A Study on Enhancement of Understanding of Radiation and Safety Management

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1. Introduction

Concerns for radiation exposure have been increased from small and big radiation works or experiments with radiation generator (RG) or radiation isotopes (RI) at institutions using radiation in Korea. Actually, due to radiation exposure occurred on the process of handling RI, etc., The exposure should be maintained as low as reasonably possible. To do this, above all, suitable training and establishment of safety culture have to be preceded. In this respect, an education institution is a place where people learn first about handling radiations in various specialties with purposes including academic research, and the first learned habits and practices acts as the basis for safety management of radiation when they continue to do radiation work after going into the society.[1] Therefore, it is needed to establish the right safety culture on radiation for its safe managing. In the present study, the direction for the right understandings and safety improvement are suggested through the radiation survey on education institutions and preparation of safety guidances for users.

2. Methods and Results

In this study, user survey, laboratory environment and safety assessment have been carried out for selected institution by grouping and sampling of 294 education institutions. Fig. 1 shows Status of permitted and registered RI/RG in Korea[2]. Also the handbook of radiation safety, mobile application, and e-book are developed based on the result of this study.

(2013.12.31.)

Classification \ Type		number of Permit and register			number of Institution
		RI	RG	Total	
Industry	General	1,227	3,367	4,594	4,279
	ND	56	56	112	56
	Sale	98	171	269	210
	Product	24	25	49	49
	Total	1,405	3,619	5,024	4,594
Medicine	General	201	94	295	195
	Sale	3	0	3	
	Product	11	1	12	11
	Total	215	95	310	206
Research	General	194	157	351	277
	Sale	2	1	3	2
	Product	2	1	3	3
	Total	198	159	357	282
Education	General	171	232	403	292
	Sale	1	0	1	
	Product	2	0	2	2
	Total	174	232	406	294
Public	General	381	331	712	642
Military	General	14	58	72	67
Total		2,387	4,494	6,881	6,085

Fig. 1. Status of education institutions for RI in Korea

2.1 Status and Survey

The survey was conducted by 341 people at 18 selected education institutions by grouping and sampling 294 institutions. Fig. 2 shows distribution of survey respondents. The Students will be given a range of five responses from “not at all” to “very much” to statements such as “Do you think you are familiar with the using radioisotope(RI) or radiation generator(RG)?” The results were analyzed using a T-Test statistical methods. The analysis procedure is as the followings;

1. Divide total samples into 2 groups by questions. (ex experience for research, whether registered as workers or not)
2. Investigate whether standards for dividing groups affect responses for the questions or not. (Realize whether it is equal variance distribution or heteroskedasticity distribution through f-test.
3. Conduct t-test equal variance distribution and t-test heteroskedasticity distribution by the result of f-test.
4. It can be evaluated that the standards affect difference of averages between two groups when the result of t-test is below 0.05.
5. Evaluate which result value was calculated by the questions. (ex. Is it positive when the average value is high? or Is it positive when the average value is low?)

Results of the survey are as the followings;

• Conduction of surveys for 341 persons at 18 selected education institutions

- For non-specialists, they thought that radiation works are dangerous.

(Average of non-specialists : 2.82, Average of specialists : 3.53 *They thought that radiations are more dangerous as the score lows.)

- For the group of research experiments of over 3 years, they thought that they knows about used sources(RI etc.) well.

(Average of experiment of below 3 years : 3.0, Average of experiment of over 3 years : 2.48 *They thought that they know more as the score lows.)

- For registered radiation workers, they thought that they are better-acquainted with handling of radiation and first response when occurring accidents.

(Average of non-registered : 3.45, Average of registered : 2.59 *They thought that they are better-acquainted as the score lows.)

- They significantly thought that any reference such like a guidebook may provide helps.(76 %, * Response rate of more “yes”)

Therefore it can be inferred from the results.(as Fig. 3 shows Trends of survey results) First of all, it is positive

direction of the questions as the score lows.(The rating scale is from 1 to 5.)

Secondly, those who specialize in radiation and over 3 years of research career, they are more understanding about radiation and have better handling.

Finally, they would like to get some guidelines such as a handbook for understanding radiation.

