

Derivation of Public Dose Distribution Around the Radioactive Waste Disposal Facility Applying Representative Person Concept

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1. Introduction

International Commission on Radiological Protection (ICRP) suggested justification, optimization, and application of dose limits as fundamental principles of radiation protection. ICRP also emphasized optimization as the main of the radiation protection principle. In addition, it was recommended to use dose constraint for radiation protection optimization which is quantitative criteria [1]. International Atomic Energy Agency (IAEA) suggested that the dose constraint could be set towards the upper end of dose distribution based on the representative person concept [2]. In Korea, research to introduce ICRP 103 recommendations within the regulatory system is underway, and the concept of dose constraint is expected to be introduced in the future.

Radioactive effluents could be released during operation of radioactive waste disposal facility, and it causes radiation exposure to the public. Therefore, management of the public dose is necessary. For management, dose constraint which is quantitative criteria for radiation protection optimization would be needed. However, research on the derivation of dose distribution for setting dose constraints is insufficient.

The object of this study is to derive public dose distribution around the radioactive waste disposal facility for the establishment of a public dose constraint in the future. Therefore, this study conducted dose assessment for representative person. Based on the results of the dose assessment, public dose distribution around the radioactive waste disposal facility was derived.

2. Material and Methods

2.1 Representative Person

ICRP defined a representative person as the concept of a person representing people exposed in high level in a group. This corresponds to the average member of the critical group previously recommended by the ICRP [3]. Therefore, in this study, the critical group was selected for dose assessment, and the average dose of the critical group was used as dose of representative person. ICRP recommended that 95th values should be used for the dominant exposure pathways and lower values should be applied for other pathways to perform dose assessment for the representative person. Therefore, in this study, 95th values was applied to two exposure pathways that accounted for the majority of the radiation dose. Also average values were used for other

exposure pathways in accordance with the definition of representative person presented by the ICRP.

2.2 Source Term

ICRP suggested that maintenance of exposure situations for a period of at least 5 years would be considered sustainable. Therefore, the source term for deriving the dose constraint should set the emission amount for at least 5 years. In this study, the radioactive effluent emission for 5 years presented in the environmental radiation monitoring report was used as the source term[4].

2.3 Exposure Scenarios

In order to perform dose assessment to members of the public around radioactive waste disposal facilities by representative person concept, the exposure pathways and exposure scenarios should be established. In this study, 6 exposure scenarios were considered: 1) 1-year-old residents, 2) 10-years-old residents, 3) Agricultural residents, 4) Fishery residents, 5) Industrial workers, and 6) Non-workers residents.

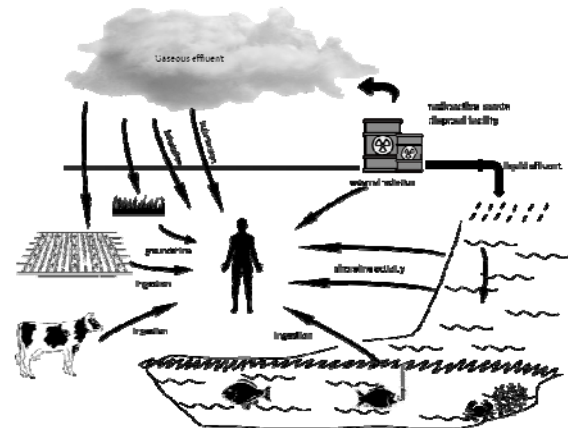


Figure 1: Exposure pathways to assess radiation dose of radioactive waste disposal facility

2.4 Exposure Pathways

The exposure pathways considered in this study were referred to the exposure pathways given in the Regulatory Guide 2.2 of the Korea Institute of Nuclear Safety (KINS) [5]. In this study, 7 exposure pathways were considered: 1) Submersion, 2) Groundshine, 3) Inhalation, 4) Ingestion of agricultural and livestock products, 5) Shoreline activities, 6) Swimming, and 7)

Ingestion of aquatic products. Figure 1 shows the exposure pathways considered in this study.

2.5 Critical Group Candidate

ICRP recommended that representative person should be assumed to occupy a location where the estimated concentrations lead to the higher doses. That is, location where the actual person lives should be considered. Therefore, in this study, the residential area around the radioactive waste disposal facility was selected as the critical group candidate based on the cadastral map. A total of 6 critical group candidates were selected. Table I shows the critical group candidates selected in this study. For each critical group, all exposure scenarios and exposure pathways were considered in this study.

Table I: Critical group candidates for representative person dose assessment

Critical group candidate	Direction	Distance (m)
Candidate 1	S	3,400
Candidate 2	SSW	3,100
Candidate 3	SW	2,500
Candidate 4	WSW	2,400
Candidate 5	N	500
Candidate 6	NE	850

2.6 Dose Distribution

In this study, the public dose distribution was derived based on the radioactive effluent for five years and the eight critical group candidates. For this purpose, dose assessment was performed for representative person around the radioactive waste disposal facility. In the case of habit data, the 95th values were used for the ingestion of grains and leafy vegetables, which are the two most dominant exposure pathways, and the average values were used for other exposure pathways. For the dose conversion factor, the values presented in ICRP 72 publication for internal exposure and FGR-15 for external exposure were used.

3. Result and Discussion

In this study, the public dose distribution around the radioactive waste disposal facility was derived based on the representative person. The public dose distribution derived in this study is shown in Figure 2. The results of the radiation dose assessment for the representative person showed 0.0002 ~ 0.0034 $\mu\text{Sv}/\text{yr}$. This was less than 10 $\mu\text{Sv}/\text{yr}$, which is the trivial dose suggested by international organizations. When setting the public dose constraint for radioactive waste disposal facilities, it is judged that it should be decided whether to set the dose constraint and value of dose constraint through

discussion with stakeholders such as regulatory agency.

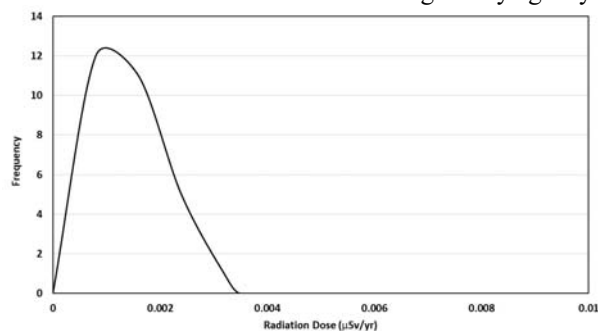


Figure 2: Result of public dose distribution around radioactive waste disposal facility

4. Conclusions

In this study, the public dose distribution around the radioactive waste disposal facility was derived by applying the representative person concept to prepare for the establishment of public dose constraint. As a result of the evaluation, the dose showed 0.0002 ~ 0.0034 $\mu\text{Sv}/\text{yr}$, which is less than the trivial dose of 10 $\mu\text{Sv}/\text{yr}$. The results of this study can be used as a preliminary study for setting the public dose constraint in the future.

Acknowledgements

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