Dose Assessment Resulting from Gaseous Effluent Released from Nuclear Research Facility Based on Representative Person Concept

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Introduction

☐ Necessity of Public Dose Assessment around Nuclear Facility

- Radioactive effluents is released during operation of a nuclear research facility, and it causes radiation exposure to the public
- The operator of nuclear research facility should prove that dose from nuclear facility meet dose criteria

☐ Necessity of Representative Person Concepts in Dose Assessment

- In Korea, radiation dose assessment of public had been conducted with the maximum exposure individual concept represented by Nuclear Regulatory Commission (NRC)
- International Commission on Radiological Protection (ICRP) published 103 recommendation and recommended the use of the representative person concept for radiation dose assessment of the public
- Representative person concept is expected to be adopted in regulatory system in the future

Objective

■ Dose Assessment Resulting from Gaseous Effluent Released from Nuclear Research Facility Based on Representative Person Concept

- Analysis of Representative Person Concept
- Analysis of Source Term
- Selection of Exposure Pathway
- Selection of Critical Group Candidates

Materials and Methods

☐ Analysis of Representative Person Concept

- Representative person is an individual receiving dose that is representative of the more highly exposed individual
- Representative person is equivalent to the average member of the critical group

☐ Analysis of Source Term

- The operation of nuclear research facility generates gaseous and liquid radioactive waste

Table 1. Source term of gaseous effluent assumed in this study (TBq/yr)

Nuclides	Emission Activity	Nuclides	Emission Activity	Nuclides	Emission Activity
H-3	1.07×10^{1}	I-134	4.88×10^{-4}	Ru-106	4.77×10^{-6}
C-14	3.33×10^{-9}	I-135	5.70×10^{-3}	Sb-125	7.22×10^{-8}
Na-24	6.66×10^{-8}	Kr-83m	6.70×10^{-5}	Cs-134	2.56×10^{-6}
P-32	1.67×10^{-8}	Kr-85	1.75×10^{1}	Cs-137	1.15×10^{-6}
Ar-41	3.58×10^{-2}	Kr-85m	3.35×10^{-4}	Ce-144	9.21×10^{-6}
Cr-51	3.33×10^{-9}	Kr-87	2.25×10^{-4}	Pm-147	1.08×10^{-6}
Fe-59	3.33×10^{-1}	Kr-88	6.55×10^{-4}	Eu-154	7.22×10^{-8}
Co-60	3.33×10^{-7}	Kr-89	1.81×10^{-5}	Eu-155	7.22×10^{-8}
Br-83	8.47×10^{-5}	Sr-89	2.31×10^{-6}	Xe-131m	3.65×10^{-5}
Br-84	3.89×10^{-5}	Sr-90	2.77×10^{-6}	Xe-133	7.36×10^{-3}
Br-85	4.51×10^{-5}	Y-91	3.39×10^{-6}	Xe-133m	1.93×10^{-4}
I-129	3.70×10^{-9}	Zr-95	5.51×10^{-6}	Xe-135	2.97×10^{-5}
I-131	3.47×10^{-3}	Nb-95	2.41×10^{-6}	Xe-135m	2.28×10^{-5}
I-132	6.85×10^{-4}	Mo-99	4.00×10^{-7}	Xe-137	2.92×10^{-5}
I-133	4.81×10^{-3}	Ru-103	2.59×10^{-6}	Xe-138	1.10×10^{-4}

☐ Selection of Exposure Pathway

- External exposures; two pathways were considered
  - (1) Air submersion of radioactive materials
  - (2) Groundshine of contaminated soil
- Internal exposures; two pathways were considered
  - (3) Ingestion of agricultural and livestock products
  - (4) Inhalation of radioactive materials.

☐ Selection of Critical Group Candidates

- ICRP recommended that representative person should be assumed to occupy a location where lead to the higher doses
- Therefore, the directions and distances of critical group resident were considered

Results and Discussion

☐ Result of Radiation Dose Assessment

- Population distribution of exposure scenarios was considered to reflect average member of critical group
- The results of the radiation dose assessment for the ten critical group candidates showed 5.31×10^{-3} – 5.59×10^{-3} mSv/yr.
- Among the ten critical group candidates, candidate 3 received the highest radiation dose. As a result, candidate 3 was selected as a critical group.
- Representative person is equivalent to the average member of the critical group. Therefore, the result of radiation dose of Representative person was 5.59×10^{-3} mSv/yr.

Table 2. Result of radiation dose assessment from gaseous effluent released from nuclear research facility (mSv/yr)

Critical Group Candidate	Radiation Dose (mSv/yr)
Candidate 1	5.34×10^{-3}
Candidate 2	5.55×10^{-3}
Candidate 3	**5.59×10^{-3}**
Candidate 4	5.35×10^{-3}
Candidate 5	5.34×10^{-3}
Candidate 6	5.33×10^{-3}
Candidate 7	5.32×10^{-3}
Candidate 8	5.31×10^{-3}
Candidate 9	5.31×10^{-3}
Candidate 10	5.31×10^{-3}

Conclusion

■ In this study, the representative person concept was applied to assess public dose resulting from gaseous effluent at nuclear research facility

■ The result of radiation dose assessment for the representative person dose showed 5.59×10^{-3} mSv/yr.

■ The result of this study can be used as preliminary study for the introduction of representative person concept recommended by ICRP 103 in Korea in the future.

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