Present Status of Control System for the RCNP Ring Cyclotron

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Abstract

The computer control system of the RCNP Ring Cyclotron was used for operation since 1991. In the initial stage we had many troubles for the software as well as hardware. In 1992, we modified the system configuration and overcame the problems which observed during the actual operation. Summary of the control system is shown and typical troubles are summarized with our means of settling.

I. INTRODUCTION

The control system of RCNP Ring Cyclotron is made from computer-complex connected with each other via networks called as Message Tree. (Fig.1) [1] This network mediate the information between three-levels of computer-complex. The first-level is Universal Device Controller (UDC) which controls a device and collect the status of a device. There are 433 UDCs in the ring cyclotron facility. The CPU of UDC is Intel 8344 which has 192-byte RAM. The programing of UDC-software for many kinds of device were performed by the help of programing language PL/M. The varieties of software are more than 60 and maintained by floppy-disks for each UDC. The second-level is Group Control Unit (GCU) which performs grouping of UDCs and collect the information from UDCs. There are five GCUs called as RING, BT, DIAG, RF and VACCOL, respectively, using two micro VAX II computers and three RTVAX 1000 computers. The eleven tasks of GCU software are witten by language C and execute on the system software VAXELN. The third level is system control unit (SCU) using VAX 4000/200 (main memory 48 M bytes). The thirty tasks of SCU software are also witten by C and execute on the system software VMS V5.4. The varieties of tasks are summarized in Table 1.

II. MAN-MACHINE INTERFACE

The operation of Ring Cyclotron is performed using twin touch-panel systems. After installation of the cyclotron facility, our skillful operators learned the manipulation of main console in a short time. They requested more rapid response of the man-machine interface and more information of the status for cyclotron. Rapid operation and large size of information generate large number of data-exchange among tasks on SCU and between SCU and GCUs. It happened the capacity of CPU and memory on SCU broke down at the most active operation.

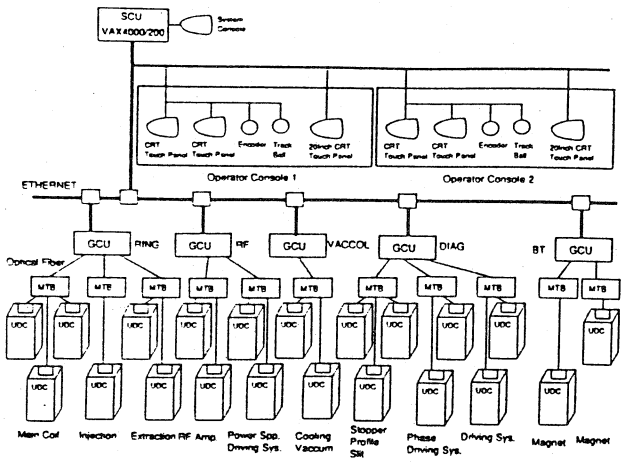
The computer-complex of the control system started with VAX 3500 (main memory 9 M bytes) as SCU and four GCUs. To overcome this problem, we decided to replace SCU to VAX 4000/200 and increase the number of GCU to five. Further more we modified the process AJP and OPP to ignore the request from operator when the number of waiting-que is increased and we separated the process BCP, which takes care of beam diagnostic, for each touch-panel system. After these modification, the man-machine interface became stable even though operators work so hard.

III. UNIVERSAL DEVICE CONTROLLER

We had a serious trouble on UDC during extensive operation for acceleration of 400 MeV proton in the end of 1992. Some UDC located in the Ring Cyclotron vault became un-controllable from local panel of UDC as well as SCU. In such case we must restart the UDC to make under control. When UDC of the power supply become hang-up it is necessary to turn off the power and we lost the isochronous magnetic field of cyclotron. It took half or one day to recover the suitable magnetic field at that time.

We made two assumptions for the origin of hang-up as follows. 1) The power supply (5V) for UDC became unstable. 2) UDC board caught external noise and CPU became non-active. For the case 1), we examined the voltage of power supply by mounting an electric circuit developed by RCNP for all of UDC. [2] We did not detect voltage reduction for any UDC. For the case 2), we tested UDC by adding high voltage pulse created artificially near UDC and detected hang-up of UDC. There were five tasks on software of UDC. Among these tasks, two tasks have the stack area on the external memory chip. Therefore we made next assumption that this stack area

Figure 1: Computer-complex



breaks down by noise. To overcome this phenomena, we modified the software of UDC and unified five tasks to three tasks without the external stack area. After this modification we got stable operation of UDC even in bad environment of cyclotron vault.

IV. CONTROL USING NETWORK

We have another control system for experimental instrument with VME. The man-machine interface has constructed on VAX 3100.[3] Experimentalists can control devices by a simple operation with VT-terminal. In oder to control some devices which is under UDC, SCU communicates with VME-system through DECnet. Experimentalists must request privilege "Operation-Right" for each device under UDC. Without this privilege, anyone can not change parameters of UDC from outside of cyclotron network. Except for this rule, devices under UDC and VME are unified on the man-machine interface.

It is possible to get parameters of cyclotron using network from any place. We constructed a system to display the status of cyclotron using personal computers. This system display the status by numerical characters or graphics. Futhermore if any parameter change unexpectedly, this system inform the status by human voice.

V. CONCLUSION AND OUTLOOK

We already have stable operation using the control system of Ring Cyclotron. We have some projects to modify the software of SCU to make the operation more convenient and more intelligent. Our cyclotron systems are made from two parts. One is ring cyclotron and the other is AVF cyclotron. The old control system of AVF cyclotron should be replaced in near future. On of the possible solution to replace is unification of two control systems. However it is still open problem.

Table 1: Processes on SCU

Name	Role
ACP	Adjust Data Communication
CCP	Control Communication
BMP	Beam-diagnostic data Communication
MCP	Mode Control Communication
SCP	Status Communication
TCP	MTC Control Communication
PCP	Communication via DECnet
OPP	Operation Panel
PFP	Parameter File
SPP	Start-Stop
TRP	Trend Report Select
LCP	Load Change
VCP	Vacuum System Control
BDP	Beam-diagnostic Device Control
AJP	Adjust Parameter
ASP	Adjust Parameter Select
DPP	Display Panel
OCP	Operation Condition
BCP	Beam Monitor
MPP	Maintenance Plan
TDP	Trend Data
GDP	Graphic Display
TAP	Trend Data Acquisition
FCP	Fault Control
RPP	Report
RQP	Requested Parameter
RCP	Recovery

VI. REFERENCE

[1] T. Yamazaki et al., Proc. 13th Int. Conf. on Cyclotron and Their Applications, Vancouver, Canada, 1992, pp.672-675.

[2] K. Nagayama, private communication.

[3] Y. Fujita et al., RCNP Ann. Rep., 1992, pp232-234.