

Comparison of Health Effect Risk Resulting from the Accidents during the Transport of Spent Fuel

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1. Introduction

The safe, environmentally sound and publicly acceptable disposal of high level wastes resulting from the operation of nuclear power plants is becoming very important issues. The operational safety assessment of a repository including transport safety assessment is a fundamental part in order to achieve this goal. In this study, the health effect risk was estimated and compared during the transport of sample spent fuel by truck and ship.

2. Modeling and Assumptions

Risks for a radioactive waste transportation arise from both conventional vehicular accidents and exposures to a ionizing radiation under both normal and accident conditions. Transportation risk includes health and safety risks that arise from the exposures of workers and members of the public to a radiation from shipments of wastes[1]. The health effect risks arise from exposures of people who travel, work, or live near transportation routes and transportation workers themselves to a radiation from radioactive waste packages. Health and safety risks are frequently characterized in terms of human health effects such as fatalities, injuries and a loss of human life.

The source terms for the estimation of health effect risk during the transport of spent fuel are summarized in Table 1[2]. In order to compare the risks for the transport by using a truck and a ship, we use the same transport distance, i.e., 250 km. We consider the impact accident for the comparison of health effect risks. The accident occurrence probabilities for truck and ship are $2.85E-07$ and $6.22E-07$, respectively. The risks were estimated using the RADTRAN5 developed by Sandia National Laboratory [3].

3. Results and Discussion

The early fatality risks resulting from the accidents during the transport by a truck and a ship are $6.84E-08$ and $5.08E-10$, respectively. These values are very small comparing with the safety goal of nuclear power plant operation of USNRC which is $5.0E-07$. The early fatality risk resulting from the impact accident of a ship is much lower than that of a truck. This is because of the difference in the population density. The population density used in the estimation of risks resulting from the

truck and ship accident is 178 persons/km^2 and 1.0 persons/km^2 . Therefore, much less persons during truck transport will be exposed to radiation than during ship transport.

Table 1. Source Terms for a sample spent fuel.

Radionuclide	Inventory (Ci)
CO-58	9.87E-01
CO-60	4.62E+04
KR-85	4.68E+04
SR-89	1.86E+00
SR-90	4.11E+05
Y-91	1.91E+01
ZR-95	8.08E+01
NB-95	1.80E+02
RU-103	4.56E-02
RU-106	4.32E+05
TE-127	9.57E+01
TE-127M	9.78E+01
TE-129M	5.29E-05
CS-134	3.65E+05
CS-137	5.73E+05
BA-140	1.98E-19
CE-141	8.40E-04
CE-144	5.46E+05
PU-238	1.48E+04
PU-239	1.84E+03
PU-240	2.78E+03
PU-241	6.05E+05
AM-241	3.62E+03
CM-242	1.88E+03

The total expected values of population risk in latent cancer fatalities for both truck and ship transport are $6.44E-08$ and $2.36E-09$, respectively. Also, these values are below the safety goal of nuclear power plant operation of USNRC which is $2.0E-06$. In RADTRAN5, the four pathways are considered in the estimation of transportation risks, i.e., groundshine, inhalation, resuspension inhalation, and cloudshine. Among the several pathways, the most important pathways during the truck transportation are groundshine and inhalation pathway. However, the most important pathway during the ship transportation is inhalation pathway. The relative contributions of each pathway to total of population risk in latent cancer fatalities for both truck and ship transport are plotted in Figures 1 and 2. The total expected values of population risk in genetic effects for both truck and ship transport are $7.44E-09$ and $5.48E-11$, respectively.

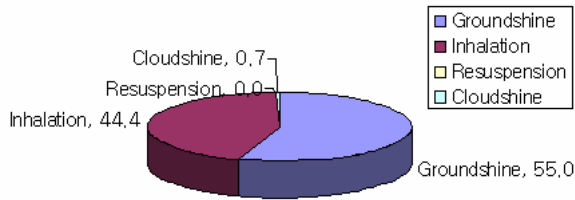


Figure 1. Relative contribution of each pathway during the accident of truck transport

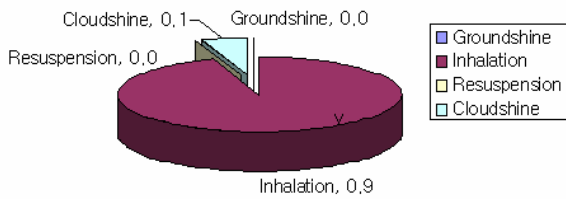


Figure 1. Relative contribution of each pathway during the accident of ship transport

4. Conclusion

We estimated and compared the health effects risks resulting from the accidents during the transport of the spent fuel. From the results of this study, the transport of radioactive wastes using both truck and ship is a low radiological risk activity with a manageable safety and health consequence. However, there may be a number of social and institutional challenges to the successful transport of spent fuel from the nuclear power plant to a repository. Therefore, detailed and sophisticated transport risk assessment and management based on this study must be made for the safe transport of spent fuel to the interim storage facility or permanent disposal repository.

Acknowledgement

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