

## Review of the Regulatory Guidelines for Radiation Protection in NORM Industries by International Organization

Byung Min Lee, Min Young Lee, Jae Kwon, Jong Hyeok Park, Kwang Pyo Kim\*  
 Nuclear Engineering Dept., Kyung Hee Univ., Gyeonggi-do, Korea  
 \*Corresponding author: kpkim@khu.ac.kr

### 1. Introduction

Naturally occurring radioactive materials (NORM) can be used in various industries. In Korea, the act on protective action guidelines against radiation in the natural environment was enacted in 2011 to manage NORM industries. Also, after the radon mattress incident in 2018, regulations on the NORM industry have been strengthened.

Due to the strengthened regulations, the social and economic burden have increased both in terms of regulators and business operators. Therefore, there is a need for regulation based on a graded approach for the domestic NORM industry. In order to derive regulation based on a graded approach for the domestic NORM industry, it is necessary to understand the regulatory guidelines presented by international organizations.

The objective of this study is to analyze regulatory guidelines for the NORM industry presented by international organizations. Therefore, we investigated the regulatory guidelines for radiation protection in NORM industry presented by the IAEA, ICRP, and EU.

### 2. Regulatory Guidelines for NORM Industries

#### 2.1 IAEA

The IAEA is an international organization established to promote the peaceful use of nuclear energy and health. In 2014, the IAEA published IAEA GSR Part 3, which corresponds to the basic safety standard for radiation protection [1]. IAEA GSR Part 3 recommended that a regulation system should be established for the NORM industry by country. In addition, IAEA GSR Part 3 recommended applying a graded approach based on radiation exposure risk when

regulating NORM industries. Table 1 shows the regulation based on graded approach for NORM industries recommended by the IAEA.

The IAEA presents the need for radiation protection by NORM industry through a series of safety report. Each safety report presents industrial characteristics, information on radiation exposure, and considerations in regulation of NORM industry. Table 2 shows the industry and contents of each IAEA safety report.

Table 2: Industry and main contents presented in the IAEA safety report

Document	Industry	Contents
SRS 49	Mineral and raw materials	1. Industrial characteristics 2. Worker exposure pathway and exposure dose 3. Consideration in regulation and radiation protection
SRS 51	Zircon, Zirconia	
SRS 76	Titanium Dioxide	
SRS 78	Phosphate	

#### 2.2 ICRP

The ICRP is an international organization that establishes basic principles for radiation protection and recommends radiation protection systems to be applied internationally. In 2018, the ICRP published ICRP 142, which provided information on radiation protection in NORM industries [2]. ICRP 142 presented the requirements for the application of the radiation protection system to the NORM industry and the management of the workplace. Figure 1 shows the major NORM activities that cause radiation exposure as suggested by the ICRP 142.

Table 1: Regulation based on graded approach for the NORM industries recommended by the IAEA

Classification	Regulatory Requirement		
	Notification	Registration	Licensing
Reporting	· Main Points Changes · Reporting Points Update	· Basic Data Report · Cycle Specified by Law	· Additional Data Report · Cycle Specified by Law
Record Maintenance	· Reporting Document	· Basic Document and Procedure	· Additional Document and Procedure
Training and Instruction	· Unnecessary	· Basic Training	· Additional Training · Cycle Specified by Law
Environmental Monitoring	· Unnecessary	· Limited Environmental Monitoring	· Detailed Environmental Monitoring
Safety Assessment	· Unnecessary or Simplified Safety Assessment	· Screening Evaluation	· Detailed Evaluation

Activities giving rise to NORM exposures (ICRP 142)	
1 Extraction of rare earth elements	7 The zircon and zirconia industries
2 Production and use of metallic thorium and its compounds	8 Production of tin, copper, iron, aluminium, lead
3 Mining and processing of ores (other than uranium)	9 Extraction and combustion of coal
4 Extraction of oil and gas	10 Water treatment
5 Manufacture of titanium dioxide	11 Building materials
6 The phosphate processing industry	12 Legacy sites

Fig. 1. Major NORM activities suggested by ICRP 142

ICRP 142 recommended that exposure to NORM industry should be managed and radiation protection should be achieved through justification and optimization. In addition, a graded approach was recommended for the radiation protection of workers, public, and the environment. Also, it was recommended to consider not only the radiological risk but also the non-radiological risk.

### 2.3 EC

The EC is the central body of European Union that protects the European Union related treaties and formulates various policies. In 1999, the EC published Radiation Protection (RP) 95 providing reference levels for NORM industries [3]. It presented major NORM industries, substances and situations that cause radiation exposure. Figure 2 shows the major NORM industries that cause radiation exposure as suggested by the RP 95.

Major NORM industries (RP 95)	
1 Phosphate and titanium dioxide pigment industry	4 Manufacture of rare earths
2 Processing of metal ores	5 Manufacture and use of thorium compounds
3 Zircon sands and refractory materials	6 Oil and gas extraction

Fig. 2. Major NORM industries suggested by RP 95

RP 95 recommends using a control band to apply a graded approach when regulating the NORM industry. The classification criterion for the band is the calculated effective dose under normal assumptions and unlikely assumptions. Figure 3 shows the control band based on the radiation risk suggested in RP 95.

Effective Dose		Regulatory level
Normal	Unlikely	
1 mSv/y	6 mSv/y	Band 1 No regulation necessary
6 mSv/y	20 mSv/y	Band 2 Lower level of regulation
20 mSv/y	50 mSv/y	Band 3 Higher level of regulation
		Band 4 Process not permitted

Fig. 3. Control band suggested by RP 95

### 3. Conclusion

In this study, we investigated the regulatory guidelines for radiation protection in the NORM industry presented by IAEA, ICRP, and EC. These three international organizations have presented the types of NORM industries that cause radiation exposure. They also recommended that a graded approach should be used when regulating the NORM industry.

If the graded approach is applied to the domestic NORM industry regulatory system, it will be helpful for regulatory agencies to implement regulations. The results of this study can be used as a basis for deriving of regulation based on graded approach on the NORM industry.

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### REFERENCES

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