Chapter 1
Outline of the Environmental Monitoring of Tepco's Fukushima Daiichi Nuclear Power Plant Accident

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Abstract The Great East Japan Earthquake and the subsequent tsunami caused severe damage to TEPCO's Fukushima Daiichi nuclear power station, and large amounts of radioactive materials were released to the environment. Environmental monitoring data are very important for evaluating radiation exposure and health effects on the public. Therefore, various kinds of environmental monitoring continue to be performed by the Japanese and prefectural government, certain research institutes, or individuals. It is important to collect a wide range of these data to obtain an accurate estimation of the radiation dose.

Keywords Environmental monitoring • Environmental radioactivity • Radiation exposure doses • Radiation survey

1.1 Introduction

The Great East Japan Earthquake and the subsequent tsunami that occurred on March 2011 in the eastern area of Japan caused severe damage to TEPCO's Fukushima Daiichi nuclear power plant (FDNPP). As a result of the core meltdown, a large amount of radioactive material was released from the reactors to the atmospheric and oceanic environment, causing radiation exposure to the public and FDNPP workers. To estimate the effects of the accident, it is necessary to evaluate accurately the levels of radiation exposure resulting from the accident.

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1.2 Exposure Pathways

To evaluate the exposure doses resulting from radionuclides released to the environment from the nuclear facilities, it is important to identify the behaviors of radionuclides in the environment. However, the mechanisms affecting the behaviors of radioactive materials are very complicated. They are related to a wide range of research fields, including physics, chemistry, and biology. In addition, the land usage modes, which include forests, urban areas, farm fields, and rice paddy fields, have a great influence on the behavior of radionuclides. The lifestyle of the public, such as their intake of foods, also affects the level of doses.

Figure 1.1 shows major transfer and exposure pathways of the radionuclides released from the nuclear facilities into the atmosphere. In the early stage after an accident, external exposure from the radioactive plume and internal exposure by inhalation of the plume are dominant exposure pathways. When the release of radionuclides from the nuclear plants becomes negligible, external exposure from radionuclides deposited in the soil or on buildings is dominant. Internal exposure by the ingestion of contaminated food may be dominant in areas where the air dose rate is relatively low.

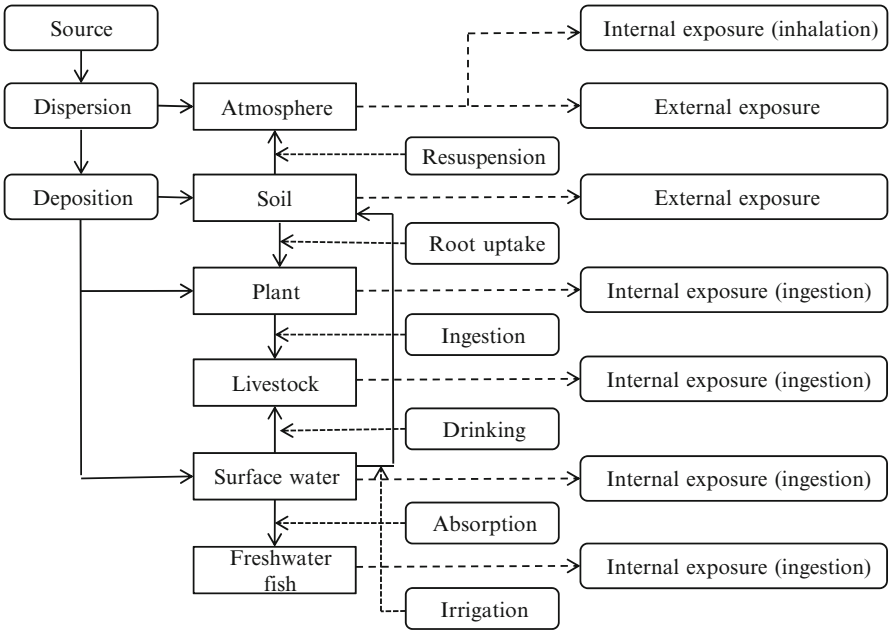

Fig. 1.1 The major transfer pathways and exposure pathways of radionuclides released from nuclear facilities into the atmosphere

Analyses using mathematical models are useful to understand the behavior of radionuclides. Many such models have been developed to predict the behavior of radionuclides in various environmental media and the radiation doses to the public. However, because it is not easy to select suitable models and parameters for a specific situation, environmental monitoring data are very important for evaluating the radiation exposure and health effects on the public.

1.3 Environmental Monitoring

In the early period after the accident, most of the fixed monitoring posts near FDNPP lost their function a a result of the earthquake. Therefore, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) started air dose rate monitoring using monitoring cars [1]. In parallel with such monitoring, a radiation survey on the environment and measurement of the concentration of radionuclides in some environmental media (such as airborne dust, food, drinking water, weeds, groundwater, and soil) was initiated by the Japanese and prefectural governments [1, 2]. Radioiodine, radiocesium, and some other radionuclides were detected in these environmental samples. These monitoring data were utilized for planning measures to protect the public.

