V. Emergency Response Measures Primarily Implemented outside the Fukushima Dai-ichi Nuclear Power Station in Response to the Accident

1. Environmental radiation monitoring

(1) Preparedness for environmental radiation monitoring and the initial situation regarding radiation after the accident

a. Role sharing among the central government, local governments, and nuclear power operators before the accident occurred

The “Basic Disaster Prevention Plans “ created by the Central Disaster Management Council stipulates that the radiation monitoring at the nuclear disaster should be undertaken by local governments; and that the Ministry of Education, Culture, Sports, Science and Technology (hereinafter referred to as "MEXT"), operators, and designated public institutions including the National Institute of Radiological Sciences (hereinafter referred to as "NIRS") and Japan Atomic Energy Agency (JAEA), should support the emergency monitoring of local governments by mobilizing both a mandatory emergency monitoring workforce and all necessary equipment to disaster-stricken areas.

According to the "Nuclear Emergency Response Manual" (hereinafter referred to as the "NE Response Manual", after the declaration of a nuclear emergency, a radiation monitoring team from the Nuclear Emergency Response Local Headquarters (“Local NERHQ”) of Japanese Government should collect and arrange radiation monitoring data. Such data will provide the basis for establishing which areas will be evacuated of all residents, as well as determining where the consumption of food and drink by the residents is to be restricted or forbidden. Moreover, the NE Response Manual stipulates that if a nuclear accident has occurred at a commercial reactor, the local NERHQ should provide a comprehensive summary of all monitoring data to the Secretariat of the Nuclear Emergency Response Headquarters (hereinafter referred to as the "METI-NERHQ), which is located at the Emergency Response Center (ERC) of the Ministry of Economy, Trade and Industry (“MITI”), and that the NERHQ Secretariat should provide this data to the Cabinet Secretariat of the Nuclear Safety Commission (hereinafter referred to as the "NSC"), as well as all other designated administrative agencies.

The Fukushima regional disaster prevention plan stipulates that the Fukushima

prefectural government should implement monitoring tasks even during normal times, that they should make provisions to take swift countermeasures if they receive a report of any unusual state of affairs based on the Act on Special Measures Concerning Nuclear Emergency Preparedness, and that they should make an effort to be well-positioned to implement emergency monitoring. This includes the need to work out a radiation monitoring strategy, prepare and maintain radiation monitoring facilities and equipment, secure all required radiation monitoring personnel, and ensure cooperation among relevant organizations.

The Fukushima prefectural government has monitoring posts established in twenty-four locations based on the Fukushima regional disaster prevention plan. Moreover, the Fukushima prefectural government constantly observes the radiation levels in the surrounding areas of the nuclear power station, which are measured through the monitoring posts operated by Environmental Radioactivity Monitoring Centre (hereinafter referred to as the "Monitoring Center"), which is adjacent to the emergency preparedness and response center (hereinafter referred to as the "Off-site Center"). The prefectural government has a total of thirteen monitoring cars for all relevant organizations including the off-site center. In addition, the local government's analytical equipment includes four germanium semiconductor detectors as well as NaI scintillation detectors located within the Monitoring Center[1].

Concerning nuclear operators' roles in monitoring, the Basic Disaster Prevention Plans stipulates that nuclear operators should prepare and maintain all the required measuring equipment (for each nuclear operator's facility), including site border monitoring posts, portable type measuring instruments and stack monitors in order to ensure that monitoring results are reported accurately when a specific incident occurs, and that nuclear operators should continue monitoring at site borders in order to notify the Nuclear Emergency Response Local Headquarters of any monitoring results.

Based on this stipulation, the Nuclear Operator Emergency Action Plan" of the Tokyo

[1] The Monitoring Center Fukushima branch, located in Fukushima City, has two germanium semiconductor detectors and one NaI scintillation detector. In addition, each of the seven Development bureaus in Fukushima Prefecture has one NaI scintillation detector.

Electric Power Company (hereinafter referred to as "TEPCO") stipulates that the health physics team of the Emergency Response Center, which is to be established at the Emergency Response Control Room in the Seismic Isolation Building of the power station, should be in charge of monitoring activities if an accident occurs at either the TEPCO Fukushima Dai-ichi Nuclear Power Station (hereinafter referred to as the "Fukushima Dai-ichi NPS") or the TEPCO Fukushima Dai-ni Nuclear Power Station (hereinafter referred to as the "Fukushima Dai-ni NPS"). With regard to monitoring equipment, TEPCO has eight monitoring posts, 14 stack monitors (two stack monitors for each stack), six liquid discharge monitors, and one monitoring car (located at the Fukushima Dai-ichi NPS).

Government's NE response manual stipulates that the monitoring data collected by the Local NERHQ is to be released to the public. The Local NERHQ radiation monitoring team shall create press releases on emergency monitoring for press conferences. The Local NERHQ public relations team shall deal with the press and all PR presentations and answer reporters' questions, while maintaining close contact and cooperation with the Local NERHQ administrative team, the Secretariat of the NERHQ and the PR groups of the emergency response headquarters of various local governments. In addition, TEPCO shall publish all data collected through the monitoring posts and stack monitors installed in each power station on its homepage.

This section mainly describes monitoring activities concerning the decisions the Government makes to limit the extent of any hazards.

b. The primary monitoring activities that were conducted outside the premises of the Fukushima Dai-ichi NPS after the accident

As a result of the earthquake and the ensuing tsunami damage, 23 of the 24 monitoring posts the Fukushima government had installed in the prefecture were rendered inoperative, the sole exception being the one installed at Ono station[2]. In addition, due to severe

[2] Sometime after 16:00, four monitoring posts (those installed at Tanashio, Ukedo, Hotokehama and Kumagawa stations) were swept away by the tsunami. The monitoring post at Namikura station had its line for transferring data rendered inoperative due to the tsunami. Eighteen additional monitoring posts were unable to transfer data to the Monitoring Center because the backup power supply to the base station for the transfer data line was cut off.

earthquake damage, two of the four germanium semiconductor detectors that had been installed at the Monitoring Center were rendered inoperative.

The Fukushima prefectural government discussed the possibility of monitoring being conducted via monitoring cars starting on March 11, 2011. They determined, however, that it might be too risky to conduct monitoring at night with caved-in roads and widespread power failure. Instead, they started the monitoring early in the morning of March 12, 2011[3].

Also, following the nuclear accident on March 11, 2011, the Ministry of Education, Culture, Sports, Science and Technology decided to dispatch monitoring cars to the Off-site Center, pursuant to the National Basic Disaster Prevention Plans. However, it was sometime late in the evening of March 12 that they actually issued directions for their dispatch. It was around 11:20 the next day on March 13 that their professional support members arrived at the Monitoring Center[4].

From March 13, staff from the Fukushima local government as well as the national government used the monitoring cars, working together to conduct monitoring activities such as measuring radiation doses in the air, collecting dust suspended in the atmosphere, environment samples and soil samples based on the radiation monitoring strategy developed by the staff of the Monitoring Center and accepted by the Local Emergency Response Headquarters (Local NERHQ). The collected samples were analyzed using the two germanium semiconductor detectors, located at the Monitoring Center. The results of

[3] On the night of March 11, 2011, the Fukushima Prefectural Emergency Response Center summoned approximately 30 monitoring members from relevant organizations at the request of the Monitoring Center. The following day, on March 12, these monitoring members were dispatched to the Monitoring Center together with 12 vehicles that could be used as monitoring cars. The same day, the Monitoring Center staff started monitoring activities with these members who had been summoned to monitor. However, by 21:00 that same day, they had disbanded the monitoring team, with the exception of ten of their staff who had specialized knowledge of and skills in radioactive substances, when monitoring activities turned out to be impossible due to devastating damage of the roads caused by the earthquake, fuel shortages, and increased radiation from the explosion at the Reactor Building of Unit 1 that had occurred earlier in the day.

[4] These support teams had a total of four vehicles consisting of three monitoring cars, from the Mito atomic energy office of MEXT, the Ibaraki Prefectural nuclear safety office and JAEA/NEAT, and one passenger car that tailed the monitoring cars. These four vehicles gathered at the JAEA Nuclear Emergency Response Support and Nuclear Emergency Assistance & Training Center (JAEA/NEAT). According to MEXT staff, the reason the directions to dispatch the monitoring cars were not given until sometime after the evening of March 12 is that they decided it was too risky for the monitoring members to move around during the night since tsunami warnings were still in effect and the condition of the roads in the affected area was unknown.

the analysis were reported to the Local NERHQ located at the adjacent off-site center.

The initial monitoring activities did not work out as intended due to a host of reasons including hazardous road conditions from earthquake damage, flat tires, vehicles that had fallen into cracks in the ground and fuel shortages. In addition, as described in Chapter III 5(1) b5, it was difficult to consolidate the monitoring data for sharing with the Secretariat of the Government Nuclear Emergency Response Headquarters (NERHQ) and other agencies since the Off-site Center had very limited means of communication due to widespread power failure.

The Local NERHQ and the Prefectural Nuclear Emergency Response Center have played a central role in conducting monitoring activities since March 15, when the Local NERHQ that had been located at the Off-site Center, was moved to the Fukushima Prefectural Office[5].

In addition, the Local NERHQ (the Off-site Center) was supposed to publish the monitoring data that was gathered from the affected areas between March 11 and 15. However, the press conference scheduled at the Off-site Center was not held since, as described in III5 (2), the Off-site Center was located in the mandatory evacuation zone that was announced early in the morning of March 12.

However, the Local NERHQ staff faxed the monitoring data that had been collected via monitoring cars from March 12 to the ERC where the NERHQ Secretariat was located. On March 12, the Local NERHQ staff delivered a report of the measurement results to the ERC as measured, which had been created by a team of monitoring members. It was determined, however, that from the following day, March 13, the radiation monitoring team of the Local NERHQ should summarize the monitoring results each day and deliver them to the ERC under the name of the site superintendent of the Local NERHQ.

The Secretariat of the NERHQ, which received monitoring data from the Local

[5] Once the Local NERHQ was moved to the Fukushima Prefectural Office, the staff dispatched from the national government left the monitoring cars (which were out of fuel) behind at the off-site center After that, there were no monitoring cars available in the affected areas. MEXT thus ordered or requested all relevant organizations to dispatch monitoring cars and monitoring personnel. A maximum of 15 monitoring cars were used from March 15 to measure the radiation levels in the air. The Fukushima prefectural government had no choice but to leave most of the monitoring devices at the Off-site Center when the Local NERHQ was moved to the Fukushima Prefectural Office.

NERHQ, successively published only the data that was believed to be summarized well enough to be officially published. As described above, the data and monitoring results, which the radiation monitoring team of the Local NERHQ summarized each day to deliver to the ERC, from March 13 was published on the website of the Nuclear and Industrial Safety Agency (hereinafter referred to as "NISA").

Moreover, on June 3, NISA published additional data, which had not yet been made public, from the monitoring data that was collected between March 11 and 15 including the results of the monitoring that was conducted on March 12 (refer to Section 8(6)).

c. The monitoring activities that were conducted within the premises of the Fukushima Dai-ichi NPS after the accident

Due to the total loss of AC power supplies resulting from the earthquake and the impact of the ensuing tsunami, on March 11 the eight monitoring posts that had been installed within the premises of the Fukushima Dai-ichi NPS and the fourteen stack monitors that had been connected to each Unit were all unable to be used to monitor. Thus monitoring activities at the Fukushima Dai-ichi NPS began at 17:00 on the same day at more than two locations within the premises of the power station to evaluate changes in the level of radiation dose and estimate the situation of the power plants using the monitoring car[6] that belonged to the power station. The monitoring results were successively made available to the public on the websites of TEPCO and NISA.

Afterwards, from March 23, TEPCO installed three temporary monitoring posts within the premises of the Fukushima Dai-ichi NPS to collect data and published their monitoring results from March 27. On March 25 and 29, the existing eight monitoring posts, which had been rendered inoperative, were restored to their former state using a temporary power supply. TEPCO resumed collecting data by making the rounds once a day from April 1. On April 9, the data transmission systems of these existing eight monitoring posts were restored to their former states enabling them to collect and publish data automatically.

