Improvement of the automated operating parameter setting system for the beam service

Jae-Ha Kim *, Young-Gi Song, Sung-yun Cho
Korea Multi-purpose Accelerator Complex, Korea Atomic Energy Research Institute, Gyeongju 38180, Korea
*Corresponding author:jhkim1@kaeri.re.kr

1. Introduction

Korea Multi-purpose Accelerator Complex (KOMAC) has been operating a 100 MeV proton linear accelerator. A proton beam, which is accelerated by low energy beam transport (LEBT), a radio frequency quadrupole (RFQ) and eleven drift tube linac (DTL) tanks, is transported to the five target room. KOMAC has been installed various system such as a power supply system for the magnets, low level radio frequency (LLRF) system and cooling system and has been implemented the control system based on EPICS[1] to monitor and control all the parameter to control lianc and peripheral devices remotely. Operators in control room should control the operating parameters and The conditions are extensive because they change according to the needs such as beam energy, dose rate of the users

To improve the convenience of operators, a save and restore system that can record and restore beam conditions and algorithms that can automatically adjust beam flux coefficients according to operating parameters and beam energy have been added. In this paper, we will describe the improvement of the automated operating parameter setting for the beam service.

2. KOMAC control system

The control system based on Experimental Physics and Industrial Control System (EPICS) framework has been implemented for a proton linac at KOMAC and control system studio(CSS)[2] toolkit that communicate with EPICS Input Output Controllers(IOCs) using Channel Access(CA) protocol has been adopted for the User interface for KOMAC. Figure 1 shows the block diagram of KOMAC control system.

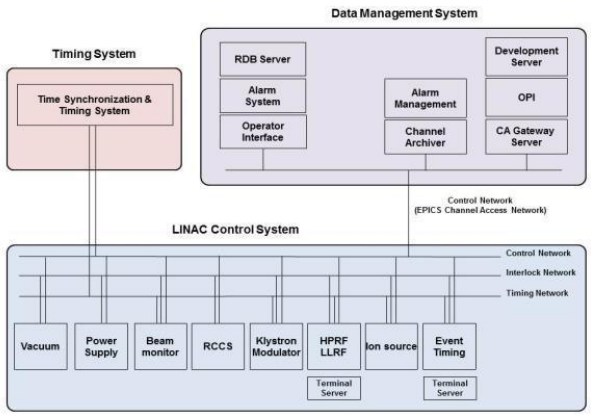

Fig. 1. The block diagram of KOMAC control system.

A timing system was installed to keep linac and peripherals operating in synchronization with each other. And sub control system was implemented to control peripherals using EPICS IOCs.

3. Beam line control system

We have been operating five target rooms according to needs of users and in order to transmit proton beams to each target rooms, gate valves and power supplies for magnets at beam lines must be adjusted.

3.1. Automated gate valves control system

Gate valve control system is involved in vacuum control system and Programmable Logic Controllers (PLCs) was installed to control vacuum status. PLCs are integrated with the KOMAC control system through the EtherIP module based on EPICS and are controlled using the CSS toolkit. To activate the desired target room, the operators have to manually open the gate valves in the corresponding path one by one. Therefore, the automated gate valves control algorithm has been constructed in conjunction with the key box that shows the currently used target room. Figure 2 shows the algorithm to control gate valves with the key box.

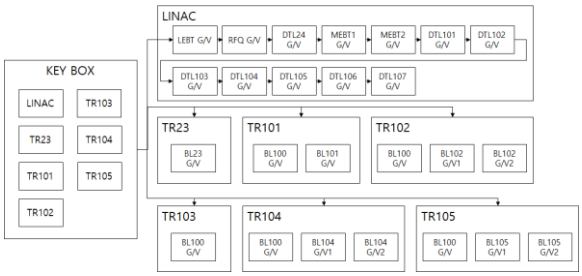

Fig. 2. Algorithm to control gate valves with the key box.

A key box signals are delivered to the E2260 ADC device and E2260 ADC is monitored by EPICS IOCs using Modbus module based on EPICS. And the algorithm to control gate valves are implemented using EPICS sequencer module.

3.2. Automated alarm setting system for power supply

The value of the power supplies for beam line quadrupole magnets and banding magnets should be adjusted to transport proton beams according to the beam energy and experiments that users require and those values are managed using Save &

Restore application that KOMAC implemented. And the alarm range of the operating variables should be changed to notify the operators of an abnormal situation whenever the value of operating variables is adjusted. The automated alarm range setting system for power supply is integrated with the KOMAC beam interlock system and displayed in the control room as shown in figure 3.

Fig. 3. LINAC status monitoring system for KOMAC

3.3 The measurement system according to Beam energy

The beam energy is changed by the delay and width of RF and the LLRF system, and the coefficient for measuring the beam flux varies for each beam energy. We installed the automated measurement system according to beam energy to measure the beam flux irradiated to the target. The system figures out beam energy through the delay and the width of RF and LLRF system, and changed the coefficient for calculating the beam flux and the result is displayed as shown in figure 4.

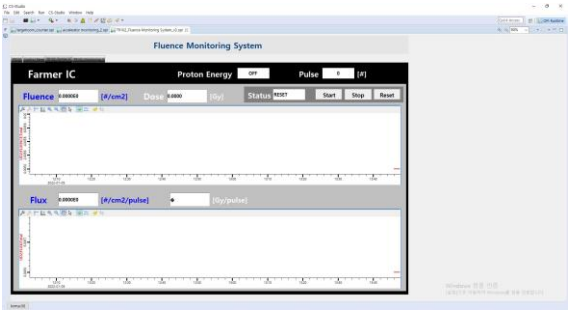

Fig. 4. The measurement system for beam flux

4. Conclusions

For operator convenience, the automated operating parameter setting system for beam service has been implemented. The system manages the gate valves for the target rooms and adjusts the value of the operating parameters. The system is integrated with the beam interlock system for KOMAC and stops the beam when an abnormal situation occurs.

In the future, we are planning to integrate beam energy adjusting system with the key box to activate the target room. The 100 MeV proton linac will be ready by turning keys of the key box.

REFERENCES

[1] EPICS, http://www.aps.anl.gov/epics/

[2] CSS, http://controlsystemstudio.org/

[2] EPICS Modbus, https://cars9.uchicaggo.edu/software/epics/modubsDoc.html