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Implementation of Local Monitoring Box for Cooling Water Flow from Drift Tube at The KOMAC

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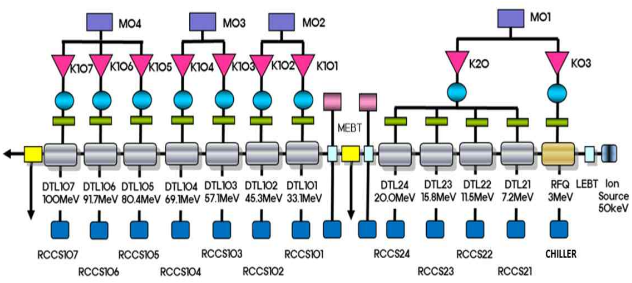
1. Introduction

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]. A Resonance Control Cooling Systems (RCCS) are providing a cooling water to the drift tube (DT) inside of DTL tank by controlling the resonance frequency. The cooling water low flow can have the heavy damage on DT so there are 52 number of flow meter were equipped on the return line of the cooling water from the DTL tank. According to the 2022 year operation report two times of trip were happened from the flow meter which cause the interlock with the power supply for the DT. It was difficult to find out which flow meters were tripped due to the common connection with the related group such as DTL 21, DTL 22, and DTL 23. For the easy acknowledgement of flow meters status, we implemented the local monitoring box for cooling water flow meters on DTL 21.

2. Methods and Results

2.1 Current System

Total 11 DTL tanks are installed to accelerate the beam from 3 MeV to 100 MeV as per below block diagram (Fig 1) [2].



M: Modulator
K: Klystron
RFQ: Radio Frequency Quadrupole
LEBT: Low Energy Beam Transport
MEBT: Medium Energy Beam Transport
DTL: Drift Tube Linac
RCCS: Resonance Control Cooling System

Fig. 1. Block diagram of 100 MeV proton accelerator at KOMAC

Figure 2 shows arranged DTL tanks in the tunnel area. DT magnet is equipped and aligned inside of DTL tank. The number of DT is different according to each tank.

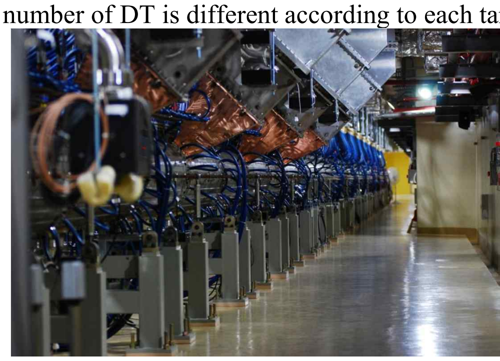


Fig. 2. DTL tanks at KOMAC

DT numbers and RCCS flow rates are indicated as per below Table I.

Table I: DT numbers per DTL tank

DTL No.	DT Number	Flow rate (m^3/h)
DTL 21	52	30.7
DTL 22	40	23.5
DTL 22	34	22.8
DTL 22	30	21.5
DTL 101	35	27.8
DTL 102	29	26.8
DTL 103	26	25.4
DTL 104	24	30.5
DTL 105	22	22.4
DTL 106	21	21.6
DTL 107	20	20.2

RCCSs provide the cooling water to DT magnet with the closed system. The break of the cooling water flow can cause the permanent damage to the magnet. The flow meters are installed on the return line of cooling water as per Figure 3.

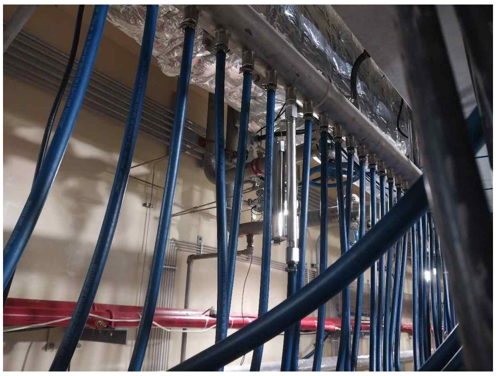


Fig. 3. Flow meter on the cooling water return line

When the cooling water flow is low, the interlock is activated to cut the power for the magnet to prevent the damage of DT magnet. But the flow meter is connected directly each other as per Figure 4 so it is hard to recognize the tripped flow meter in the site.

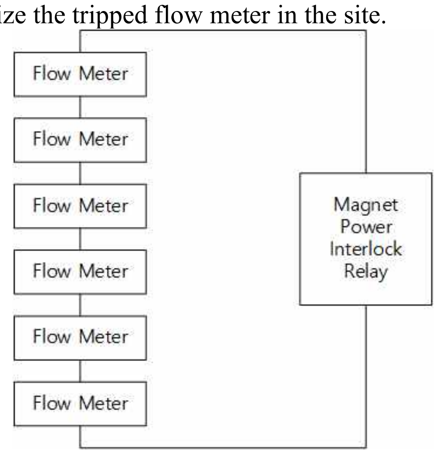


Fig. 4. Block diagram of flow meter

2.2 Method

As per Figure 5 the flow meters are grouped for the magnet power supplies and DTL tanks.