[6] The next day, March 12, another monitoring car dispatched by the TEPCO Kashiwazaki-Kariwa Nuclear Power Plant joined the monitoring activities within the premises of the Fukushima Dai-ichi NPS. This vehicle was, however, rendered inoperative due to fuel shortages from March 14.

At the Fukushima Dai-ichi NPS, TEPCO started collecting and analyzing samples from the sea near the two water discharge canals on the premises from March 21, when the rubble and debris created by the tsunami were sufficiently cleared away to allow access to the seashore. Because seawater was sprayed into the reactor building, and due to rainfall, water contaminated with radioactivity may have flowed out into the sea. In addition, for the comparison of data, TEPCO also started collecting and analyzing samples from the sea near the two water discharge canals on the premises of the Fukushima Dai-ni NPS[7].

On or around March 20, TEPCO corrected its previously published data concerning neutron measurement frequency. Taking advantage of this opportunity, TEPCO conducted an in-depth investigation and discovered that some monitoring data for a certain period of time that had been collected within the premises of the Fukushima Dai-ichi NPS immediately after the accident had not yet been published.

Following NISA's directions, TEPCO started preparing to publish these data. All data that had not been published was added to the previously published data between March 11 and 21 and this combined data was published on May 28. In addition, as directed by the Prime Minister's Office to explain the delay in the publication of the data, TEPCO put the monitoring data on its website again accompanied by an explanation for the delay in publishing the data.

[7] TEPCO also monitored the water in the water intake and the subdrain at the Fukushima Dai-ichi NPS as follows:
- On March 26, it was discovered that highly concentrated radioactive water had accumulated in the first basement of the turbine building of Unit 2. Based on expert advice provided by NSC on March 28 that sampling of the groundwater in the subdrain should be conducted, sampling of the water in the subdrain started from March 30.
- On April 2, it was discovered that highly contaminated radioactive water had been flowing into the sea from the part of concrete near the water intake of Unit 2. Thus the sampling of seawater began near the water intake from the same day.
- It was decided that the highly concentrated radioactive waste water should be transferred to the main processing building of the centralized waste treatment facility from April 19. Based on this decision, sampling and analysis of the water in the subdrain of the centralized waste treatment facility started from April 16 to confirm that no radioactive materials had leaked from the transferred contaminated water into the groundwater.

(2) Efforts to assign responsibility for radiation monitoring and the subsequent enhancement of monitoring activities

a. Efforts to assign responsibility for radiation monitoring within the Government for the overland area more than 20km from the Fukushima Dai-ichi NPS

As described in Section (1)b above, radiation monitoring activities based in the Local Emergency Response Center located in the Off-site Center were not sufficient to satisfy the parties concerned within the government. Thus around and after March 13, Special Advisor to the Prime Minister, Mr. Goshi Hosono (hereinafter referred to as "Special Advisor Hosono"), contacted executive officials at MEXT to for details on the status of the radiation monitoring, and the government asked all parties concerned several times to conduct more proactive radiation monitoring activities on a national basis.

On the night of March 15, the monitoring of the radiation level in the air conducted by a monitoring car traveling around Hirusone in Namie-town in Futaba-gun, Fukushima Prefecture observed radiation dose rates as high as 330μSv/h. MEXT thus recognized that it might also be necessary to explain its evaluation of how these levels should be dealt with. On the other hand, the Ministry also recognized that it might be difficult to handle everything on its own, including the collection, publication and evaluation of the monitoring data[8].

A meeting in relation to the above chaired by Chief Cabinet Secretary, Mr. Yukio Edano (hereinafter referred to as "Chief Cabinet Secretary Edano"), was held at the Prime Minister's Office on the morning of March 16. It was decided in the meeting that the roles and responsibilities within the government should be as follows: MEXT should compile and publish the monitoring data collected by individual organizations concerned using monitoring cars in the land area beyond 20km from the Fukushima Dai-ichi NPS; the NSC should evaluate this monitoring data; and the Government Emergency Response Center should take any necessary measures based on the evaluations of the NSC.

[8] MEXT was asked by the media how the Ministry had evaluated the monitoring data mentioned above when it released the results of the monitoring conducted around Hirusone at a press conference held by the Ministry on March 16. The officials from the Ministry responded by saying that the results of monitoring activities were to be evaluated by the NSC from March 16 based on the assignment of responsibility concerning radiation monitoring activities within the Government (refer to the next paragraph of this report) on the same day.

From March 16, based on the roles and responsibilities within the government that had been decided in the aforementioned meeting, the Local NERHQ[9], located at the Fukushima Prefectural Office, decided to deliver the monitoring data compiled by its own to both the ERC and the Emergency Operating Center (EOC) of MEXT while MEXT collected this data to deliver to the NSC for its evaluation for its evaluation and started publishing it from the same day[10].

Moreover, the NSC shared the results of its evaluation of the monitoring data with the all relevant ministries and agencies by delivering the data to the ERC, EOC, and the Prime Minister's Office[11]. The Commission did not initially release its evaluation results when the roles and responsibilities within the government were determined on March 16 as Chief Cabinet Secretary Edano had continually held press conferences, addressing various issues including the evaluation of the monitoring activities. Subsequently, however, the Commission started to release its evaluation results from March 25 since it had been strongly urged to and also because it had been pointed out by the media that its activities were hard for the general public to understand.

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[9] On March 15, the Local Emergency Response Center was moved from the Off-site Center to the Fukushima Prefectural Office (for details of the circumstances surrounding this move, refer to Section III5 (3) above).

[10] MEXT decided that if any discrepancies were found in the monitored values, the monitoring data should be verified and validated first within the Ministry before being made public. If no discrepancies were found in the monitoring data, then to ensure speed the Ministry should contact the three most important officials (the Minister, the Vice Minister, and the Parliamentary Secretary) of the Ministry and the Fukushima prefectural government in advance before making the monitoring data public.

[11] On March 21, MEXT released a "plan to improve monitoring activities in the area beyond 20km from the Fukushima Dai-ichi NPS" based on recommendations (including implementing efficient environmental radiation monitoring in extensive contaminated zones, strengthening the environmental radiation monitoring team and implementing reasonable environmental radiation monitoring) of the Advisory Team led by Mr. Toshisou Kosako, a professor at the University of Tokyo Graduate School, who had been appointed Cabinet Secretariat advisor on March 16 (refer to Section III2(6)).

Also, on April 22, the Government Emergency Response Headquarters released a "plan to enhance environmental radiation monitoring activities." This plan was created by a team led by Cabinet Office advisor, Mr. Kenkichi Hirose, with a view to enhancing the environmental radiation monitoring activities in order to capture the full scope of the nuclear accident and to reduce or eliminate the designated evacuation zone and the emergency evacuation preparation zone (refer to Section 3(2) d below), the implementation of which had been discussed within the government.

b. The monitoring activities conducted in the area beyond 20km from the Fukushima Dai-ichi NPS from March 15

As described in Section (1)b above, the monitoring activities implemented immediately after the nuclear accident were based on the radiation monitoring plan that had been devised by the Fukushima prefectural government staff and approved by Local NERHQ. On the contrary, regarding the monitoring activities in the area beyond 20km from the Fukushima Dai-ichi NPS, the monitoring plans had been separately devised by the Local NERHQ and the Fukushima Prefectural Emergency Response Center since Local NERHQ was moved to the Fukushima Prefectural Office on March 15.

Subsequently, the national government decided to conduct radiation monitoring mainly in an area where high levels of radiation had been detected in order to estimate the levels in a wider area. On the contrary, in response to requests from local communities, the Fukushima prefectural government decided to develop a radiation monitoring strategy in the Fukushima Prefectural Emergency Response Center (hereinafter referred to as the "Prefectural Headquarters") and collaborate closely with the Local NERHQ to implement monitoring activities since it had been planning to conduct radiation monitoring mainly in highly populated areas within the prefecture.

MEXT started to discuss monitoring by aircraft in order to do survey a wide area from around March 12 and released its "MEXT Aircraft Monitoring Action Program" on March 25. On the same day, with the cooperation of the Japan Aerospace Exploration Agency (JAXA), an independent administrative organization, the Ministry measured the levels of radiation in the air beyond 30km from the Fukushima Dai-ichi NPS[12]. In response to a request from MEXT, the Self Defense Forces measured the concentration of radioactive materials in airborne dust particles above Fukushima Prefecture between March 24 and April 1.

In addition, the Japanese and US Governments met to start discussing how the two nations could cooperate to conduct aircraft monitoring in a U.S.-Japan conference (hereinafter referred to as the "U.S.-Japan conference"), which began around the end of

[12] This aircraft monitoring was conducted using JAXA's small aircraft equipped with radiation measuring instruments provided by the Nuclear Safety Technology Center.

March. Previously, the United States Department of Energy (DOE) had independently conducted aircraft monitoring after the nuclear accident. Two subsequent joint U.S.-Japan aircraft surveys were conducted[13].

Moreover, from March 21, with the cooperation of the Maritime Safety Agency and the Fisheries Agency, MEXT monitored the sea area beyond a 30km radius of the Fukushima Dai-ichi NPS. The geographical scope of the monitoring area was extended because TEPCO had discharged retained water including low-level radioactive water into the sea on April 4[14]. TEPCO also conducted coastal sea area monitoring in Fukushima Prefecture and Ibaraki Prefecture in the sea area beyond a 30km radius of the Fukushima Dai-ichi NPS.

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[13] This aircraft monitoring was conducted by MEXT and the U.S. DOE working within their respective designated air space from April 6 to 29 and from May 18 to 26. They estimated the levels of radiation in the air at a height of 1m above the ground within an 80km radius and within an 80 to 100km radius (and within a 120km radius to the south of the NPS) respectively from the Fukushima Dai-ichi NPS and confirmed the accumulation of radioactive substance on the ground. MEXT released these results on May 6 and on June 16. In addition, between May 31 and July 2, with the cooperation of the Ministry of Defense, MEXT conducted its third aircraft monitoring within an 80km radius of the Fukushima Dai-ichi NPS to estimate the level of radiation in the air dose at a height of 1m above the ground and the accumulation of radioactive substance on the ground. The Ministry released these results on July 8. In addition to the aircraft monitoring described above, in response to requests from the prefectures concerned, MEXT conducted joint aircraft monitoring in Miyagi, Tochigi, Ibaraki, and Yamagata prefectures. The results of the monitoring were subsequently released.

[14] In response to the recommendations of the Advisory Team led by Cabinet Secretariat advisor, Mr. Toshisou Kosako, MEXT developed a policy to conduct sea area monitoring with the cooperation of the Maritime Safety Agency on March 21 and released its "sea area monitoring action program" on March 22. The next day on March 23, MEXT requested that the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) conducted a sampling of seawater from the sea area precisely like the "comprehensive evaluation program of radioactivity in the marine environment" that the Marine Ecology Research Institute had been conducting before the nuclear accident occurred. The results of the sampling were compared with those of past surveys in terms of concentration of radioactive materials in the seawater, levels of radiation in the air above the sea and concentration of radioactive materials in dust particles in the atmosphere above the sea.
In addition, in response to the "plan to enhance the environmental radiation monitoring activities," which was released by NERHQ on April 22, (which stipulates that, in terms of ocean areas, the number of measurement points should be increased and that predictions on the dispersion of radioactive materials should be successively performed based on the predictions of ocean currents), the Ministry released the "planned enhancement of sea area monitoring" in response to the "plan to enhance environmental monitoring," and 11 sampling points were added on April 25.
On May 6, based on the anticipation that radioactive materials could disperse in the sea, the Ministry released a plan of "wider sea area monitoring." In response to this, it was decided that JAMSTEC should conduct monitoring in more pelagic zones and that TEPCO should perform water sampling at some of the sampling points within the sea area of 30km offshore from the Fukushima Dai-ichi NPS, a zone which had previously been overseen by JAMSTEC since late March.

c. The monitoring activities conducted in the areas surrounding the Fukushima Dai-ichi NPS

As described in Section (1)b above, between March 12 and 14, the monitoring activities were intermittently conducted using monitoring cars that were provided by the Fukushima prefectural government in the areas within a 20km radius of the Fukushima Dai-ichi NPS. From March 14, the monitoring activities using monitoring cars were suspended because evacuations were completed within a 20km radius and the levels of radiation increased in the areas of land outside that radius[15].

