Development of Measurement Guideline in Radioactively Contaminated Area after Nuclear Power Plant Accident

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As an emergency preparedness, it is necessary to develop guidelines to select contamination areas and carry out decontamination of the contaminated areas. A guideline for investigation and measurement of radioactively contaminated areas was developed. The developed guideline consists of three steps. Step 1 is to select intensive contamination survey areas. Step 2 is to verify decontamination effects. Step 3 is to monitor post. Fig. 1 shows the overall composition of the guideline. Based on the developed guideline, the pollution level of the contaminated areas can be systematically identified for the decontamination procedure.

I. INTRODUCTION

Radionuclides were released to the atmosphere following the Fukushima Daiichi NPP accident. It led to the radioactive contamination of large area. The Japanese government developed guidelines to select intensive contamination survey areas and carry out decontamination of the contaminated areas (Ref. 1). However, there is no guideline for the investigation and measurement in Korea. The objective of this study was to develop a guideline for the investigation and measurement of radioactively contaminated areas after NPP accident for emergency preparedness purpose.

II. GUIDELINE

The developed guideline consists of three steps. Step 1 is to select intensive contamination survey areas. Step 2 is to verify decontamination effects. Step 3 is to monitor post. Fig. 1 shows the overall composition of the guideline.

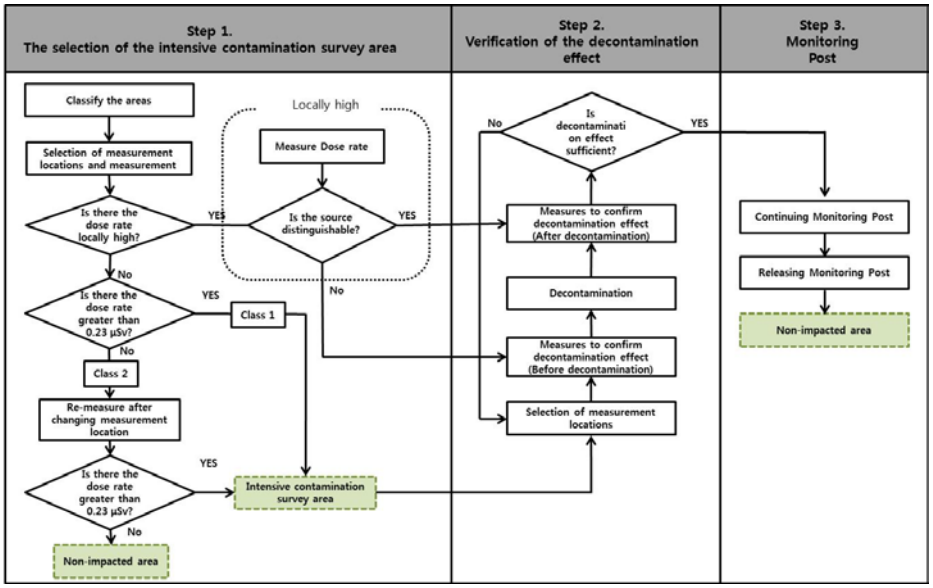

Fig.1. Flow diagram of measurement guideline for radioactively contaminated area after NPP accident

At step 1, contamination areas are classified by considering the circumstances of the contaminated areas after selecting the mesh for investigation and measurement. For school, detached housing, and collective housing, at least five measurement points shall be set among places where people are deemed to spend much time in outdoor. For ground and open land areas, at least four measurement points shall be set per 10 m x 10 m (Ref. 2). However, we suggested four measurement points per 30 m x 30 m based on JAEA's verification test. In principle, measurement at point should be

taken at a height of 1 m from the surface. However, we recommended measurement at each point should be taken at a height of 50 cm from the surface for facilities such as elementary school, playground, and park considering the living spaces of children. After the measurements, the measured values are averaged to find the mean dose rate for whole area. If the mean dose rate is greater than 0.23 μSv, the area will be classified as Class 1. When the mean dose rate is less than 0.23 μSv but several measurement points are greater than 0.23 μSv, the area will be classified as Class 2. The others will be classified as non-impacted area. Class 1 is set as decontamination zone. For the class 2, new measurement points are selected and measurements are performed again.

Since the purpose of this step is to determine the average dose in the area, we avoid measurement points such as under trees or street drains where the dose rate may be locally high.

At step 2, we classified decontamination zone that can be applied to the same evaluation index. Then, the number of radiation measurement points was set by applying the area, length, and contamination degree of the target area. Using WRS test, number of data points are determined as follows (Ref. 4):

$$N = \frac{(Z_{1-\alpha}+Z_{1-\beta})^2}{3(P_r-0.5)^2} \quad (1)$$

Using sign test, number of data points are determined as follows (Ref. 4):

$$N = \frac{(Z_{1-\alpha}+Z_{1-\beta})^2}{4(\text{Sign p}-0.5)^2} \quad (2)$$

N is the number of data points. P_r is probability that a random measured value of the survey unit exceeds the reference value by less than the legal standard. $Z_{1-\alpha}$ and $Z_{1-\beta}$ represents the selected decision error levels α and β. Sign p is the estimated probability that a random measurement from the survey unit will be less than the legal standard (Ref. 4). To confirm the decontamination effect, the air dose rate and surface contamination should be measured above 1 cm on the surface using the same instrument before and after decontamination. Also, the period between decontamination and measurement must be as short as possible.

Step 3 should be carried out within 6 ~ 12 months after the decontamination to confirm whether decontamination effect is maintained or not. In addition, it is recommended to measure dose rate once or twice a year to release the contaminated areas.

III. CONCLUSIONS

We developed a guideline consisting of three levels for the investigation and measurement of radioactively contaminated areas after NPP accident. Based on the developed guideline, the pollution level of the contaminated areas can be systematically identified for the decontamination procedure. As a next step, we are going to develop a measurement guideline for radioactively contaminated areas.

ACKNOWLEDGMENTS

This research was supported by Grant (20141510101630) from the Energy Technology Development Project of Korea.

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