried out. The synchrotron is operating smoothly and continuously.

Reference

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