

A Preliminary Assessment of Daily Weather Conditions in Nuclear Site for Development of Effective Emergency Plan

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1. Introduction

A radiological emergency preparedness for nuclear sites is recognized as an important measure against anticipated severe accidents with environmental releases of radioactive materials [1]. While there are many individual means in the emergency preparedness for nuclear accidents, one of most important means is to make a decision of evacuation or shelter of the public residents with the emergency plan zone (EPZ) of a nuclear site.

In order to prepare an effective strategy for the evacuation as a basis of the emergency preparedness, it may need the understanding of atmospheric dispersion characteristics of radiation releases to the environment, mainly depending upon the weather conditions of a radiation releases location, i.e., a nuclear site.

As a preliminary study for the development of an effective emergency plan, the basic features of the weather conditions of a specific site were investigated. A main interest of this study is to identify whether or not the site weather conditions have specific features helpful for a decision making of evacuation of the public residents.

2. Assessment Methods

A prerequisite to develop an effective emergency plan is to examine the specific weather conditions of the given site and then assess whether or not the specific weather patterns are profitable in the development of an emergency plan. Wherever the relevant insights are profitable to a strategy development, more comprehensive study should be focused.

As an assessment method, this study focuses on repeatable weather patterns according to time scale such as annual, and seasonal, etc. The parameters of interest for this are related to atmospheric dispersion characteristics, i.e., atmospheric stability, winds directions, and winds speed, etc. From the emergency plan point of view, however, daily weather conditions are more relevant among them, because an evacuation strategy to prevent the radiological exposure of public residents may be highly influenced by the average daily life style of the public residents. When considering this aspect, daily weather conditions should be more focused in order to identify specific patterns that may affect their evacuation strategy.

Daily weather conditions are classified by the hour of

day from an annual data as a typical considering period of risk assessment. Atmospheric stability and wind direction are selected as the investigate parameters. to identify the basic features of daily weather conditions. These parameters are simplified as three class of atmospheric stability (stable, neutral, and unstable) and sixteen of wind directions.

Seasonal effects on daily weather conditions to identify the deviation from the annual aspect are additionally examined. Seasonal effects specific to the domestic climate features are investigated by simply dividing into two seasons: summer and winter. It is noted that the periods of summer and winter are divided by 7 months (3/16 – 10/15) and 5 months (10/16 – 3/15), respectively.

For feasibility, weather data in year 2004 of a domestic nuclear site on the east coast of Korean peninsula was used in this study [2].

3. Results and Discussion

3.1. Atmospheric Stability Class

Fig. 1 provides a typical example of the daily weather conditions for the atmospheric stability, showing the basic features:

- The atmospheric stability was changed according to day or night.
- In daytime, the atmosphere became strongly unstable (> 90%), whereas dominant tendency of atmosphere in the nighttime was stable (~ 50%) or some was unstable (~ 30%).

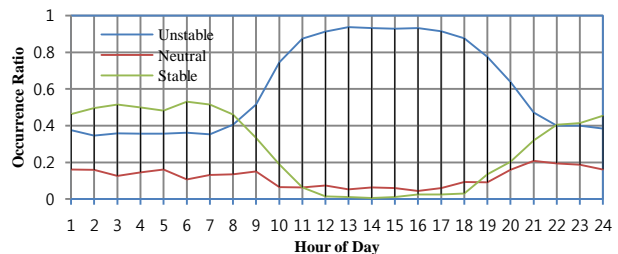


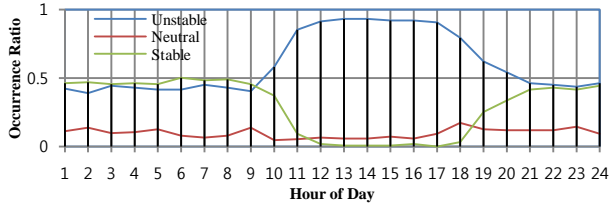
Fig. 1. Daily atmospheric stability chart - 2004

