Transactions of the Korean Nuclear Society Autumn Meeting
Busan, Korea, October 27-28, 2005

Hardware of a Control System for the 20MeV PEFP DTL

I.S. Hong, Y.G. Song, H.M. Choi, and Y.S. Cho
Proton Engineering Frontier Project(PEFP), KAERI
ish@kaeri.re.kr

1. Introduction

The control system for the PEFP DTL also started its operation shortly. Although some applications in the control system had limited to vacuum instruments, basic operation of the equipment could be performed using PEFP control system.

2. Control hardware for the PEFP DTL

The PEFP control system is constructed following so-called standard model architecture based on EPICS.[1] The system consists of network, Input/output controllers (IOCs), interfaces, and host server.

Network

The PEFP control system has not an independent network to control the equipments of the accelerator. Of Network of a temporary control room is linked with KAERI-NET in KAERI site. We constructed a small network to control the DTL. In this control rooms, Host computer and Input/Output Controller connected to the PEFP control system network through 100Mbps L3 Ethernet switch. A console port of IOC and a serial port on a system monitor board in each VME subrack are connected to a terminal server and remotely accessible.

IOCs

We use various equipments as IOCs , e.g. industrial PC, compact embedded controller with the chipset of the MPC 860, and VME single-board computers equipped with Motrolla Power PC 74xx(MVME5100).

Fieldbus interfaces

We use several field buses such as Modbus serial, Modbus TCP and the serial line, in the PEFP control system. IOC controls devices on these field buses using a field bus interface board in a VME subrack. We developed drivers for RS 485 to Ethernet interfaces.

Host server

Sun blade 2000 computer (Solaris 9) equipped with two CPUs is used as the host computer in the PEFP accelerator control system. The host computer also serves a development environment for VxWorks which is the operating system of IOCs. Xterminals are used as an operator interface in the PEFP accelerator control system. The server also has network interfaces to control network and runs some control system applications.

3. IOCs for the target instruments

We have several target instruments with requirements of control speed. Event and beam diagnostic system are necessary to fast control and monitoring, while control system of the vacuum and magnet power supplies of drift tubes (DTs) are relatively slow. We constructed hardwires based control system at fast control. Industrial protocols, serial, and Ethernet are used to slow control system.

IOC of the Event system

The PEFP event system is based on the global distribution of timing signals, e.g. a beam and RF pulse. This system is based on a design from the APS(Advanced Photon Source)[2], but enhancements and additional functionality of the redesigned system enabled us to use the event system for all timing distribution. We could utilize the software and work done to integrate the event system into the EPICS control system software toolbox. The PEFP event system is VME based control system that is composed of Power PC CPU(MVME 5100), Event generator, its receiver.

Event generators(EVG110) broadcast timing events over fiber optic links to event receivers which are programmed to decode specific events. Event generators generate events in response to external inputs, from internal programmable event sequence RAMs, and from VME bus writes. The event receivers(EVR100) was programmed to generate both pulse and set/reset level outputs to synchronize proton beam and RF system.

IOC of the Vacuum

The PEFP vacuum has turbo-pump, gauge, gate valve, and cryo-pump compressor. All these devices are communicating with vacuum IOC through serial connections with hardwires and network. Gate valve and turbo pump have their own embedded controlling devices which are connected to IOC through serial connections.[3] Since the real time control is not an issue for serial connections, we chose industrial PC (Personal Computer) as the IOC hardware, and Linux as the operating system.

IOC of the Low level RF system and Beam diagnostics

The control system for PEFP LLRF and diagnostic system is VMEbus based system.[4] A Power PC(MVME5100) single board computer host module is running the vxWorks real-time operating system. Control interfaces of the system consist of analog input/output, digital input/output, and TCP Modbus[5] LAN connections. All essentially monitored, controlled signals of PEFP RF and high voltage systems are well incorporated and engineered into the new VMEbus system to fulfill requirements of the commission stage. We use MFL32 (*Multifunction VME Board)* to connect TCP Modbus to LAN. The connection between the MFL32 and the embedded LLRF Controller is established using the MODBUS TCP/IP socket mechanism. The MFL32 is a client and the LLRF Controllers are servers. The MFL32 can automatically control LLRF Controller by sending a set of commands through the TCP/IP network.

The fast and highly accurate ADC I/O boards (VTR812/40) are used for digitizing measured beam currents and pick-up signals, which is operated at 10Mhz and stored and 1M samples of data per channel in SRAM, 8M samples total in a single width.

IOC of the DTs Magnet power supplies

A proto-type of the VME based digital controller for the DTs magnet power supplies has been constructed. Each DTs power supplies (PS) has a digital regulation loop build by a digital signal processor (DSP) and Pulse width modulation (PWM)card, a power converter, a current measurement (DCCT), and a precise analog to digital and digital to analog converter (ADC/DAC) card. A point-to-point optical fiber link connects the PS controller with an industry pack module hosted on a VME carrier board. An industry pack (IP) module, proposed by the Accelerator Control Group at PSI, serves two PS. Four IP modules fits on each IP carrier VME card. Therefore even with the point to point high bandwidth link a high control density of eight PS per VME card can be reached. On average 16, at maximum 24 PS are controlled by one crate.

3. Conclusion

We designed and constructed a control system for accelerator equipments. Hardware of the control system was installed and has been working on the PEFP DTL. Vacuum control system has been stably operated so far. Commissioning control hardware of the other equipments will be performed. We are upgrading and modifying the control system, especially interlock systems, to accommodate control requirements from operational experiences and to apply long-term operation.

REFERENCES

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