Design of Accelerator Emergency Stop System for the Proton Accelerator Research Center of PEFP

Sung Sik Park [a*], Jun Yeon Kim [a], Jang-Hyung Cho [a],
Kyeong-Jun Mun [a], Jin Sam Cho [a], Gye Po Jeon [a], Yi Sub Min [a] , and Jung Min Nam [a]
[a] *Proton Engineering Frontier Project, Korea Atomic Energy Research Institute,*
Daedeok-Daero 1045, Dukjin-Dong Yuseong-Ku, Daejeon, 305-353, Korea
[*] *Corresponding author: pssik@kaeri.re.kr*

1. Introduction

Proton Engineering Frontier Project (PEFP) of Korea Atomic Energy Research Institute was established as one of the 21st Centuty Frotier Research & Development Programs by Ministry of Science &Technology, is aiming to develop the 100 MeV, 20mA proton linear accelerator as a user's facility for scientific and industrial utilization [1] [2] [3].

When using high power 100MeV proton linear accelerator, a high radiation field is formed in the surrounded area, the surrounded substances are radiation-activated.

For this reason, this paper describes the design of Accelerator Emergency Stop System, which in Proton Accelerator Research Center(PARC) of PEFP protects personnel from radiation hazards and the machine operation in case unsafe conditions occur.

2. Design of Accelerator Emergency Stop System

Accelerator Emergency Stop System switches the operative state (in which the beam is being accelerated) of the accelerator to non-operative state (in which the beam is not being accelerated) when a emergency stop signal related to Personnel Safety & Interlock System (PSIS) and Radiation Monitoring System (RMS) is generated.

In this section, the designs for Accelerator Emergency Stop System are described. The designs include PSIS related emergency stop and RMS related emergency stop.

.

2.1 Personnel Safety & Interlock System (PSIS) related emergency stop

The PSIS in PARC of PEFP controls access to the restricted areas of the PARC in order to protect personnel from radiation exposure hazards, abnormal operation, and unexpected accidents.

■ PSIS related emergency stop

① Emergency stop due to Programmable Logic Controller (PLC) equipment: Emergency stop occurs when the power supply to the PSIS system is cut abnormally or when the PLC equipment fails.

② Emergency stop due to the sequence of the access control system : Emergency stop occurs when he access control system is abnormal.

③ Emergency stop due to the access door open : Emergency stop occurs when the access door to a high radiation area is detected to be open.

④ Emergency stop due to pushing the Stop button in the emergency stop system : Emergency stop is applied when the emergency stop button is pressed.

⑤ Emergency stop due to pushing the button in the emergency entrance box/emergency exit box system : Emergency stop is applied when the emergency entrance/exit button is pressed.

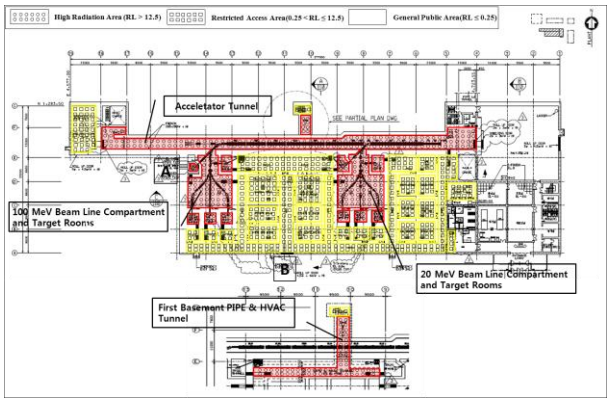
⑥ etc.

2.2 Radiation Monitoring System (RMS) related emergency stop

The RMS in PARC of PEFP protects personnel from radiation exposure hazards. RMS related emergency stop occurs when high level of radiation is detected by the radiation measuring instruments.