In response to directions from Chief Cabinet Secretary Edano, the Emergency Gathering Team subsequently started to discuss how to conduct monitoring in the area within a 20km radius of the Fukushima Dai-ichi NPS to establish restricted areas and make a temporary access plan to those restricted areas (refer to Section 3(2)g). On March 30 and 31, with the cooperation of the Federation of Electric Power Companies (hereinafter referred to as "FEPC"), TEPCO thus conducted radiation monitoring at 33 locations in the area within a 20km radius of the Fukushima Dai-ichi NPS. Subsequently on April 2, MEXT conducted additional monitoring at 17 locations in the area within a 20km radius of the Fukushima Dai-ichi NPS.

In mid-April, the zoning of restricted areas and the planning of temporary access to the restricted areas were nearly finished. The emergency operations team decided to conduct radiation monitoring to grasp the areal dispersion of radioactive materials within a 20km radius of the Fukushima Dai-ichi NPS in order to implement temporary access to the restricted areas. In response to this decision, on April 18 and 19, MEXT, TEPCO and FEPC conducted joint monitoring activities at 128 locations in the area within a 20km radius of the Fukushima Dai-ichi NPS. The results of these monitoring activities were published on MEXT website along with the joint monitoring activities that were conducted

[15] In the aftermath of the nuclear accident, the Defense Agency provided dosimeters to an emergency team of Self-Defense Force personnel, which had been summoned to work around the Nuclear Power Station, to prevent them from being exposed to radiation and to measure the air radiation doses where necessary, depending on the prescribed activities of the Self-Defense Force personnel. On March 28, the Defense Agency shared its monitoring data obtained within 20km radius from the NPS with the government emergency operations team in order to use as a reference for the establishment of restricted areas and to help organize temporary access to those restricted areas.

by MEXT and TEPCO in the area within a 20km radius of the Fukushima Dai-ichi NPS from late March to early April.

As described previously it was discovered that highly concentrated radioactive water had accumulated in the basement of the turbine building of Unit 2. On March 28, and NSC issued an advisory that sea area monitoring activities should be enhanced for safety purposes. Thus from April 2, TEPCO started sea area monitoring activities at multiple locations in the area 15km offshore from the Fukushima Dai-ichi NPS. To conduct sea area monitoring activities, TEPCO initially requested, via the NERHQ ships and vessels from the Maritime Safety Agency because TEPCO could not afford to provide them. Subsequently, in early April, highly radioactive water was discharged or found to be leaking. In response to this situation, TEPCO added water sampling points to the sea area monitoring zone situated in the area 30km offshore from the Fukushima Dai-ichi NPS after holding consultations with MEXT and NISA.

d. Monitoring coordination meeting

MEXT was compiling and releasing the data that had been collected through monitoring activities conducted by the Ministry, TEPCO, the National Police Agency and the Defense Agency based on the responsibility concerning radiation monitoring activities assigned within the Government on March 16. Subsequently, because further dispersion and accumulation of radioactive materials were observed, monitoring activities for a wider range of items including foods , were conducted by relevant organizations (refer to Section 5 below). Based on this situation, to ensure various monitoring activities both on the environment and foods the monitoring coordination meeting was held on July 4.

During this meeting, it was decided that MEXT should not only conduct environmental radiation monitoring, but also provide comprehensive coordination of monitoring activities conducted by relevant organizations. The NSC was supposed to not only perform a comprehensive evaluation of the results of these monitoring activities, but also to provide these relevant organizations with advice concerning their monitoring activities. In addition, each of the governmental organizations, relevant local governments and nuclear power operators were supposed to conduct their own monitoring activities to collect monitoring

data.

On August 2, the meeting participants released a "Comprehensive Monitoring Strategy" to clarify the scope of monitoring conducted by relevant governments, local governments and TEPCO as well as their respective roles and responsibilities.

2. Utilization and dissemination of information yielded by SPEEDI

(1)Overview of the SPEEDI system

The System for Prediction of Environmental Emergency Dose Information (SPEEDI) quickly predicts the atmospheric concentration of radioactive materials and radiation dose in the surrounding area of an emergency situation, including nuclear power stations, based on release sources, meteorological conditions and topographical data. Predicted results are shown with symbols and isolines on a map.

Release sources data for the calculations of the SPEEDI are to be provided by the Emergency Response Support System (ERSS). The ERSS predicts and analyzes the outcome and subsequent development of the accident based on information concerning the behavior of the reactor, which is provided by nuclear power station operators, and its predicted amounts of discharged radioactive materials are provided to SPEEDI.

The Basic Disaster Prevention Plans stipulates that MEXT should adequately prepare and maintain the SPEEDI system even during normal times and improve necessary functions, including connections to the Off-site center. The Plan also stipulates that MEXT should shift SPEEDI to emergency mode immediately after the Ministry is notified of the occurrence of a specified event (stipulated in Article 10 (1) of the Act on Special Measures Concerning Nuclear Emergency Preparedness (Specific Event)), and make proper predictions on the impacts of radiation and share the results of those predictions with all relevant ministries and agencies.

The Government's NE Response Manual stipulates that if an accident occurs in a commercial reactor, NISA should activate ERSS to grasp release source information, which is transferred to the MEXT. MEXT should predict based on this release source information the impacts of radiation using the SPEEDI computer, which is installed at the Nuclear Safety Technology Center (hereinafter referred to as the "Nuclear Safety Technology Center") and

provide the results to the NISA, NSC, all relevant prefectural governments and the Off-site center.

This NE Response Manual stipulates that the results of the SPEEDI calculations should be used at a nuclear incident as the basis of discussions on how to take measures to protect residents in the vicinity of the NPS. Actually, when the national government conducted a comprehensive nuclear emergency response drill in Fukushima Prefecture in 2008, drills on shifting SPEEDI to emergency mode, taking adequate protective actions and verifying the results using SPEEDI were included.

In this Accident the release source information from ERSS on which SPEEDI calculations are based was not obtained. To be more precise, due to the loss of external power supply caused by the earthquake on March 11, TEPCO's Safety Parameter Display System (SPDS), which was installed within the premises of the Fukushima Dai-ichi NPS to provide the reactor data to ERSS, ended up being unable to transfer data to ERSS[16]. Moreover, as described in Section III5(1)b, after 16:43 on March 11, the Government's dedicated line, which sends data from the Fukushima Dai-ichi NPS to the main computer of ERSS through the Off-site Center, became unavailable[17].

Thus in the implementation of response measures for the nuclear accident, SPEEDI which is based on release source information from ERSS, was not able to perform calculation predictions on the dispersion of radioactive materials since plant data could not be transferred to ERSS as a result of at least two transfer line failures. Against the expectation of aforementioned training drills, it was impossible to utilize the SPEEDI for setting the evacuation zones because SPEEDI could not predict the atmospheric concentration of radioactivity and radiation dose.

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[16] This was most probably due to the fact that neither an emergency power source nor batteries were connected to the equipment that was supposed to send data collected by SPDS to ERSS. The equipment most likely stopped due to the loss of its emergency power source after the earthquake hit.

[17] On the other hand, some equipment at the Fukushima Dai-ni NPS including SPDS was functioning properly even after the earthquake hit and the SPDS plant data was being transferred outside the NPS. However, as described above, the dedicated line that connected the Off-site Center and the ERSS main computer was rendered unavailable after 16:43 on March 11. From that point in time, the Fukushima Dai-ni NPS was unable to send its data to the main computer of ERSS.

(2)Utilization and dissemination of information yielded by SPEEDI up to March 15

a. Utilization and dissemination of the results of an hourly basis calculation, assuming a unit radioactivity release rate

As described in Section (1) above, MEXT directed the Nuclear Safety Technology Center, which manages and operates SPEEDI, to switch the SPEEDI system to emergency mode at 16:40 on March 11.

In response to this directive, the Center switched SPEEDI to emergency mode at 16:49 that day. At the same time, the Center started calculations to predict the atmospheric dispersion of radioactive materials on hourly basis using the meteorological data from 16:00 that day and assuming a unit radioactivity release rate of a 1Bq/h from the Fukushima Dai-ichi NPS based on the Environmental Radiation Monitoring Guidelines prepared by NSC. It should be noted, however, that the results of the calculations above was not a prediction based on an actual release rate, but simply a prediction of the direction of dispersion and the relative concentration of radioactive materials in the air based on a unit release rate.

In response to the directive from MEXT, the Nuclear Safety Technology Center provided the predicted results of their unit release rate calculation, to MEXT, the ERC, the NSC, the Off-site Center, the Fukushima Prefectural Office, and JAEA[18]. The Nuclear Center requested that the Nuclear Safety Technology Center adjacent to the Off-site Center provide the results of their unit release rate calculation[19]. In response to the request, at approximately 23:00 on March 11, the Nuclear Safety Technology Center provided the results of their unit release rate calculations only once to the Fukushima prefectural

[18] The Fukushima Prefectural Office and the Off-site Center were unable to provide SPEEDI predicted results, since their data communication links for transferring SPEEDI calculation results were disrupted by the earthquake on March 11. In addition, the SPEEDI terminal that had been installed at the Fukushima Prefectural Office was unavailable since the Prefectural Office building was severely damaged and the staff was not able to access the data by any means. As a result, the Nuclear Safety Technology Center faxed through the satellite telephone line copies of the results of the calculations assuming radioactive release at the unit release rate, which had been conducted from March 11, to the off-site center. Meanwhile, the Fukushima Prefectural Office was able to use their internet lines effectively immediately after the earthquake and thus received the SPEEDI calculation results by email from the Nuclear Safety Technology Center from the night of March 12.

[19] The Monitoring Center was not able to receive the calculation results because the SPEEDI terminal that had been installed at the Center was unavailable to use due to the earthquake on March 11 and could not receive the calculation results.

Monitoring Center via email, which had been intermittently available during that time.

Among the organizations that received the unit release rate calculations, the Monitoring Center used the results as a reference to formulate their monitoring program from March 12. Other organizations did not use these results to discuss practical and concrete measures since they thought that the calculations based on an assumed unit release rate did not show any actual radiation dose levels. They also had no idea of making the results public. As described earlier, the results of the unit release rate calculation, however, had predict the direction of dispersion of radioactive materials and the distribution of relative amounts of radioactive materials, they could have been useful in determining the direction of evacuation of residents (refer to Section 3 (3) c and f).

b. Utilization and dissemination of the results of calculations conducted by organizations based on various assumptions

Besides the unit release rate calculations, between March 11 and 15, MEXT, NISA and NSC conducted calculations to predict the impact of radioactive materials released from the Fukushima Dai-ichi NPS by entering various assumed values into SPEEDI as release source information. Between March 12 and 16, the MEXT, conducted 38 SPEEDI calculations with various release source information and shared the results within the MEXT emergency operation Center (EOC), and provided some of the calculation results to both the ERC and the NSC.

Aside from this, on the night of March 12, NSC made one request for a SPEEDI calculation to the Nuclear Safety Technology Center. The NSC received the calculation results and shared them with its members, members of its technical advisory body at an emergency, and some staff members of the NSC Secretariat. The NSC, however, believed that the calculation results should only be utilized for internal discussion. As a result, the calculation results were not shared with any other organizations.

Meanwhile between March 11 and 15, NISA conducted 45 SPEEDI calculations by entering various assumptions of release source information in order to grasp the dispersion feature of radioactive materials. The obtained predicted results were shared with various functional teams within the MEXT-ERC. The first set of results were provided to the

Prime Minister's Office and the Off-site center

NISA had requested that the Nuclear Safety Technology Center to conduct the SPEEDI calculation to predict the impacts of radioactive materials released from Unit 1 of the Fukushima Dai-ichi NPS and provided the SPEEDI predictions to the Agency staff at just past 1:30 on March 12. The officials gave the predictions to the staff of the Cabinet Secretariat who attempted to share the predictions with the staff of various ministries who were stationed in the basement of the Prime Minister's Office.

NISA sent the Prime Minister's Office the SPEEDI predictions with an accompanying message that. NISA, believed that the SPEEDI predictions were of low reliability because of calculations based on assumed release source information. Cabinet Secretariat staff, who received the predictions from NISA staff before dawn on the morning of March 12, treated them as reference information and did not report to Prime Minister Naoto Kan (hereinafter referred to as "Prime Minister Kan")[20]. Also NISA itself did not report the predictions to Prime Minister Kan either.

