Experiences With the Ground Based and Mobile Gamma-Ray Spectrometry in Contaminated Areas of the Fukushima Prefecture

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1. Introduction

According to the lesson learned from nuclear accidents in Fukushima Daiichi nuclear power plant (FDNPP), the response technology against the accident should be systematically prepared to produce the quick and reliable information to appropriately support the decision making by the accident aspect, such as the early, intermediate, and recovery phase. This technology includes the assessment of the radioactivity distribution in the environment owing to the release from the accident. In JAEA (Japan Atomic Energy Agency), the mapping project [1-3] around Fukushima prefecture has been conducting to obtain the information on contaminated conditions, that is, contaminated ranges, radionuclides and their depth profiles and concentrations in the ground, and their temporal variations.

Diverse survey platforms, which mean backpack, carborne, and airborne survey, are generally applied to assess the dose rate and radioactivity from a series of large-scale environmental radiation monitoring. In addition, a ground-based gamma-ray spectrometry at 1 m above the ground should be accompanied with the mobile survey, because it can be particularly useful as reference values of mobile gamma-ray spectrometry. In KAERI (Korea Atomic Energy Research Institute), the studies on comprehensive environmental radiation survey (ERS) have been conducting for the purpose of systematically integrating diverse survey methods and their results.

The purpose of this study is to apply the method developed in KAERI to the ERS to around FDNPP in cooperation with JAEA. The joint experiments were then conducted in several contaminated areas of the Fukushima prefecture and the results were evaluated by comparing the data of JAEA. The dose rate and radioactivity of radiocesium deposited in the ground were assessed using the ground based and mobile gamma-ray spectrometry equipped with $LaBr_3$(Ce) scintillation detectors.

2. Method and Results

2.1 Survey methods

Fig. 1 shows the survey sites around FDNPP. As a reference site, in situ gamma-ray spectrometry at 1 m above the ground was first conducted in Sendai city, which is located to about north 100 km distance from the FDNPP. Then, the mobile survey was performed using a backpack based on a $LaBr_3$(Ce) around the same site in which the ground based survey was done. With the same method, the ground based and mobile survey was conducted in two contaminated sites, which were about north 6 km and north-west 60 km distance from the FDNPP.

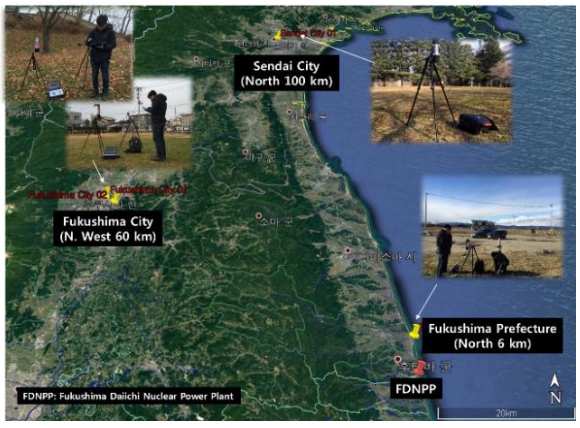

Fig. 1. The sites for the environmental radiation survey around the FDNPP.

2.2 Ground based gamma-ray spectrometry

Fig. 2 show the result of the ground based gamma-

ray spectrometry using a $LaBr_3(Ce)$ detector, which was performed at 1 m above the ground using a tripod during about 1600 sec. The intrinsic background of used $LaBr_3(Ce)$ detector was successfully subtracted and then three peaks contributing radiocesium, as shown in Table 1, analyzed to calculate the dose rate and radioactivity of ^{134}Cs and ^{137}Cs.

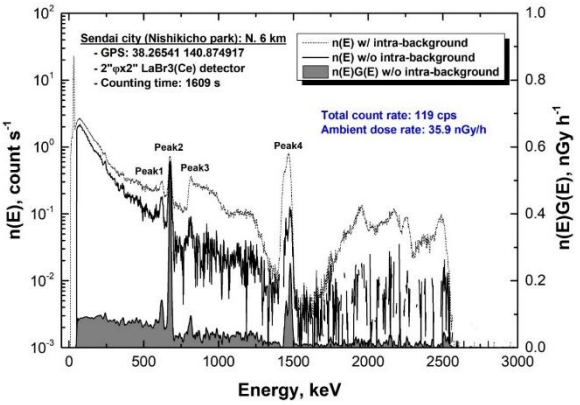

Fig. 2. The energy spectra for count rate and dose rate measured in Sendai city.

Table 4. The peak information in measured energy spectrum

Peak	Peak information
1	^{134}Cs(605 keV, 97.6%), ^{214}Bi(609 keV, 46.4%)
2	^{137}Cs(662 keV, 85.0%)
3	^{134}Cs(796 keV, 85.5%), ^{134}C (802 keV, 8.69%)
4	^{40}K(1461 keV, 10.6%)

2.3 Mobile gamma-ray spectrometry

The backpack and carborne survey based on a $LaBr_3(Ce)$ detector were performed in contaminated areas around the FDNPP, after the ground based gamma-ray spectrometry. Fig. 3 shows the mapping result of ambient dose rate using the backpack survey at the site of about north 6 km from the FDNPP. The averaged ambient dose rate was 68.1±13.7 nGy/h in the survey site.

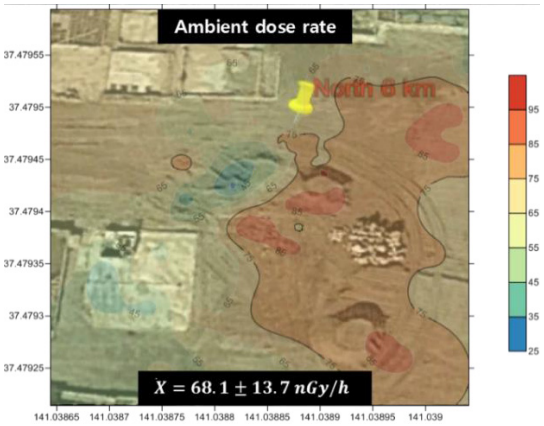

Fig. 3. The mapping results of ambient dose rate using the backpack survey.

3. Conclusion

The diverse survey methods were developed to calculate the ambient dose rate as well as individual dose rate of detected gamma nuclide and its radioactivity in the contaminated area. Therefore, it is very important to conduct the feasibility of developed survey technology in the real contaminated site. From the joint experiment with JAEA, the KAERI's method was successfully performed and applied to the environmental radiation survey around the FDNPP.

ACKNOWLEDGMENTS

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