The PLC Based Resonance Control Cooling System Upgrade at The KOMAC

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1. Introduction

The Korea Multi-purpose Accelerator Complex (KOMAC) has 11 sets of Drift Tube Linac (DTL) tank in order to accelerate the proton beam from 3-MeV to 100-MeV [1]. 11 sets of The Resonance Control Cooling Systems (RCCS) are in the operation to control each DTL tanks due to the each DTL's different characteristics. RCCS has been implemented via in-house custom built hardware unit in the control panel which can support to modify the control logic since 2013. Due to the phenomenon of aging including the sudden system failure of control unit, we decided to apply the new PLC based control system to RCCS21 and RCCS22 in KOMAC.

2. Methods and Results

2.1 System Setup

The RCCS is consisted with pump, heat exchanger, 3way valves and accessories on the skid plate, size of 2m(W) x 2.2m(D) x 2m (H) as per Figure1[2].

Fig. 1. RCCS's piping and instrument diagram

RCCS's piping and instrument diagram is shown in Figure 2[3].

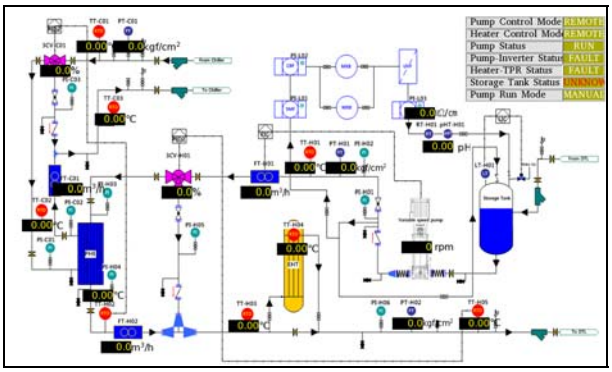

Fig. 2. RCCS's piping and instrument diagram [3]

The each RCCS has the motor control panel and local control panel as per the below Figure 3.

Fig. 3. RCCS motor control panel and local control panel.

The motor control panel provide power to the pump motor and the heater and the local control panel. The local control panel is equipped with the control I/O unit, temperature indicator and pressure indicator. The control I/O unit has the analog input, analog output, digital input, digital output, RTD, backplane board and single board computer (SBC) shown in Figure 4.

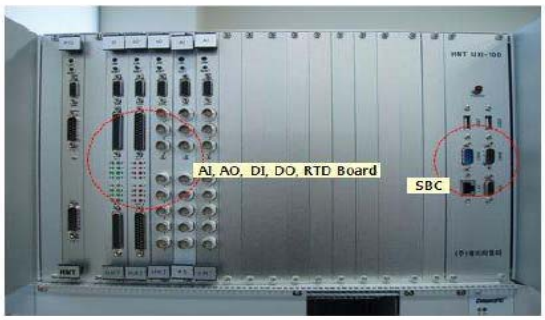

Figure 4. The control I/O unit

The specification of SBC is indicated on Table 1.

Local Controller	Specification
RCCS-022-WPS-CBN-LC	-19”, 6U Subrack -Backplane slot type -Memory: 512 MB -HDD: 4GB Compact Flach Memory -Ethernet: 10/100/1000 -Linux (Fedora Core8) -RT Kernel: 2.6.23.1 -EPICS Sequencer 2.0.11

Table 1. Single Board Computer specification

2.2 Method

During the operation we noted that RCCS 21 controller was disconnected to main control server during the beam service. Engineer visited to the local site for checking the states of equipment. The control I/O unit was failed and control authority was moved to Eurotherm unit which is back up system for the control I/O unit. The control I/O unit has the difficulty of the modification and maintenance due to the in-house custom built hardware unit.

So RCCS control panel need to be updated based widely using PLC system. The PLC based controller has the various advantages such as easy modification, replacement and extension. The new control panel is designed as per the below block diagram refer to Figure 5.

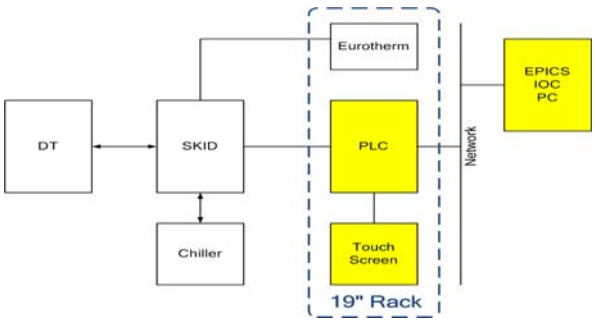

Figure 5. RCCS 21,22 Control Panel Block Diagram.

As per Figure 5. The control panel is consisted with PLC, Touch screen and Eurotherm unit. The control system will connect to the EPICS network via IOC server refer to Figure 6.

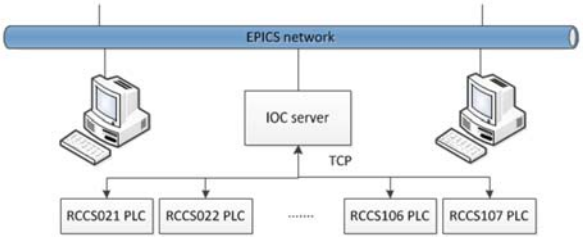

Figure 6. EPICS IOC Server Block Diagram

This upgrades were implemented only to RCCS 21, RCCS 22 out of 11 sets of RCCSs. The work was proceeded during the regular maintenance period in KOMAC. The specification of component for new control panel is indicated in Table 2.

