Improvement in the interlock system for the vacuum system at KOMAC

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

1. Introduction

The Korea Multi-purpose Accelerator Complex (KOMAC) has been operating a 100 MeV linear accelerator and various subsystems such as vacuum system, RF system, cooling system and power system have been established to control the linac. The proton linac is precisely controlled by the subsystems, and since malfunctions of these system can significantly impact other systems and the linac, an interlock system that protects the relevant systems from such malfunctions has been implemented and is in operation. However, with advancements such as improvements in the linac and beamline expansion, several equipment and systems are being added and upgraded. In line with these developments, the interlock system for KOMAC must be upgraded. As a part of these initiatives, enhancements have been applied to the interlock logic of the vacuum interlock system. In this paper, we provide a detailed account of the upgraded interlock system for the vacuum system.

2. Vacuum System

A proton linear accelerator is composed of an ion source, a radio-frequency quadrupole(RFQ) and 11 drift tube linacs(DTLs) to accelerator proton beam. And the proton beam is delivered to 5 target rooms prepared for user experiments. Figure 1 shows the layout of the 100 MeV linear accelerator at KOMAC.

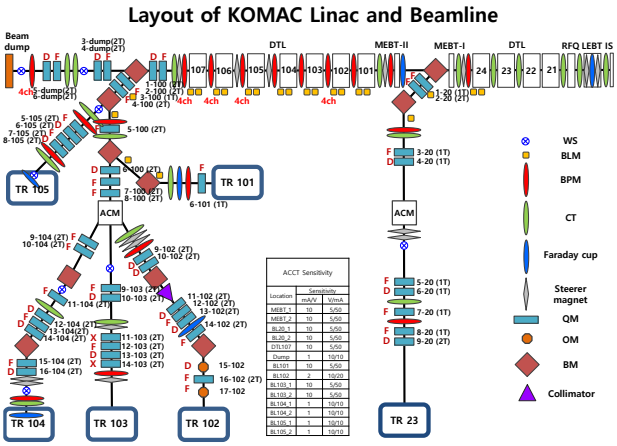

Fig. 1. layout of the 100 MeV linear accelerator at KOMAC.

Since the acceleration and transmission of the beam occur in a vacuum environment, maintaining a specific vacuum level is important for stable beam service. Thus a vacuum system based on a Programmable Logic Controller(PLC) has been implemented to maintain and regulate the vacuum conditions of the linac. Figure 2 shows the block diagram of vacuum system at KOMAC.

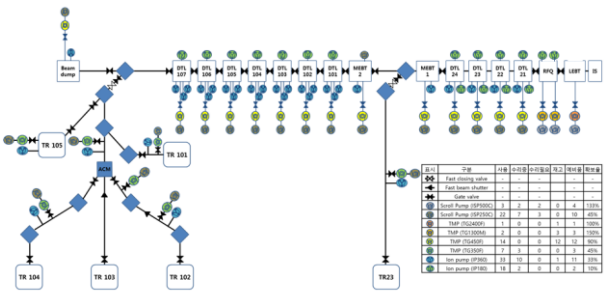

Fig. 2. The Block diagram of the vacuum system at KOMAC.

PLCs control components of the vacuum system, including ion pumps, turbo-molecular pumps, scroll pumps, gate valves and vacuum gauges. The status of the components is delivered to the control room through a control system based Experimental Physics and Industrial Control System(EPICS).

2.1 Vacuum Control System

KOMAC has been implemented the EPICS-based control system to control the linac and peripherals. Figure 3 shows the block diagram of the KOMAC control system.

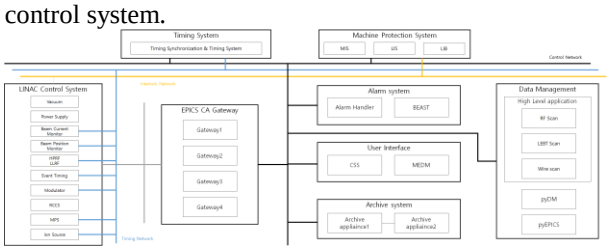

Fig. 3. The Block diagram of the KOMAC control system.

Each subsystem is controlled by one or more EPICS IOCs and adoption of distributed control system has enhanced the stability of the control system. To interface the vacuum system with EPICS IOC, and EtherIP module developed based on EPICS was adopted to control the PLCs. EPICS IOC for vacuum system transmitted the status of the vacuum system to the control room and the information is shown using a Control System Stuido(CSS) toolkit that can communicate with EPICS. Figure 4 shows the user interface for the vacuum system.

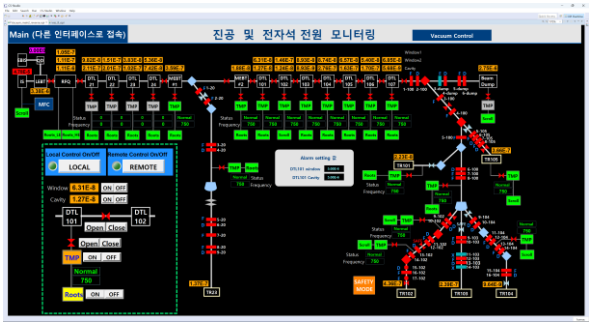

Fig. 4. The Block diagram of the KOMAC control system.

.

2.2 Interlock Systeml

The Interlock system for vacuum system is configured through PLC logic. Figure 5 shows the interlock sequence of the vacuum system.

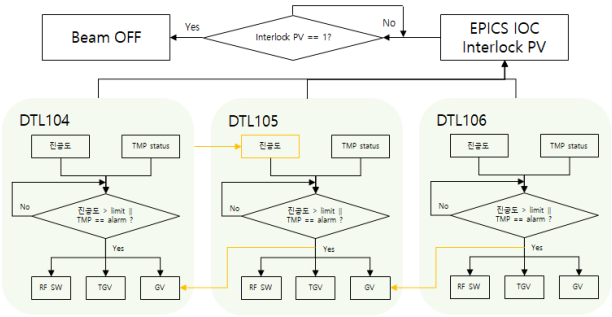

Fig. 5. The interlock sequence of the vacuum system.

The Existing vacuum interlock system is designed to monitor a vacuum level of a cavity and the state of the TMP. In case of anomalies, it closes the gate valves of the DTL to isolate the section and terminate beam extraction. However improved interlock system is configured to closed the gate valve of the respective DTL and the TMP gate valve, generating an interlock signals to automatically turn off the RF system applied to the corresponding DTL.

3. Conclusions

The improved interlock system for vacuum system has been applied to the linac. It has been verified that the corresponding DTL is isolated and the RF system is turned off when an event occurred.

In the future, we will modify the interlock logic to include the vacuum level of the window at DTL and integrate the interlock system with the Machin Protection System.

REFERENCES

[1] EPICS, http://www.aps.anl.gov/epics/
[2] CSS, http://controlsystemstudio.org/
[3] EhterIP, https://github.com/epics-modules/ether_ip