Preliminary Study of Radiological Environmental Impact Assessment for 5MW Nuclear Research Reactor in Kenya

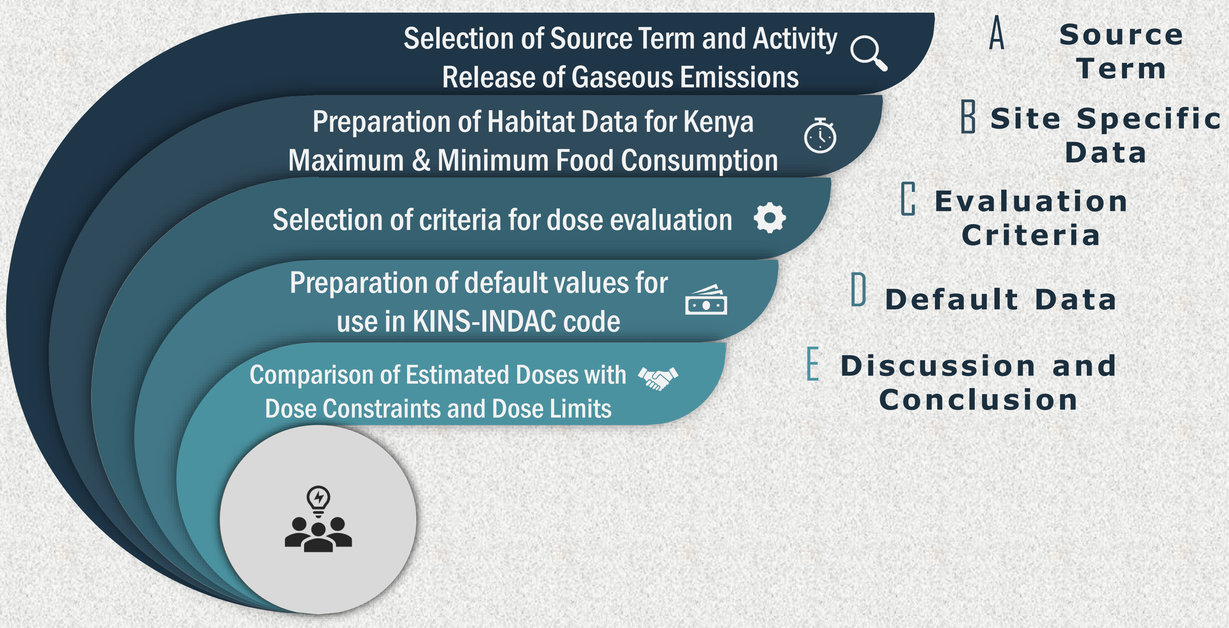
Achoki Stacy [a], Byeongsoo Kim [b]

[a] Korea Advanced Institute of Science and Technology (KAIST), [b] Korea Institute of Nuclear Safety (KINS)

Introduction

- Kenya plans to construct a 5MW nuclear research reactor to be upgraded to 10MW.
- This research focuses on exposure to the public from normal operation of a nuclear research reactor.
- Using site specific food consumption data, the KINS-INDAC code is used to estimate dose to the representative person and representative organ from release of gaseous effluents.

Methodology



i. Derivation of an age-specific correction factor

- Age specific food consumption intake rate was not available for the Kenyan population. Therefore, the following formula from US EPA was used to derive age-specific correction factors.

$$\text{Correction Factor (C.F)} = \frac{\text{Age Specific mean per capita total intake } \left(\frac{\text{g}}{\text{day}}\right)}{\text{Total Population mean per capita total intake } \left(\frac{\text{g}}{\text{day}}\right)}$$

ii. Average Individual Consumption Data

- Mean Age-Specific individual intake rate is useful for calculation of dose to the population living beyond the Exclusion Area Boundary (EAB). In this study, this value was obtained by multiplying mean total population intake data from Kenya by the C.Fs..

iii. Maximum Individual Consumption Data

- The ICRP recommends, the maximum value/95th percentile usually exceeds the average by 3. Maximum individual data to calculate dose was obtained by multiplying the average individual consumption data result above (ii) by 3.

iv. Evaluation Criteria

- Dose evaluation criteria was compared between the US, England, Canada and ROK. Criteria from the US is detailed and conservative and thus was chosen as the acceptance criteria for this study.

Results

Classification	Criteria	Evaluation Result (mSv/yr)	Ratio (%)	Organ
Beta-Air (mGy/yr)	0.2	4.56E-03	2.28	
Gamma-Air (mGy/yr)	0.1	1.24E-02	12.40	
Effective Dose	0.05	6.67E-03	13.34	
Skin Dose	0.15	1.33E-02	8.87	
Organ Dose – Adult	0.15	4.37E-02	2.91	Thyroid
Organ Dose - 15 Years	0.15	7.34E-03	4.89	Thyroid
Organ Dose - 10 Years	0.15	1.00E-02	6.67	Thyroid
Organ Dose - 5 Years	0.15	2.11E-02	14.07	Thyroid
Organ Dose - 1 Year	0.15	9.04E-03	6.03	Thyroid
Organ Dose - 3 Months	0.15	8.18E-03	5.45	Thyroid

Discussion

The results shown indicate an estimation of dose to the representative person from the continuous release of gaseous effluents from a 5MW HANARO research reactor. The ratio column is a fraction of evaluation result to criteria for 21m EAB, North. The representative individual in this study is the 5-year-old and the representative organ is the thyroid.

The thyroid is identified as the representative organ. The dose to the thyroid tends to increase with an decrease in age due an increase in sensitivity of their organs, smaller body diameters and their organs being less shielded by the overlying tissues. Additionally, the thyroid cannot distinguish between stable and radioactive iodine. As a result, it is the most sensitive organ and most likely organ to be affected.

The effective dose to the representative individual considering all exposure pathways is 6.67μSv/yr. This value is far below the annual dose limit of 0.05mS/yr. The main exposure pathways identified in this study include inhalation and ingestion of milk.

Conclusion

The dosimetry endpoints of this study are effective dose and equivalent dose to the thyroid in mSv/yr. The impact of I-131 is an important factor to the overall exposure of the representative individual. For internal exposure ingestion of Cs-137 is of particular concern due to its homogenous biological distribution.

The sources within this practice may be exempted without further consideration as the expected effective dose is below 10μSv/year and exposure incurred by members of the public does not exceed 1mSv/year by the IAEA GSR Part 3.

Recommendations for future study

- Collection of local meteorological data for the site such as wind speed and wind direction at reference height.
- Identification of statistical procedures to accurately determine maximum individual consumption data.