Moreover, the SPEEDI predictions of various organizations based on assumed input data as well as those of the unit release rate were not made public for a certain period of time after the earthquake As a result, the predictions were not utilized by local governments for their implementation of evacuation measures (for details on how the SPEEDI calculation results were made public, refer to Section (3)c and for details on how local governments implemented evacuation measures, refer to Section 3(3) below.

(3) Utilization and dissemination of information produced by SPEEDI from March 16 onward

a. Assignment of roles and responsibilities concerning how to operate and utilize SPEEDI within the Government from March 16 onward

MEXT was urged by the media to release SPEEDI predictions at a press conference held by the Ministry on March 15. In response to this, the Ministry held an in-ministry meeting attended by the three most important officials (the Minister, the Vice Minister and the Parliamentary Secretary) of the Ministry. The predictions were obtained by both

[20] It is expected that this matter will be investigated further.

SPEEDI and the global version of SPEEDI (WSPEEDI), which covers wider regions, assuming that all radioactive materials (10^{18}Bq of iodine and 10^{19}Bq of noble gas) are released at one time. The predictions provided in the meeting showed that high level radioactive clouds would move over the Tohoku District and there was opinions that a release of the predictions could cause people unnecessary confusion. No concrete decision was made as to whether it might be necessary to publicize the SPEEDI predictions.

The next day, on March 16, at a meeting attended by the three most important officials of MEXT, Vice Minister Kan Suzuki of MEXT mentioned that the roles and responsibilities concerning monitoring activities within the Government had been decided at a meeting held in the Prime Minister's Office in the morning of that same day (refer to Section 1(2) above): MEXT should collect and publicize monitoring data, the NSC should evaluate the data and the NERHQ should implement measures based on the evaluation. No mention was made of SPEEDI. Thus he proposed that SPEEDI matters should hereafter be operated and its predictions should be publicized by the NSC, because the NSC was designated the role of evaluating monitoring data. His proposal was agreed by the attendance.

In response to this decision, MEXT verbally informed NSC this decision of a change of an operation body of SPEEDI. The Ministry then sent both the operators of the Nuclear Safety Technology Center, who had been working in EOC, to the Secretariat of NSC.

In response to this MEXT decision on the SPEEDI operation, the NSC understood that SPEEDI control had not yet been transferred to the Agency, but that the Agency was supposed to conduct calculations using SPEEDI. At that point, the Agency (NSC) started operating and maintaining the SPEEDI system.

b. Performing a retrospective estimation of release source information by SPEEDI and publicizing the predictions

In response to the change of operation body of SPEEDI from MEXT to NSC, as described in Section a above, from March 16, NSC began discussions on how to utilize SPEEDI in a situation where release source information from ERSS was not available.

As part of the discussion, on the following day, March 17, in response to the direction of

the Vice Chairman of NSC, Mr. Yutaka Kukita (hereinafter referred to as "NSC Vice Chairman Kukita") and under the cooperation of JAEA and the Japan Chemical Analysis Center, the NSC, led by a member of the Emergency Response Technical Advisory Body, started discussions on how to estimate release source information using SPEEDI and how to estimate the radiation dose based on the estimated release source information.

What is specifically meant by estimating release source information using SPEEDI in a situation where release source information is not available, is to estimate the actual amount of radioactivity released by multiplying the unit amount of radioactivity released by a ratio of observed radiation dose rate at a specific point to a calculated radiation dose rate of the unit release rate at the same point. In the calculation above, the NSC used radiation dose rates in the air obtained by the monitoring and the atmospheric concentration of radioactive materials obtained by dust sampling. To be more precise, the NSC selected data for calculation by analyzing the monitoring data collected before March 15 and newly obtained data from MEXT.

As a result, at around 09:00 on March 23, NSC obtained the results of calculation concerning the cumulative radiation dose in the surrounding areas of the Fukushima Dai-ichi NPS between March 11 and 24. It was found that an equivalent dose of the thyroid gland of infants, which were part of the calculation results, exceeded 100mSv of the criteria for stable iodine distribution (refer to Section 4 (1) c below) indicated in the "the Guideline for Measures for Nuclear Installations" (hereinafter referred to as "Guideline for Measures"), which was prepared by the NSC. Thus NSC Chairman Haruki Madarame (hereinafter referred to as "NSC Chairman Madarame") and NSC member Ms. Shizuyo Kusumi reported these results to the Prime Minister's Office (for the results of this report, refer to Section 3(2)a below).

As According to the direction of the Prime Minister's Office, the NSC held a press conference at around 21 p.m. on March 23 and publicize the calculation results[21].

[21] In addition to this press conference, the NSC subsequently held three additional press conferences on April 10, 25, and 27 and published the SPEEDI calculation result with higher precision of the retrospective estimation method.

c. Disclosure of SPEEDI calculation results

People had become increasingly interested in SPEEDI calculation results and the disclosure of them before they were disclosed on March 23.

Subsequently, on the occasion of MEXT response on March 24, to a request to disclose SPEEDI calculation results based on the Administrative Organs Information Disclosure Act (hereinafter referred to as "Information Disclosure Act"), MEXT, NISA and NSC discussed how to respond to a request to disclose SPEEDI calculation results based on the Information Disclosure Act.

As a result, by around mid-April, a disclosure policy for SPEEDI calculation results was decided as a result of discussion based on Information Disclosure Act among MEXT, NISA and NSC. In response to a request to disclose the SPEEDI calculation results based on Information Disclosure Act: (i) the results of calculation assuming radioactive release at the unit rate of 1Bq/h should be disclosed; (ii) the results of SPEEDI calculations of cumulative dose, which is estimated by the retrospective method which contains the release source information estimated by the observed monitoring data, should be disclosed when the predictions are judged by the NSC to be reliable enough for the disclosure; and (iii) the results of the SPEEDI calculations conducted by MEXT, NISA, NSC and other organizations based on the assumption of input data should not be disclosed since people would confuse if such the results were disclosed.[22].

On the other hand, some media reported that the Government had not disclosed the SPEEDI calculation results. In response to these reports, further discussion was held regarding this matter. On April 25, according to the direction of the Prime Minister's Office, it was determined that all SPEEDI calculation results of categories from (i) to (iii) above should be disclosed. In response to this, MEXT, NISA and NSC published the SPEEDI calculation results on their websites by May 3.

[22] The discussion and categorization was done in consultation with the Prime Minister's Office. It will be further investigated, however, how exactly the Prime Minister's Office was involved in, the discussion and categorization.

3. Evacuation of Citizens

(1) Initial situation regarding the decision, instruction, communication and implementation of evacuation programs

a. Implementation of evacuation programs regarding the Fukushima Dai-ichi NPS accident

In response to the fact that all AC power supplies were lost and the Emergency Core Cooling System was unable to provide water to Fukushima Dai-ichi NPS, Prime Minister Kan declared a nuclear emergency situation at 19:03 on March 11 and established the Nuclear Emergency Response Headquarters (NERHQ) in the Prime Minister's Office (refer to Section III 2 (1)).

In response to the declaration of the nuclear emergency state at the Fukushima Dai-ichi NPS, the Prefectural Nuclear Emergency Response Center discussed an instruction of evacuation for citizens within a 2km radius of the nuclear power plant, where regular nuclear emergency drills and exercises were conducted. At 20:50 that day, Prefectural Governor Yuhei Sato instructed citizens an evacuation within a 2km radius of the Fukushima Dai-ichi NPS.

This evacuation instruction was not issued on the basis of a specific act but de facto measure to prevent a disastrous scenario. In response to this order, officials from the towns of Okuma and Futaba took all possible measures by alerting citizens in the area, using a municipal disaster management radio communication network, sound trucks and having fire fighters make door-to-door visits.

Later, after a press conference by Chief Cabinet Secretary Edano concerning the declaration of the nuclear emergency state, NSC Chairman Madarame, Vice Chairman of the Nuclear and Industrial Safety Agency, Eiji Hiraoka (hereinafter referred to as "Vice Director-General of NISA Hiraoka"), and TEPCO executives convened on the fifth floor of the Prime Minister's Office (not at the Crisis Control Center on the basement floor), where concerned ministers asked for their opinions on the conditions of the nuclear reactors, the range of the evacuation area and other matters[23].

[23] The NE Response Manual stipulates that if it is too difficult for the Joint Council for Nuclear Emergency Response, which is organized by Local NERHQ and other relevant organizations, to discuss a draft evacuation

In that discussion, various opinions were offered including "reactor cores might be damaged in the worst case scenario" and "a vent operation is required to avoid that." In terms of the range of the evacuation area, the Nuclear Emergency Guideline, which was created by the NSC, states that the range of the emergency preparedness zone (EPZ) where emergency countermeasures are sufficiently taken should be within a 10km radius but the preventive action zone (PAZ) that is described in a document of the International Atomic Energy Agency (IAEA) is the area within a 3km radius. So "within a 3km radius" is sufficient, even if it assumed that a vent operation is required. In addition, Vice Director-General of NISA Hiraoka explained that a regular evacuation drill is conducted within a 3km radius under a supposed vent operation. Based on these opinions and explanations, the evacuation was instructed for the zone within a 3km radius, and a stay-indoors was instructed for the zone within a 3 to 10km radius from the Fukushima Dai-ichi NPS.

In response to this decision reached in a meeting held on the fifth floor of the Prime Minister's Office at 21:23 that day, the NERHQ instructed the Fukushima Prefectural Governor and all relevant local governments to issue an evacuation order to citizens within a 3km radius of the Fukushima Dai-ichi NPS and to issue a stay-indoors order to citizens within a 10km radius of the power station. At 21:52 the same day, Chief Cabinet Secretary Edano held a press conference concerning the evacuation orders.

Subsequently, no vent operation was conducted despite an abnormal increase in the pressure inside the primary containment vessel at Unit 1 and despite the fact that the implementation of a vent operation at Units 1 and 2 was instructed by the Prime Minister. Before dawn on the morning of March 12, concerned ministers discussed the range of the evacuation zone again on the fifth floor of the Prime Minister's Office in the presence of Vice Director-General of NISA Hiraoka and NSC Chairman Madarame. During this discussion, an opinion was expressed that it would not be necessary to extend the

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order in the case of a commercial nuclear power plant disaster, then the Ministry of Economy, Trade and Industry (METI) should discuss a draft evacuation order and the METI Minister, in the presence of the Deputy Chief Cabinet Secretary for Crisis Management, the NISA Vice Chairman, and the Disaster Prevention Minister, should present the draft evacuation order to the Chief of the NERHQ, then the NERHQ issues an evacuation order. In the case of the nuclear accident at the Fukushima Nuclear Power Station, an evacuation order was ordered without following this protocol.

evacuation zone if a vent operation were conducted under well-controlled conditions but, if taking a conservative stance on this matter, even a relatively significant hazard could be handled if an EPZ were expanded to within a 10km radius. Based on this opinion, it was decided that the evacuation zone would be expanded to within a 10km radius. At 05:44 on March 12, the NERHQ instructed the Fukushima Prefectural Governor and all relevant local governments to issue an evacuation order to citizens within a 10km radius of the Fukushima Dai-ichi NPS. At 09:35 the same day, Chief Cabinet Secretary Edano held a press conference about the evacuation order. A 06:15 the same day, after the decision was made to expansion the evacuation zone, Prime Minister Kan flew to Fukushima Dai-ichi NPS by helicopter.

During a vent operation had still been tried at 15:36 on March 12, there was an explosion in the Reactor Building of Unit 1. A discussion was held on the fifth floor of the Prime Minister's Office about how to grasp the plant situation and how to take protective measures. It was decided that an evacuation order would be issued to citizens within a 20km radius. At 18:25 on March 12, the NERHQ instructed the Fukushima Prefectural Governor and relevant local governments to issue an evacuation order to citizens within a 20km radius of the Fukushima Dai-ichi NPS.

At 20:32 the same day, Prime Minister Kan addressed the Japanese people to explain the expansion of the evacuation zone range. Following Prime Minister Kan, at 20:50 the same day, Chief Cabinet Secretary Edano talked about the explosion at the Reactor Building of Unit 1, explaining that it was not the explosion of the primary containment vessel so a large volume of radioactive material would not leak out. He also explained the expansion of the evacuation zone range.

