EPICS-based Control system For KOMAC RI Beam line

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1. Introduction

Korea Multi-purpose Accelerator Complex (KOMAC) has been operating 100 MeV proton linear accelerator. The beam is accelerated with RF and transported into beam-line halls using two 45 bending magnets. The KOMAC is operating 2 beam lines that are separated by the beam energy, 20 MeV and 100 MeV [1, 2]. A beam line that produce radioisotope using 100 MeV beam line has been constructed to provide various beam service to user and the control system for RI beam line control system is implemented. The KOMAC control system is based on Experimental Physics and Industrial control System (EPICS) software [3, 4]. To synchronize with the KOMAC control system, RI beam line control system is based on EPICS and using Control System Studio (CSS), operators control and monitor status of RI beam line. Implementation of RI beam line control system is presented and some preliminary results are reported.

2. Design of RI beam line

The KOMAC has two beam line halls that are separated by beam energy. One is 20 MeV beam line hall and the other is 100 MeV beam hall. Each beam line hall has five beam lines that beam is transported into and one beam lines (TR23, TR103) are operating for user service. The structure of 100 MeV beam line is shown in Fig. 1.

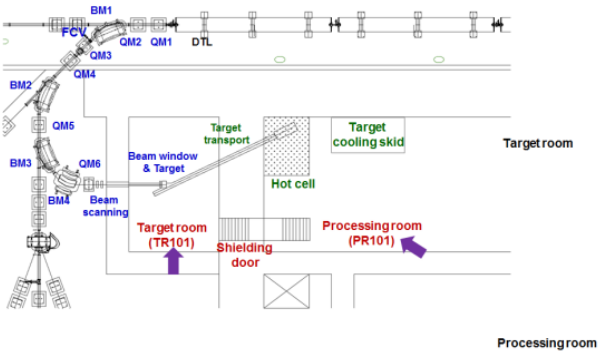

Fig. 1. Structur of the KOMAC 100-MeV beam line

The beam is accelerated and transported into 100 MeV beam line hall using two 45 bending magnet. To carry the beam into RI beam line, two additional bending magnets (BM3, BM4) are installed and three quadrupole magnets to minimize the dispersion are installed. As the beam status is monitored using Beam Loss Monitor (BLM) and Beam Phase Monitor (BPM) which are set 45 bending magnets, we adjust the accelerator to improve the beam.

The KOMAC vacuum system is designed to maintain the degree of vacuum in beam line below high-degree vacuum using scroll pump, gate valve and Turbo Molecular Pump (TMP).

3. Control system for RI beam line

2.1 KOMAC control system

KOMAC has been operating 100 MeV proton linac, using EPICS based control system. Following Fig.1 shows the block diagram of KOMAC control system.

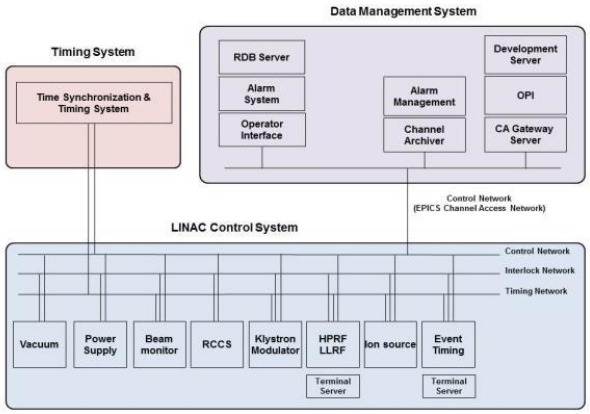

Fig.2. Block diagram of KOMAC control system

EPICS InputOuput Controllers (IOCs) have been implemented for each sub systems. About 70 EPICS IOCs and about 10,000 Process vaiables (PVs) are implemented and configured to operate KOMAC linac. CSS tool that communicate with EPICS IOC using Channel Access (CA) protocol is adopted for KOMAC user inteface. The KOMAC linac is controlled and monitored in the control room using EPICS IOC and CSS

2.2 RI beam line control system

The EPICS IOC was created and two EPICS IOCs were reconfigured to control devices for RI beam line.

