# Radiation Zone Classification and Protection Aspect for the Proton Accelerator Research Center of PEFP

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## 1. Introduction

To protect radiation workers and the members of the public from radiation exposures, appropriate radiation shielding and protection aspect are required.

In this paper, we defined the classification of the zone for the radiation protection. The radiation zone is divided into three parts by a reliable domestic regulation by considering the safety margin. According to the radiation zone classification scheme, we divided Accelerator & Beam Application Building, which will be installed proton accelerator, into predefined radiation zone.

We also introduced environmental radiation monitoring system of PEFP to monitor local and offsite environmental conditions.

## 2. Radiation Protection & Safety

To protect radiation workers and the members of the public from radiation exposures, appropriate radiation monitoring system is required..

### *2.1 Limits for each Radiation Zone*

When operating proton accelerator conventional facilities, radiation levels should be minimized to keep the occupational doses and doses to the general public as low as reasonably achievable (ALARA), and preventing a loss or degradation of the equipment performance caused by a radiation environment during normal operation conditions.

For the radiation shielding design, we divided the proton accelerator research center into several types of zones based on the design values listed in Table 1. As shown in Table 1, the zones are divided by three classifications according to the degree of access required.

Table I: Radiation Zone Classification

| Zone Designation | Dose in an Hour (uSv/hr) |
|---|---|
| General Public Area | DL≤ 0.25 |
| Radiation Worker Area | 0.25<DL≤ 12.5 |
| High Radiation Area | DL>12.5 |

### *2.2 Radiation Zone Classification for Accelerator & Beam Application Building*

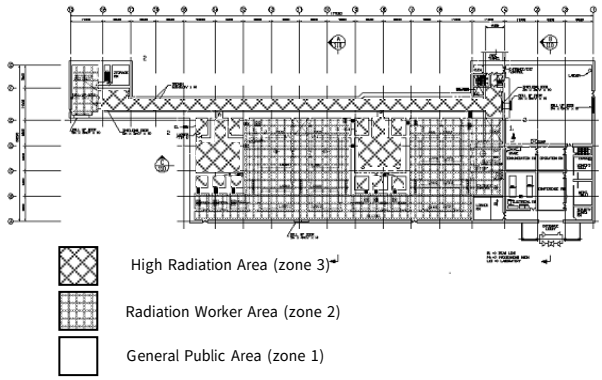
Accelerator & Beam Application Building consists of the accelerator tunnel, klystron gallery area, accelerator assembly area, accelerator control area, beam experiment hall and the beam application research area[1].

The accelerator tunnel is a space for installing the LINAC components. These components consist of the RFQ, DTL, etc. Therefore, the accelerator tunnel is a high radiation area of operation. Proper radiation shielding must be designed to reduce radiation levels in each area such as the Radiation Worker Area or General Public Area, etc. to acceptable radiation levels. For the proper radiation shielding design, a classification of each area of the proton accelerator conventional facilities is needed. Beam experiment hall contacts justly with the accelerator tunnel that generates the main cause of a radiation. Klystron gallery is arranged at the 2nd floor in the Accelerator Building. During accelerator operation, because radiation level inside the accelerator tunnel, target room and beam line enclosure is high, it is classified as high radiation area. Therefore, accelerator tunnel, target room and beam line enclosure access is not allowed during beam operation.

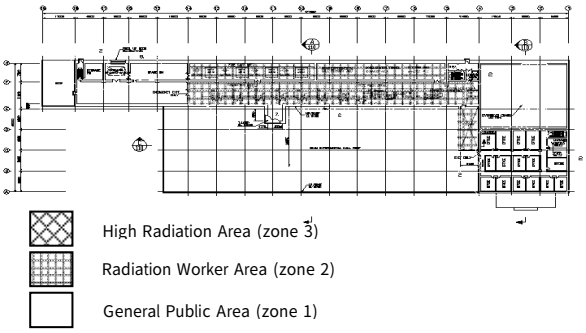
In Table 2, we described the classification of each area. Depending on each area classification, associated access restriction should be applied. In Fig. 1, we marked radiation zone classified results of Accelerator & Beam Application Research Area.

Table Ⅱ: The Radiation controlled Area Classification

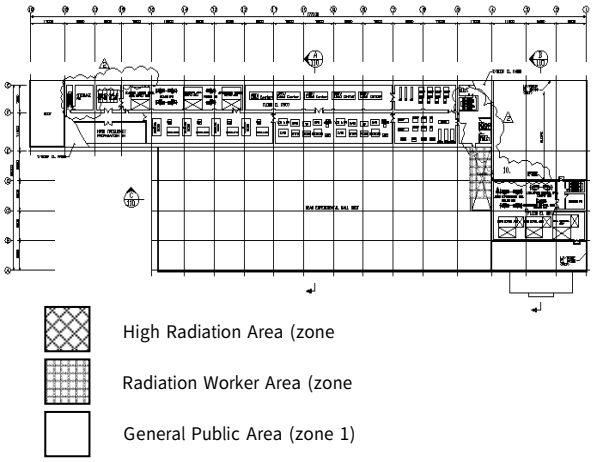
| Building | Area | | Classification |
|---|---|---|---|
| Accelerator & Beam Application Research Area | Accelerator Tunnel | | High Radiation Area |
| | Klystron Gallery | | Radiation Worker Area |
| | Beam Experiment Hall | Target Room | High Radiation Area |
| | | Beam Line Enclosure | High Radiation Area |
| | | Lab & Corridor | General Public Area |
| | Office & Outside of a Building | | General Public Area |
| Ion Beam Application Building | 300 keV Ion Implanter & 1MeV Tandem region | | Radiation Worker Area |




(a) 1st floor




(b) 2nd floor




(c) 3rd floor

Fig. 1 Radiation zone classified results of Accelerator & Beam Application Research Area.

### *2.3 Radiation Monitoring System for the Accelerator Research Center*

The aim of the Radiation Monitoring System (RMS) is to measure the radiation and radioactivity. RMS generates local and remote alarms for the designed limit level and it sends to the radiation monitoring system station in the Main Control Room.

RMS continuously monitors the radiation conditions and the radioactivity concentration in gaseous and liquid effluents within a facility inside and around the site boundary. RMS consists of the environmental radiation monitoring and the process radiation monitoring system.

The main purpose environmental radiation monitoring system is to monitor the levels of radioactive contamination in air and the skyshine from the accelerator building in order to avoid undesirable in/external exposure for the general public or workers.

Environmental radiation monitoring system measures the neutron/gamma ray and airborne radioactivity by particle/GAS detectors. Environmental radiation monitors generates prompt warning in case of elevated levels of radiation on the territory of Proton Accelerator Research Center of PEFP. Environmental radiation monitors also monitors gaseous effluents from the accelerator building.

Local radiation monitoring system provides radiation monitoring over a controlled area such as accelerator tunnel and target rooms in the beam application research area. For the area radiation monitor, neutron/gamma detector and radiation monitor for liquid and particle/gas. The liquid monitor is installed at the activated liquid waste storage system. The air monitoring system is also installed in the area needed to access after operation.

## 3. Conclusions

In this paper, we defined the classification of the zone for the radiation protection. The zoning is divided into three parts by a reliable domestic regulation by considering the safety margin. There must not be any damage in the facilities by the first and second radiation of the proton accelerator and by the activation during an operation or not. A lot of previous studies for the shielding design were considered in the shielding design of the proton accelerator. A radiation protection system of the facilities and the shielding design shall be made according to the domestic conditions and 'ALARA' protection principles.

## Acknowledgement

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

## REFERENCES

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