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Control System Design for Magnet Power Supply of 20MeV DTL

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1. Introduction

The 20MeV proton accelerator was developed at the end of 2005. Power Supply Control System becomes more important in supervisory control system as a rapid transformation in system monitoring and control is taking place due to evolution of various states. A large number of magnets have been installed and commissioned to guide the beam from LEBT to DTL at proton accelerator system. All these magnets need to be powered by highly stabilized current to maintain the alignment of the beam. Our objective is to design and develop a powerful system to control and monitor the operation of these power supplies through optical fiber communication and VME system. This paper describes the design and implementation for control and monitoring of magnet power supply for PEFP.

2. Hardware architecture of power supply control system

Power Supply Control System was designed to control 20 power supplies to power current at the DTL Quadruple of about 150. To process and develop a number of control points, fast repetition rate of control, interfaces of hardware component and software development, PEFP proton accelerator system has been built with a module based on EPICS[1] which is able to provide a large scale of a distributed control system. Power supply system has Modbus/RTU[2] protocol. It was a very important problem we decide one of the two methods, direct control based on Modbus/RTU and control through optical fiber converter interface. After discussions, we decided to develop optical fiber converter.

The magnet power supplies for 20Mev DTL will be connected to the accelerator control system. It also becomes very important to reduce the number of cables between the magnet power supplies and the control system. As using optical fiber converter, these problems will be resolved and ensure stability and fast speed.

This control system developed based on EPICS is classed in four groups, OPI(Operator Interface) Layer of the Sun Workstation, Linux PC in which operator can access, IOC(Input/Output Controller) Layer of the VME[3] system in which EPICS core is performed, Device Layer of serial to optical fiber converter connected between power supply and IOC. Figure 1 shows control system architecture and interface layer.

We completed to install real time operating system at Single Board Computer of Motorola PowerPC and compile EPICS R3.14.6 with tornado. Data Acquisition Server Board was designed to have optical input/output and Ethernet communication to make high efficiency of Modbus/RTU communication. The system will support its hardware interlock and software interlock. The operations can be controlled from OPI, power ON/OFF, Current setting.

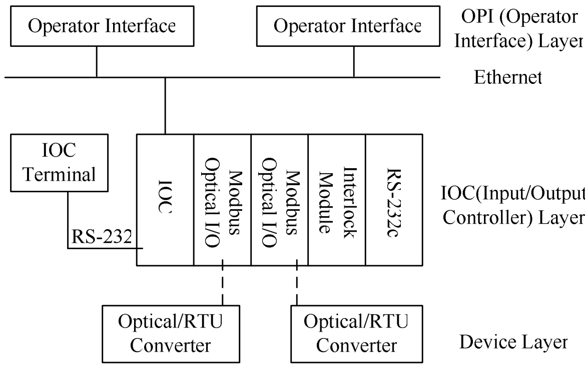

Figure 1. Control system architecture and interface layer of power supply system

3. Software components

EPICS is a collection of software tools developed by the EPICS collaboration. EPICS assumes that Input/Output Controllers(IOCs), network based on TCP/IP and Unix/Linux and Windows NT host computers for various high level control applications including operator interfaces and data logging of archiver. A VME CPU board machine running the real-time operating system of VxWorks is used as an IOC in EPICS compiled by tornado.

The EPICS run-time database on the IOC and CA constitute the core of the EPICS software. EPICS client software accesses the record in this run-time database using this logical name of the record. The protocol to access data in the run-time database is called Channel Access(CA) [4]. Read and write accesses to the EPICS run-time database from the EPICS client software triggers the access to the hardware from the IOC. User of EPICS only needs to supply hardware specific routines, hardware driver and device support routines.

EPICS core software also includes programs such as a scanner to scan the status of hardware in the way specified by the user, a CA server to handle the database access request from the client program. Configuration files prepared by the user define the actual behaviors of these programs. Figure 3 shows IOC core of control system.

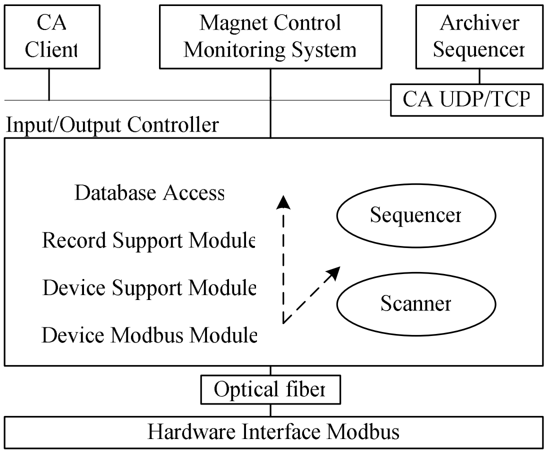

Figure 2. IOC scans the status of power supply and dispose of matters in due order through sequencer

A user can also extend the EPICS core software using the hooks in itself. For example, a user can add support fro a new device to the EPICS by supplying a device driver and device support routines. EPICS Extension applications is EDM(Extensible Display Manager), ALH(Alarm Handler) and Archiver [5,6,7]. These applications is installed on host computers. The EPICS can be built a basic control application without any programming. The host computer also serves a development environment for VxWorks which is the operating system of IOCs. X-terminals are used as an operator interface in the PEFP accelerator control system.

4. Conclusion

The control system design of the magnet power supply for PEFP 20MeV DTL was fixed and will be developed by the end of this year. The optical fiber converter will support stability, much faster speed than normal serial cable. We are also performing to design the EPICS database for each hardware device.

Acknowledgements

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