

Environmental radiation status in Nagareyama city (Chiba prefecture) after the TEPCO Fukushima Dai-ichi nuclear power plant disaster

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Nagareyama city is located in the northwestern part of Chiba prefecture in the metropolitan area of Tokyo, Japan. The city is located ~200 km south of the TEPCO Fukushima Dai-ichi nuclear power plant. As of April 1, 2012, the population of the city was 166,493 and its area was 35.28 km². Responding to many requests from the citizens, the local government has performed official surveys of environmental radiation status after the disaster. The radiation surveillance in this area has been conducted by the radiation protection specialists. The two primary measured quantities were (1) the ambient radiation dose (microsieverts per hour) at all school yards, public parks and at representative locations as selected by the local government, and (2) the specific radioactivity (becquerels per kilogram) of the drinking water and of local food items. These data have been reported on the city's website, in addition to being reported three times per month in the public relations magazine of the local government. This presentation provides the background status and technical information on the related activities. In addition, this presentation documents the measured environmental radiation data. The ambient radiation dose in the city has been surveyed since June of 2011. In the 1st period of the surveillance (from May to September of 2011), data were collected from 40 locations. The highest value of the measured ambient radiation dose was 0.58 $\mu\text{Sv h}^{-1}$, obtained at the elevation of 1 m above the ground, and the lowest value was 0.17 $\mu\text{Sv h}^{-1}$. The average level of ambient radiation was ~0.32 $\mu\text{Sv h}^{-1}$, and those measured values included the natural background dose rate that was detected by the energy compensation type survey- meters. In the latest period of surveillance, the ambient radiation levels were measured around school yards. The peak value of ambient radiation level was 0.36 $\mu\text{Sv h}^{-1}$, the minimal value was 0.08 $\mu\text{Sv h}^{-1}$, and the average over all locations was 0.17 $\mu\text{Sv h}^{-1}$. As of the end of August 2012, the ambient radiation dose at all of the 23 school yards and in 57 of 275 parks has been reduced to a greater or lesser extent, as a result of the decontamination project carried out by the local government. The reduction rate of the net dose (without natural background dose) has ranged from 80% to 20% in the school yards and parks. Decontamination activity in residential areas has only recently been started.

The specific radioactivity of drinking water and local food items has been surveyed since March of 2011 and April of 2011, respectively. Thus far, one sample of service water showed 110 Bq kg⁻¹ of ¹³¹I on March 23, 2011; however, no water sample other than this has been shown to be exceeding the limits. Further, 478 samples of the local food items have been checked using a NaI(Tl) scintillation spectroscopy system. A flat Japanese mushroom, cultivated on Japanese oak logs, was sampled in the city on November 16, 2011, and it

showed the highest specific radioactivity measured as 831 Bq kg⁻¹ of ¹³⁴⁺¹³⁷Cs. For all food items (excluding an outdoor bamboo shoot, one sample of water as described above, and a flat mushroom) disaster-related specific radioactivity was found to be below the acceptable limits for intake dose.

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

1. Introduction

Nagareyama city is located in the northwestern part of Chiba prefecture in the metropolitan area of Tokyo, Japan¹⁾. The city is located ~200 km south of the TEPCO Fukushima Dai-ichi nuclear power plant. As of April 1, 2012, the population of the city was 166,493, and its area was 35.28 km². Responding to many requests from the citizens, the local government has performed official surveys of environmental radiation status after the disaster. The radiation surveillance in this area has been conducted by the radiation protection specialists. This activity has been based on the decision of a local forum, “Conference on Radiation Countermeasure in Tohkatsu area (CRCT)”²⁾, which included six cities, among them Nagareyama city.

This presentation provides the background status and technical information on the related activities. In addition, this presentation documents the estimated environmental radiation data.

2. Monitoring targets and methods

The two primary targets of the surveillance were: (1) the ambient radiation dose (microsieverts per hour) measured at all school yards, at public parks and at representative locations as selected by the local government, and (2) the specific radioactivity (becquerels per kilogram) of the drinking water and of the local food items.

The ambient dose rate was monitored according to the CRCT manual. The latest dose distribution data obtained at the elevation of 5 cm (for identification of contaminated areas), 50 cm (for dosimetry of children) and 100 cm (for dosimetry of adults) above the ground in the city can be seen on the background of Google map on the city’s home page¹⁾. Monitored targets include all school yards (nursery schools, kindergartens, child centers, elementary schools, and junior high schools), parks and sports grounds, the outside of local government institutions, city pools, and surroundings of sewage

adjustment ponds and waste disposal sites. These sites are monitored by gamma survey meters of the energy-response compensation type of NaI(Tl) or CsI(Tl) scintillation detectors. The survey meters used are the standard ones, selected based on the CRCT discussion, and a few hundred survey meters were independently selected by the local government. The monitoring frequency for each investigated location is more than once monthly.

In addition to the monitoring of the ambient radiation dose rate, dose measurements were performed by distributing one (or two) electric personal dose meter(s) to all of the preschools, elementary schools, and junior high schools, both public and private. The purpose of this was to measure, on a monthly basis, the dose rate in children during their daily routines, and to make this information available to the citizens. The information collected on a monthly basis was used to estimate an actual annual dose. Rather than being the ambient dose, this dose is a personal dose of a representative child. Unfortunately, at the early stage the citizens tend to be concerned with the effect of high contamination in extremely small areas (so-called “microspots”). To present the actual value of exposure dose in “microspots,” quantitative, rather than qualitative, explanations would be preferred. For this purpose, an electric personal dose meter was given to a representative staff in each school, and the staff, together with children, wore the dose meters at the height as that corresponding to the height of the childrens’ chests. The personal dose meter collected data for 8 h per day, from Monday to Friday.

