DEVELOPMENT OF EPICS CONTROL SYSTEM FOR ODA MAGNET POWER SUPPLIES AND GIGE CCD CAMERA

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Abstract

The Radiation Equipment Research Division of the Korea Atomic Energy Research Institute has been operating a 10 MeV RF electron linear accelerator, which is used for electron beam irradiation. The beam power and energy of the RF electron linear accelerator are 10 kW and 10 MeV. The accelerator is composed of an electron gun, an S-band (= 2856 MHz) accelerating structure, a klystron, electromagnetic solenoids, a scanning electromagnet, an RF driver, a modulator, and a chiller. The linac components have deteriorated due to a long operation time of 9 years. In this paper, we described Experimental Physics and Industrial Control System (EPICS) to control ODA magnet power supplies for solenoids and steering magnets of the 10 MeV electron beam irradiation accelerator.

INTRODUCTION

The Korea Atomic Energy Research Institute has used a 10 MeV RF electron linac [1-2] for electron beam irradiation service. The accelerator was fabricated from Russian about 10 years ago. Therefore, the overall system is corroded and difficult for user services due to the use of Russian. Thus, our purpose is upgrade and convert the linac to Korea designed linac. The accelerator is used for irradiation treatment by electron beam radiation such as deformation ecology / environment, disinfection / sterilization, radiation treatment of foodstuffs, sterilization of organic fertilizer, and wood / sterilization. The accelerator specifications are summarized in table 1. The linac has a beam energy of 10 MeV, operation frequency of 2856 MHz (S-band), and a variable energy range of 5 MeV and 10 MeV. Table 2 summarizes the specifications of the klystron. In the linear RF electron accelerator, the klystron produces a high RF power from the RF driver's low RF power. The peak power of the klystron is 6 MW, the average power is 25 kW, and the beam duty is 0.4%. The vacuum system of the RF linac is operated at about 1×10^{-6} Torr and cooling has been supplied through the chiller. Currently, the accelerator control is operated using a Windows XP system. The communication system has difficulty maintaining the linac, which has a complicated configuration with a double jumper wire. In this paper, we describe how to implement control through EPICS and clear the old version of the window operating system.

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Table 1: RF Linac Specifications

Parameter	Value	Unit
Particle	Electron	-
Operation Mode	Pulse	-
RF Frequency	2856 ± 5	MHz
Repetition Rate	10 - 300	Hz
RF Power	6	MW
Pulse Width	10	μs
Beam Energy (Max)	10	MeV
Beam Current (Average)	1	mA
Scanning Size	800 × 200	mm

Table 2: Klystron Specifications

Parameter	Value	Unit
Peak Power	6	MW
Average Power	25	kW
Pulse Width	10	μs
Maximum Current	235	A
Maximum Voltage	50	kV
Duty Cycle	0.4	%

DESIGN CONCEPT

Overall accelerator structure is shown in Fig. 1.

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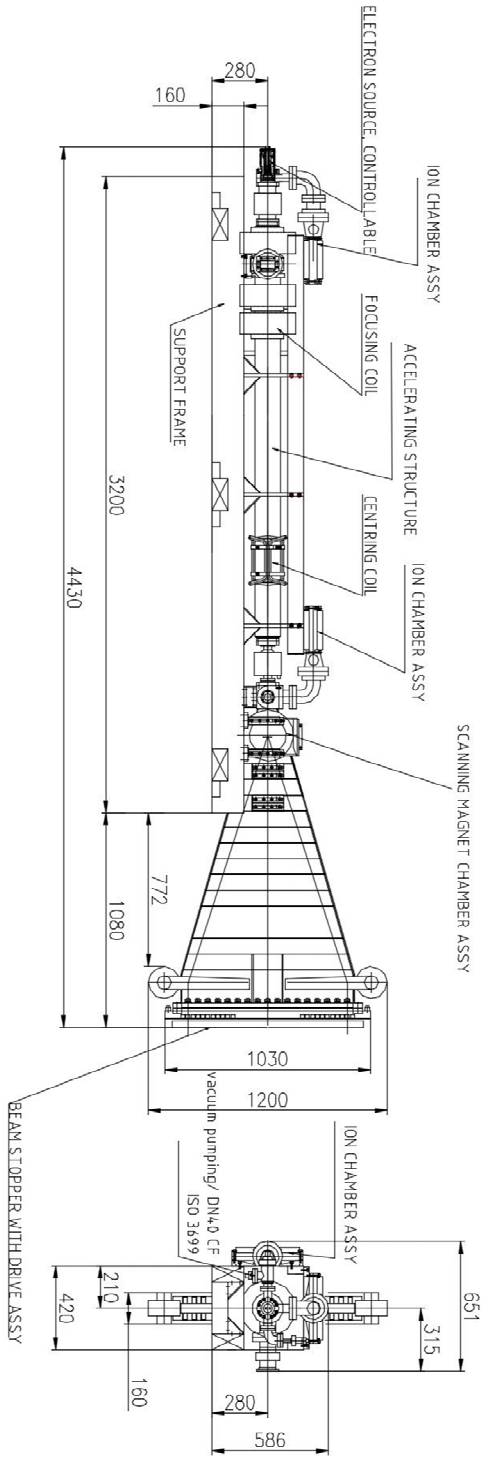

Figure 1: 10 MeV RF Linac Structure.

