

# Analysis of the Status of the Facilities Used for Radiographic Testing in KOREA

Jin Ho Park, Sang In Bak, Inchang Choi, and Sang Min Lee\*

*Korea Institute of Nuclear Safety, 62, Gwahak-ro, Yuseong-gu, Daejeon, 34142, Republic of Korea*

\*Corresponding author's e-mail: sm@kins.re.kr

**Abstract.** The industrial radiographic testing workplaces (called by 'temporary job site') were divided into use facility, shop, and field. Technical standards for use facility as amended in 2019 include access control devices, radiation detection devices, remote controllers, etc. Therefore, the facilities used for radiographic testing have been inspected to confirm whether the technical standards were applied. The objective of this study was to analyse the status of the facilities used for radiographic testing in order to improve safety of radiographic workplaces. We analysed the inspection results of facilities used for radiographic testing, the status of notified radioisotope, radiation generating device, and radiation safety officers by workplaces. Based on the inspection results, the facilities used for radiographic testing were analysed for the size of the facility, the thickness of the shielding wall, and the presence of ceiling shielding. The status of notified sealed radioisotopes, radiation generating devices, radiation safety officer, and occupational radiation exposure by workplaces was analysed through the analysis of workplace for radiographic testing declaration in 2019. The size distribution of the facilities used for radiographic testing in KOREA was (width) 1,800 to 65,000 mm, (length) 1,250 to 26,200 mm, (height) 1,850 to 21,000 mm. Also, the average size of the facilities used for radiographic testing was (width) 10,000 mm × (length) 5,000 mm × (height) 4,000 mm, with the thickness of the shielding wall of 1,000 mm and the ceiling shielding of 400 mm. The proportion of notified sealed radioisotope and radiation generating device by 616 workplaces was 53% (Ir-192), 28% (radiation generating device), 10% (Se-75), and 9% (Co-60), respectively. There were designated 392 radiation safety officers to the 616 use facilities, and 36% of the radiation safety officers were assigned to one or more workplaces. Facilities used for radiographic testing by region are mainly located near shipbuilding and chemical plant. The average annual radiation exposure of 4,343 radiation workers at the use facility was 2.89 mSv. We analysed the status of facilities used for radiographic testing in order to improve safety of radiographic workplaces in 2019. The results of this study will be used to amend the safety control of mobile use in the facilities used for radiographic testing in KOREA.

**KEYWORDS:** *Use Facility, Radiographic testing, Temporary job site*

## 1 INTRODUCTION

The radiation risk in the field of the safety control of mobile use is relatively high due to the use of radioisotope and radiation generation device (RG) in unfixed locations. The industrial radiographic testing workplaces (called by 'temporary job site') were divided into use facility, shop, and field [1, 2]. However, there were no standards for safety devices of radiation workers when working on the facilities used for radiographic testing. In order to improve safety of the use facility, the technical standards for use facility as amended in 2019 include access control devices, radiation detection devices, remote controllers, etc [3]. Therefore, the facilities used for radiographic testing have been inspected to confirm whether the technical standards were applied.

The objective of this study was to analyse the status of the facilities used for radiographic testing in order to improve safety of radiographic workplaces.

## 2 MATERIALS AND METHODS

We analysed the status of 1) the facilities used for radiographic testing, 2) the notified source in use facility, 3) the designated radiation safety officer, and 4) the average annual radiation exposure. The status of the use facility was performed through analysis of the self-inspection results. The status of the notified source is use facility and the designated radiation safety officer were carried out through analysis of the workplace for radiographic testing declaration in 2019. The status of the average annual radiation exposure was performed through analysis of Radiation Worker Information Service System (RAWIS) by Korea Foundation of Nuclear Safety (KoFONS) [4].

