Radiological Safety Analysis in Transportation for Radioactive Wastes Disposal

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1. Introduction

The resin mixture containing the radioactive materials will be transported to the radioactive waste disposal facility in Gyeongju after disposal. When transporting for disposal, radioactive wastes should undergo a radiological safety assessment of the process of transportation. In this study, radiological safety assessment is conducted using RADTRAN ver 6 code [1]. For using RADTRAN code, parameters such as the specification of the container, dose rate, and surrounding population are required.

2. Method

2.1 Packaging container

PC-HIC (Polymer Concrete High Integrity Container) drums are used for packaging. The height of PC-HIC drum is 1,260 mm, the diameter is 1,200 mm and the thickness of outer concrete is 65 mm.

The resin mixture consists of zeolite, activated carbon and spent resin. They will be separated during the treatment process and transported in a PC-HIC packaging container with the internal volume of 860 L. Since radionuclides have different radioactivity concentrations at different sampling locations where Manhole 1,2 and 3 located in Wolseong NPP (nuclear power plant) Unit 1's spent resin storage tank #3, they were evaluated for each sampling locations.

Dose rates were calculated by using the Microshield version 10 which is the commercial code [2]. The dose rate was calculated at 1 m outside of the PC-HIC packaging containers.

2.2 Transportation route and population density

It was assumed that truck which transports radioactive materials travels at a speed of 30 km/h and drives 4.7 km from Wolseong NPP to radioactive waste disposal facility in Gyeongju.

Subjects that are exposed to radiation outside the vehicle during transport are divided into truck drivers, on-link and off-link public. On-link public are considered in vehicles that are on the move and off-link public are considered to be next to the road while on the move.

Population density was obtained as the 54.5 persons/km^2 per area [3]. And the accident probability was calculated as the 8.31-E-08 accidents/veh-km [4].

2.3 Loading and unloading operation and driver

When the waste drums were loaded and unloaded, the number of workers was set as 4 and the working time 1 hour. The average distance between the drums and the workers was entered as 0.1 m.

Conservatively, it was assumed that two people boarded the truck.

2.4 Assumptions of accident scenarios

The accident scenarios were assumed that the exposure of radioactive nuclides to the public was

caused by accidents during truck transportation. And conservatively, it was assumed that the accident caused 0.1 % of the total radioactivity leakage. Also, it was assumed that all leaked radionuclides like ^{3}H, ^{14}C, ^{60}Co, ^{134}Cs, ^{137}Cs, etc., were aerosolizing and leaking into respirable form.

Atmospheric stability was set as the most frequent weak stability (E) of the atmospheric stability distribution of Wolseong Nuclear Power Plant site [5].

3. Result and Discussion

As shown in Table 1, the individual doses of truck driver, off-link and on-link in normal transportation were 6.10E-03 mSv, 1.59E-04 mSv and 1.96E-06 mSv, respectively. All of these did not reach the individual dose limit.

Tables 2 shows collective and individual doses of the loading and unloading workers in normal transportation of spent resin and the public at the time of truck accident at Manhole 3. The highest dose value was 11.2 mSv.

Table 1. Collective and Individual Doses in Normal Transportation

Object		Collective Dose (man·mSv)	Individual Dose (mSv)	Individual Dose Limit (mSv/year)
Truck driver		1.22E-02	6.10E-03	12
Public	on-link	2.77E-02	1.59E-04	1
	off-link	7.50E-04	1.96E-06	1

Table 2. Collective and Individual Doses of Loading and Unloading Workers and Public at the Time of Accident

Object	Manhole 3		Individual Dose Limit (mSv/year)
	Collective Dose (man·mSv)	Individual Dose (mSv)	
Worker	4.48E+01	1.12E+01	50
Public	1.55E-10	2.09E-15	1

4. Conclusion

In the case of disposal of spent resin, zeolite and activated carbon in a waste disposal container of PC-HIC, the maximum dose received value was 11.2 mSv. This value dose not reach the maximum dose limit of 50 mSv/year of radiation workers.

Doses were below the limit at all routes, objects and sampling locations. Therefore, it was evaluated that radiological safe in transportation for radioactive wastes disposal.

REFERENCES

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