Analysis of Exposure Dose by RESRAD Sensitivity Analysis

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1. Introduction

When decommissioning an old nuclear power plant, evaluation of exposure dose is essential. Dose can vary depending on the radionuclide concentration, scenario, exposure pathway and parameters. RESRAD-ONSITE code was used to evaluate exposure dose.

The RESRAD code was developed by Argonne National Laboratory (ANL) with support of the U.S. Department of Energy (DOE), and the U.S. Nuclear Regulatory Commission (NRC). This code was used for remediation standards, evaluation of doses and risks for contaminated sites.

The code used in this study is the RESRAD-ONSITE code, which can be used to assess radiation exposures of a human receptor located on top of soils contaminated with radioactive materials. [1]

The purpose of this study is to analyze the dose by changing characteristics of cover, which is one of RESRAD parameters.

RESRAD Sensitivity Analysis was performed for characterization of dose.

2. Methodology

The radionuclides used in this study are ^{240}Pu, ^{137}Cs, ^{90}Sr, and the radionuclides concentration was 1 Bq/g. In RESRAD, the main parameters related to the cover are the cover depth, the density of cover material, and the cover erosion rate.

RESRAD default values were used for the above three parameters. Sensitivity analysis was carried out after setting the density to 1.5 g/cm^3, the erosion rate to 0.001 m/yr, and the thickness to 20 cm.

We quantitatively confirmed the characteristics of the derived dose through sensitivity analysis of each parameters.

3. Results and Discussion

3.1 Cover depth

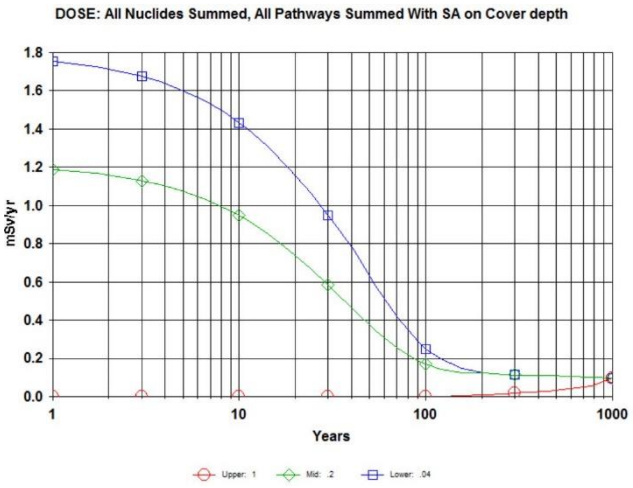

Fig. 1. Graph of dose for the cover depth.

If the thickness of the cover is 1 m, the initial dose is 0 and the maximum dose is 0.1 mSv/yr after 1000 years. In the case of 20 cm and 4 cm, the maximum dose occurs at the beginning and is 1.2 mSv/yr and 1.75 mSv/yr.

3.2 Density of cover material

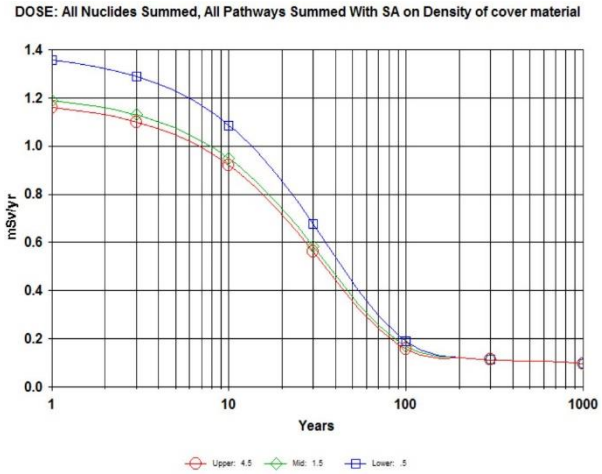

Fig. 2. Graph of dose for the density of cover materil.

The maximum dose occurred at t = 0, and dose values were 1.35 mSv/yr (0.5 g/cm^3), 1.2 mSv/yr (1.5 g/cm^3) and 1.15 mSv/yr (4.5 g/cm^3).

3.3 Cover erosion rate

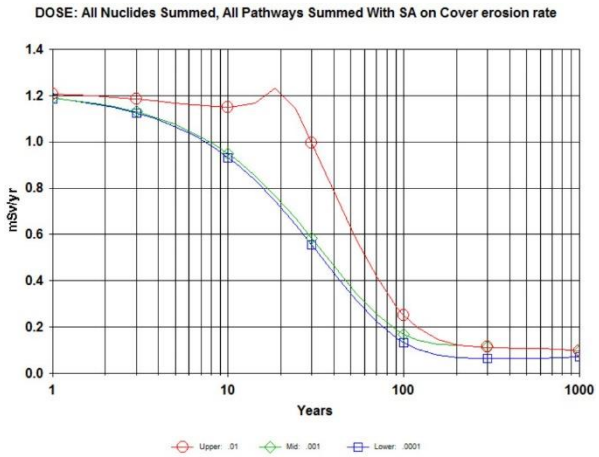

Fig. 3. Graph of dose for the cover erosion rate.

The maximum dose occurred at t = 0 except when the erosion rate was 0.1 m/yr, and the maximum dose occurred after 20 years for 0.1 m/yr erosion rate. The dose values are about 1.2 mSv/yr in all three cases.

4. Conclusion

In this study, dose were derived through sensitivity analysis of cover thickness, density, and erosion rate.

The most sensitive parameter is cover thickness. The change in dose was most prominent with the change in thickness. In the case of erosion rate, special attention should be paid to the exposure dose even after the elapse of time since it was confirmed that the maximum dose occurred at 20 years after the initial dose.

The exposure dose was quantitatively confirmed by the graph that the dose decrease with the cover thickness increased, the density increased, and the erosion rate decreased. Also, if a thick cover is used with a dense material, the exposure dose will be reduced immediately.

In Korea, because of the lack of experience in decommissioning commercial nuclear power plants, it is considered effective to reduce the exposure dose by using the cover in the case of unexpected exposure situation.

REFERENCES

[1] ANL, “User’s Manual for RESRAD version 6”.