## **2.1 The status of the facilities used for radiographic testing**

The facilities used for radiographic testing have been inspected to confirm whether the technical standards were applied using the inspection results. The inspection results of the facilities used for radiographic testing include information such as drawings and photographs of the use facility, access control devices, radiation detection devices, alarm devices, remote controllers, etc. Based on the inspection results, the facilities used for radiographic testing were analysed for the structural integrity, the size of the facility, the thickness of the shielding wall, and the presence of ceiling shielding.

## **2.2 The status of the notified source in use facility and the designated radiation safety officer**

The status of notified sealed radioisotopes, radiation generating devices, and designated radiation safety officer were performed through the analysis of workplace for radiographic testing declaration in 2019. The attached documents of workplace for radiographic testing declaration are required such as 1) radiograph test contract with project owner, 2) description of conditions around the workplace and its circumstances, 3) architecture spec. and internal assessment findings for storage and maintenance facilities, 4) description of radiation maintenance areas, 5) description of working procedures, 6) description of transporting methods, and 7) documents on assignment of radiation safety officers at the workplace. The above attached documents were analysed to identify the status of the notified source in use facility and the designated radiation safety officer.

The attached documents of workplace for radiographic testing declaration were reviewed to analyse the status of the notified source in use facility and the designated radiation safety officer. The notified sealed source and radiation generation device were used in the use facility in field of the safety control of mobile use. And, the notified source was determined according to the structure of the use facility, and the specifications of the objects to be inspected.

## **2.3 The status of the average annual radiation exposure**

The status of the average annual radiation exposure was performed through analysis of RAWIS by KoFONS. KoFONS has been operating RAWIS to manage annual radiation exposure and medical examination records. The information of the average annual radiation exposure registered in the RAWIS was extracted for the analysis of radiation workers in the field of the safety control of mobile use. Also, the validation of the extracted information of the average annual radiation exposure, the classification of workplace and working period by radiation workers were performed using Python programming.

