

# Impact of Operating Nuclear Power Plants to Decommissioning Workers

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## 1. Introduction

During the licensing phase of construction or operation, Domestic nuclear power plant operator should prove that if the radiation dose meet the dose criteria according to requirements of Article 16 (Prevention of Environmental Hazards) of Notification (Radiation 001. Standard for Radiation Protection) to protect the residents and the environment.

Likewise, it would be also important to evaluate the exposure dose to the dismantling workers in terms of protection of workers because the dismantling worker may be affected by the radiation effluents emitted from the nuclear power plant operated nearby.

In case of Kori Unit 1, Kori Unit 2 to 4 and Shin-Kori Unit 1&2 are adjacent in the same Kori site. Close to Kori site, there is Sae-wul site which include Shin Kori Unit 3&4 and Shin Kori 5&6 which is under construction now. Thus it is essentially required to evaluate the exposure dose to the decommissioning workers by operating multiple NPP units nearby.

## 2. Exposure dose calculation model

ENDOS program is used to calculate the exposure dose which was developed by KAERI based on NRC Regulatory Guide 1.109. Two of sub-programs of ENDOS are used in this assessment, ENDOS-ATM which performs atmospheric transport and diffusion assessments and ENDOS-G performs exposure dose assessment by gaseous radioactive emissions.

### 2.1 Exposure Pathways from gaseous effluents

The most of exposure pathway for the decommissioning workers is due to the gaseous emissions. There are three main considerations for exposure pathways for workers exposed to gaseous emissions: First, external exposures due to plume; second, external exposures due to the contaminated ground; and the last, internal exposures due to the inhalation of contaminated air. In case of workers, the consideration of contaminated food intake was neglected.

### 2.2 Assumptions

The decommissioning work will start after the 5 years after the permanent stop of Kori Unit 1 and the decommissioning worker assumed 8 hours of work per a day. Since the maximum individual dose in the ENDOS program is based on the residents who always present 24 hours therefore, one third of the evaluation value is used to evaluate the exposure dose to the decommissioning workers.

As the input data of the ENDOS-ATM program, the atmospheric meteorological data, which was used for the radiation environmental impact assessment for the construction permit of Shin-Kori 5&6, was applied. As the input data of the ENDOS-G program, the emissions of gaseous effluents from adjacent operating NPP was used for evaluation. This emission data, in case of the Kori Unit 2~4, it is based on the operating results from 2000 to 2009 and in case of Shin-Kori Unit 1~6, it is the estimated emission by PWR-GALE code.

### 3. Results

Atmospheric dispersion factors and deposition factors are obtained by using ENDOS-ATM depending on distance and direction between the Kori Unit 1 and each of the adjacent NPP units as summarized in Table 1.

Table 1. Atmospheric dispersion factors and deposition factors

(Kori 1)	Direction	Distance (m)	x/Q (sec/m <sup>3</sup> )	(x/Q)D (sec/m <sup>3</sup> )	(x/Q)DD (sec/m <sup>3</sup> )	D/Q (sec/m <sup>3</sup> )
Kori2	WSW	100	1.31E-04	1.30E-04	1.28E-04	1.71E-07
Kori3	W	410	6.51E-06	6.49E-06	6.15E-06	1.51E-08
Kori4	W	660	2.75E-06	2.73E-06	2.53E-06	7.22E-09
Shin-12	SW	1225	1.65E-06	1.63E-06	1.46E-06	6.42E-09
Shin-34	SW	2720	4.49E-07	4.38E-07	3.75E-07	1.64E-09
Shin-56	SW	3035	3.79E-07	3.69E-07	3.13E-07	1.36E-09

To evaluate the maximum individual dose for decommissioning workers affecting by operating nearby NPP units, ENDOS-G program was used base on dispersion and deposition factors and the emissions gaseous effluents from each of the adjacent NPP units. In this paper, exposures only causing by plume, ground, and inhalation are considered. Table 2 summarizes this results. 8 hours of work per a day is assumed in this analysis.

Table 2. Maximum individual dose (mSv/yr)

exposure pathway	plume	ground	inhalation	Sum	Evaluation value
Kori2	3.66E-03	1.80E-04	5.16E-02	<b>5.54E-02</b>	<b>1.85E-02</b>
Kori3	1.38E-04	1.11E-07	4.67E-04	<b>6.05E-04</b>	<b>2.02E-04</b>
Kori4	5.07E-04	4.17E-06	3.01E-04	<b>8.12E-04</b>	<b>2.71E-04</b>
Shin-12	3.28E-03	8.07E-05	1.10E-03	<b>4.46E-03</b>	<b>1.49E-03</b>
Shin34	2.00E-04	1.39E-05	3.61E-04	<b>5.75E-04</b>	<b>1.92E-04</b>
Shin-56	1.64E-04	1.15E-05	3.04E-04	<b>4.80E-04</b>	<b>1.60E-04</b>

### 4. Conclusion

In 2023, decommissioning of Kori unit 1 will be started. In consideration of Kori 2 shutdown expected in 2023, we could consider only the impacts of Kori 3,4 and Shin-Kori 1~6. As a result, the annual maximum individual dose of the decommissioning workers is estimated to be 2.31E-03mSv/yr and it is insignificant compared to the effective dose limit of 1mSv/yr.

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### REFERENCES

- [1] KHNP, "Environmental Impact Assessment Report for Construction of Shin-Kori Unit 5,6" (2016).
- [2] KAERI, "Environmental Impact Assessment around Nuclear Facilities", KAERI/RR-3327 (2001).