THE CONTROL SYSTEM FOR THE PEFP 20MEV PROTON LINAC

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Abstract

The 20MeV PEFP(Proton Engineering Frontier Project) Linac consists of Injector, 3MeV RFQ and 20 Mev DTL. The control system for 20MeV beam commissioning of this facility has been developed since the last year at PAL (Pohang Accelerator Laboratory). The Control system is based on EPICS which is widely used in accelerators. Four VME 64 Crates and MVME5110 Power PC CPU Boards running under VxWorks are used for this system. This paper presents the development progress of the control system for RF , BPM , MPS and Timing system.

INTRODUCTION

KAERI(Korea Atomic Energy Research Institute) has been launched in 2002.7 to construct proton accelerator, and it will be under construction for next 10 years. The name of this project is PEFP and Beam parameters are showed below Table 1.[5]

Table 1: PEFP Accelerator Parameters

Parametes	Values
Particle	proton
Beam energy	100MeV
Maximum peak current	20mA
Operation mode	pulse
Repetition rate	15Hz(120Hz)
Pulse width	<1ms(2ms)
Maximum beam duty	1.5%(24%)
Maximum average beam current	0.3mA(4.8mA)

The entire project is divided into 3 phases, and we aim to finish 20 MeV accelerator for the first phase. For KAERI, our institute is chosen in competition with other institutes to develop control system for successful commissioning of 20Mev accelerator.

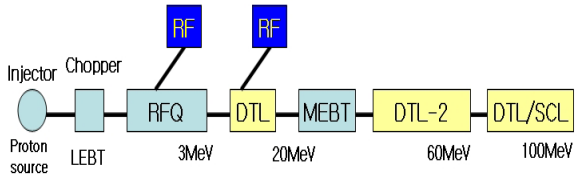

Fig. 1: PEFP Accelerator structure

Also before taking over this project, our control group has already decided to switch PLS control system to EPICS in the middle of 2001, and we are partly applying EPICS to old control system.

Due to complete two project with limited human resource, EPICS Toolkit that has become de facto Standard in Accelerator Control Field is applied to PEFP as it has been done to PLS.[1][4]

For the devices of PEFP that are installed one at a time, step by step, control system has been developed for corresponding SubSystem, and we plan to set up on site at KAERI, and use it for control system of 20Mev commissioning.

CONTROL SYSTEM FOR 20MEV PEFP

4 VME systems and 2 industrial PCs will be used for LowLevel Data Acquisition at control system for 20Mev PEFP. Fig 2. shows Control System Architecture for 20MeV PEFP.

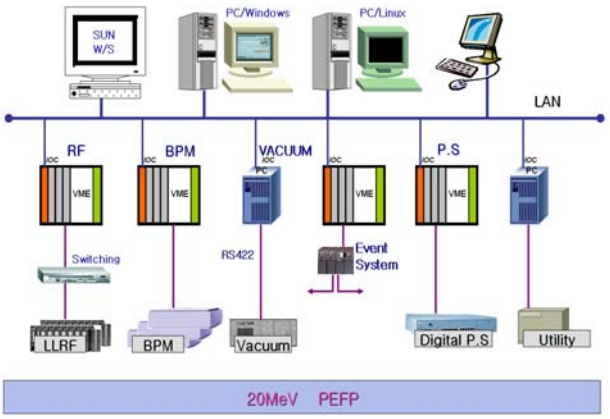

Fig. 2: Control System Architecture for the 20MeV PEFP

Sub-items shown next are development environment and status for 20Mev Control system.

EPICS Development Environment

Sun W/S is used as host to develop EPICS IOC, and Tornado Development Tool will be loaded on this host. As target hardware, PPC VME Computer and industrial PC are used. Also, of this host, various tools of EPICS extension are configured and installed.

Low Level RF System Control

RF system consists of devices such as RFQ, DTL, High Power RF Circuit , cooling system, and RFQ Klystron.

In order to apply advanced Control Algorism to complex devices of RF system, studies about various control methods have done. As a result, for independence of RF devices and simplification of the connection to upper EPICS control system, we decided to embed local controller into Low level RF system. Connection between two systems is Ethernet using Modbus bus protocol.

To control LLRF system, Motorola PPC Single Board computer will be used as IOC. System mentioned above is already developed in the lab, simulation system that enables testing this control system without LLRF is also developed.

Beam Diagnostics

Four BPM(Beam Position Monitor) are used to monitor beam position, and Electronics module custom-made by Bergoz company was received. Based on this, system layout and control signal list was decided.

