2. Decontamination Works in the Accident of the TEPCO Fukushima Daiichi NPS and Necessary Radiation Protection Measures

2.1 Radiation protection of workers involved in decontamination works

The accident at the Fukushima Daiichi Nuclear Power Station (NPS) released large amounts of radioactive materials. For rehabilitation of the contaminated areas, the Japanese Government has decided to carry out decontamination works (e.g., clean-up of buildings and remediation of soil and vegetation) and to manage the wastes resulting from decontamination works and clean-up of unmarketable contaminated goods. Prevention of radiological contamination of the workers has required that the Government ensure sufficient radiological protection is provided to them.

2.1.1 Radiation protection for workers engaged in decontamination works

The Act on Special Measures Concerning the Handling of Environmental Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District Off the Pacific Ocean Earthquake That Occurred on 11 March 2011 (Act. No.110, 2011, hereinafter referred to as the "Act on Disaster Special Measures") was passed into law in August 2011, and fully implemented starting from 1 January 2012.

(1) The regulations established by the Act on Disaster Special Measures are as follows:
   a)Treatment of wastes contaminated with radioactive materials; and
   b) Actions such as decontamination of soil contaminated with radioactive materials.

   However, the Act on Disaster Special Measures does not include measures for protecting workers engaged in these tasks from health hazards caused by exposure to ionizing radiation.

(2) In addition, in the current Regulation on Prevention of Ionizing Radiation Hazards (Ordinance No. 41 of the Ministry of Labour, 1972, hereinafter referred to as the "Ionizing Radiation Ordinance"), measures are established on the premise that the radioactive sources are located at a certain place, such as at medical facilities or at NPSs, where workers mainly work indoors (planned exposure situations).

   Measures for responding to the types of decontamination works that involve collection of wastes stipulated in the Act on Disaster Special Measures are not included. Furthermore, the Ordinance was not established on the premise that the radioactive sources are dispersed over wide areas and that workers mostly work outdoors (existing exposure situations).

(3) Further, under the fundamental policies, based on the Act on Disaster Special Measures, approved by the cabinet on 11 November 2011, it is stated that "ensuring the safety of workers is the highest priority when handling environmental decontamination. Therefore, the employers should take great care regarding the safety and health of workers engaged in duties concerning decontamination of the environment, for example, by providing radiological protection guidance. In addition, they should manage the radiation doses received by the workers and provide workers with opportunities to enhance their knowledge of safety and health."

   Considering the situation, a new ordinance was formulated that regulates measures to properly protect workers from health hazards caused by ionizing radiation based on the nature of the works such as decontamination works and waste collection works; this is the "Ordinance on Prevention of Ionizing Radiation Hazards at Works to Decontaminate Soil and Wastes Contaminated by Radioactive Materials Resulting from the Great East Japan Earthquake and Related Works" (hereinafter referred to as the "Decontamination Ordinance." This Ordinance was formulated separately from the current Ionizing Radiation Ordinance.

2.1.2 Radiation protection for workers engaged in restoration and reconstruction works

The Nuclear Emergency Response Headquarters and the National Reconstruction Agency revised the classification of the evacuation areas around the TEPCO Fukushima Daiichi NPS (restricted areas and deliberate evacuation areas) into 3 types of areas on 1 April 2012: (1) Areas for which evacuation orders are ready to be lifted; (2) Areas in which the residents are not permitted to live; and (3) Areas where it is expected that the residents will have difficulties in returning for a long time.

In the "Areas in which evacuation orders are ready to be lifted", activities can be started for:

(1) Restoring local infrastructures other than those requiring decontamination;
(2) Restarting businesses such as manufacturing industries;
(3) Preparing to reopen hospitals and welfare facilities;
(4) Restarting agriculture and forestry industries; and
(5) Restarting transportation services associated with these activities.

The Decontamination Ordinance which came into force on 1 January 2012 was applicable only for decontamination operations (decontaminating soil, and collecting, transporting and storing wastes). For applications of the above activities, revision of the Ordinance was required.

Therefore, the expert meeting originally organized to discuss decontamination operations was reorganized to discuss measures to protect workers from radiation hazards in the evacuation areas. The committee compiled their discussions and issued a second report on 27 April 2012.

Based on this report, the Decontamination Ordinance was amended and guidelines were prepared that summarize relevant laws and regulations comprehensively and in an easy way to understand manner.*1)

*1) Under the amended Decontamination Ordinance definitions were given for: "specified contaminated soil handling work (tasks handling soil with a cesium concentration exceeding 10,000 Bq/kg)" and "work under a designated dose rate (tasks performed

in the areas where the average ambient dose rate exceeds 2.5 μSv/h" (excluding decontamination operation, etc.)

2.1.3 Radiation protection for workers engaged in disposal of accident-derived waste

The Ministry of the Environment estimated that approximately 15 - 31 million tons of soil and wastes had been generated from decontamination works and clean-up of unmarketable contaminated goods had reached approximately 0.56 million tons in Fukushima Prefecture alone. The Ministry was expected to start deploying full-scale activities to dispose of those wastes in the summer of 2013.