Subsequently, the following incidents occurred in succession: at 11:01 on March 14, Unit 3 exploded; at around 06:00 on March 15, a big boom was heard from Unit 4; at around 08:11 the same day, some damage to the fifth floor of the Reactor Building of Unit 4 was confirmed; and at 09:38 on the same day, a fire broke out in the northwest section of the third floor of the Reactor Building of Unit 4. In response to these incidents, at 11:00 on the same day, the NERHQ issued an order to the Fukushima Prefectural Governor and all relevant local governments to issue a stay-indoors order to citizens within a 20 to 30km

radius of the Fukushima Dai-ichi NPS[24]. Immediately after this, a press conference by the Prime Minister and the Chief Cabinet Secretary was held to explain the order in greater detail.

b. Implementation of evacuation plans regarding the Fukushima Dai-ni NPS

At 18:33 on March 11, the cooling function of the reactor cores at Units 1, 2 and 4 of the Fukushima Dai-ni NPS was lost. In response to this incident, a notice to that effect pursuant to the provisions of Article 10, Paragraph 1 of the Act on Special Measures Concerning Nuclear Emergency Preparedness was issued. At 05:22 the next day, March 12, at Unit 1, at 05:32 on the same day at Unit 2 and at 06:07 the same day at Unit 4, the pressure suppression function was lost. A report of a specified event to that effect, pursuant to the provisions of Article 15, Paragraph 1 of the Act on Special Measures Concerning Nuclear Emergency Preparedness was submitted.

In response to this report, METI judged that a nuclear emergency had occurred and reported to this to Prime Minister Kan, who was at the Fukushima Dai-ichi NPS. Having obtained approval from Prime Minister Kan, at 7:45 on March 12, METI issued a declaration of a nuclear emergency state concerning the Fukushima Dai-ni NPS and established the government nuclear emergency response headquarters. This emergency response headquarters was integrated into the NERHQ, which had been established the previous day to take care of Fukushima Dai-ichi NPS.

At the same time that METI issued a declaration of nuclear emergency state in the name of the Prime Minister, they also issued an evacuation order to citizens within a 3km radius of the Fukushima Dai-ichi NPS and issued a stay-indoors order to citizens within a 3 to 10km radius of the power station.

At 15:36 on March 12, an explosion occurred in Unit 1 of the Fukushima Dai-ichi NPS. In response to this explosion, a discussion was held in a meeting held on the fifth floor of the Prime Minister's Office on how to grasp the plant situation and how to take protective

[24] On the previous day at the Prime Minister's Office, NSC Chairman Madarame, NSC Vice Chairman Kukita and JAEA staff talked to Prime Minister Kan and Chief Cabinet Secretary Edano suggesting that the evacuation zone should not be expanded beyond a 20km radius of Fukushima Dai-ichi NPS and that a stay-indoors order for those within a 30km radius should be issued instead.

measures. A similar incident is expected to occur at the Fukushima Dai-ni NPS. Thus, on the off chance that an incident might occur, it was decided that the range of the evacuation zone be extended. At 17:39 the same day, the NERHQ instructed the Fukushima prefectural government and other relevant local governments to issue an evacuation order to citizens within a 10km radius of the Fukushima Dai-ni NPS.

Moreover, it was less probable that any additional hazardous incidents might occur at the Fukushima Dai-ni NPS. Even if a hazardous incident were to occur, it would most likely be an incident that would not be too difficult to handle and its impact on the surrounding area might be limited. In response to this probability, on April 21, the NERHQ issued an order to reduce the range of the evacuation zone to within an 8km of radius of the Fukushima Dai-ni NPS excluding the zone within a 20km radius of the Fukushima Dai-ichi NPS.

c. How evacuation orders were communicated

The NE Response Manual prescribes that the head of Local Headquarters shall communicate an evacuation order to each municipality including cities, towns and villages.

In fact, however, immediately after the earthquake, communication by telephone proved to be difficult. Moreover, the relevant personnel were unable to reach the Nuclear Emergency Response Local Headquarters (Local NERHQ). Thus it was decided that a new communication route through the Fukushima Prefectural Office and another one through the Secretariat of the NERHQ be added to the Local NERHQ communication route.

However, most of the municipalities actually learned of the evacuation orders through the mass media including TV since it took a long time for a telephone call to get through[25].

[25] As far as most of the municipalities located in the evacuation zone were concerned, no confirmation was ever given that any of the municipalities received notification of an evacuation order from the Secretariat of NERHQ, the Fukushima prefectural government or the Local NERHQ. One significant reason for this is that communication from the Off-site Center to the cities, towns and villages took a long time after an evacuation order was issued. Since citizens learned through media such as TV that an evacuation order had been issued and started evacuating on their own, the city, town and village leaders did not dare to communicate the evacuation order directly to citizens. Instead, they simply confirmed how the evacuation had been conducted. That is most

Some learned through the verbal announcements by police vehicles, including police patrol cars.

The cities, towns and villages communicated with citizens in the area by using a municipal disaster management radio communication network, sound trucks, police cars, and by fire fighters making door-to-door visits.

In addition, when an evacuation order went out to residents in the area within a 3km radius of the Fukushima Dai-ichi NPS on March 11, nearly all of the residents had already evacuated outside a 3km radius. At 00:30 the next day, March 12, the Emergency Operators Team confirmed that all the residents within a 3km radius had been evacuated (the team confirmed that again at 01:45).

d. How evacuation buses were arranged

After the declaration of a nuclear emergency state regarding the Fukushima Dai-ichi NPS on March 11, the Crisis Control Center supposed a situation that a mandatory evacuation of residents might be required. The Center needed to arrange buses for evacuation and so at around 21:00 the same day, it requested the Passenger Transport Division of the Automobile Bureau of the Ministry of Land, Infrastructure, Transport and Tourism to charter about 100 buses for evacuation.

Since detailed information on dispatch locations, dispatch times and periods of jobs was required in order to contact bus companies about organizing buses, the Passenger Transport Division coordinated all necessary matters with the Prime Minister's Office and the Crisis Control Center and then asked bus companies in the Tohoku and Kanto areas to organize the buses[26].

The buses that had been organized, which were gathered at the Off-site Center in the town of Okuma, were allotted to the municipalities located in the evacuation zone by Local NERHQ staff. In response to the evacuation order issued at 05:44 on March 12, the

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likely why these cities, towns and villages have no recognition that they received any evacuation order.

[26] A list of relevant ministries that are supposed to gather in the event of a nuclear hazard contained in the NE Response Manual. The Passenger Transport Division, Automobile Bureau of Ministry of Land, Infrastructure, Transport and Tourism, however, is not included in the list. Thus, the Passenger Transport Division has never participated in any nuclear emergency drill or exercise.

buses were used for the evacuation of residents in the area within a 10km radius of the Fukushima Dai-ichi NPS.

However, since there were not enough personnel who had assembled at the Local NERHQ, the buses were not assigned efficiently. In addition, since roads were damaged by the earthquake and streets were congested with evacuation vehicles, the number of buses dispatched to the municipalities was not enough to fulfill their needs. As a result, most of the buses were only used to evacuate some of the municipalities including the town of Okuma.

(2) Decision, instruction, communication and implementation of long-term evacuation programs (refer to Attachment V－1)

a. How high-level radiation points were found outside the evacuation zone and how the Government handled them

From March 16, the NSC evaluated the radiation monitoring data that was collected by MEXT (refer to Section 1(2)a) above. As a result, high radiation doses (values greater than 10mSv of the stay-indoors evacuation criteria prescribed in the Nuclear Emergency Guideline) were located at points outside the 30km radius. On March 18, the NSC asked NISA to investigate the presence of private houses around these points. The NSC then asked MEXT to install fixed cumulative radiation dose meters at these points to conduct environmental monitoring[27].

However, on March 20, the NSC judged that high radiation doses had occurred at this time of year due to the influence of both radioactive clouds (plumes) that passed from midnight to the early morning of March 15 and the rainfall that deposited radioactive materials on the ground surface and that because radiation doses would decrease due to both physical decay of radioactive materials and rainfall, it was not necessary to immediately change the stay-indoors evacuation zone in this situation.

In the meantime, the NSC, as described in Section 2 (3) b above, performed the

[27] On March 18, NISA responded to the request regarding the presence of private houses in the area as shown on house maps. On March 23, MEXT installed cumulative radiation level meters in the area and started taking measurements, (which MEXT released on March 25).

SPEEDI retrospective estimation of the release source information. On March 23, the NSC performed a SPEEDI infant thyroid gland equivalent dose calculation based on a limited number of monitoring results. As a result, the NSC estimated that there were areas with high equivalent doses beyond the designated evacuation zone to the northwest and south of the Fukushima Dai-ichi NPS. The NSC took this fact serious and reported the following to the Prime Minister's Office: (i) the SPEEDI retrospective estimation of release source information, which was conducted for an outdoor stay for 24 hours, should be considered to be overestimation of the radiation dose, (ii) the estimation, which was based only on data obtained from two locations in Fukushima prefecture and one location (Tokai-mura) in Ibaraki prefecture, were lacking in accuracy, and (iii) it might require a great deal of time to make prior arrangements to facilitate the implementation of evacuation programs. Based on this report, it was decided that the evacuation zone should not be expanded immediately and that further discussion should be devoted to this issue by conducting research on the exposure of infant thyroid glands to radiation to confirm the data values based on actual measurement. In addition, the retrospective estimation results were publicized on the same day.

In response to the results of the SPEEDI retrospective estimation, on March 24, Cabinet Secretariat advisor, Mr. Toshiso Kosako (hereinafter referred to as "Advisor Kosako"), provided an advisory report of “Advice for Evacuation Zone and Intake of Iodine Tablets” to the Prime Minister's Office stating that it would not be immediately necessary to implement the intake of iodine tablets and that, as a temporary countermeasure against the current situation, it might be preferable to begin a voluntary evacuation of residents in stay-indoors evacuation zones within a 20 to 30km radius. The NSC received an order from the Prime Minister's Office to summarize what the NSC would suggest doing based on the advice of Advisor Kosako. On March 25, the NSC provided NERHQ with "Advice for emergency monitoring and protective countermeasures," stating that, at this time, it might not be necessary to change the current evacuation and stay-indoors evacuation zones; it might be necessary to strongly advise residents in areas where radiation doses were likely to be relatively high to begin voluntary evacuation, even if they were in a stay-indoors evacuation zone within a 20 to 30km radius; and it might be better, from a

protective point of view, to advise residents in areas where radiation doses were not very high to begin voluntary evacuation.

In addition, on March 29, in response to a request for further consideration from the Prime Minister's Office, the NSC submitted its summary report of recommendations on high radiation dose locations (Namie-town, Iitate-village) beyond a 30km radius of the Fukushima Dai-ichi NPS to the Prime Minister's Office stating that, concerning areas of high radiation doses, cumulative radiation doses might be approximately 28mSv if a person regularly spent time outdoors from March 15 to March 28; cumulative radiation doses might be approximately 21mSv, even taking into consideration the shield effect of wooden houses; and the cumulative radiation doses were already considered to be beyond the 10mSv of the stay-indoors evacuation dose level and that residents in these areas should stay indoors for as long as possible.

Subsequently, in response to instructions from the Prime Minister's Office, NISA instructed officials from Namie-town and Iitate-village to tell residents to stay-indoors for as long as possible in order to avoid radiation exposure, even if they lived outside the 30km radius.

b. Dissemination of IAEA's opinions

In the meantime, on March 30, IAEA announced that the radiation dose level in Iitate-village had exceeded the IAEA criterion for evacuation, which corresponded to 100mSv for 7 days. The IAEA value, which exceeded its criteria was one data from one point of total 9 points, was presented after converting the data measured by Japan to the IAEA's standard.

The inconsistency between Japan and IAEA happened even the same original data was used. It might be caused by different criteria and method of judgment for evacuation. IAEA criteria[28] was based on a value of the ground surface density of radioactivity

[28] The IAEA criteria prescribes that the criterion for radioactive iodine 131 should be 10MBq/㎡. It was discovered that the value that had been measured and converted at one particular point was an average value for the concentration of radioactive iodine (Bq/kg) in the soil that had actually been measured between March 19 and 27, that it was obtained by converting the surface concentration of radioactivity of radioactive iodine (Bq/㎡), and that the value was approximately 20MBq/㎡.

