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Introduction of the activity of the radiation safety for KOMAC

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1. Introduction

Korea Multi-purpose Accelerator Complex (KOMAC) is branched off from Korea Atomic Energy Research Institute (KAERI). The 100 MeV linear proton accelerator as well as the various types of the ion accelerator have been operated and developed in KOMAC. These accelerators are classified as a radiation generator by the nuclear law of Korea. The operation of these accelerators included in the KOMAC site should be approved by Nuclear Safety & Security Committee (NSSC). This paper introduces the activity in terms of the radiation safety for these accelerator operations and their future plan. Recently, KOMAC has prepared the approval of NSSC to operate a 1.7 MV tandem accelerator for ion beam analysis in April 2016. We also has been developed a proton irradiation facility for radioisotope production.

2. Radiation Safety Activity

2.1 License of Ion beam accelerator for analysis[1]

The model of the ion beam accelerator for analysis installed in KOMAC is a 5SDH-2, produced by National Electrostatics Corporation. This ion beam accelerator, devolved from Korea Institute of Geoscience and Mineral Resources (KIGAM), consists of two ion source, accelerating tanks and four beam-lines. Ions in the ion beam accelerator are accelerated using a tandem method, that is, ions accelerated have been drawn out by the negative ions from the ion source and then changed into positive ions in the acceleration tube intermediate. Four beam-lines would be used for a Particle Induced X-ray Emission (PIXE), neutron source, RBS/ERD and ion implantation respectively, described in Table 1.

Table 1. Specification according to Beam-line of 1.7 MV Ion Accelerator

Beam Line	Particle	Beam Energy & Current
PIXE	Proton	2.5 MeV, ~ 100 nA
RBS/ERD	He	3.4 MeV, ~ 1 uA
Ion Implatation	He	5.1 MeV, ~ 1 uA
Neutron Source	Proton	3.4 MeV, ~ 2 uA

A configuration of the 1.7 MV ion beam accelerator for analysis is illustrated in Figure 1. The operation license for this ion beam accelerator was approved in December 2015 and the facility inspection of NSSC has been currently prepared.

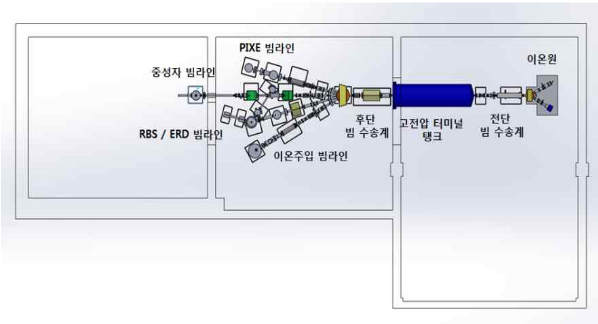

Figure 2. Illustration of 1.7 MV Ion Accelerator for Analysis

2.2 Preparing a Irradiation Facility for Radio-isotope production

In addition to the two research facilities (TR23, TR103) of the linear proton accelerator, an irradiation room (TR101) is prepared to produce radioactive isotopes. The radioisotopes, Sr-82 and Cu-67 for the diagnostics and treatment would be produced at this facility. To produce these isotopes, RbCl and ZnO target are bombarded with the proton beam. A lot of radio-isotopes are produced by the irradiation with proton beam to the target as well as interest one. So in order to safely treat a target activated highly, automatic transport device and hot-cells, shown in Figure 2, are required to isolate the radiation source. Since the total weight of the hot-cell is about 46 tons, the stability for the supporter of the hot-cell should be checked [2]. The lead thickness designed for this hot-cell is 150 mm and the radiation shielding performance [3] to check the reliability of the hot-cell was carried out.

Figure 2. Hot-Cell constructed in PR101 of KOMAC for the treatment of irradiated targets.

2.3 Instrument for Radiation Safety

The values of the radiation dose and radioactivity are measured using survey meters on the radiation safety controlled area as well as the public area periodically to ensure the safety of the site. And a lot of equipments for monitoring the radiation are installed to monitor the radiation continuously.