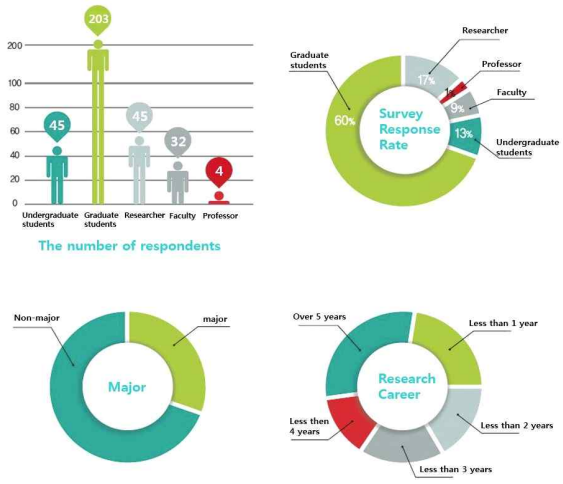

Fig. 2. Distribution of survey respondents

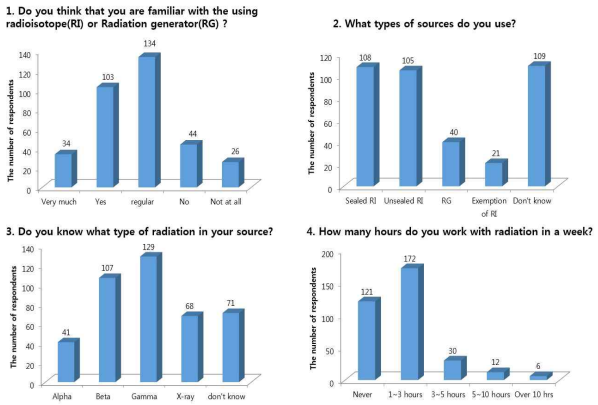

Fig. 3. Trends Survey Results

2.2 Analysis for radiation experimental environments and evaluation for safety

In this analysis, it can be inferred status of laboratory management. The contamination test was conducted by a survey meter and smear test (Refer to Fig. 4) for analysis for radiation experimental environments safety in 12 education institutions.

Fig. 4. A View of Contamination Test at Lab.

- Gamma dose rate in laboratory environment was measured 0.01 ~ 1.60 μSv/h, and results of direct measurement of surface contamination was 0.01 ~ 5.43 Bq/100cm^2 and indirect measurement was 0.02 ~ 11.1 Bq/100cm^2, thus it was less than maximum surface contaminant limits.(Refer to Table I)

Table I: Results of Contamination test at 12 Lab.

University	Date	Place	Dose rate (μSv/h)	Direct surface contaminant rate (Bq/100cm^2)	Indirect surface contaminat rate (Bq/100cm^2)
A	2014.05.16	RI Lab.	1.6	0.83	0.06
B	2014.05.19	Lab.	0.01	0.03	0.02
C	2014.05.20	Lab.	0.06	0.05	0.03
D	2014.05.22	Lab.	0.05	0.15	0.04
E	2014.05.27	RI Lab.	0.07	5.43	11.1
F	2014.05.28	Lab.	0.03	0.06	0.02
G	2014.05.30	RI Lab.	0.02	0.03	3.97
H	2014.06.03	Lab.	0.01	0.01	0.04
I	2014.06.11	Lab.	0.01	0.04	0.05
J	2014.06.12	Lab.	0.01	0.15	0.07
K	2014.06.17	Lab.	0.01	0.06	0.03
L	2014.06.18	RI Lab.	0.08	0.02	0.06

By the results, The measured values were below the legally permitted limits.(limits of surface in radiation area ; β, γ-emitting nuclide : 40 Bq/100 cm^2, α-emitting nuclide : 4 Bq/100 cm^2 [3])

therefore, it was confirmed that the radiation environments of 12 laboratories are managed by safety

2.3 Development of Safety Guideline

Opportunities have provided for a radiation user to acquire key points for radiation handling and proper understanding on the basis of user survey, laboratory safety assessment and a supervisor for radiation safety

- Publishment of safety guidelines for radiations for education institutions(universities)
- Development of mobile App and e-book for various accessibility
- Publishment of books in English for international students or foreign researchers

3. Conclusions

The basic guidance at the radiation experiment was prepared for the right understanding of the radiation to prevent radiation accidents from careless handling by workers based on the surveyed results for education institutions. It is expected to be used as fundamentals for improvement for radiation safety management of workers and researchers and, further, safety policy for national nuclear energy and radiations.

REFERENCES

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[3] H. R. Kim, et. al. “Handbook of Radiation Safety for laboratory users of the university” UNIST, 2014