(Bq/m^2) which was derived by converting 100mSv for 7days, while Japanese criteria for evacuation is based on the radiation dose in the air. Moreover IAEA judged the necessity of evacuation based on only one value above while Japan judged taking into account the extended area of the radiation dose because only one particular point data of higher radiation dose in the air does not necessarily indicates a higher air radiation dose in the living space.

In addition, on April 1, the NSC determined that the air radiation dose rate was decreasing day by day and that it might not be necessary to change the protective zone. Subsequently, the NSC made an announcement to that effect.

c. Halt of daily services

From March 15, when the stay-indoors evacuation order was issued, more and more residents began to stay indoors. Supermarkets, banks and other stores, which were necessary for daily life, were rapidly disappearing. Under these conditions, it was hard not only for residents who lived within the stay-indoors evacuation zones, but also for those who lived outside the zones to live their lives.

For example, in Iwaki-city, from March 15, a stay-indoors evacuation order was issued to residents in one area in the north of the city. However, since misinformation had spread that the stay-indoors evacuation order had been issued to the whole city, convenience stores and supermarkets, whose employees had been evacuated, successively closed down. In addition, there were fewer and fewer trucks available in the city. Under these circumstances, for example, a firefighter with a heavy-vehicle license had to go to Koriyama-city to drive a tank truck filled with basic necessities back to Iwaki-city.

In Minami-soma-city, residents who lived within the stay-indoors evacuation zone voluntarily evacuated and stores in the city began to close down. In addition, fewer and fewer trucks were available within a 30km radius of the stay-indoors evacuation zone. Such a situation caused the distribution of essential items to be interrupted making it hard for residents to live their daily lives. Thus, between March 18 and 20, and on March 25, chartered buses were made available to evacuate groups of residents.

In response to this situation, on March 25, Chief Cabinet Secretary Edano held a press

conference stating that the distribution of essential items had been interrupted making it hard for residents to maintain their daily social lives and that, depending on how things developed, there was no denying that the levels of radiation could increase and another evacuation order might be issued. He concluded by instructing residents in the evacuation zone to stay indoors.

In addition, at the Local NERHQ on the same day, Chief Cabinet Secretary Edano instructed Local NERHQ that there be adequate communication with cities, towns and villages located within the stay-indoors evacuation zone and that, depending on their needs, proper countermeasures should be taken either by providing residents with support for their daily lives or by helping them with their evacuation. In response to the instructions, it was decided that the head of the Local Headquarters should visit cities, towns and villages in the stay-indoors evacuation zone. On March 25, he visited the mayors of Minami-soma-city and Namie-town. Subsequently, he visited the heads of the each city, town and village located in the stay-indoors evacuation zone and explained the evacuation plans and exchanged opinions with them.

In addition, between March 26 and 27, NERHQ first-hand observations both in Minami-soma-city and Soma-city allowed the Local NERHQ to conduct a comprehensive study of the halt of daily commodities. On March 26, the Local NERHQ dispatched staff to Minami-soma-city to be stationed as government liaison officers.

d. Establishment of deliberate evacuation zones and emergency evacuation preparation zones

In the NE Guideline, it is not assumed that a stay-indoors evacuation is carried out for a long period of time. As per the description above, the results of radiation monitoring and SPEEDI retrospective estimation showed there were areas with high levels of radiation dose even in areas more than 20km from the Fukushima Dai-ichi NPS. The distribution of essential items was interrupted in stay-indoors evacuation zones and it was hard for residents to conduct their daily lives. In response, from March 31, the NERHQ started further discussions on additional evacuation zones based on estimation results of the annual cumulative dose that had been created by MEXT.

In this discussion, it was decided that actual measurement data should be used for the cumulative dose between the start date and the latest date of measurements, values corrected by SPEEDI simulation results should be used for the cumulative dose before measurement started, the latest actual measured values should be used for the cumulative dose after the latest measurement date for the conservative purpose, and then the cumulative dose over a year from the nuclear accident was decided to be estimated, and all these results were decided to be mapped.

In addition, the guidelines in the NE Guideline stating that "stay-indoors evacuation orders shall be issued if the cumulative dose is 10mSv or more, and evacuation orders if 50mSv or more" might be appropriate for incidents where radioactive material is released for a relatively short period of time. But these indices might not be appropriate for the current nuclear accident where there has been an extended period of exposure to radioactive materials accumulated on the ground. Hence, it was decided to take the lowest limit of 20mSv out of the range from 20mSv to 100mSv[29] which ICRP defined as indices for the evacuation under the nuclear emergency situation. It was decided that residents in an area higher than 20mSv/year should be evacuated according to the evacuation program, and residents in an area lower than 20mSv/year should be prepared to begin evacuating or follow a stay-indoors evacuation order at a nuclear emergency, assuming a worst case scenario for the conservative purpose, even if a hydrogen explosion is less likely due to the filling of nitrogen.

On April 10, the NERHQ officially asked the NSC for their advice on the evacuation strategy for residents living in (i) areas beyond a 20km radius of the Fukushima Dai-ichi NPS that had high levels of radiation dose, and (ii) areas beyond a 20km radius of the Fukushima Dai-ichi NPS with a probability of high levels of radiation dose at the emergency,.

On the same day, in response to the request of NERHQ, the NSC proposed the following advice: with regards to (i), areas beyond a 20km radius of the Fukushima Dai-ichi NPS (including areas beyond a 30km radius) where cumulative dose may reach 20mSv within the period of one year from the date of the nuclear accident shall be

[29] Refer to Section 4(1) b below.

designated "deliberate evacuation zones"; areas that are in stay-indoors evacuation zones within a 20 to 30km radius but outside deliberate evacuation zones shall be designated "emergency evacuation preparation zones"; and residents should always be ready and able to follow a stay-indoors evacuation order or evacuation order at the emergency[30]. In addition, even residents in emergency evacuation preparation zones are advised to begin voluntary evacuation. Because it is anticipated that it may be difficult to complete evacuations swiftly in an emergency situation, it is strongly recommended that children, pregnant women, those who require nursing care and hospitalized patients should not enter these areas.

On April 11, based on the advice of the NSC, Chief Cabinet Secretary Edano announced a fundamental concept of how deliberate evacuation zones and emergency evacuation preparation zones should be established.

Subsequently, the government issued early advice to the affected municipalities and then, on April 22, based on "Estimated Values of Cumulative Dose Based on Actual Measurements" concerning zones beyond a 20km radius of the Fukushima Dai-ichi NPS, which was prepared by MEXT on April 10, the NERHQ established deliberate evacuation zones[31] and emergency evacuation preparation zones[32] pursuant to the provisions of Article 20, Paragraph 3 of the Act on Special Measures Concerning Nuclear Emergency Preparedness. In addition, the NERHQ provided those municipalities with a directive to tell residents in the former zones to be prepared to leave their homes in an evacuation after a period of approximately one month, and those in the latter zones to always be prepared to either evacuate from their homes at the emergency or to be prepared to begin a stay-indoors evacuation. Further, the stay-indoors evacuation order to residents in areas within a 20 to 30km radius of the Fukushima Dai-ichi NPS was lifted.

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[30] This idea that an emergency evacuation preparation zone should be established based on a 20mSv criterion in order to take countermeasures against a deliberate evacuation zone and the current nuclear power plant conditions was created by Cabinet Office advisor, Mr. Kenkichi Hirose, after careful consultation with all relevant ministers.

[31] Katsurao-village, Namie-town, Iitate-village, Kawamata-town and part of Minami-soma-city, (excluding those areas within a 20km radius of the Fukushima Dai-ichi NPS that had already been issued with evacuation orders).

[32] Hirono-town, Naraha-town, Kawauchi-village, Tamura-city and part of Minami-soma-city, (excluding those areas within a 20km radius of the Fukushima Dai-ichi NPS that had already been issued with evacuation orders).

e. Radiation monitoring activities in evacuation zones

The NERHQ developed an environmental radiation monitoring enhancement program to grasp the entire picture of the nuclear accident and establish deliberate evacuation zones and other zones, and then released a statement to that effect on April 22.

Based on this program, two maps were decided to create: one was "a radiation dose measurement map" to grasp the current status of radiation dose distribution, and another was a cumulative radiation dose estimation map to grasp the cumulative dose distribution for one year after the accident. MEXT should be in charge of creating and publishing these maps. Following this program, it was decided that additional radiation monitoring points should be installed in areas within a 20km radius of the Fukushima Dai-ichi NPS and that MEXT should conduct radiation monitoring activities via monitoring cars at fifty designated points. Subsequently, the radiation dose measurement maps and cumulative radiation dose estimation map, which have been published regularly, are now used for establishing specific evacuation recommendation points (refer to f below).

In addition, on June 13, the Team in Charge of Assisting the Lives of Disaster Victims from the Cabinet Office (refer to Section III 2 (6)) and MEXT developed a "Plan to Conduct Detailed Monitoring in Restricted Areas and Planned Evacuation Zones" and decided to conduct detailed research on air radiation dose rates in the restricted zones and deliberate evacuation zones. By late August, they had divided the restricted zones and deliberate evacuation zones into a 2kmx2km mesh, selected 20 monitoring points per mesh and conducted extensive monitoring to subsequently measure the selected points. In addition, it was decided that detailed research on houses, roads and streets, as well as school yards was to be conducted based on this extensive monitoring to obtain basic data to be used to improve the environment in these zones.

f. Establishment of specific spots recommended for evacuation

By April 22 when deliberate evacuation areas and emergency evacuation preparation zones had been established, spots where annual cumulative radiation dose might exceed 20mSv assuming that the radiation dose levels continued afterwards had been found in parts of Date-city and Minami-soma-city. However, the distribution of these spots was not

understood for an extended area, but for a limited area. Hence, the Government Emergency Response Center did not designate those entire areas including these points as deliberate evacuation zones. Instead, they decided to take a wait-and-see approach to observe how radiation dose might decrease with time by monitoring them over time.

Subsequently, however, on June 3, MEXT estimated cumulative radiation dose and found that there were spots where the estimated annual cumulative radiation dose for one year after the nuclear accident might exceed 20mSv of a criteria for deliberate evacuation zones, in parts of Date-city and Minami-soma-city, which are located outside the deliberate evacuation zone.

In response to this fact, the NERHQ discussed the adoption of concrete measures for locations where spots with high radiation dose were found in some areas and created a guideline referred to as "Response to specific spots estimated to exceed an integral level of exposure of 20mSv over a one-year period after the accident." The guideline stated that spots where the estimated annual cumulative radiation dose over a one-year period after the nuclear accident might exceed 20mSv should be designated as "specific spots recommended for evacuation," and that the NERHQ should notify all residents living in these spots and assist and support their evacuation. On June 16, the NERHQ asked the NSC for its advice on this guideline. That same day, the NSC responded to this request replying to the effect that it had no objection to the NERHQ's ideas, although it might be necessary to consider possible ways to solve this problem without conducting an evacuation, including finding ways to decontaminate the areas that were only partially contaminated with high concentration of radioactive materials.

Based on this advice, the NERHQ decided that the spots where the estimated annual cumulative radiation dose over a one-year period might exceed 20mSv should be designated as specific spots recommended for evacuation. That same day, Chief Cabinet Secretary Edano released a statement to that effect.

It was decided that the Local NERHQ should specify spots, per house, where decontamination is not easy and are estimated to exceed 20mSv/year, through mutual consultation between the Fukushima prefectural government and the cities, towns or villages where those spots are located. Through mutual consultation with the respective

municipal governments, the Local NERHQ designated parts of Date-city on June 30 and November 25, parts of Minami-soma-city on July 21 and August 3, and parts of Kawauchi-village as specific spots recommended for evacuation.

