Evaluation of Offsite Dose from Landfill Disposal and Incineration of Household Waste Containing Naturally Occurring Radioactive Materials

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Introduction

- Consumer products (CPs) containing NORMs are used both directly and indirectly in our daily lives, and they are discarded uncontrollably in landfills alongside other household wastes.
- The public is exposed to a significant amount of radiation as a result of this unauthorized disposal.
- The IAEA considers uncontrolled disposal of consumer products containing small amounts of radioactive materials to be beyond effective regulation.

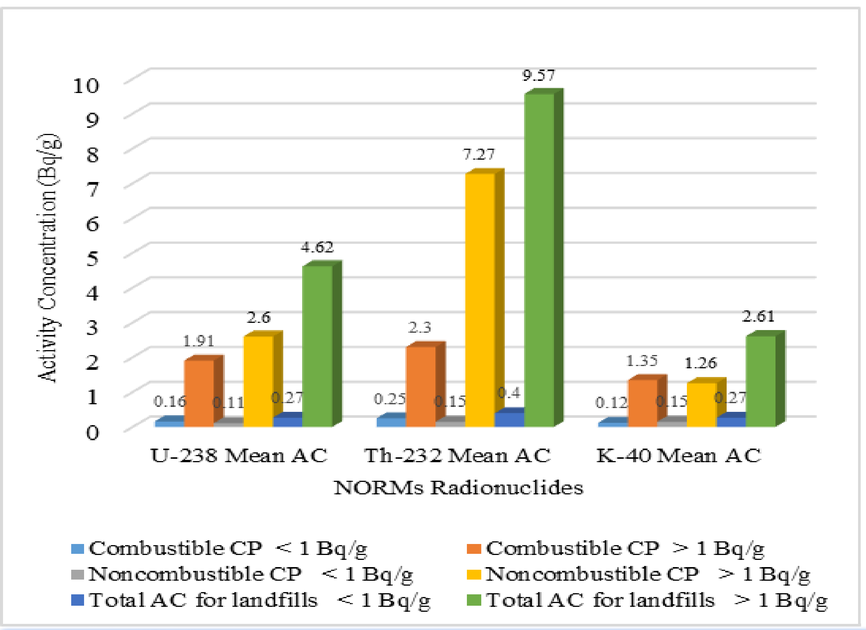
Objective

The objective of this study is to evaluate the offsite dose evaluation to the public resulting from landfill disposal and incineration of household waste containing NORMs in South Korea

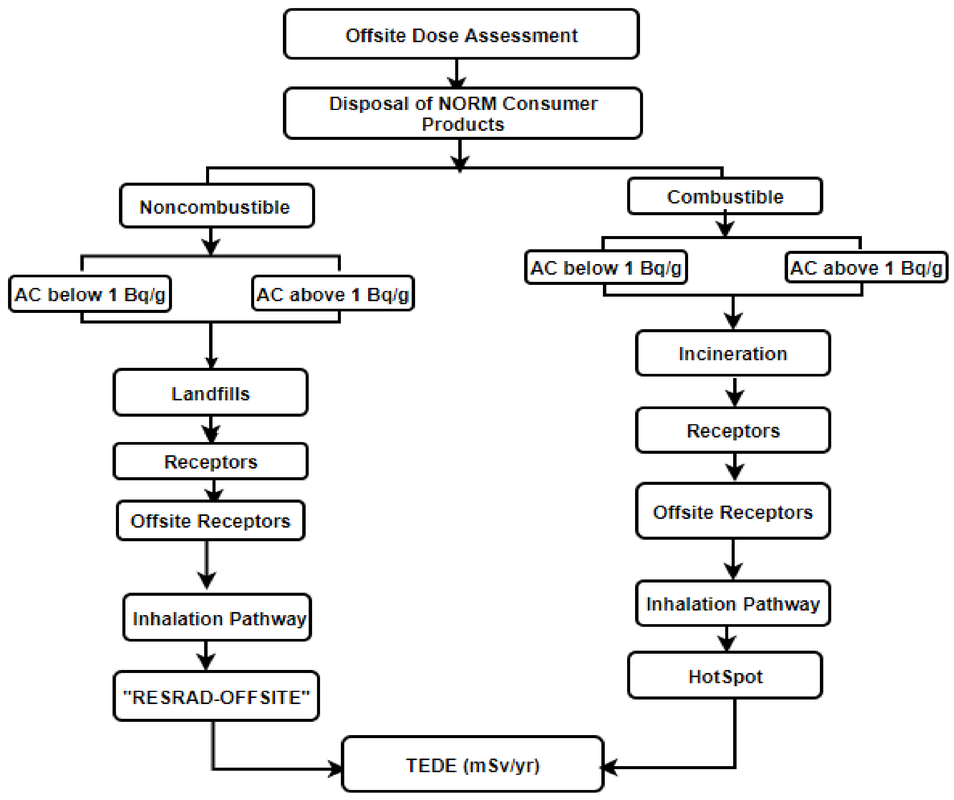
Methodology

Activity Concentration

- Data on AC of various CP containing NORMs were obtained and analyzed using interval plot
- Data were further categorized into combustible and non combustible with AC < 1Bq/g and above 1Bq/g
- The 95% confidence interval for the mean specific ACs of all radionuclides in question is summarized in the graph below.