# **3 RESULTS AND DISCUSSIONS**

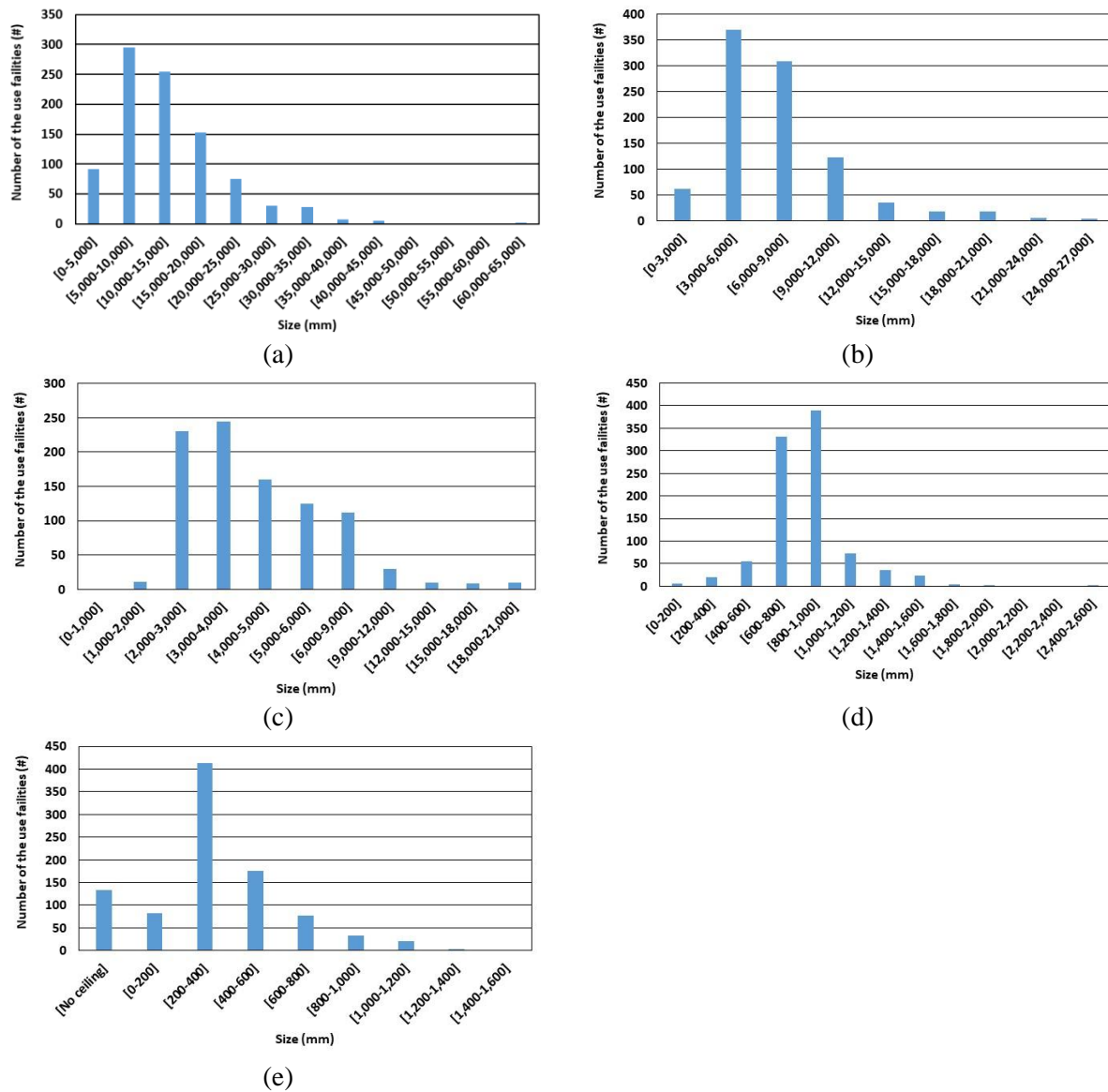
We analysed the status of 1) the facilities used for radiographic testing, 2) the notified source in use facility, 3) the designated radiation safety officer, and 4) the average annual radiation exposure. The size distribution of the facilities used for radiographic testing in KOREA was (width) 1,800 to 65,000 mm, (length) 1,250 to 26,200 mm, (height) 1,850 to 21,000 mm. Also, the average size of the facilities used for radiographic testing was (width) 10,000 mm × (length) 5,000 mm × (height) 4,000 mm, with the thickness of the shielding wall of 1,000 mm and the ceiling shielding of 400 mm. The proportion of notified sealed radioisotope and radiation generating device by 616 workplaces was 53% (Ir-192), 28% (RG), 10% (Se-75), and 9% (Co-60), respectively. There were designated 392 radiation safety officers to the 616 use facilities, and 36% of the radiation safety officers were assigned to one or more workplaces. The average annual radiation exposure of 4,343 radiation workers at the use facility was 2.89 mSv.

## **3.1 The status of the facilities used for radiographic testing**

The technical standards and structural integrity of the use facilities were verified using the drawings and photographs of the use facility, access control devices, radiation detection devices, alarm devices, remote controllers included in the inspection results. The size distribution of the facilities used for radiographic testing in KOREA was (width) 1,800 to 65,000 mm, (length) 1,250 to 26,200 mm, (height) 1,850 to

21,000 mm (see Figure 1). Also, the average size of the facilities used for radiographic testing was (width) 10,000 mm × (length) 5,000 mm × (height) 4,000 mm, with the thickness of the shielding wall of 1,000 mm and the ceiling shielding of 400 mm. The 16% of the use facilities without ceiling shielding were operated with an additional shield design, adjustment of the radioactive source used, and restrictions on irradiation methods.