Radiation / contamination measurements that are performed periodically have carried out at the public area and radiation controlled area at least once a week. At a specific place, contamination control has been performed using by the indirect method (smear). The equipments for the radiation / contamination measurement are shown in Table 2.

Table 2. Equipment list used for the radiation and contamination measurements

Detector Type	Model(Manufacturer)	The number of Amount(EA)
Radiation and Contamination Survey Meter	LB124-D(Berthold)	5
Radiation Survey Meter	451B(FLUKE)	8
Alpha/Beta Contamination Counter	FHZ732(Thermo)	3
Low Background Alpha/Beta Counter	5XLB(Canberra)	1

A performance test and calibration for the fixed radiation monitoring equipment, described in Table 3, are conducted periodically to ensure the reliability once a year. Figure 5 shows the tool used to calibrate the area monitor and the environmental monitor. RMS data is collected on the centralized server, shown in Figure 3. This server provides the data to the required place by user interface unit, shown in Figure 4.

Figure 3. Centralized RMS data server

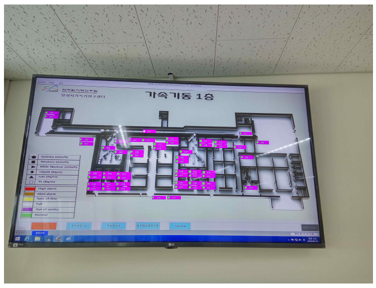

Figure 4. RMS user interface unit

Table 3. Fixed type of Radiation Monitoring Device.

Classification for Installation type of Instrument		Type of Detection Radiation	The number of Amount(EA)
Fixed type	Area Monitoring	Gamma	45
		Neutron	12
		Hi-energy Neutron	11
	Environmental Monitoring	Gamma	4
		Neutron	4
	Air Effluent Monitoring	Particulate and Gaseous	1
	Liquid Effluent Monitoring	Gross γ	6
	Area Monitoring	Particulate and Gaseous	2
	Hand Foot Monitor		1
	Whole Body Counter		1
Total			86

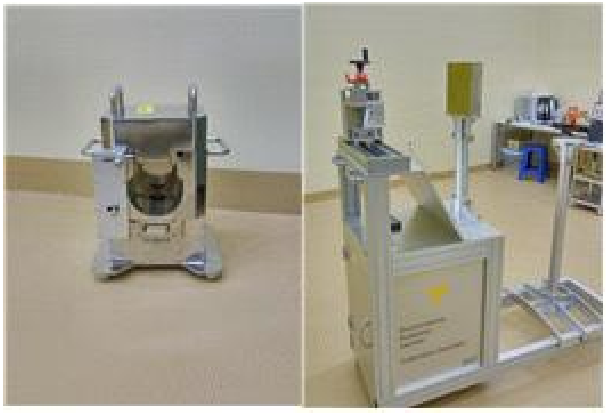

Figure 5. Calibrator for the area monitor (left) & calibrator for the environmental monitor (right)

3. Future Work

Risks of radiation accident at radiation utilization facilities should always be present. It is important to actively perform a preventive activity on usual. The main task of the radiation safety management is to assess the safety of the facility and meet the applicable laws. In addition to the status of the equipments for radiation monitoring should be maintained to have the reliability. This paper introduces the recent radiation safety activities done in KOMAC. Radiation safety program based on these activities will be further developed.

REFERENCES

[1] Yi-Sub Min, Radiation Safety Analysis Report for Ion Accelerators in KOMAC, KOREA(2015).

[2] Sung-Kyun Park, et.al, “KOMAC 의 TR101 에서 생산할 방사성동위원소를 위한 Hot-Cell 제작”, KARP 2016, April6-8, Korea (2016)

[3] Jeong-Min Park, “Evaluation of the Shielding Performance for the Hot-cell built in 100 MeV Beam-line of KOMAC, 2016 KNS Spring Meeting, May12-13, Korea (2016)