Activities for accident-derived waste disposal*2) were subject to the Ionizing Radiation Ordinance; however, this ordinance did not contain sufficient regulations for employers involved in disposal work

The expert meeting on radiation protection and waste disposal was held to consider measures to prevent radiological hazards. The report of the expert meeting was published on 14 February 2013.

Based on the report, the Ionizing Radiation Ordinance was amended and the new guidelines were developed that summarize relevant laws and regulations.

*2) These include e.g., final disposal (landfill), interim storage, and interim treatments (incineration, crushing, etc.)

2.2 Outline of ordinances which provide radiation protection during decontamination works and restoration and reconstruction works, etc.

Measures to prevent ionizing radiation hazards for each step are outlined below.

2.2.1 Radiation protection measures during decontamination works

The Decontamination Ordinance specifies actions to be taken by the employer to prevent radiation exposure of workers engaged in decontamination of soil, collection of removed soil/waste in the areas contaminated by radioactive materials released from the accident at the Fukushima Daiichi NPS. Actions are largely divided into three types as follows:

(1) **Actions to reduce exposure**

- The dose limit for the workers shall be 100 mSv for five years, and not exceed 50 mSv for any one year (it shall not exceed 5 mSv for three months for potentially pregnant workers)
- In areas where dose rates are higher than 2.5 μSv/h (equivalent to 5 mSv/y)*3), the external dose shall be measured with a personal dosimeter (it should be noted that, in areas where dose rate is in the range of 0.23 μSv/h -2.5 μSv/h (1 mSv - 5 mSv/y), simple methods of measurement may be acceptable.)
- Measured data shall be kept for 30 years*4), as well, workers shall be notified of their doses.
- The decontamination shall be started after measuring dose rates, and conducted under the direction of an operation leader in accordance with the work plan. The decontamination in areas where the dose rate is higher than 2.5 μSv/h in particular, requires submitting a work plan to the relevant Labour Standards Inspection Office.

*3) This approximately corresponds to the areas that cover the deliberate evacuation areas and the restricted areas.

*4) After 5 years, the stored data may be transferred to the organization designated by the MHLW.

(2) **Actions to prevent spread of contamination**

- When dust containing a high concentration of radioactive cesium may be generated, dispersion of soil shall be prevented by moistening the soil. When works are involving soil with a high radioactivity concentration or the possibility that a high concentration of dust may be generated, workers shall wear proper respiratory protective equipment and protective clothes.
- Removed soil shall be stored in a container that meets certain requirements*5) and access to the containers shall be restricted.
- Smoking, drinking or eating in working areas that may have a risk of ingestion or inhalation of radioactive material shall be prohibited.
- Contamination inspection areas shall be set up where contamination surveys are conducted for the body and clothing of workers.

*5) The requirements are: no risk of dispersal or leaking of container contents; and the 1 cm dose equivalent rate at 1 m from the container surface shall be 0.1 mSv/h or less.

(3) **Education and health care of workers**

- Education shall be provided to workers who will be engaged in the decontamination works with respect to radiation effects, radiation dose control, work methods, etc.
- Special medical examinations shall be provided to workers when they are employed, changed to the decontamination works, and once every six months. The records of the medical examinations implemented for each worker shall be kept for 30 years*6) and notified to each worker. When any abnormalities are found in the medical examination of any workers, some consideration in their work shall be made, such as a change of workplace.
- When the workers leave the job or the companies terminate their decontamination business, the records of radiation doses of the workers and their individual medical examination records shall be delivered to the organization designated by the MHLW, and copies shall be given to the workers.
- The results of periodical special medical examinations shall be reported to the relevant Labour Standards Inspection Office.

*6) After 5 years, the data may be transferred to the organization designated by the MHLW.

2.2.2 Radiation protection measures during restoration and reconstruction work

The MHLW published the ministerial ordinance which partially revises the "Ordinance on Prevention of Ionizing Radiation

Hazards at Works to Decontaminate Soil and Wastes Contaminated by Radioactive Materials Resulting from the Great East Japan Earthquake and Related Works" (hereafter referred to as the "Ionizing Radiation Ordinance for Decontamination"). It was put into effect on 1 July 2012.

The revision was made anticipating the start and resumption of "restoration of life infrastructures (excluding decontamination works) and manufacturing industries"*7) in "special decontamination areas"*8) in response to the readjustment of the evacuation areas.

*7) This includes preparations for restarting hospitals and welfare facilities, agriculture and forestry operations, and associated transportation services.

*8) Specified by Article 25, Paragraph 1, of the Act on Disaster Special Measures.

The revision focuses on the following points:

1. Work involving contaminated soil with radioactivity higher than 10,000 Bq/kg (designated contaminated soil handling work) shall also be included in the decontamination operation, and
2. The Ionizing Radiation Ordinance for Decontamination shall also be applied to work other than decontamination at areas with an average ambient dose rate higher than 2.5 μSv/h (works under a designated dose rate).

