# Design Study of Radiation Protection and Safety System for National Radiation Equipment Research and Fabrication Center in KAERI

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## 1. Introduction

As stated in the Fundamental Safety Principles [1], "The fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation." This objective must be achieved without unduly limiting the operation of facilities or the conduct of activities that give rise to radiation risk [2]. Therefore, the design of radiation protection and safety system focus on management and control the radiation risk to minimize exposure to workers and to reduce the extent reasonably achievable.

The National Radiation Equipment Research and Fabrication Center is located at Korea Atomic Energy Research Institute (KAERI), Jeongeup. The purpose of Radiation Equipment Fab. is invigorate of national radiation equipment research through setup the radiation generating/monitoring facilities and performance test of facility and radiation equipment. It was constucted on November 2016 support of The Ministry of Science, ICT and Planning, on a scale of about 21,000 square meters.

## 2. Methods and Results

### *2.1 Schematic view of Radiation Protection and Safety System*

Table I: Configuration of the system

| |
|---|
| RMS<br>- Gamma area monitors<br>- Neutron area monitors<br>- RMS Software |
| Radiation Area Access Control System<br>- Personal dosimeter reading module<br>- Radiation area access control software |
| CCTV System<br>- Infrared Cameras<br>- Display and control program |
| Interlock System<br>- Device interlock<br>- RMS interlock<br>- Main entrance & (shield) doors<br>- Warning lamps & alarms<br>- Emergency buttons |

The radiation protection and safety system consist of Radiation Monitoring System (RMS), Radiation Area Access Control System (RAACS), Closed Circuit TeleVision (CCTV) system and interlock system.

Table I and Fig. 1 show configuration and design of the radiation protection and safety system for National Radiation Equipment Research and Fabrication Center in KAERI. Various protection and safety devices are installed inside and outside radiation area. The main server and display equipments that store and display monitoring data on radiation are installed in control room. And they are controlled and managed 24 hours to ensure safety.

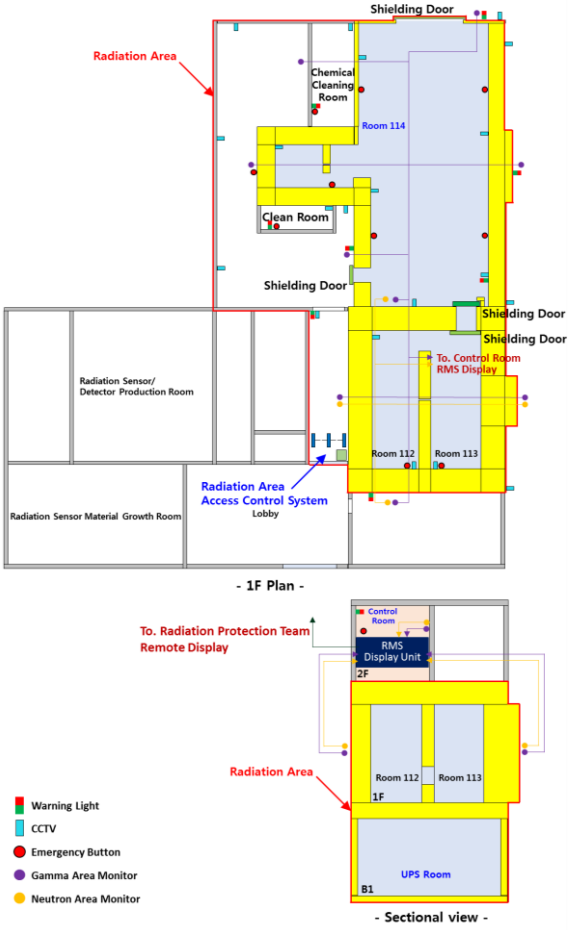


Fig. 1. The design of radiation protection and safety system.

### *2.2 RMS*

RMS is a system to monitor dose rates inside and outside radiation area. Each monitor at different section of radiation area is installed in the region of interest and displays dose rates in real time on displaying monitors in control room and main entrance as shown in Fig. 2. It monitors 24 hours, saves data on main server and can retrieve in necessary.

If the user setting criterion is exceeded, warning will be displayed on the screen, alarm will sound when the legal standard dose rate is exceeded, and the irradiation of the radiation generator will cease.

In addition, workers are provided with personal dosimeters and survey meters to calculate worker's cumulative dose and to minimize exposure.

