

Importance of Meteorological Condition on Environmental Effect of Radioactive Material From a Nuclear Facility



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1. Introduction

- Environmental effect of the air pollutants released from an industrial facility into the atmosphere is closely related to the meteorological condition.
- By the analysis of the site meteorological condition, it is possible to estimate the suitability of the site as a nuclear site.
- Authors analyzed the site meteorological condition by categorizing the atmospheric flow condition of a Korean four nuclear sites and Jordan research reactor site using integral quantities for characterizing stagnation and recirculation.

2. Methodology

- Authors devised three categorization methods for stagnation and recirculation using the integral quantities defined by Allwine and Whitemen.
- The integral quantities are used to identify 'stagnation' and 'recirculation' during a certain period only with the surface wind data.



$$L_1 = \sqrt{X_1^2 + Y_1^2} \quad \text{Straight-line distance}$$

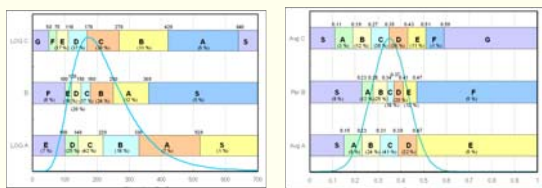
$$S_1 = \tau \sum_{j=i}^{i+p} U_j \quad \text{Wind run}$$

$$R_1 = 1 - \frac{L_1}{S_1} \quad \text{Recirculation factor}$$

2.1 Categorization if the Integral Quantities

- The meteorological data measured at 76 measuring points which cover the whole of the Republic of Korea including the four nuclear power plant sites were analyzed for categorizing the integral quantities.
- Authors devised three categorization methods for stagnation and recirculation.

- Based on the Average
- Upper and Lower Percentiles : adjust 5%, 15%, 20%
- Average based (Similar to the 1st method except the center)

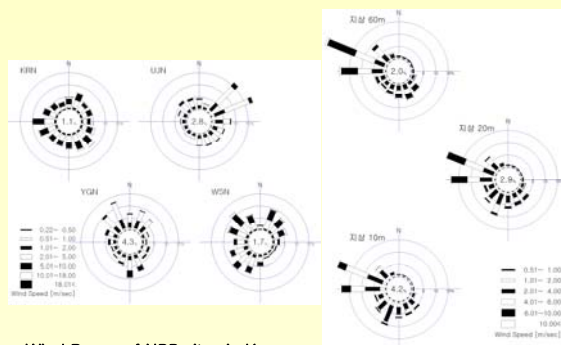


Gradation into 6 groups

Grade	Stagnation [km]	(%)	Recirculation (%)
S	$520 \leq \bar{S}$	1	$\bar{R} < 0.15$ 0
A	$330 \leq \bar{S} < 520$	7	$0.15 \leq \bar{R} < 0.23$ 8
B	$220 \leq \bar{S} < 330$	18	$0.23 \leq \bar{R} < 0.31$ 24
C	$140 \leq \bar{S} < 220$	42	$0.31 \leq \bar{R} < 0.39$ 41
D	$100 \leq \bar{S} < 140$	25	$0.39 \leq \bar{R} < 0.47$ 22
E	$\bar{S} < 100$	7	$0.47 \leq \bar{R}$ 5

2.2 Analysis of Meteorological Data

- The meteorological data measured at four nuclear power plant sites in Korea and the data measured at Jordan Research reactor site were analyzed.



Wind Roses of NPP sites in Korea

Wind Roses of JRTR sites in Jordan

3. Results

- The devised methods were applied to the four Korean nuclear power plant sites and Jordan research reactor site and the two reference sites in U.S.A.
- The following table represents the SR grades of several sites, and it shows that the Kori and Wolsung sites have "AB" grade.
- The Jordanian research reactor site has the grade of "AA" and "BA" depending on the measuring height, which represents quite good atmospheric conditions in from the view of atmospheric diffusion aspect.

Site	\bar{S} (Grade)	\bar{R} (Grade)	SR grade
USA Arizona	Bullfrog Basin 145 (C)	0.49 (E)	CE
	Desert View 250 (B)	0.18 (A)	BA
Korea	KRN 449 (A)	0.23 (B)	AB
	UJN 225 (B)	0.33 (C)	BC
	YGN 241 (B)	0.26 (B)	BB
	WSN 399 (A)	0.28 (B)	AB
JRTR	JUST 60m 420 (A)	0.18 (A)	AA
	JUST 20m 360 (A)	0.21 (A)	AA
	JUST 10m 290 (B)	0.21 (A)	BA

4. Conclusion

- Meteorological condition is the key factor for estimating the environmental effects of a nuclear facility.
- The devised method can be used for assessing the relative environmental risk of a nuclear facility with only meteorological data. And the devised categorization method can be used for choosing a suitable site for an industrial facility such as a nuclear power plant and a chemical complex.