The neutrino beam line control system

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Abstract

The construction of the beam line for the long base-line neutrino oscillation experiment is in its final stages now. This beam line consists of a 400m proton beam section and a 200m pion decay section. In the proton beam section, there are 104 magnet power supplies, and two 250kA pulse power supplies operated synchronously with 12GeV proton synchrotron. These components are installed in three houses far from each other. The demands for the control system, are low cost, high reliability, and good assistance of the maintenance of power supplies.

On this situation, as components of the control system, PC and POD (Programmable operation display), and LAN and GPIB are adopted. The system controller is the PC with Windows NT, and controls magnet power supplies and 250kA pulse power supplies through LAN and GPIB. For operator, the PC offers control panel on the POD through LAN, and also offers status display of magnet power supplies as Web service. The low-level magnet power supply controller has GPIB interface, and is connected to LAN.

1 Introduction

The speeds of improvement in computers are very fast. The devices expected to use in the control system were changed. Two years ago, when the design work for the neutrino beam line control system started, a WS (HP-UX) and a PC (WindowsNT4.0) was introduced, and tested them. The test result was that the PC was 12 times faster than the WS. On the performance of Web service the PC was faster 6 times. Finally, the PC with Pentium 450MHz CPU as the system controller was chosen. X-terminal for user interface device was changed to POD (programmable operation display). As the programming language of the control system HP-VEE was chosen.

2 System configuration

Figure 1 shows the configuration of the control system. As the system controller PC WindowsNT4.0 has Pentium 450MHz CPU and 384MB memory. HP-VEE 5.0 is installed as programming language. The POD is originally the user interface device dedicated to the PLC (programmable logic controller). The POD is programmed as the user interface of the neutrino beam line control. The POD is connected to LAN through a terminal (RS-232c) server TOA-7413. Magnet power supplies in the North experimental hall is connected to PSCx8 (eight magnet power supply controller). In 1st and 2nd power station, magnet power supplies are also connected to PSCx8. The PSCx8 is connected to PC through GPIB or LAN. Seventeen auxiliary low power supplies are also connected through LAN/HP-IB gateway and HP-IB extender 37204A. There are two 250kA pulse power supplies for Horn-magnets. Each of those have a horn power supply controller (HPSC). The HPSC controls not only the pulsed power, but also the timing of the synchronisation to the 12GeV proton synchrotron. [1]

3 PSC

The PSCx8 is the interface to control eight magnet power supplies. It has a ROM-based microcomputer, and easy to maintain. The PSCx8 communication protocol is GPIB. The GPIB is a popular interface. When PSC is tested with PC, the PSCx8 is connected to PC directly with GPIB cable without LAN. Finally the PSCx8 is connected to LAN through LAN/HP-IB Gateway or HP-IB extender. The complicated procedure of magnet power supplies operation is installed in the PSCx8. Therefore the communication between the PC (system controller) and PSCx8 becomes simple, dose not disturb the LAN.

4 HPSC

The horn magnet power supply controller is the modified device of the power supply controller (PSC) which was developed 10 years ago, and have been running in K6 and Pi2 beam line. The improvement has done on timing control and timing measurement. The function is performed in one-chip IC Z80-CTC (counter timer circuit). The capacitor charge of the HMPS is done by feed the regulator circuit the ramped reference voltage controlled by microcomputer. The trigger timing of 250kA pulse is controlled with the CTC, and the 250kA pulse is synchronised to the fast extraction beam from the 12GeV proton synchrotron. The coincidence of the proton beam and 250kA pulse is measured by the CTC. This HPSC has also GPIB interface, and connected to LAN through LAN/HP-IB Gateway E2050.

5 User interface POD

The POD was selected for the user(operator) interface. The reason is that there is any account or any shard resource for users on the system computer or PC. The second reason is the POD has coloured effective display function, and decreases the load of he system controller PC.

6. System programming

The system programming of the neutrino beam line is performed with HP VEE 5.0. By the original function the VEE is able to communicate with the PSCx8, HPSC, and TOA-7413. The PSC and HPSC perform the complicated operation of the magnet power supply. Therefor the load of the PC is reduced, and the communication between the PC and the PSC or HPSC is becomes simple.

7. Web service

By the original VEE function the neutrino beam line control system offers Web service. The beam line status or the magnet power supplies conditions are monitored through Web browser.

The actual Web transfer speed is below,
230k Bytes / 3sec,
66 k Bytes / 1or 2 sec
(WS speed is 170 k Bytes / 14 sec, 47 k bytes / 6 sec)

8. Conclusion

When look back over the development work of the control system, some chief points are as follows.

1. Powerful PC.
2. PSCx8, HPSC lower level controllers perform the complicated operation of the magnet power supplies.
3. The communication between PC and low level controllers is simple message.
4. The user interface is offered on POD (programmable operation display).

REFERENCES

[1] Y. Suzuki, et al. “Control and Timing of the 250kA Pulsed Magnetic Horn”, ICALEPCS’97, China 1997