■ RMS related emergency stop

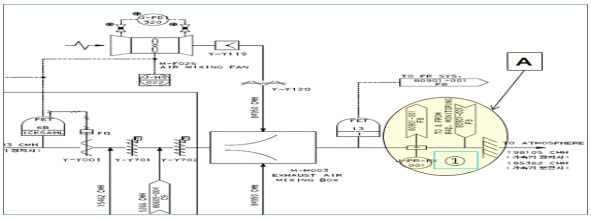
① Emergency stop due to Area Monitor



• Area Monitor detection Point : A and B area
• Detection Type : Proton recoil scintillator, NaI(TI) scintillator

Fig. 1. Radiation area of accelerator & beam experiment hall building in proton accelerator research center and Area Monitor detection Point

② Emergency stop due to Exhaust Monitor



• Area Monitor detection Point : A
• Detection Type : 3-H, 7-Be, 11-Be, 10-C, 11-C (14-C), 13-N, 14-O, 15-O, and 41-Ar

Fig. 2. Exhaust Monitor detection Point

2.3 Hardware Configuration of Accelerator Emergency Stop System

PSIS and RMS are operated independently with the accelerator control system and the utility control system necessary for the operation of the accelerator in order to prevent interruption from the aforementioned systems (Fig. 3).

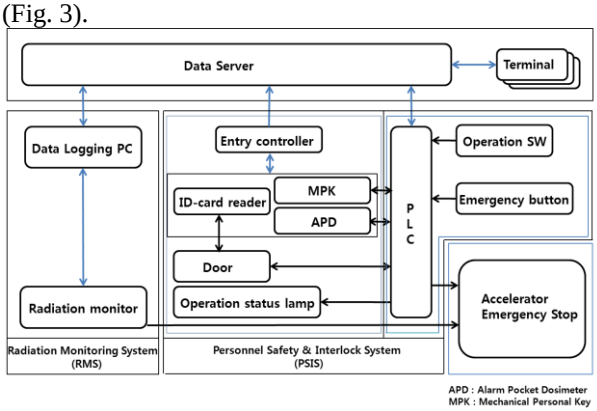


Fig. 3. Main flow diagram of the Accelerator Emergency Stop System

2.4 Types and application conditions of accelerator emergency stop by operation mode

Table-1 describes the types and application conditions of accelerator emergency stop by operation mode.

Table 1. Types and application conditions of accelerator emergency stop by operation mode

Emergency stop types \ Access Mode		Free Access Mode	Controlled Access Mode	No Access Mode
PSIS related emergency stop	Emergency stop due to PLC	-	○	○
	Emergency stop due to sequence of PSIS	-	○	○
	Emergency stop when managed access doors are opened	-	○	○
	Emergency stop due to pressed stop button detection by emergency stop system (Installed at high level radiation area)	-	○	○
	Emergency stop due to pressed stop button detection by emergency entrance/exit system (Installed at high level radiation area access doors)	-	○	○
RMS related emergency stop	Emergency stop due to area monitor	-	○	○
	Emergency stop due to exhaust monitor	-	○	○

3. Conclusions

We designed Accelerator Emergency Stop System in Proton Accelerator Research Center so as to guarantee the safety and protect the lives of personnel from radiation hazards, abnormal operation, and unexpected accidents.

ACKNOWLEDGEMENT

This work was supported by the Ministry of Education, Science and Technology(MOST) of the Republic of Korea through the Proton Engineering Frontier Project.

REFERENCES

[1] Y. S. Cho, H. J. Kwon, J. H. Jang, H. S. Kim, K. T. Seol, D. I. Kim, Y. G. Song, I. S. Hong, and Y.H. Kim, J. Korean Phys. Soc. **52**, 721(2008)
[2] Y. H. Kim, J. H. Jang, and Y. S. Cho, *Procceding of Particle Accelerator Conference 2007*(Albuquerque, NM, 2007), P. 1553.
[3] Y. S. Cho, H. M. Choi, I. S. Hong, J. H. Jang, H. J. Kwon, H. S. Kim, K. Y. Kim, Y. H. Kim, K. T. Seol, and Y. G. Song, *LINAC' 06* (Knoxuille, 2006), P. 501