Local Controller	Specification
RCCS-022-WPS-CBN-LC	-ControlLogix 2 MB Enet Controller -Dual Loop Controller/Programmer -PanelView Plus 7 Graphic Terminal -5069 DC Input Module -5069 Analog Input Module -5069 Analog Output Module -5060 Compact I/O Module

Table 2. Component specification

First the original components had been removed from the panel case shown in Figure 7. The wiring and termination was completed as per diagram indicated on Figure 8.

Figure 7. Original Component Removal of RCCS 21,22 Control Panel

Figure 8. PLC Installation and Termination

During the commissioning we had the difficulties for finding optimized value for control RCCS. The reason is that the different characteristics was found between PLC system and the original custom built hardware unit. By testing RCCS with new control panel the appropriated value was checked and implemented. In addition the interlock for pump, heater and temperature control was tested and ensured.

2.3 Result

The PLC based upgraded RCCS control system was installed and completed as per Figure 9.

Figure 9. RCCS 21, 22 control panel

The RCCS control screen shows the clear view of the status including water temperature and pressures based on the piping and instrument diagram refer to Figure 10.

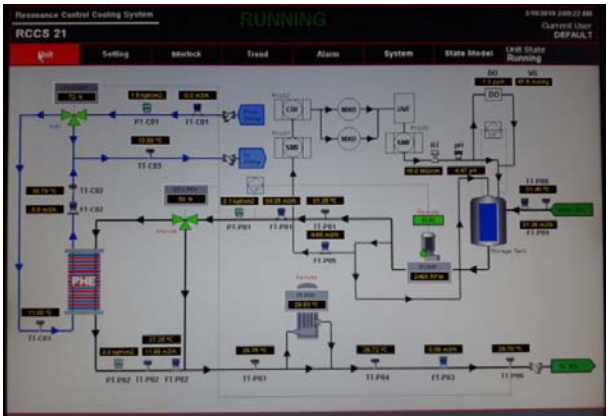

Figure 10. RCCS 21 Unit Screen

In the Figure 11, the interlock system is also updated for the uncomplicated diagram. In the diagram, interlock can be enable to the water pressure, water flow rate, and water temperature and storage tank level. In addition, the alarm is available for the water heater unit by monitoring water temperature and water flow meter.

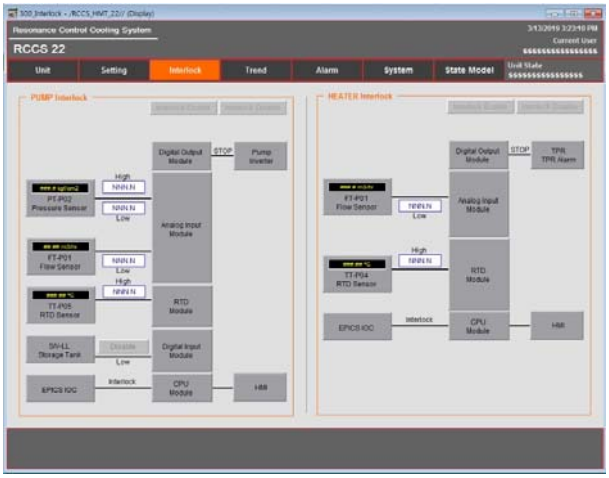

Figure 11. Interlock Diagram

During the beam operation we monitored the RCCS 21, 22 control stabilities. As per below Figure 12 the temperature range for RCCS21 is from 29.71℃ to 29.69℃ (Setting temperature is 29.70℃) and for RCCS22 is from 27.21℃ to 27.19℃ (Setting temperature is 27.20℃). Considering acceptable temperature deviation which is ±0.1, the temperature deviation of ±0.02 is totally acceptable condition.

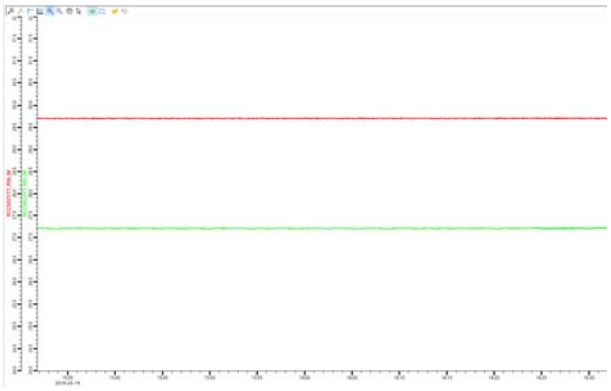

Figure 12. RCCS 21, 22 temperature deviation

3. Conclusions

Changing the aging control system to new control system is a critical part for operating equipment sustainably. RCCS 21 and 22 control panel including in-house custom built hardware unit was upgraded to AB PLC with touch screen for easy maintenance and modification successfully. In this year RCCS 23, 24 control panel will be changed to the PLC based system.

ACKNOWLEDGMENT

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