When considering the seasonal factors, daily atmospheric stability charts for winter and summer are shown in Fig. 3 (a) and (b), respectively. When comparing with the annual average, the atmospheric stability has the following characteristics:

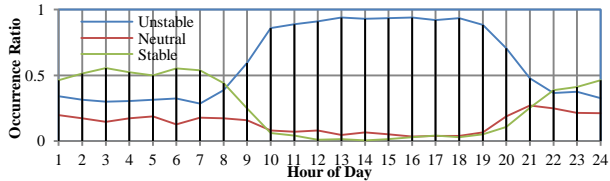
- The transient time was changed by the duration of day

and night according to the seasonal differences.

- In summer, the stable class was observed with higher frequency comparing with the winter.



(a) Winter season



(b) Summer season

Fig. 2. Daily atmospheric stability charts for seasons (2004)

3.2. Wind Directions

Fig. 3 show the daily distribution of the wind directions which is based on the foregoing approach.

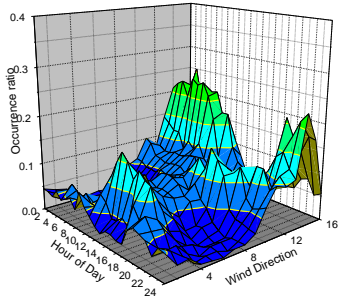
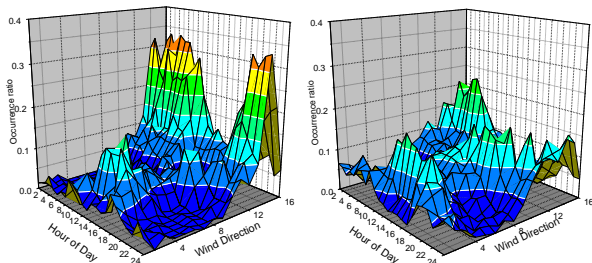


Fig. 3. Daily wind directions distribution – 2004

This chart shows that the daily wind directions had a close relation with the atmospheric stability and a specific pattern such that it is higher occurrence of NW direction in the nighttime and higher occurrence of NE and SW direction in the daytime but the frequencies of dominant wind directions during the daytime was lower than those during the night time.



(a) Winter

(b) Summer

Fig. 4. Seasonal wind directions distributions (2004)

Fig. 4 (a) and (b) show the winter and summer wind directions distributions, respectively, based on the seasonal factors. When comparing with the annual

average, key features of the wind directions distributions are as follows:

- In winter, the wind directions were highly concentrated to the NW direction.
- In summer, frequencies of specific wind directions were lower, but the S direction was highly observed during the daytime.

3.3. Discussion

On the basis of the annual or seasonal weather aspects for the assessment site, the specific daily weather patterns were observed through this study, which could be considered for the development of an effective emergency plan. Insights into the analysis of these observed daily weather patterns are summarized as follows:

- Averaged hourly patterns in a day could become a main factor of the development of an evacuation strategy.
- The atmospheric stability is closely related to the dispersion rate of radioactive materials, and thus the radiation exposure features are directly related to the atmospheric stability patterns during a day. Based on this observation, the stability drastically changes according to day or night. Thus, this daily weather pattern should be considered as one of key factors when developing an emergency plan.
- The observed wind directions patterns would be applied for the decision making of evacuation strategy, i.e., evacuation direction and location of destination.

4. Concluding Remark

In this study, a few specific features of weather conditions were examined as a pioneering work to develop an effective emergency plan. The present study shows that these specific patterns are closely related to the radiation exposure characteristics of public residents. More comprehensive study including exposure effects is needed to prepare a framework for a risk-informed emergency plan.

ACKNOWLEDGEMENT

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- [2] J. Jeong, "An Assessment of Hypothetical Severe Accident Risks for PWR and PHWR Plants in Korea," KAERI/TR-2730/2004.