The accelerator is composed of an electron gun, an accelerating tube, six beam focusing solenoid magnets, an ICT, a klystron, an scanning electromagnet, and a chiller.

Currently, the accelerator control system uses Windows XP, and is inconvenient and difficult to use. Therefore, in this project, we show the configuration of the epics [3] control system for controlling the accelerator, and Fig. 2 shows the magnet power supply for the electromagnetic control. Table 3 summarizes the model number, the interface, and the control type of the magnet power supply.

Table 3: Magnet Power Supply and MOXA Terminal Server - Model, Interface, and Port Number

Model	Interface	Port Number
ODA 20-30	RS-232, Ethernet	4001
ODA 20-60	RS-232, Ethernet	4002
ODA 20-60	RS-232, Ethernet	4003
nPORT 6650-32	Ethernet	-

Figure 2: Magnet Power Supply and MOXA Terminal Server

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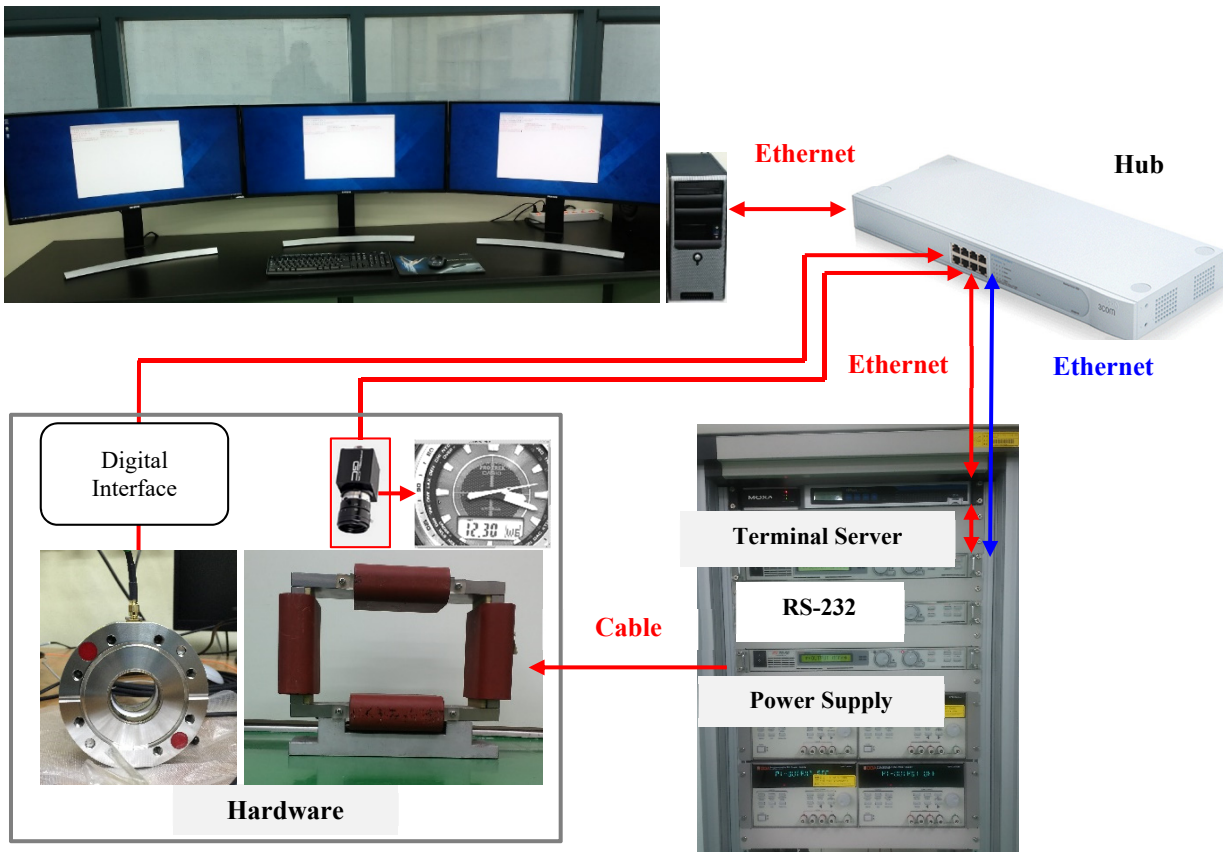

Figure 3: Current Design Configuration of the EPICS Control System for 10 MeV RF Linac

Figure 3 shows a configuration of the EPICS system for controlling the solenoid electromagnet power supply and obtaining the beam image. The accelerator was implemented via Ethernet and RS-232 communications.

CONCLUSION

A 10 MeV RF linac EPICS upgrade project was performed by the Korea Atomic Energy Research Institute. In this paper, we implemented a solenoid magnet power supply control and camera control for image acquisition which is used for EPICS. In the near future, we will try to apply a vacuum monitoring system, cooling temperature monitoring system, and an RF power monitoring system, and implement an automatic beam optimization system using MATLAB and MCA.

ACKNOWLEDGEMENT

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