**Figure 1:** The size distribution of the facilities used for radiographic testing in KOREA; (a) width, (b) length, (c) height, (d) thickness of the shielding wall, and (e) thickness of the ceiling shielding



### 3.2 The status of the notified source in use facility and the designated radiation safety officer

The status of notified sealed radioisotopes, radiation generating devices, and designated radiation safety officer were analysed through the attached documents of workplace for radiographic testing declaration, such as 1) description of conditions around the workplace and its circumstances, 2) description of radiation maintenance areas, 3) description of working procedures, and 4) documents on assignment of radiation safety officers at the workplace. Figure 2 shows the status of notified sealed radioisotope, radiation generating device in 2019. The proportion of notified sealed radioisotope and radiation generating device by 616 workplaces was 53% (Ir-192), 28% (radiation generating device), 10% (Se-75), and 9% (Co-60), respectively. The use facilities using Co-60 source were used in

facilities with a concrete shielding thickness of about 1,000 mm or more. Therefore, the proportion is lower than other notified source.

**Figure 2:** The status of notified sealed radioisotope, radiation generating device in 2019

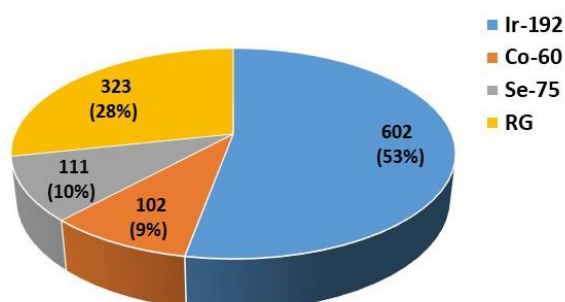


Table 1 shows the status of the designated radiation safety officer and the use facility by region. There were designated 392 radiation safety officers to the 616 use facilities, and 36% of the radiation safety officers were assigned to one or more workplaces. Facilities used for radiographic testing by region are mainly located near shipbuilding and chemical plant. The shipbuilding and chemical plant were mainly located in Gyeongsangnam-do, Ulsan Metropolitan City, and Jeollanam-do.

**Table 1:** The status of the designated radiation safety officer and the use facility by region

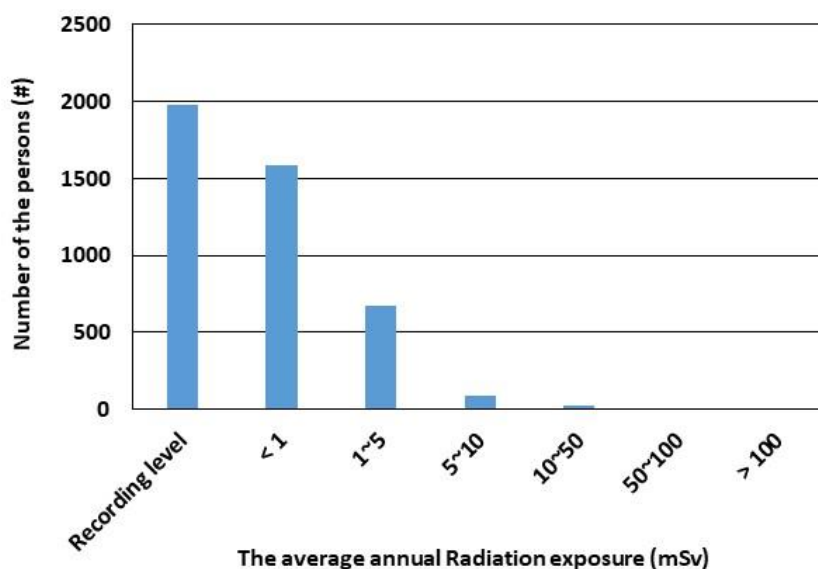
Region	Number of the use facility	Number of the designated radiation safety officer	Number of the radiation safety officer was assigned to one or more workplaces	Proportion of the radiation safety officer was assigned to one or more workplaces
Gyeonggi-do	80	58	22	28%
Gyeongsangnam-do	156	100	56	36%
Gyeongsangbuk-do	43	28	15	35%
Gwangju Metropolitan City	2	2	-	-
Daegu Metropolitan City	5	4	1	20%
Daejeon Metropolitan City	4	3	1	25%
Busan Metropolitan City	65	34	31	48%
Seoul Metropolitan Government	-	-	-	-
Ulsan Metropolitan City	108	59	49	45%
Incheon Metropolitan City	16	12	4	25%
Jeollanam-do	69	43	26	38%
Jeollabuk-do	12	8	4	33%

