

Radiation Shielding Evaluation for IP-2 Transport Container Including Activated Cutting Waste of KORI Unit 1 RV/RVI

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1. Introduction

In order to secure safety and to improve economics for disposal of VLLW/LLW, radioactive cutting wastes generated during decommissioning of the RV/RVI are should considered for characteristics of waste, site conditions, transportation and the temporary storage. Therefore it is essential to secure packaging technology these radwaste. Most of the RV/RVI cutting waste is classified as LLW and VLLW, and in the case of KORI unit 1, it accounts for about 65% of the activated RV/RVI radwaste. Accordingly in Korea, where nuclear power plant decommissioning has been actively researched, has been developing packaging containers for cut radwaste of KORI unit 1 RV/RVI, recently. In this paper, the calculation of the dose rate under the normal transportation conditions of the IP-2 transport package for transporting the packaging containers for the RV/RVI cutting waste currently under development to the disposal facility was performed.

2. Shielding Evaluation of IP-2 container

2.1 Dose Rates Criteria

There are several regulations related to radioactive waste transport in the domestic and international laws. Under the Normal transport condition, dose rate at the surface of the IP-2 transport container is limited to 2mSv/hr and one at any point 2m away from the container is limited to 0.1mSv/hr.

2.2 Source Terms

According to previous evaluation for radioactive nuclide inventory of the KORI unit 1 RV/RVI, LLW/VLLW accounts for about 65% of the activated RV/RVI radwaste. The region with the highest radioactivity level in LLW is the upper core plate of reactor vessel internal. The cut of the upper core plate is filled in only 50% of the volume inside the package,

and the remaining space is grouted with cement for immobilization, therefore calculated weight of this inside the container is 7.88tons. Table 1 shows specific activity and radioactivity considered weights of the upper core plate.

Table 1. Radioactivity of Upper Core plate

Nuclides	Specific Activity [TBq/g]	Activity [Bq]
Fe-55	1.91E-06	1.28E+13
Co-60	7.51E-09	5.03E+10
Ni-59	1.78E-08	1.19E+11
Ni-63	1.88E-06	1.26E+13

2.3 LLW Package for cut RV/RVI

The dimensions of the container for packaging the LLW of the RV/RVI are 1.46m(W) × 1.46m(L) × 0.95m(H) and thickness of it is 0.3cm. In the inside of the packaging container there is a steel-ridge for fixing and draining the contents, and the grouting using the cement is filled between the inside of the steel-ridge and the packaging container. External dimensions of the IP-2 transport container are 1.6m(W) × 3.4m(L) × 1.2m(H) and thickness of it is 0.12cm. The IP-2 transport packaging contains two LLW packaging containers. Fig. 1 shows IP-2 transport container with decommissioning waste that is LLW such as upper core plate.

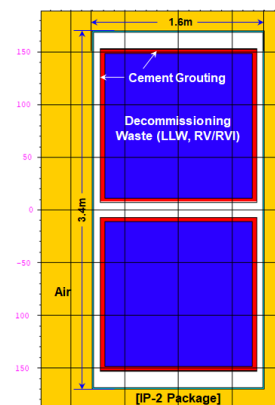


Fig. 1. Shielding Evaluation Model.

2.4 Shielding Evaluation

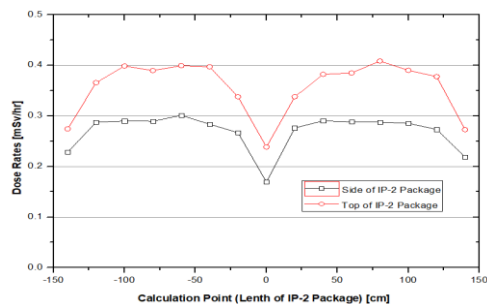
MCNP5 computer code using the three-dimensional Monte Carlo method was used to analyze to calculation dose rates at the various desired location of the IP-2 transport container [1]. It calculates photon flux which can be converted into dose rates by the use dose conversion factors. The dose conversion factors used in this calculation was taken from ICRP-74(1996) [2].

3. Shielding Evaluation Results

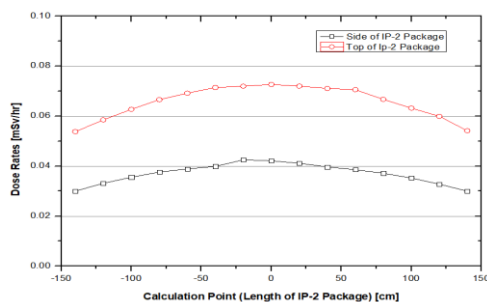
In this MCNP calculation, virtual detectors are placed at the considering points to obtain the information for dose rate. 15 detectors are respectively placed at external surface and 2m position of the IP-2 transport container. Table 2 and Fig. 2 show respectively maximum dose rates at all position and dose rates at considered points for the top and side of the IP-2 transport container. Relative errors of these detectors are showed 0.03~0.05.

Table 2. Dose Rates Results for IP-2 Container

Cal. Point	[Unit : mSv/hr]			
	External Surface		2m from the Surface	
	Results	Limit	Results	Limit
Front	0.288		0.023	
Side	0.301	2.0	0.043	0.1
Top	0.408		0.073	
Bottom	0.299		0.058	



(a) Dose rates at External Surface



(b) Dose rates at 2m form the Surface

Fig. 2. Results of Shielding Evaluation.

4. Conclusion

Recently, containers for RV/ RVI cut contents packaging are being conceptually designed, radiation shielding evaluation was performed to IP-2 transport container with decommissioning waste that is LLW such as upper core plate. IP-2 transport container including RV/RVI of Low-Level Waste radioactive waste satisfies radiation dose limits under normal transport condition.

ACKNOWLEDGEMENT

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REFERENCES

- [1] Los Alamos National Laboratory, MCNP –A General Monte Carlo N particle Transport Code, Ver.5, Release 1.40 (2005).
- [2] ICRP, Conversion Coefficients for Use in Radiological Protection Against External Radiation, ICRP-74 (1996).