Environmental radiation status in Bunkyo-ku, Tokyo, after the TEPCO Fukushima Dai-ichi Nuclear Power Plant disaster

Takao EBISAWA[1)], Seiichi HIROSE[1)], Etsuko FURUTA[2)],
Keiji KUSAMA[3)], and Takeshi IIMOTO[4)*]

1) The Bunkyo Ward Office
2) Ochanomizu University
3) Japan Radioisotope Association
4) The University of Tokyo, 7-3-1 Hongo Bunkyo-ku, Tokyo 113-8654, Japan
* iimoto.takeshi@mail.u-tokyo.ac.jp

Bunkyo-ku is located in the eastern part of the metropolitan area of Tokyo, Japan, and is roughly 220 km south of the TEPCO Fukushima Dai-ichi Nuclear Power Plant. The population of the city was 201,079 as of August 1, 2012, and its area is 11.31 km^2. The local government has officially been surveying the environmental radiation status after the disaster in response to numerous requests from its citizens. The radiation surveillance in this area has been technically guided by radiation protection specialists. The two main targets for surveillance are (1) the ambient radiation dose (microsieverts per hour) at all the school yards, public parks, and representative measurement points selected by the local government, and (2) the specific radioactivity (becquerels per kilogram) present in school lunch. These data have been reported to the citizens through the city website as well as in a bi-monthly report in the public relations magazine of the local government. This report presents the background status and technical information of the related activities, as well as the measured environmental radiation data.

The ambient radiation dose in the city has been surveyed since July 2011. In the 1st period of surveillance (from July to August, 2012), over a total of 304 measurement points, the highest recorded value of the ambient radiation dose was 0.22 μSv h^{-1} at the height of 1 m from the ground, the lowest was 0.05 μSv h^{-1}, and the average was around 0.09 μSv h^{-1}. These values include the natural background dose rate detected by the energy compensation type survey-meters. In the most recent surveillance records, the maximum value recorded was 0.10, the minimum was 0.05, and 0.07 μSv h^{-1} was the average value.

The specific radioactivity of drinking water has been monitored at local purification plants since the accident occurred. No water sample supplied to the city has exceeded the national limits for intake dose. The specific radioactivity of school lunch was also surveyed four times (in December, 2011; and May, July, and September, 2012) by the local government. Thus far, 162 sets of school lunch in the city have been checked using a Ge spectroscopy system. The highest specific radioactivity of $^{134+137}Cs$ detected was 2.5 Bq kg^{-1} in school lunch and 15.4 Bq kg^{-1} in milk, which were recorded in December, 2011.

Key Words: *ambient radiation dose, specific radioactivity, Tokyo*

1. Introduction

Bunkyo-ku[1)] is located in the eastern part of the metropolitan area of Tokyo, Japan, at a distance of 220 km, south of the TEPCO Fukushima Dai-ichi Nuclear Power Plant. The population of the city was 201,079 as of August 1, 2012, and its area is 11.31 km^2. The local government has officially surveyed the environmental radiation status after the disaster in response to requests from its citizens. The radiation surveillance in this area has been technically guided by radiation protection specialists. This report presents the background status and technical information of the related activities, and the estimated environmental radiation data.

2. Monitoring targets and methods

The two main targets for surveillance are (1) the ambient radiation dose (microsieverts per hour) at all the school yards, public parks, and representative measurement points selected by the local government, and (2) the specific radioactivity (becquerels per kilogram) present in school lunch.

It was presumed in advance that the ambient radiation levels measured by the Tokyo Metropolitan Government Office would be around 0.05 to 0.2 μSv h^{-1}. Thus, an adequate instrument was selected for this dose rate range to be measured. The TCS-171B by Hitachi Aloka Medical was used, which is a well calibrated NaI (Tl) scintillation energy compensation survey meter. The Time-Constant was set as 30 s, the longest possible value. The number of times (once) to check data for one measurement was determined under the consideration of the standard deviation of background measurements. Thus, the indicated value was read after the duration of three times the time constant, i.e., 90 s. The team for ambient dose measumenent consisted of one staff for measurement, one staff for recording data and setting the height of the survey meter, and one staff for public relations and timekeeping. Measurement positions were not near any high buildings or trees within a distance of five meters. This was to ensure that the measured value was not influenced by physical objects in the environment and was representative of the measurement zone. One position in the central part of each target zone was selected and measured. As there were preschools, elementary schools, and junior high schools among the candidates for measurement, the height for data collection was set to 1 m, 50 cm, and 5 cm above the ground, in consideration of the various age groups of students.

Specific radioactivity of lunch and milk supplied by the local government at preschools and elementary schools were measured by the Tokyo Kenbikyoin Foundation, which is a technical organization for radiation measurement. Each sample meal was prepared based on the typical amount of one person's intake. At least once a year, the specific radioactivity of lunch and milk was measured in each of the candidate public schools. For each school lunch, all items were mixed except for milk and blended in a grinder (juicer) (See Fig.1 left). The blended lunch was weighed and some part of it was placed in a Marinelli beaker (inner ϕ : 160 mm) of 2 L. The weight of the lunch sample in the Marinelli beaker was from 1.6 to 2.1 kg/ 2L (see Fig.1 right). Two types of high pure germanium detectors were used for analysis of the samples: GC3018-7500-2002 and GC2520-7500SL-2002-CSL (CANBERRA). Further, the software used for analyzing the gamma ray spectroscope data were the Spectrum Explorer Ver.1.635 and the Gamma-ray Analysis WorkshopVer.1.48 (CANBERRA). The measurement time was from 1,000 to 3,430 s, depending on the radioactivities of the samples. The detection limit of each radionuclide was defined as the standard deviation (SD) of the sum of the background counts (BG) in the channels corresponding to the photon peak position. Further, when the peak area was more than 2 SD of BG, an “LTD” sign was indicated by the software, and the measurement time was automatically extended.

These data have been reported to the citizens through the city website as well as in a bi-monthly report in the public relations magazine of the local government.

Fig.1 School lunch items mixed and blended in a grinder (left), Marinelli beaker (inner ϕ : 160 mm) of 2 L (right)

3. Results and discussion

(1) Ambient radiation dose

The ambient radiation dose in the city has been surveyed since July, 2011. In the 1st period of surveillance (from July to August, 2012), at a total of 304 measurement points, the highest recorded value of the ambient radiation dose was 0.22 μSv h^{-1}, the lowest was 0.05 μSv h^{-1}, and the average was 0.09 μSv h^{-1}. These values include the natural background dose rate. In the latest period of surveillance, the values were 0.10 at maximum, 0.05 at minimum, and 0.07 μSv h^{-1} on average.

Fig.2 Ambient radiation dose measurements

(2) Specific radioactivity

The specific radioactivity of drinking water has been monitored at the local purification plants since the accident. No water sample supplied to the city has exceeded the national limits for intake dose. The specific radioactivity of school lunch was also surveyed four times (in December, 2011; and May, July, and September, 2012) by the local government. Thus far, 162 sets of school lunch in the city have been checked using a Ge spectroscopy system. The highest specific radioactivity of $^{134+137}$Cs was detected as 2.5 Bq kg^{-1} in a school lunch and 15.4 Bq kg^{-1} in milk, which were recorded in December, 2011.

References

1) Website of Bunkyo ward office, http://www.city.bunkyo.lg.jp/