**Table 1:** The status of the designated radiation safety officer and the use facility by region (continued)

Region	Number of the use facility	Number of the designated radiation safety officer	Number of the radiation safety officer was assigned to one or more workplaces	Proportion of the radiation safety officer was assigned to one or more workplaces
Chungcheongnam-do	47	32	15	32%
Chungcheongbuk-do	9	9	-	-
total	616	392	224	36%

### 3.3 The status of the average annual radiation exposure

The distribution of the average annual radiation exposure to radiation workers in the field of the safety control of mobile use in 2019 is represented Figure 3 and Table 2. The average annual radiation exposure of 4,343 radiation workers at the use facility was 2.89 mSv. The number of the radiation workers above the recording level was 2,363 and the proportion is 54% of all radiation workers. Recording level means the value of 0.1 mSv as the minimal value for controlling radiation dose exposed to radiation workers [5]. However, the distribution of the average annual radiation exposure to radiation workers might be different because there are some people with the same name in the mobile use licensing agency.

**Figure 3:** The distribution of the average annual radiation exposure to radiation workers in the field of the safety control of mobile use in 2019**Table 2:** The distribution of the average annual radiation exposure to radiation workers in the field of the safety control of mobile use in 2019

	Recording level	< 1 mSv	1~5 mSv	5~10 mSv	10~50 mSv	50~100 mSv	> 100 mSv
persons	1,980	1,582	670	85	25	0	1

## 4 CONCLUSION

The technical standards for use facility as amended in 2019 include access control devices, radiation detection devices, remote controllers, etc. Therefore, the facilities used for radiographic testing have been inspected to confirm whether the technical standards were applied. We analysed the status of facilities used for radiographic testing in order to improve safety of radiographic workplaces in 2019. The analysis was performed through the status of 1) the facilities used for radiographic testing, 2) the notified source in use facility, 3) the designated radiation safety officer, and 4) the average annual radiation exposure. The size distribution of the facilities used for radiographic testing in KOREA was (width) 1,800 to 65,000 mm, (length) 1,250 to 26,200 mm, (height) 1,850 to 21,000 mm. Also, the average size of the facilities used for radiographic testing was (width) 10,000 mm × (length) 5,000 mm × (height) 4,000 mm, with the thickness of the shielding wall of 1,000 mm and the ceiling shielding of 400 mm. The proportion of notified sealed radioisotope and radiation generating device by 616 workplaces was 53% (Ir-192), 28% (radiation generating device), 10% (Se-75), and 9% (Co-60), respectively. There were designated 392 radiation safety officers to the 616 use facilities, and 36% of the radiation safety officers were assigned to one or more workplaces. The average annual radiation exposure of 4,343 radiation workers at the use facility was 2.89 mSv. The results of this study will be used to amend the safety control of mobile use in the facilities used for radiographic testing in KOREA. Also, it will be used to improve the working environment in the use facility and to reduce radiation exposure of radiation workers.

## 5 REFERENCES

- [1] Nuclear Safety and Security Commission, Nuclear Safety Act. (2019).
- [2] Nuclear Safety and Security Commission, Enforcement Regulation of the Nuclear Safety Act. (2019).
- [3] Nuclear Safety and Security Commission, Regulations on Technical Standards for Radiation Safety Control, Etc. (2019).
- [4] Korea Foundation of Nuclear Safety, Radiation Worker Information Service System website: <https://rawis.kofons.or.kr/portal/login/retrieveLogin.do>
- [5] Nuclear Safety and Security Commission, Regulations on Criteria and Inspection of Registration for Dosimeter Reading Service. (2018)