Radiation Monitoring System of 30 MeV Cyclotron

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Abstract. A state-of-the-art radiation monitoring system was implemented at KAERI for a 30-MeV cyclotron. This system consists of several types of radiation measuring systems for ambient dose equivalent rate measurements of outside photon and neutron areas as well as inside the cyclotron, and monitors the alpha and beta particulates released from a stack, as well as the results of worker contamination at the portal of the cyclotron. In addition, an automatic alarm system is also mounted if there are alarms in the measuring systems.

1 Introduction

ARTI (Advanced Radiation Technology Institute) is one of the research centers of KAERI (Korea Atomic Energy Research Institute). The main role of ARTI is to research the radiation usage for a variety of technologies. ARTI has large radioisotope irradiation facilities, and thus many laboratories using isotopes and a 30MeV cyclotron for research and development. In Korea, many cyclotrons are being operated for hospitals at low energy levels compared to the research cyclotron of ARTI. A 30MeV cyclotron has been utilized for the research of new diagnostic isotope production, and utilization of the beam and target. The main facilities of a 30MeV cyclotron are the main body, target room, hot cell room, and affiliated laboratory. In addition, over 20 researchers are working in the controlled radiation area of the facilities of the cyclotron. Thus, it is necessary to measure periodically the radiation level and inspect the radioactive remains of the facilities of the cyclotron.

2 The need to operate RMS

It is necessary to check the radiation exposure unexpected during the radioisotope production in a cyclotron, and manipulate the isotopes in a hot cell and the contamination of radiation workers after radioisotope handling. In particular, it is very important for the radiation safety staff to monitor the radiation data during an unsealed radioisotope production and usage of the radiation in real time because particulates and gases from the radioisotopes might be vented into the atmosphere.
The facility of the 30MeV cyclotron has several radiation measuring instruments for radiation safety and protection. The on-line radiation monitor instruments that are currently operating in the ARTI cyclotron are gamma and neutron area monitors, stack monitors, and portal monitors. In addition, all of the measuring instruments have their own specific measurement methods, shown in Tables 1 and 2. Each instrument has a separate monitoring system [1].
A variety of communication methods such as Ethernet and serial connections are applied depending on the time of the installation and the instrument manufacturer.

Table 1. Area monitor

Instrument	Detector	Quantity	Communication
Gamma Detector	Proportional counter	6	Serial (RS-232)
Neutron Detector	He-3 counter	3	Ethernet (TCP/IP)
Portal Monitor	Plastic Scintillator	2	Ethernet (TCP/IP)

If radiation safety staff members operate all monitoring systems of the instruments, they cannot do anything but monitor all systems. Thus, the combined radiation monitoring system is essential for the radiation staff because of the limited radiation personnel and budget.
Thus, it is necessary to develop a combined RMS (radiation monitoring system), which includes all measuring data from each instrument for real-time remote monitoring and the measurement information database management of these instruments [2].

Table 2. Stack air monitor

Instrument	Detector	Quantity	Communication
Particulate Monitor	Proportional counter	2	Ethernet (TCP/IP)
Iodine Monitor	NaI(Tl) scintillator	1	Ethernet (TCP/IP)
PET Monitor	Plastic Scintillator	1	Serial (RS-485)