Employers are required to take radiological protection measures for the types of works described above.

In conjunction with the above, the "guidelines on decontamination works, etc." was also revised, and "guidelines on work under a designated dose rate" were newly formulated. These guidelines summarized the content of the Ionizing Radiation Ordinance for Decontamination in a comprehensive manner and described provisions specified in the Industrial Safety and Health Act and other relevant regulations; as well they described recommended actions for employers to take in order to prevent workers from encountering radiological hazards. Specifically, the guidelines summarize the following items:

1. Identification of personnel for whom radiation dose needs to be controlled, and prescribe methods to control the radiation dose;
2. Measures to reduce radiation exposure;
3. Measures to prevent spread of contamination and internal exposure;
4. Worker education programs;
5. Actions for health care; and
6. Safety and health control system.

It should be noted that the guidelines are also expected to be useful for local residents or volunteers who are in the special decontamination areas, though their original purpose was to ensure safety of workers engaged in decontamination works or works under a designated dose rate. In addition, a textbook for special education of workers as specified in the Ionizing Radiation Ordinance for Decontamination was also prepared, and is available from the MHLW website.

2.2.3 Radiation protection measures during disposal of accident-derived waste

The MHLW published a ministerial ordinance to revise the Ordinance on Preventing Ionizing Radiation Hazards on 12 April 2013, and put the revised ordinance into effect on 1 July 2013.

This revision was made in light of the fact that disposal of wastes contaminated with radioactive materials discharged by the NPS accident associated with the 11 March 2011 earthquake and tsunami is expected to increase in scale with the progress of decontamination project.

Disposal business employers were mandatory to take radiological hazard prevention measures for the 5 revised points shown below. It should be noted that definitions of controlled area, dose limits, dose measurement and recording and measures for health care shall follow the provisions in the current Ordinance on Preventing Ionizing Radiation Hazards.

1. Requirements to be satisfied by such facilities as incineration plants and landfills where the disposal of accident-derived wastes will be performed.
2. Measures to prevent the spread of contamination, such as the use of dust masks and protective clothing, as well as making contamination inspection.
3. Operation management by, for example, preparing operation manuals.
4. Special education for workers engaged in disposal work.
5. Exemptions when the disposal facility is constructed in special decontamination areas.

In parallel with the revision, "Guidelines on prevention of radiation hazards for workers engaged in the accident-derived waste disposal" were also prepared. These guidelines summarize the provisions specified in the Industrial Safety and Health Act and other relevant regulations, including related laws and regulations, as well as recommended actions that employers shall implement in order to prevent workers from encountering radiological hazards. Specifically, the following subjects were included:

1. Methods for defining radiation controlled areas and controlling radiation doses
2. Education of workers
3. Dose limits in facilities
4. Actions for health care
5. Requirements for facilities to prevent contamination
6. Safety and health control system
7. Measures to prevent contamination
8. Exemptions in the special decontamination areas
9. Work management, etc.

A textbook for special education of workers engaged in the disposal works, as specified in this revision, was also prepared. This textbook is available from the MHLW website. The MHLW is making public the textbook so that it will be widely utilized by employers and workers in taking appropriate measures at work sites.

2.3 Status of the implementation of radiation protection in decontamination works

2.3.1 Results of inspections and instructions provided to employers engaged in decontamination works, etc.

The Fukushima Prefectural Labour Bureau (PLB) has conducted inspections and given instructions within the jurisdiction of the Labour Standards Inspection Offices to employers in order to ensure proper conditions of employment and safety, and the health of workers engaged in decontamination works, etc.

The investigations were focused on safety and health-related measures, health care for workers, and working conditions such as clear indications of conditions of employment, reflecting the circumstances that some inquiries were raised about wages and other conditions of employment such as the special duty (decontamination) allowance.

As a result of inspections for 125 employers from January to December 2024, a total of 63 employers were found in violation. (violation rate: 50.4%) of applicable laws such as the Labour Standards Act or the Industrial Safety and Health Act Corrective recommendations were issued to these employers to correct the said violations accordingly.

2.3.2 Voluntary activities towards compliance with laws and ordinances

On 30 October 2015, the Fukushima PLB formulated its own "General Measures toward Improvement of Level of Compliance with Laws and Ordinances for Decontamination Works, etc." Its contents include provision of focused supervision and instruction for decontamination worksites and promotion of voluntary activities towards compliance with the related laws and ordinances by the relevant employers.

On 9 November 2015, the Fukushima PLB held an information session on the General Measures. At the information session, the Bureau provided all the primary contractors of decontamination works ordered by the National Government (Ministry of the Environment) with detailed information on the General Measures, provided them with instruction on ensuring proper working conditions, safety and health of workers engaged in decontamination works as well as maintaining and improving the fairness in subcontracting relations, and requested them to thoroughly comply with the related laws and ordinances in collaboration with the Fukushima Office for Environmental Restoration.