Additionally, specific spots recommended for evacuation have not been issued with evacuation orders pursuant to the provisions of Article 20, Paragraph 3 of the Act on Special Measures Concerning Nuclear Emergency Preparedness. This policy is based on the idea that specific spots recommended for evacuation are not dangerous enough to instruct all residents to begin evacuation since radiation levels will be minimal if residents leave the area, and that the government will provide information to alert them to the possibility of radiation exposure and support residents if they need to be evacuated.

g. Establishment of restricted areas and temporary access to the restricted areas

Following an evacuation order issued at 18:25 on March 12, residents in regions within a 20km radius were evacuated to areas outside the designated regions. During their ongoing and prolonged life as evacuees, some of the residents started to return home to the evacuation zones to collect their belongings. The Nuclear Emergency Response Local Headquarters (Local NERHQ) submitted a report on this situation the Government Emergency Response Headquarters (NERHQ). Around and after March 24, the NERHQ started discussions on how to deal with this situation and enthusiastically work on this matter corresponding to, Chief Cabinet Secretary Edano's directive issued on March 28.

On March 28, as a measure to prohibit residents from entering the evacuation zones, the Local NERHQ provided all the cities, towns and villages concerned with a notification of "Prohibition of access to evacuation zones within a 20km radius". On March 30, the Prefectural Headquarters also notified all evacuation centers and other facilities of this measure.

Based on discussions about temporary access to the restricted areas and mutual consultation with the relevant heads of cities, towns and villages, the NERHQ had already asked the NSC for its advice on the implementation of restricted areas[33] within a 20km

[33] Restricted areas, established pursuant to the provisions of Article 63, Paragraph (1) of the Basic Act on Disaster Control Measures, applied by replacing the terms and phrases pursuant to Article 28, Paragraph (2) of the Act on

radius of the Fukushima Dai-ichi NPS, and the NSC replied that it had no objection to the NERHQ' ideas. At 11:00 on April 21, the NERHQ issued a directive to the heads of all the cities, towns and villages concerned that restricted areas should be established within the specified radius[34].

Additionally, temporary access to an established restricted area within a 20km radius of the Fukushima Dai-ichi NPS was permitted only to those individuals who were exposed to air radiation dose rate lower than 200μSv/h and were planning to stay in the area for five hours. This value of 200μSv/h was obtained by assuming five hours consisting of a three-hour round trip from the boundary of the 20km radius to the furthest access area and two hours spent at home or other access points, and by dividing 1mSv of annual permissible radiation dose, advised by the NSC, by 5.

The steps for applying for temporary access to an established restricted area were as follows: first, all applications for temporary access to an established restricted area were accepted at an information booth established by the Fukushima prefectural government[35]; lists of names were sorted by cities, towns or villages and sent to the respective municipalities; those lists of names were further sorted by regions and grouped into smaller districts; and then preferred dates were arranged. Additionally, it was decided that the staff of cities, towns or villages should attend to those temporarily accessing the established restricted areas.

However, this work created a great burden for cities, towns and villages suffering from the nuclear accident and the tsunami. Thus a total of approximately 5,560 staff was dispatched from METI and other government offices to support the related work[36].

Initially, areas within a 3km radius of the Fukushima Dai-ichi NPS were excluded from this initiative to temporarily access restricted areas. The zones within a 3km radius of the Fukushima Dai-ichi NPS were those to which were initially issued with evacuation orders.

Special Measures Concerning Nuclear Emergency Preparedness.

34 The official establishment date is 00:00 on April 22.

35 These applications were accepted between May 13 and June 30 and in 11,609 households (19,717 residents) in total were accepted.

36 As of October 28, a total of an additional 390 staff were subsequently dispatched from METI to create nuclear evacuation programs and disaster recovery programs, and support decontamination-related work to reconstruct the disaster areas.

In a situation where the impact of the nuclear accident had not been settled, it was necessary to take successive measures against an unforeseen emergency.

Subsequently, the conditions of the nuclear reactors at the Fukushima Dai-ichi NPS stabilized. In response to this, on August 9, NERHQ confirmed that it was safe to enter the areas within a 3km radius of the Fukushima Dai-ichi NPS and issued an announcement to that effect. Thus, temporary access to those established restricted areas in Okuma-town and Futaba-town was officially granted.

(3) Implementation of evacuation programs in various municipalities[37]

a. Implementation of evacuation programs in Okuma-town

Okuma-town received an evacuation order for residents within a 3km radius of the Fukushima Dai-ichi NPS at 21:23 on March 11. Okuma-town officials took all possible measures by alerting citizens in the area, using a municipal disaster management radio communication network and making door-to-door visits to take residents to safer places. The evacuation was completed around midnight on May 12. Okuma-town received a second evacuation order for residents within a 10km radius of the Fukushima Dai-ichi NPS at 05:44 on March 12. These residents evacuated traveling in buses that had been arranged by the Ministry of Land, Infrastructure, Transport and Tourism. At 18:25 the same day, Okuma-town received a third evacuation order this time for residents within a 20km radius of the Fukushima Dai-ichi NPS. At that point, an evacuation directive was issued to residents throughout the entire town. Residents evacuated to Tamura-city, Koriyama-city, Miharu-town and Ono-town.

Subsequently, from April 3, transition of the town hall began as office functions were shifted to Aizu-wakamatsu-city. Currently, all of Okuma-town is designated as a restricted area. As of September 30, 7,734 displaced residents remain in various parts of Fukushima Prefecture and 3,757 displaced residents remain in other prefectures.

[37] Numbers of evacuees in this section were obtained from research conducted by each of the municipalities concerned.

b. Implementation of evacuation programs in Futaba-town

Futaba-town received an evacuation order for residents within a 3km radius of the Fukushima Dai-ichi NPS at 21:23 on March 11. Futaba-town officials took all possible measures by alerting citizens in the area, using a municipal disaster management radio communication network and making door-to-door visits in order to take residents to safer places. Futaba-town received a second evacuation order for residents within a 10km radius of the Fukushima Dai-ichi NPS at 05:44 the next day on March 12. Finally, Futaba-town officials order residents throughout the entire town, including the area beyond a 10km radius, to evacuate to Kawamata-town. The Futaba-town town office is located about 3km from the Fukushima Dai-ichi NPS. Although the town office was situated within the evacuation zone, some Futaba-town officials chose to remain to help residents move to safer places. At approximately 15:30 the same day, a big boom was heard and white smoke was seen rising[38] from the site of the Fukushima Dai-ichi NPS. The town office was thrown into chaos and all remaining officials were evacuated to Kawamata-town. Looking back, the mayor of Futaba-town, Mr. Katsutaka Idokawa, said that heat insulating materials and other matters were falling from the sky like snow.

While Futaba-town residents had already been evacuated to Kawamata-town, on March 19, the mayor of Futaba-town, at his own discretion, decided to transfer all official functions from the town office to Saitama Super Arena and proceeded with the move. Subsequently, over a period of two days, on March 30 and 31, all official functions were moved from Saitama Super Arena to Kazo-city in Saitama Prefecture (formerly the Kisai Senior High School building). Currently, the entire area of Futaba-town is designated as a restricted area. As of November 22, 3,319 displaced residents remain in various parts of Fukushima Prefecture, and 3,694 displaced residents remain in other prefectures.

c. Implementation of evacuation programs in Namie-town

Namie-town received an evacuation order for residents within a 10km radius of the Fukushima Dai-ichi NPS at 05:44 on March 12. It was decided to transfer all official functions from the town office to Tsushima branch in Tsushima district (in the northwest

[38] At 15:36 the same day, a hydrogen explosion occurred at Unit 1 of the Fukushima Dai-ichi NPS.

of the town), which is located beyond a 20km radius of the Fukushima Dai-ichi NPS. Using the private bus companies buses and town's minibuses, Namie-town officials helped residents evacuate to Tatsuno, Murohara and Suenomori districts within a 10 to 20km radius of the Fukushima Dai-ichi NPS, and the Tsushima district.

Namie-town received a second evacuation order for residents within a 20km radius of the Fukushima Dai-ichi NPS at 18:25 the same day. Namie-town officials helped residents who lived within a 20km radius and those who had previously been evacuated to Tatsuno, Murohara and Suenomori and were also within a 20km radius, evacuate to a new location.

Subsequently, based on the situation concerning the Fukushima Dai-ichi NPS, the mayor of Namie-town, at his own discretion, decided to evacuate residents to Nihonmatsu-city (Towa district) and gave residents instructions to begin evacuating. Their evacuation route eventually overlapped with that of the spread of radioactive materials. Many residents took this evacuation route not knowing this because SPEEDI calculation results had not been publicized[39]. Additionally, Namie-town, which was designated as a deliberate evacuation area, transferred all official functions to the Men-Women Coexistence Center in Nihonmatsu-city on May 23.

Namie-town was designated as a restricted area within a 20km radius of the Fukushima Dai-ichi NPS. All areas in the town beyond a 20km radius were designated as deliberate evacuation zones. As of September 17, its 21,541 residents have been evacuated from the town.

d. Implementation of evacuation programs in Tomioka-town

Tomioka-town received an evacuation order for residents within a 10km radius of the Fukushima Dai-ichi NPS at 05:44 on March 12 and then received a second evacuation order for residents within a 3km radius of the Fukushima Dai-ni NPS at 07:45 the same day. Most of the town was designated as an evacuation area. The head of the town gave residents instructions to evacuate to Kawauchi-village and transferred all official functions

[39] As described in Section 2 (1) (2), predictive data on the dispersion of radioactive materials based on release source information from ERSS was not obtained, but results of the calculation assuming radioactive release at a unit release rate had been obtained

to Kawauchi-village.

From March 13, news of the nuclear power stations made residents depressed and anxious. While the town office was flooded with inquiries about the nuclear power station accidents, town office staff had no idea what was going on there except for information from the media. Some time on the night of March 14, the head of Tomioka-town used a satellite-based mobile phone to call a NISA executive official to ask if any further evacuation should be carried out. The NISA executive official replied that the current 20km evacuation had been determined from a safer viewpoint and that no further evacuation was necessary[40]. The head of the town gave an explanation to that effect to both Kawauchi-village residents and Tomioka-town residents who had been evacuated to Kawauchi-village.

However, Tomioka-town received another evacuation order for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 11:00 the following day, March 15. To make matters worse, nearly the entire area of Kawauchi-village, where Tomioka-town residents had been evacuated, was designated as a stay-indoors evacuation zone. It was decided through mutual discussion with Kawauchi-village to transfer all official functions to Koriyama-city and, on March 16, all official functions were transferred to Koriyama Big Palette. Currently, the entire area of Tomioka-town is designated as a restricted area. As of November 4, 10,169 displaced residents remain in other parts of Fukushima Prefecture and 5,563 displaced residents remain outside the prefecture.

e. Implementation of evacuation programs in Kawauchi-village

Kawauchi-village received a request from Tomioka-town, which had been designated as a restricted area within a 10km radius of the Fukushima Dai-ichi NPS at 05:44 on March 12, to accept its residents. The head of Kawauchi-village agreed to accept them and established evacuation facilities mainly in buildings at elementary and junior high schools in the village, where evacuees from Tomioka-town were to be evacuated. Kawauchi-village received a second evacuation order for residents within a 20km radius of

[40] A NISA executive official did not attend a meeting at Prime Minister's Office to discuss a stay-indoors evacuation order that was issued on March 15.

the Fukushima Dai-ichi NPS at 18:25 the same day. The eastern part of the village was designated as an evacuation zone and residents in that zone started evacuating to areas beyond a 20km radius.

From March 13, the town office was flooded with inquiries about the accident at the nuclear power stations, but the town office staff had little information to offer except what they had got from the media. In the meantime, as per the description above (refer to d), the head of Tomioka-town explained to residents what he had heard from a NISA officer.

Kawauchi-village received a stay-indoors evacuation order for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 11:00 on March 15. Nearly the entire area of Kawauchi-village was within an evacuation zone or a stay-indoors evacuation zone. It was decided through mutual discussions with leaders from Tomioka-town, whose residents had been evacuated to this village, to transfer all official functions from the village office to Koriyama-city and, on March 16, all official functions were transferred to Koriyama Big Palette.