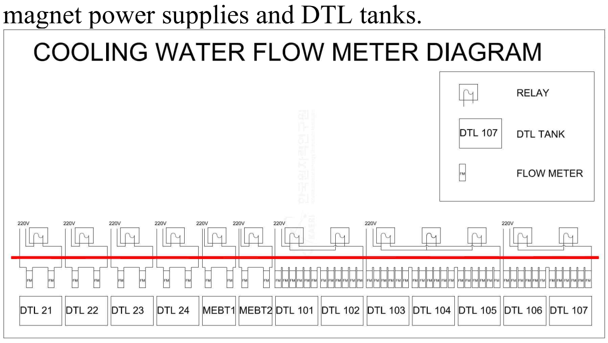


Fig. 5. Cooling water flow meter diagram

The 52 number of flow meter are operated. For the implementation, flow meters of DTL 21 were selected due to the only two numbers of flow meters in the one system. The separated power needs to be provided to each flow meter to find the tripped flow meter. In addition, the relay will be used for indicating the status of the flow meter and bypassing the flow meter which has the broken sensor. The block diagram was updated from Figure 6 to Figure 7 which has the independent power and relay.

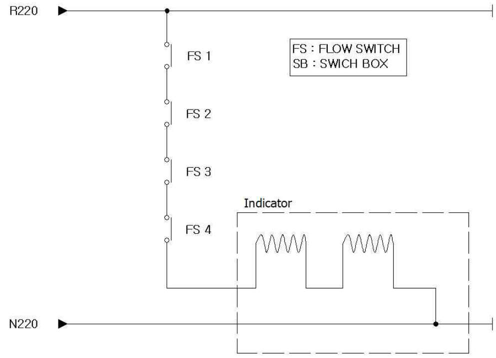


Fig. 6. Single line diagram of flow meter on DTL 21 (Before)

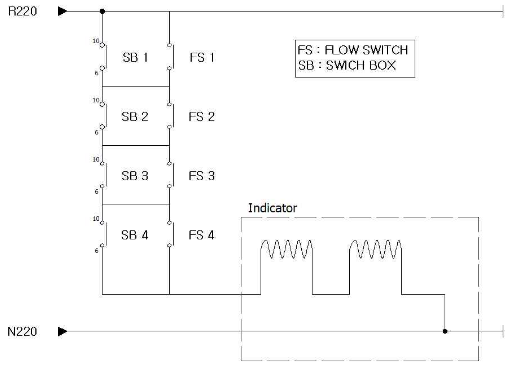


Fig. 7. Single line diagram of flow meter on DTL 21 (After)

Based on the diagram the local monitoring box was designed and fabricated as per Figure 8.

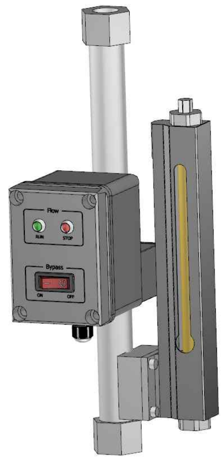


Fig. 8. Local monitoring box for the flow meter

2.3 Result

The fabricated local monitoring box was installed on DTL 21 flow meter as per Fig 9.

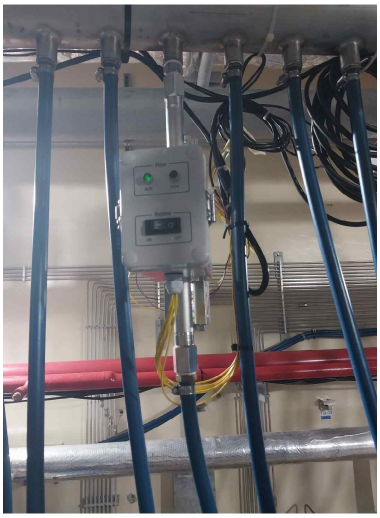


Fig. 9. Operation of the local monitoring box for the DTL 21 flow meter

The operation test was proceeded and completed. When flow is low and flow meter tripped, the monitoring box shows the red light. The flow meter is operated without any trip and then the monitoring box indicates the green light. If flow meter needs to have an inhabitation the operator can select the bypass button.

3. Conclusions

The local monitoring box for the DTL 21 flow meter was successfully adopted and operated. This system can indicate the tripped flow meter with the status and reduce the time to search for the outstanding flow meter in the site. In the future we will consider the extension of this system to DTL 22 ~ 107.

ACKNOWLEDGMENT

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