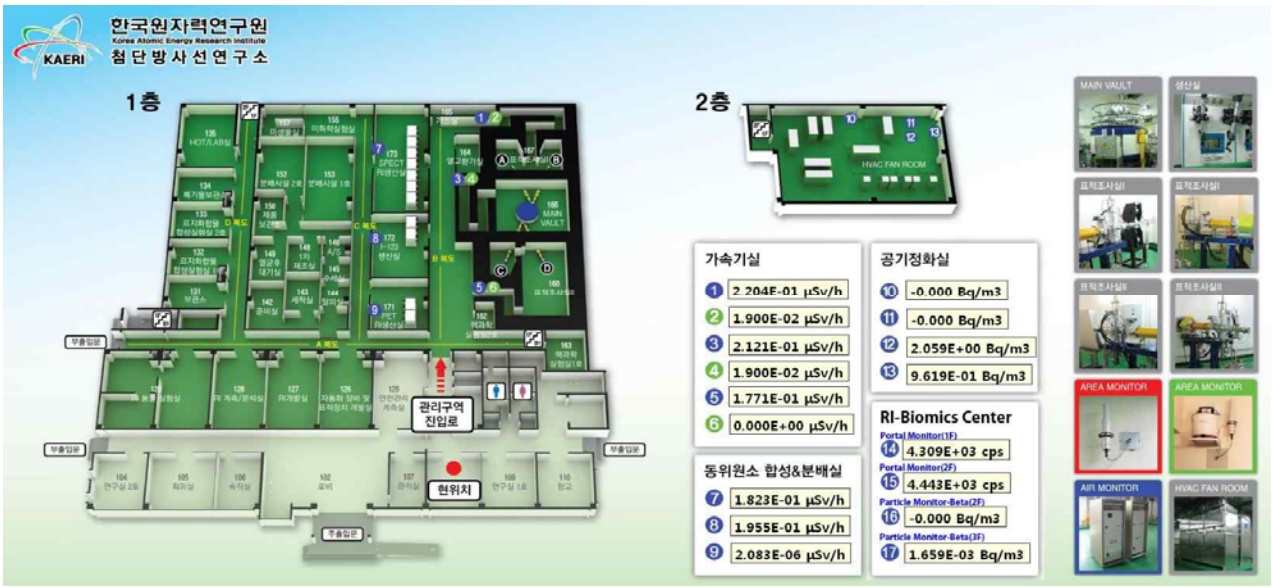

Figure 1. Main Portal Screen of RMS

3 Function of RMS

The configuration of the RMS of a 30 MeV cyclotron is composed of radiation measuring systems, Agent, DBMS (Database Management System) and an administrator program. Agent receives real-time data provided by the radiation measuring systems and communication, and performs the storage the reception of data to the DBMS. In addition, it has a function of setting the raw data from each radiation measuring system in units such as the dose rate (μSv/h), air concentration of radioactive materials being released (Bq/m^3), and the count rate of the portal monitor (cps). In addition, radiation staff members can give each instrument the calibration constants if needed, and be notified through an alarm from each radiation measuring system any transmission error between the RMS and radiation measuring systems in real time.

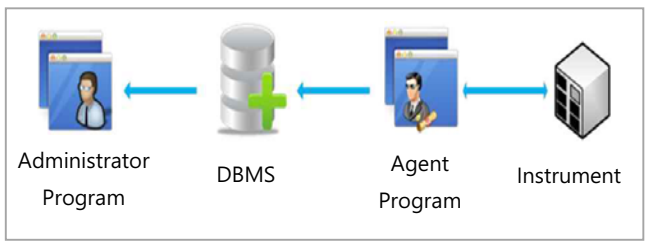

Figure 2. The basic configuration of RMS

The DBMS uses Microsoft SQL Server 2008 R2 Version. Each instrument is managed by classifying through a data table, and the table of the alarm history has been configured independently to facilitate the expansion of the system. An administrator program collects data in real time on the screen to query the database by the Agent. The main menu of the administrator program utilized by radiation safety manager is the query of real-time data and historical data and the alarm data The report of the administrator program are the measuring data in real-time and for a daily, weekly, and monthly basis. In addition, it is possible for radiation safety managers to make reports for specific periodic doses.

4 Conclusions

The recent developments of radiation measurement technology have occurred faster than before owing to the rapid development of information technology based on the MMI (Man-Machine Interface) technique. In this paper, we introduced the combined RMS as a part of the optimal radiation safety management of ARTI for radiation safety officers and management staff. In addition, it is also the basic infrastructure of the radiation safety program. In particular, the real-time display of the dose rate, air concentration of radioactive materials being released, and the count rate of the portal monitor of the radiation controlled area enables radiation workers and radiation safety staff members to achieve good side effects to check the availability of the radiation measuring instrument remotely on one screen. In the future, the contents of RMS will be applicable to other sites and other organizations within KAERI.

References

1. KAERI Manual of operating radiation measuring instrument (2015)
2. C. Kim, J. Shin, J. Cha J..The journal of Institute of Internet, Broadcasting and Communication (JIWIT 2012-5-32), A Study for Protocol for Heterogeneous Interface in Sensor Networks within Water Restore Facilities (2012)