Under the present policy of “Local Production for Local Consumption,” local governments were strongly requested to monitor local food, which was grown up and circulated in the city, and drinking water. Parallel to the national survey and to the prefecture’s survey, Nagareyama city has been using its own resources to continue to monitor various materials and to announce the results to the citizens. Monitored target materials include school lunch food items and food items, local food items, tap water, supplied water, food items

obtained from citizens, and water from school or public pools and waste disposal.

For example, choiced food items that were supplied for lunch have been monitored at all schools twice a week. In addition, for each specific school, all of the school lunch food items for a specific day, which were mixed into one sample, have been monitored once a week. These measurements were performed using the NaI (TI) scintillation spectroscopy system.

In addition to lunch food items, monitoring of local food items is also important. Specific radioactivity of representative food items from three areas of Nagareyama city is measured using the NaI (TI) scintillation spectroscopy system. The data are announced, at an approximately monthly frequency, on the official website.

The monitoring instruments were renewed to elevate the sensitivity of measurements, so as to comply with the new safety control rule on food items (100 Bq kg^{-1}) introduced in April of 2012. The new measurement system started to operate on April 13, 2012.

In the period of measurements under the old safety rule (500 Bq kg^{-1}) that preceded the introduction of the new safety rule, 205 food item samples were monitored. Since the enforcement of the new system, 273 samples have been monitored.

These data have been reported on the city's website. In addition, the data were reported three times a month in the public relations magazine issued by the local government.

3. Results and discussion

(1) Ambient radiation dose and personal exposure dose

The ambient radiation dose in the city has been surveyed since June of 2011. In the 1st period of the surveillance (from May to September of 2011) the data were collected from ~40 locations. The highest value of the ambient radiation dose was $0.58 \mu\text{Sv h}^{-1}$, obtained at



Fig.1 Monitoring of specific radioactivity of local food items.

the elevation of 1 m above the ground, the lowest value was $0.17 \mu\text{Sv h}^{-1}$, and the average value was $\sim 0.32 \mu\text{Sv h}^{-1}$. Those values included the natural background dose rate that was detected by the survey meters of the energy compensation type.

In the latest period, the ambient radiation levels around school yards were determined. Peak radiation level was 0.36, minimal radiation level was 0.08, and average value was $0.17 \mu\text{Sv h}^{-1}$. As of the end of August of 2012, the ambient radiation dose at all of the 23 school yards and in 57 of 275 parks has been reduced to a greater or lesser extent due to the decontamination project carried out by the local government. The reduction rate of the net dose (without natural background dose) ranged from 80% to 20% in the school yards and in the parks. Decontamination activity in residential areas has only recently been started.

Fig.2 shows the map of dose distribution in Nagareyama city (as shown on the official website of Nagareyama city), for which the doses were measured by the energy compensation type survey-meters. Each position mark on the map shows selected measured locations. When a cursor points to a specific position mark, information will be displayed listing the latest (and historical) radiation dose rate measured at the elevation of 1 m, 50 cm, and 5 cm above the ground.

(2) Specific radioactivity

The specific radioactivity of the drinking water and of the local food items has been surveyed since March 2011 and April 2011, respectively. As of March 23, 2011, only one sample of service water showed 110 Bq kg^{-1} of ^{131}I ; no water sample other than this has been found to exceed the limits.



Fig.2 Map of dose distribution in Nagareyama city, as seen on the official website of Nagareyama city.

Table 1 Specific radioactivity of service water in Nagareyama purification plant in April 2011

Date in April 2011	22	23	24	25	26	27	28	29	30
Bq kg ⁻¹	—	110	—	33	14	—	ND	ND	ND

—: no data

ND: less than lower detectable limit concentration

Thus far, 478 samples of the local food items have been checked using a NaI(Tl) scintillation spectroscopy system. The highest specific radioactivity was 831 Bq kg⁻¹ of ¹³⁴⁺¹³⁷Cs and it was measured for a flat Japanese mushroom that was cultivated on Japanese oak logs that were sampled in the city on November 16, 2011. This was detected during the monitoring carried out for Chiba prefecture. In addition, the radioactivity levels of an outdoor bamboo shoot and a flat mushroom also temporarily exceeded the acceptable limits for the specific concentration of food items. These were also detected by Chiba prefecture. According to the monitoring results for Nagareyama city, disaster-induced specific radioactivity of all surveyed food items (excluding the items listed above) was found to be below the limits for intake dose, (see Tables 2-1 and 2-2).

4. Conclusion

This presentation provided the outline of the environmental radiation status in Nagareyama city of Chiba prefecture after the nuclear disaster of TEPCO Fukushima Dai-ichi nuclear power plant. In addition, this presentation introduced the background status and technical information on the related measuring activities, and documented the estimated data.

Following the local government policy, Nagareyama city is continuing to monitor the environmental radiation

Table 2-1 Specific radioactivity of local food items in Nagareyama city, measured on April 13, 2012. This monitoring was carried out by Nagareyama city.

Bq kg ⁻¹	< 25	25<, <50	50<, <100	100<
No. of items	269	4	0	0

Table 2-2 Specific radioactivity of local food items in Nagareyama city, measured before April 13, 2012. This monitoring is carried out by Nagareyama city.

Bq kg ⁻¹	< 20	20<, <500	500<
No. of items	203	2	0

and to carry out the decontamination program. The website of Nagareyama city may be checked periodically for the most recently updated data.

References

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