Dose Assessment Scenario



Computer codes

Codes	Models	Advantage	Disadvantage
RESRAD-OFFSITE	Gaussian plume model	Evaluates radiological dose and risk to offsite receptors.	Breaks down during low wind speed condition
HotSpot	Atmospheric dispersion model	Evaluates incident involving radioactive materials.	Estimate the short range (less than 10 km)

Input Parameters of RESRAD offsite

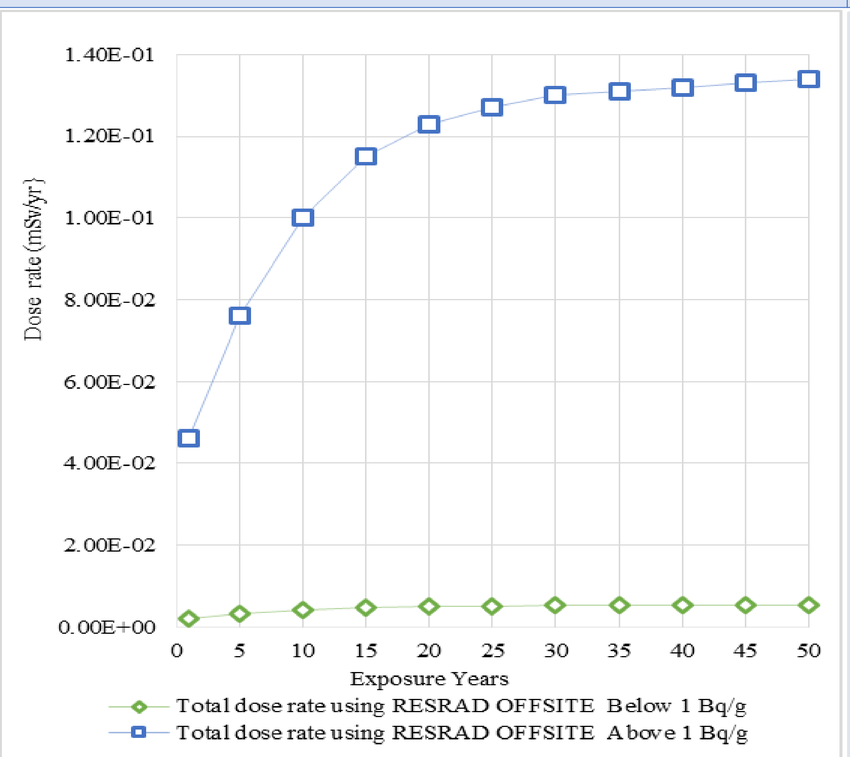
Input parameter	Value	Source
Exposure duration	50 years	RESRAD default
Area of the contamination zone	659 m^2	Korea statistics, 2018
Density of cover material	1.5 g/cm3	RESRAD default
Inhalation rate for onsite resident Inhalation rate for industrial workers	8400 m^3/year 11,400 m^3/year	RESRAD default RESRAD default
Cover radon diffusion coefficient	0.000002 m^2/s	RESRAD default

Input Parameters of HotSpot Code

Parameters	Values
AC below and above 1000 Bq/kg	AC of ^{238}U ^{232}Th and ^{40}K
Receptors height	5 m
Sample time	40 mins
Effective release height	7 ft.
Atmospheric stability	Sun high in the sky
Wind Speed	2.24 mph
Wind direction	270
Wind Speed	10 m/s
Stability class	A
Breathing rate	3.33E-04 m^3/sec