For VME ADC I/O (Input/Output) Board, 2 ADC Board that is VTR812/10 and AVME9325-5 are used to meet the various needs of Beam diagnosis device, and EPICS Driver is done set up. Also we developed simulation module that can produce imaginary pickup signal to test in the lab.

Power Supply Control

In 20Mev DTL, there needs to be 42 Magnet power supplies for Quadrupole to have the accurate alignment of beam. At PLS, we have kept on upgrading magnet power supply of corrector for Beam Orbit Stabilization. Due to limited time and human resource, we decided to develop layout of control system identical to promote maximum efficiency. After reviewing MPS Control system and MPS from foreign accelerator labs, we have chosen SLS type which is applicable to our system. Now, prototype system for this is under test in the lab.

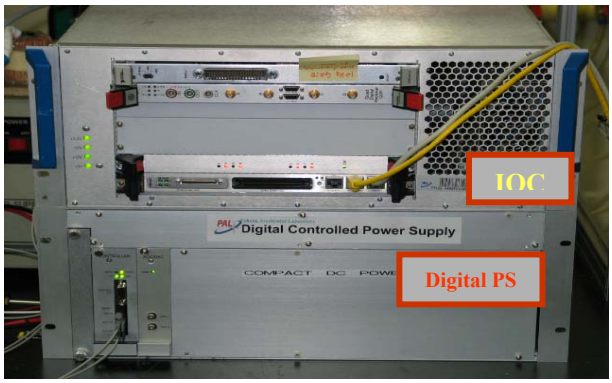

Fig. 3: MPS Control system and Digital Power Supply

Utility Monitoring

Cooling system for RFQ and DTL is installed, and it is managed manually. At PLS Linac, we accurately set the accelerator column water temperature 45+ -0.2C. Therefore, we plan to refer to DDC(Direct Digital control) of Cooling system at PLS Linac. Spec for Cooling system of DTL is following; Flow rate:6000 L/min, pressure drop: 3kgf/cm^2, cooling capacity: 2MW, temperature difference: ~5^{0}C. Because of all types of sensors attached to cooling system, control and monitoring of temperature, flow rate, pressure, flow switch on/off signal. This low level control system will consists of PLC, Industrial PC, and RTM(Remote Terminal Module), and Mod-bus will serve as connection between EPICS and this low level control system.

TIMING SYSTEM

As timing system, it was first developed at APS, and we chose Event system with improved safety and performance based on PSI. Detail Spec. has been decided and system layout is configured. Event Generator and Event Receive VME Module was set up based on EPICS.

OPERATOR INTERFACE

We use Sun workstation (solaris8) as platform, used as Operator interface for PEFP. Screen development tool uses MEDM, EDM of EPICS Extension, then developed Monitoring and Control screen. Screen design is set to operate sub-system screen at the menu. We designed Control and Monitoring screen of Vacuum, LLRF, Time Event System, and successfully finished each test for IOC and channel interface.

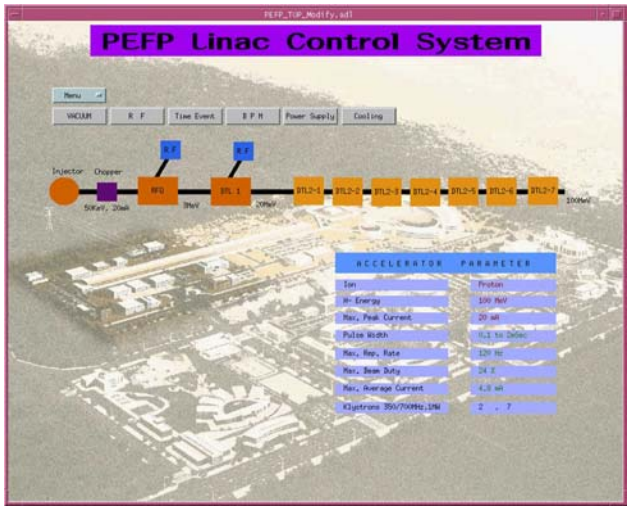

Fig. 4: Control System Architecture for the 20MeV PEFP

FUTURE PLANS

After completion of development of the control system, it will be installed and operated in KAERI, Daejeon in 2005.4. First of all, sufficient education of control system must be executed to PEFP control Gr. For stable operation and extension of control system. Also, it has to be debugging through on site test to see if control system works fine as in commissioning scenario.

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[4] *http://www.aps.anl.gov/epics/*

[5] *http://www.kaeri.re.kr/npet/proton*