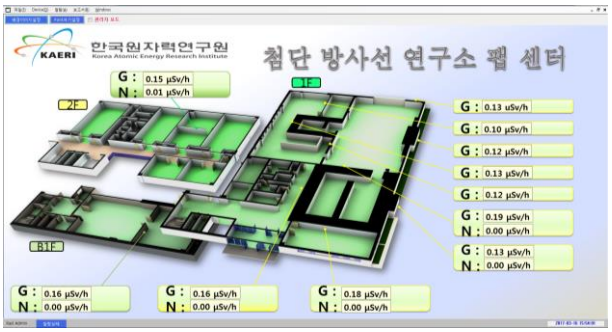


Fig. 2. Main view of radiation monitoring system

### *2.3 Radiation Area Access Control System*

The access control system allows only authorized workers to access and manage the cumulative dose and work time of the workers. The system consists of personal dosimeter reading module and access control software as shown in Fig. 3.

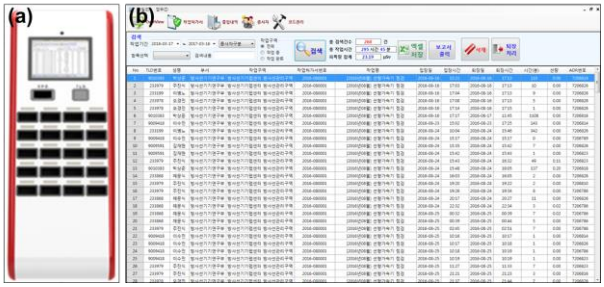


Fig. 3. (a) Personal dosimeter reading module (left) and (b) radiation area access control software (right) of radiation area access control system.

The reading module installed in front of the main entrance of the radiation area. When entering, the personal dosimeter is given and returned when it comes out to record the worker's working time and dose. Through the software, input the work plan, allow the worker, check the worker's time and dose in real time. If the worker's cumulative dose exceeds the legal standard, worker's entrance is prohibited automatically.

### *2.4. CCTV system*

In order to respond to safety accidents, CCTV system is installed without blind spots inside and outside the radiation area including entrance. It is always monitored 24 hours in control room and automatically recorded when an event occurs due to movement of workers or objects.

### *2.5. Interlock System*

The interlock system consist of doors in the radiation area, various electrical devices that supply power to the radiation source, radiation area monitors, emergency buttons, an alarms, and warning lamps. Fig. 4 shows schematic diagram of interlock system. These are all connected by TCP/IP communication. When the interlock system is activated, the alarm will sound for a few minutes and the warning lamps will operate. If door is open it is not possible to irradiation, and if the door is opened during exposure, the radiation output of the device is automatically stopped. Furthermore, it is not designed to automatically resume even when the doors are closed again. If dose rate beyond the legal standard is detected due to the abnormal output of the electrical device, the irradiation will be stopped immediately.

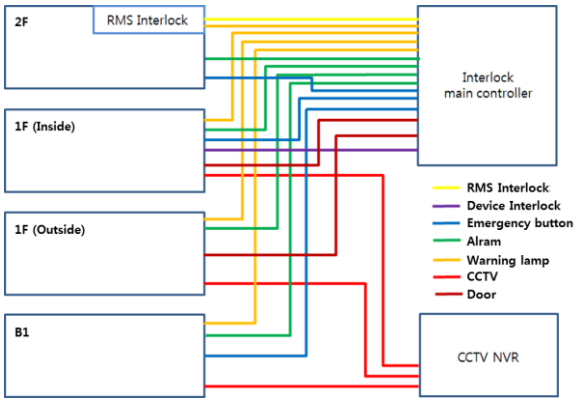


Fig. 4. Schematic diagram of interlock system.

## 3. Conclusions

Radiation protection and safety system is designed for national radiation equipment research and fabrication center at KAERI, Jeongeup. This system is mainly focused on people's safety and composed of RMS, RAACS, CCTVs and interlock devices. Thereafter radiation protection and safety system will be constructed and verified based on this design. The system is expected to be available in variety of fields such as container inspection system, non-destructive testing, etc.

## REFERENCES

[1] EUROPEAN ATOMIC ENERGY COMMUNITY, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED

NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIROMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Fundamental Safety Principles, IAEA Safety Standards Series No. SF-1, IAEA, Vienna, 2006.
[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards Interim Edition, IAEA, Vienna, 2011.