Evaluation of Atmospheric Relative Concentration through analyzing Meteorological Data at Kori NPP

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Ⅰ. Introduction

Given that the period of temporary storage of LILW was has been relatively longer than that of other countries, there is risk that a variety of arbitrary accidents could occur in the temporary storage facility at each reactor site. While there is a wealth of research available in the literature on the disposal of LILW, few risk assessments on temporary storage facilities have been conducted. Moreover, details regarding safety analysis on temporary storage facilities have not been considered in the preliminary and final safety analysis reports. According to the consequences of these situations, there is need for research on potential arbitrary accidents in temporary storage facilities.

In order to do this work, we have conducted exposure dose assessments for workers and public originating from temporary storage facilities. Atmospheric relative concentration (χ/Q) is one of important parameters to evaluate the exposure dose assessment.

The main objective of this study is to evaluate the atmospheric relative concentration (χ/Q) through analyzing meteorological data at Kori NPP.

Ⅱ. Model for Calculation of the Atmospheric Relative Concentration (χ/Q)

In this study the atmospheric relative concentration was calculated by the U.S. NRC computer program PAVAN [1]. This program is based on various models and assumptions suggested in the U.S. NRC RG1.145 [2]. In the case of ground-level release, the χ/Q values are evaluated via the following equations:

$$\frac{\chi}{Q}(x,i,j) = \frac{1}{U_{ij(10)}\left[\pi\sigma_{yj}(x)\sigma_{zj}(x) + A/2\right]} \quad \text{----------} \quad (1)$$

$$\frac{\chi}{Q}(x,i,j) = \frac{1}{U_{ij(10)}\left[3\pi\sigma_{yj}(x)\sigma_{zj}(x)\right]} \quad \text{----------} \quad (2)$$

$$\frac{\chi}{Q}(x,i,j) = \frac{1}{U_{ij(10)}\left[\pi M_{ij}(x)\sigma_{yj}(x)\sigma_{zj}(x)\right]} \quad \text{----------} \quad (3)$$

where i is the grade of wind speed, j is the level of atmospheric stability, x is the distance (m), χ/Q is the relative concentration (sec/m^3), $U_{ij(10)}$ is the wind speed measured at a height of 10 m (m/sec), $\sigma_{yj}(x)$ is a horizontal dispersion coefficient (m), $\sigma_{zj}(x)$ is a vertical dispersion coefficient (m), A is the cross section of the facility, and $M_{ij}(x)$ is a horizontal vortex factor.

Ⅲ. Determination of the atmospheric relative concentration (χ/Q)

Ⅲ-1. Meteorological data input

All meteorological data were collected at a point of 10-meter height in the meteorological observation tower of Kori NPP. For more accurate calculation, about 100,000 meteorological data measured between January 1, 2005 and December 31, 2007 were used. The meteorological monitoring program for NPP indicated in the U.S. NRC RG1.23 was used for the calculations of joint frequency distribution (JFD) of wind direction and wind speed by atmospheric stability [3]. Figure 1 shows the meteorological data related to wind

direction and wind speed.

Ⅲ-2. Determination of the atmospheric relative concentraion (χ/Q)

The distance of the χ/Q value for workers was set at 50 m so as to include all workers around the temporary storage facility for LILW and the distance for public was also established as 700 m which reflects the restricted area boundary with respect to the Kori NPP. The χ/Q-frequency values normalized with respect to all time for workers and public were determined by the PAVAN code (Fig. 2). For final exposure dose assessment, we are considering the χ/Q value corresponding to the 50 percentiles for workers and public, i.e., 4.82E-3 sec/m^3 and 2.92E-5 sec/m^3, respectively.

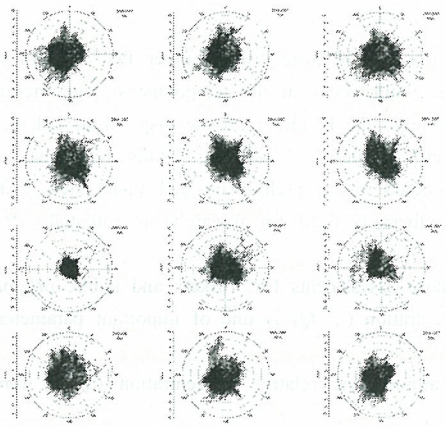

Figure 1. The meteorological data related to wind direction and wind speed

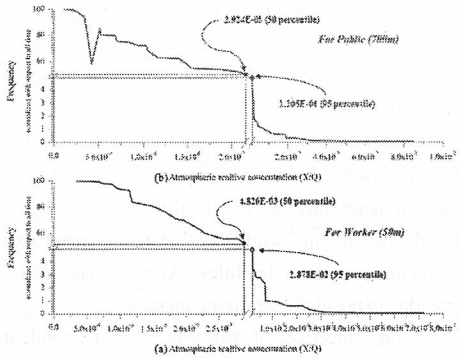

Figure 2. The χ/Q-frequency values normalized with respect to all time (a) for workers, (b) public

Ⅳ. Conclusion

Atmospheric relative concentration (χ/Q) was evaluated through analyzing meteorological data measured between January 1, 2005 and December 31, 2007. And then this values were derived by JFD method using wind direction and wind speed by atmospheric stability. Consequently, max χ/Q value used for design-basis accident was estimated by 3.81E-2 sec/m^3 and 2.69E-4 sec/m^3 for workers and public. Furthermore, the χ/Q value corresponding to the 50 percentiles for workers and public was evaluated by 4.82E-3 sec/m^3 and 2.92E-5 sec/m^3, respectively.

References

[1] Nuclear Regulatory Commission, 1982, PAVAN: An Atmospheric Dispersion Program for Evaluating Design-basis Accidental Releases of Radioactive Materials from Nuclear Power Stations, NUREG/CR-2858 PNL-4413

[2] Nuclear Regulatory Commission, 1983, Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants, U.S. NRC Regulatory Guide 1.145 (Rev.01)

[3] Nuclear Regulatory Commission, 2007, Meteorological Monitoring Programs for Nuclear Power Plants, U.S. NRC Regulatory Guide 1.23 (Rev.01)