The specifications of the RI beam line control devices to control are summarized in Table 1.

Table I: The Specification of RI beam line control devices

Device	Quantity	Remark
Magnet Power supply	2	Magnet
TMP controller	1	TMP
Vacuum gauge	1	Degree of vacuum
Vacuum PLC	1	Valve, scroll pump
Nport	1	Serial to Ethernet
Switch	1	network
ADC	1	BLM, BPM

The control devices are installed in klystron gallery. The network of KOMAC control system is based on Ethernet, so control system for RI beam line communicates via Ethernet. Serial communication is converted to Ethernet using Nport serial to Ethernet converter.

The Vacuum IOC was configured with EPICS base3.14.12.4, asyn4-25 and streamdevice2-6 on Centos 6.3. The vacuum IOC controls TMP and monitors the status of TMP and degree of vacuum. Magnet power supply and vacuum PLC were included in existing EPICS IOCs that are magnet power supply IOC and vacuum interlock IOC, reconfiguring IOC configuration.

2.3 Archive system

The operating data of RI beam line are archived every second using channel archiver. CSS and archive Viewer export the stored data. Following Fig.3 shows the archived data of the RI beam line.

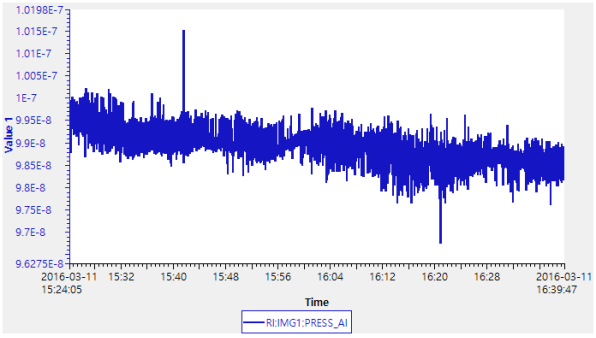

Fig.3. The archived data of the RI beam line.

2.4 User Interface

User Interfaces of KOMAC are implemented with CSS that communicates with EPICS IOC via CA protocol. Operators control and monitor the status of RI beam line using user interface in control room.

Alarm Handler alarms when operating parameters are greater or lower than limits. The limits are set with HIHI, HI, LOW and LOLO field of EPICS DataBase (DB). Alarm Handler of KOMAC is shown in Fig.4

Fig.2. Alarm Handler of KOMAC

3. Conclusions

The control system for RI beam line is implemented. The direction and dispersion of the accelerated beam is controlled and monitored using the control system.

In the future, autosave module that automatically saves the values of EPICS process variables to file on a server, and restores those values when IOC is rebooted is added in RI beam line control system.

ACKNOWLEDGMENT

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REFERENCES

[1] Hyeok-Jung Kwon, “Design Study on the Beam Line for Radioisotope Production at KOMAC”, Journal of the Korean Physical Society, Vol. 67, No. 8, October 2015, pp. 1387～1392

[2] Yong-Sub Cho, Hyeok-Jung Kwon, Dae-Il Kim, Han-Sung Kim, Jin-YeongRyu, Bum-Sik Park, Kyung-Tae Seol, Young-Gi Song, Sang-Pil Yun, Ji-Ho Jang, “The Komac Accelerator Facility”, Proceeding of International Particle Accelerator Conference, Shanghai, China, 2013.

[3] Young-Gi Song*, Jae-Ha Kim, Tae-Sung Ahn, Hyeok-Jung Kwon, Yong-Sub Cho, “Improvement of Control System Infrastructure and High Level Application for KOMAC LINAC”, Transactions of the Korean Nuclear Society Autumn Meeting Gyeongju, Korea, October 29-30, 2015

[4] Experimental Physics and Industrial Control System (EPICS). URL:http://www.aps.anl.gov/epics.