Comprehensive environmental monitoring was conducted by MEXT with the cooperation of various universities and research institutes, and distribution maps of radiation dose and soil deposition density were prepared [3]. For example, distribution maps of ambient dose rates based on continuous measurement results through a vehicle-borne survey are shown in Fig. 1.2. This vehicle-borne survey was mainly carried out by the KURAMA system [4]; the details of this system are presented in this book in Chap. 7. The vehicle-borne survey was carried out repeatedly, and distribution maps of ambient dose rates prepared by the survey are used to predict the reduction of dose rates in future [5]. Various kinds of environmental monitoring continue to be conducted by the Japanese and prefectural governments.

Some research organizations or individuals in Japan also carried out environmental monitoring from an early stage after the accident. The "Proceedings of International Symposium on Environmental Monitoring and Dose Estimation of Residents after Accident of TEPCO's Fukushima Daiichi Nuclear Power Stations" [6] include 12 papers on a radiation survey on the environment and 18 papers on environmental radioactivity related to the accident. For example, Iimoto et al. surveyed the environmental status in and around Tokyo immediately after the accident (see Chap. 5 in this book). Zheng et al. investigated the distribution of plutonium isotopes in marine sediments off the coast of Japan before and after the accident (see Chap. 10 in this book). These monitoring data are important and valuable to supplement the large-scale monitoring data and to accurately estimate the radiation dose for the public.

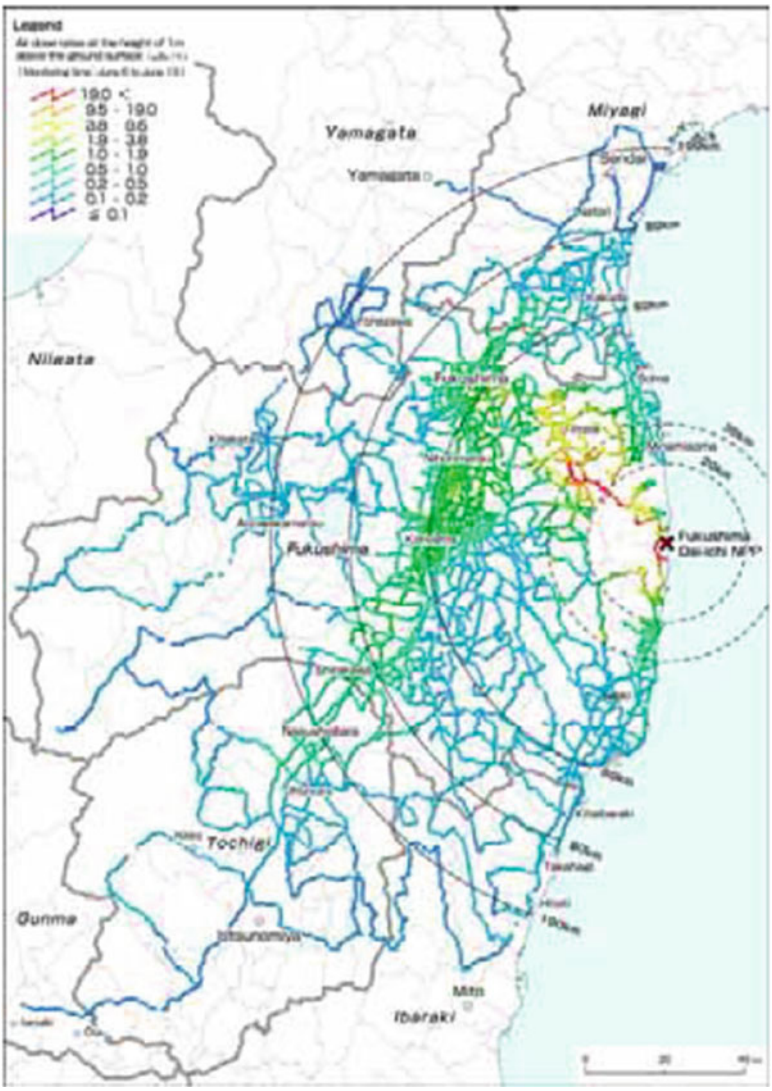

Fig. 1.2 Distribution map of ambient dose rates based on continuous measurement results from vehicle-borne survey [3]

1.4 Conclusion

Environmental monitoring data and analyses conducted using mathematical models are both necessary to accurately evaluate the levels of radiation exposure resulting from the accident. Therefore, it is important to collect a wide range of these data for

an estimation of the radiation dose. In addition, these monitoring data should be preserved as a record of the earthquake and the accident.

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