

Report on Licensing and Safety Issues for the Proton Accelerator Research Center of PEFP

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1. Introduction

The construction for the Proton Accelerator Research Center is under going at GyeongJu site in Korea. The Proton Accelerator Research Center involved with the Proton Engineering Frontier Project (PEFP) includes the building structures, electric power and communication systems, HVAC systems, mechanical and piping systems, wastewater treatment systems, equipment control systems, radiation monitoring systems, and maintenance facilities. On the operation of the accelerator or the beam utilization device which generates high energy and current, radiation damage might occurs by a leakage of the primary proton beam and by the secondary particles and activation as well as non-radioactive hazards. So, the Proton Accelerator Research Center emphasized the objective of setting radiation shielding and safety system and developing a safety program for all periods of project.

2. General Safety Criteria

Concerning radiation, the ALARA principle shall be applied. In other word, the radiation shielding of the proton accelerator facility should be capable of reducing the radiation levels, by keeping the occupational doses and doses to the members of the 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 safety design, the Proton Accelerator Research Center must have some dose criteria according to zones classification listed in Table 1. As shown in Table 1, the zones are divided by three classifications according to the workers' access availability and frequency. The design values have been made as a half value of the law in order to ensure the safety margin.

Table 1 Design Criteria (Zones Classification)

Zone Designation	Design Value (uSv/hr)
General Public Area	$DL \leq 0.25$
Radiation Worker Area	$0.25 < DL \leq 12.5$
High Level Radiation Area	$DL > 12.5$

The areas in the building where worker's in and out is frequent are not admitted to exceed the amount of 1 mSv per week. Whereas in the general public area outside the radiation worker area, it is not admitted to exceed the amount of 1 mSv per year.[1] These limitations described above are regulated by the nuclear energy law in Korea. When multiple sources affect the protected area, shield thickness should be adequately determined to ensure that the radiation level from all the significant radiation sources in that area will not exceed the designated dose limits.

3. Status of Licensing for the Proton Accelerator Research Center

The linear accelerator and beam utilization devices are defined as a radiation generator (RG) by regulation. Before using them, those should be permitted by Nuclear Safety & Security Commission (NSSC).

The licensing process includes reviewing on the safety design of facilities or devices and inspecting them to confirm to be constructed after reviewed design.

The first of licensing process, which is reviewed on the safety design by the NSSC, had ended up on January 2012. The process includes an application towards the NSSC. The application and review are based on the Safety Analysis Report (SAR) of the Proton Accelerator Research Center.

2.1 Propounded Safety Issues during the Operation Licensing Review Periods

Table 2 shows the number of issues in accordance with the field concerning radiation safety.

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Fields	Issues Number
Radiation Protection & Safety Management	18
Radiation Safety Evaluation	18
Instrumentation and Control	23
Radioactive Waste Safety Evaluation	4
Structural System & Site Evaluation	5
Radiological Emergency & Security Preparedness	16

1) Radiation Protection & Safety Management Field

During or after operation, an assessment of the expected dose of worker and public, and how to work the radiation safety interlock system was

reviewed. Also, the radiation safety management rule and procedure were checked.

2) Radiation Safety Evaluation Field

The input and output of computer code system used to evaluate the shielding design were reviewed to verify appropriateness of the shielding evaluation methods.

3) Instrumentation and Control Field

The system design (the system security design, cable protection, network design) and maintenance plan of the safety interlock system were checked about a reliability and a robustness.

4) Radioactive Waste Safety Evaluation Field

Radioactive waste amounts and disposal method were evaluated and reviewed. As a result of the review by NSSC, liquid waste collection and a processing system of the concept of zero-release were recommended. In addition, radioactivity level of the device was evaluated according to an operation period scenario.

5) Structural System & Site Evaluation Field

In the aspects of structural safety of buildings and site, the geological structure of the site, the foundation soil depth of each building, and the data of field survey were reviewed.

In addition, the evaluation was required in terms of the impact assessment on the flooding inundation. It includes assessment on flooding according to the recurrent intervals, and rainfall estimation. Estimation of rainfall and streams flood was performed to evaluate their impact for the project site. Based on this analysis, flood depth was calculated for the main structural buildings of on-site due to local rainfall.

6) Radiological Emergency & Security Preparedness

In terms of types and frequencies of radiation accidents, an accident definition was established. Emergency safety measures against the accident were verified to be appropriate or not.

Design and operation reliability of the fire protection system in accordance with fire zone were reviewed with respect to a fire safety. Also, a disposal method of extinguishing water after a fire in radioactive zone was reviewed.

2.2 Preparation for Second Step of Licensing

The construction of facility and the installation of device system will be verified at second step of licensing. We have a plan to apply for inspection of

facility to NSSC in August. Procedure manuals must be prepared for this inspection, such as an accelerator operation manual, a radiation detection procedure and an evaluation procedure for shielding performance.



Fig. 1 Safety Analysis Report and Operation License

4. Summary

The Proton Accelerator Research Center is a complex facility where several hazards might occur. These include radioactive hazards as well as non-radioactive ones. So, the Proton Accelerator Research Center emphasizes safety system and radiation shielding design as a priority during project phases.

The facility design of the Proton Accelerator Research Center was reviewed by NSSC as a first step of operation licensing process. That has ended up on January 2012. Now, we are preparing its second step.

REFERENCES

- [1] Enforcement Decree of the Act, Korea
- [2] Final Safety Analysis Report of the Proton Accelerator Research Center, 2012