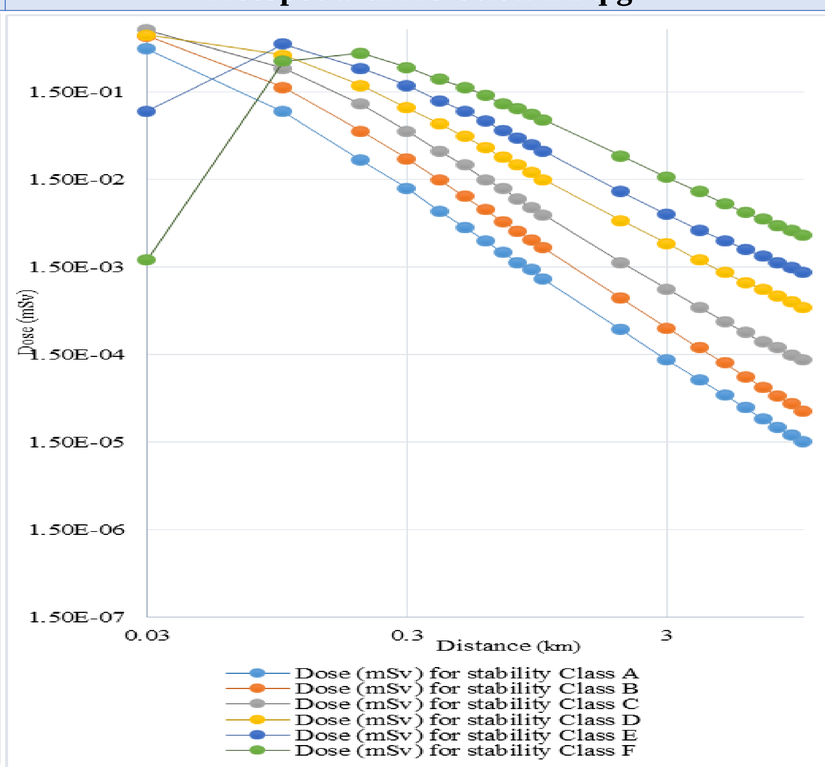
Results

RESRAD Offsite



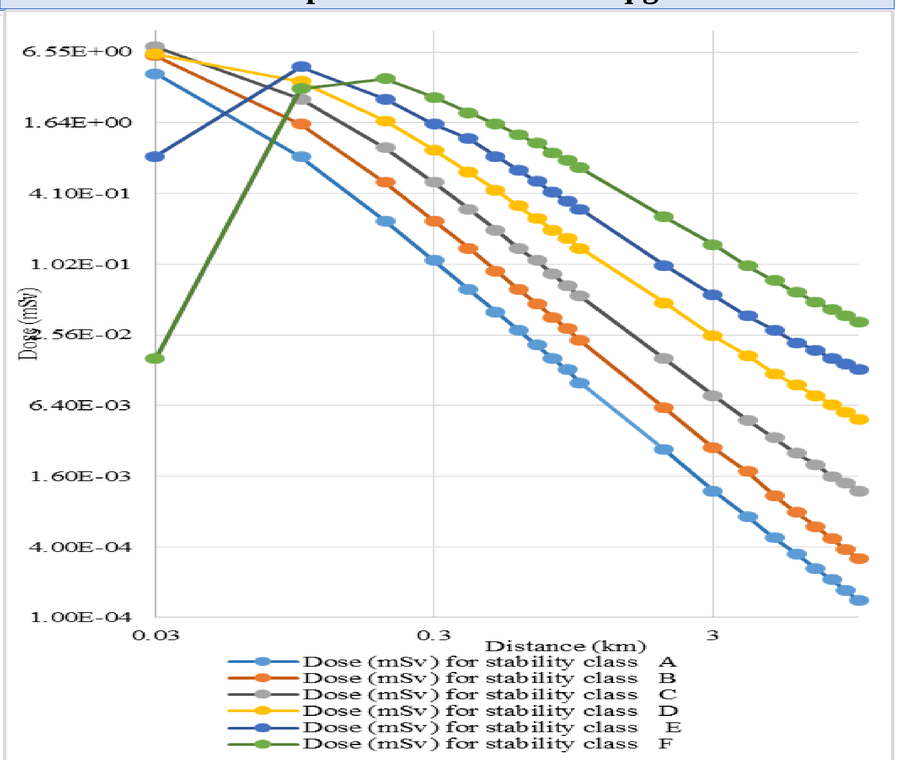
- Exposure Pathway considered was inhalation.
- Assessment period of 50-years. The input data for both ranges of activity concentration were used along with other default RESRAD parameters.
- All the resultant doses are below the recommended ICRP public dose limit of 1 mSv/y

HotSpot with AC below 1 Bq/g



- The highest dose for stability class A is 0.47 mSv at a distance of 0.03 km from the release point.
- The dose dispersed throughout a 10 km radius of the release site is influenced by the stability class.
- People living within 10 kilometers of the incinerator are thus exposed to a higher dose than those living further away.

HotSpot with AC above 1 Bq/g



- The maximum dose at a distance of 0.03 km from the release point for ACs above 1 Bq/g for stability classes A, B, C and D are above the ICRP dose limit of 1 mSv/y.
- The dose for AC above 1 Bq/g is greater than that for AC below 1 Bq/g
- People residing within 10 kilometers of the incinerator are more susceptible to higher exposure dosages.

Conclusion

- Combustible and noncombustible CPs were identified in household waste containing NORMs.
- These were then divided into two groups depending on the AC range, and all the doses were below 1 mSv/yr.
- Therefore, it is safe for people to reside within the vicinity of landfill.
- However, the competent authorities must implement a protection measure for residents residing near the incinerator and landfill site for their own safety and well being.