Kawauchi-village was designated as a restricted area within a 20km radius of the Fukushima Dai-ichi NPS. Shimo-kawauchi district, which is beyond a 20km radius, was designated as a specific spot recommended for evacuation and, as of November 17, 2,679 residents were evacuated from the village.

f. Implementation of evacuation programs in Minami-soma-city

Minami-soma-city received an evacuation order for residents within a 20km radius of the Fukushima Dai-ichi NPS at 18:25 on March 12. In response to this evacuation order, residents in the southern part of the city, within the evacuation zone, began evacuating to Haramachi district located in the central part of the city. Subsequently, Minami-soma-city received a stay-indoors evacuation order for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 11:00 on March 15. To make matters worse, Haramachi district was within a stay-indoors evacuation zone. Following a discussion about this evacuation plan Minami-soma-city officials helped residents willing to be evacuated from the city from March 15.

There were three main evacuation routes: the first was the Iwaki trail, the second the

Sendai trail and the third the Iitate/Kawamata trail. The Iwaki trail passed very close to the Fukushima Dai-ichi NPS. The Sendai trail was, they imagined, severely damaged by the earthquake and the tsunami. Thus many residents opted to evacuate via the Iitate/Kawamata trail after arrangements were made by the city staff.

The path of the Iitate/Kawamata trail eventually overlapped with the spread of radioactive material. Many residents took that evacuation trail unwittingly because SPEEDI calculation results had not been released[41].

On April 22, the stay-indoors evacuation order was lifted and Minami-soma-city was designated as a deliberate evacuation zone or an emergency evacuation preparation zone. Its residents gradually returned home to the emergency evacuation preparation zone.

Part of Minami-soma-city, situated within a 20km radius of the Fukushima Dai-ichi NPS, was designated as a restricted area and an area beyond a 20km radius, the western part of the city, was designated as a deliberate evacuation zone. Some houses near the deliberate evacuation zone were designated as a specific spot recommended for evacuation. As of November 2, 8,728 residents have been evacuated to other parts of Fukushima Prefecture and 14,401 residents have been evacuated to locations outside the Prefecture.

g. Implementation of evacuation programs in Naraha-town

Naraha-town received an evacuation order for residents within a 3km radius of the Fukushima Dai-ichi NPS at 07:45 on March 12. The town office took a conservative approach deciding to evacuate all of its residents to Iwaki-city more than 30km away from the town and began the evacuation immediately. Subsequently, Naraha-town received a stay-indoors evacuation order for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 11:00 on March 15. To make matters worse, part of Iwaki-city was within a stay-indoors evacuation zone and the distribution of essential items had been interrupted (refer to Section (2) c). Given that Iwaki-city was also badly damaged by the tsunami, the town office discussed transferring its office functions to Aizu-misato-town, which has an agreement with Naraha-town to work together to help each other through disasters. From

[41] See footnote 39.

March 25, the town office helped its residents evacuate to Aizu-misato-town.

Most of Naraha-town is now designated as a restricted area within a 20km radius of the Fukushima Dai-ichi NPS. As of November 1, its 7,714 residents remain evacuated outside the city.

h. Implementation of evacuation programs in Iwaki-city

In response to requests from Naraha-town and Hirono-town, Iwaki-city allowed residents to be evacuated to the city. Subsequently, the city received an evacuation order for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 18:25 on March 12. Although part of the city was beyond the 30 km radius and thus outside the evacuation zone, city officials discussed whether, in terms of safety, a total evacuation was necessary and ultimately advised all residents within 30 km of the Fukushima Dai-ichi NPS to leave.

Iwaki-city received a stay-indoors evacuation order[42] for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 11:00 on March 15. Subsequently, the distribution of essential items was interrupted even though most of the city was outside of the stay-indoors evacuation zone and more and more residents started evacuating voluntarily (refer to Section (2) c above). At present, due to various efforts including "All Iwaki Caravan Sales - Buy Iwaki's safe farm products" held in the city and Tokyo and the fact that the stay-indoors evacuation order was lifted, many of the evacuees have now returned to their homes. As of September 30, 7,709 residents (3,716 households) were evacuated from the city.

i. Implementation of evacuation programs in Tamura-city

Tamura-city received a request from Okuma-town, which had been designated as a restricted area within a 10km radius of the Fukushima Dai-ichi NPS at 05:44 on March 12, to accept its evacuated residents. The two offices agreed and established evacuation facilities where evacuees from Okuma-town could be relocated. At approximately 20:10 the same day, Tamura-city received an evacuation order from the Fukushima Prefectural Government for residents within a 20km radius of the Fukushima Dai-ichi NPS. The town

[42] The northern part of Iwaki-city is partly within the zone.

office gave instructions to that effect to both residents in the greater area of the former Toro-village, situated within the designated evacuation zone, and to the evacuees from Okuma-town. The town staff assisted in the evacuation of everyone using town office-owned school buses until sometime in the morning of March 13.

Subsequently, the town office received a stay-indoors evacuation order for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 11:00 on March 15. Residents in Toro district, which was the most densely populated area within a 30km radius, had already been evacuated. The town office alerted its residents to stay indoors unless specifically asked to evacuate.

At present, only a part of Tamura-city has been designated as a restricted area. As of October 31, 379 residents (120 households) in the restricted area have been evacuated to and 2,168 residents (658 households) in formerly an emergency evacuation preparation zone have been evacuated.

j. Implementation of evacuation programs in Katsurao-village

Katsurao-village received requests from Namie-town, Futaba-town and Okuma-town, which had been designated as restricted areas within a 10km radius of the Fukushima Dai-ichi NPS at 05:44 on March 12, to accept their evacuees and Katsurao-village leaders agreed to do so. Katsurao-village received an evacuation order for residents within a 20km radius of the Fukushima Dai-ichi NPS at 18:25 the same day. Part of the village was within the specified radius. The village office gave notice to that effect to concerned residents using an IP telephone system, which had been installed throughout the entire village.

From March 13, while waiting to see what would transpire at Unit 3 of the Fukushima Dai-ichi NPS, the village office had several discussions on the necessity of an evacuation. However, there was very little information about what to do next and the village office was not able to decide whether to evacuate its residents at its own discretion.

In the meantime, at approximately 21:00 on March 14, the village office received

information[43] from the regional fire department that the Off-site Center was to be evacuated. The village office decided, at its own discretion, to evacuate everyone from the village and gave notified its residents. The village office began the evacuation at 22:00 using village-owned buses and office cars to transport its residents to Fukushima-city (Azuma Sports Park) and finished around 23:50.

The village office was informed that there had been an explosion near Unit 2 the following morning on March 15. While continuing discussions of its evacuation program, the village office heard that Aizu-bange-town town officials were willing to accept their evacuees. The village office decided, at its own discretion, to evacuate its residents to Aizu-bange-town and, after explaining this decision, began moving everyone the same day. By 17:00 all residents had arrived at Aizu-bange-town and the evacuation was complete.

Additionally, Miharu-town decided to accept temporary housing to accommodate the influx of people. In response to this situation, the Katsurao-village village office completed transferring its office functions to Miharu-town by August 11.

Currently, part of Katsurao-village is designated as a restricted area and the rest of it is designated as a deliberate evacuation zone. As of October 1, 120 residents have been evacuated out of the prefecture and 1,404 residents have been evacuated to other locations within Fukushima Prefecture.

k. Implementation of evacuation programs in Hirono-town

Hirono-town received an evacuation order for residents within a 10km radius of the Fukushima Dai-ni NPS at 17:39 on March 12. On behalf of the mayor, the town office, alerted all its residents within the entire town, including the area beyond a 10km radius, to prepare for voluntary evacuation and began helping its residents if they chose to relocate. By March 13, the town office finished organizing its plan to evacuate all of its residents to the following six municipalities: Ono-town, Hirata-village, Ishikawa-town, Asakawa-town, Iwaki-city and Misato-city in Saitama Prefecture. They implemented their

[43] For detailed information on the transfer of the Off-site Center, refer to Section III5 (3).

evacuation program by using town-owned buses as well as additional buses, which had been arranged for this purpose.

The town office staff, at its own discretion, organized where its residents were to be evacuated to and completed these arrangements by March 13[44]. On March 12, when the town office staff had not yet completed these arrangements, many residents had already reached their own evacuation sites with the help of relatives and friends. The town office staff received a great deal of criticism and many complaints because of this uncoordinated arrangement, which held that the town office staff should not have given evacuation instructions when relocation sites had not yet been determined.

Hirono-town town office staff transferred its office functions to the town gymnasium of Ono-town on March 15 by which time the Hirono-town town office staff had nearly completed the evacuation of its residents. Subsequently, more and more evacuees from Hirono-town gathered in Iwaki-city. In response to this situation, the Hirono-town office transferred its office functions to Iwaki-city.

The emergency evacuation preparation zone designation was lifted on September 30. At present, Hirono-town has not yet received an official evacuation order, but its approximately 5,200 residents have been evacuated.

l. Implementation of evacuation programs in Iitate-village

Iitate-village received a stay-indoors evacuation order for residents within a 20 to 30km radius of the Fukushima Dai-ichi NPS at 11:00 on March 15. The eastern part of the village was partially within the stay-indoors evacuation zone. The village office gave a stay-indoors evacuation order to that effect. Subsequently, on March 21, restrictions on tap water intake were announced (refer to Section 5 (1) f below). In response to this announcement, more and more residents, mainly families with infants, started evacuating voluntarily. The voluntary evacuees slowly started returning home to the village after the restrictions on tap water intake had been lifted. The Japanese Government informed the Iitate-village village office that the village would be designated as a deliberate evacuation zone. The village office held a meeting with its residents to explain this. In the meeting,

[44] It was difficult for town office staff to complete the arrangements of evacuation destination at night.

some residents did not accept the explanation provided by village officers as to why they had to be evacuated. On April 22, the entire village was designated as a deliberate evacuation zone. As of October 1, its 6,164 residents have been evacuated.

m. Implementation of evacuation programs in Kawamata-town

Kawamata-town, which is located beyond a 30km radius of the Fukushima Dai-ichi NPS, was not initially designated as an evacuation zone. Kawamata-town town office accepted evacuees from Futaba-town, Namie-town, Minami-soma-city and Okuma-town. However, the southeastern part of the town (Yamakiya district) was partially designated as a deliberate evacuation zone on April 22 when Futaba-town town office had its office functions transferred to Saitama Prefecture. Subsequently, nearly all 1,250 residents in that area have been evacuated. Additionally, as of November 7, 140 residents from Kawamata-town (excluding those in the deliberate evacuation zone) have voluntarily evacuated mainly concerning about the effect of radiation on their infants.

n. Implementation of evacuation programs in Date-city

Date-city town office had accepted about 1,800 evacuees mainly from Soso district (Soma district and Futaba district) since the earthquake disaster on March 11. MEXT monitoring data that was published on April 11 ("Estimated Values of Cumulative Dose Based on Actual Measurement" (refer to Section (2) d above) showed that some spots in the city exceeded the estimated annual cumulative dose of 20mSv. In response to this, the city office conducted its own monitoring. On June 30, spots where some (113) of the city's households were located were designated as specific spots recommended for evacuation. Eighty households (272 residents) were evacuated. Moreover, on November 25, additional spots where 15 households were located were designated as specific spots recommended for evacuation. Additionally, as of November 4, 180 households (516 residents) had been evacuated from Date-city.

(4) Cancellation of areas prepared for emergency evacuation (refer to Attachment V-2)

On August 4, the NERHQ asked the NSC for advice on how to deal with zones where

emergency measures should be taken, including a review of emergency evacuation preparation zones. In response to this request, the NSC provided "Initiatives to Lift the Evacuation-Prepared Area in Case of Emergency Designation for the TEPCO Fukushima Dai-ichi NPS Accident" the same day. On August 9, based on this reply, the NERHQ decided to prepare a "Review of evacuation areas," which addressed the following three points to be confirmed: (i) the safety of nuclear power reactor facilities, (ii) a decrease of the air radiation dose rate, and (iii) restoring of the public service functions and infrastructure.

On the same day, NISA referenced the report "Regarding the confirmation of safety of nuclear power reactor facilities of the TEPCO Fukushima Dai-ichi NPS" stating that it was unlikely that a hydrogen explosion would occur and unlikely that the nuclear reactor cooling system might fail due to following countermeasures taken such as the filling nitrogen into the primary containment vessel and the establishment of a system of circulation cooling including the treatment of accumulated drainage water in reactor buildings, a multiplexing of electric power supply, the relocation of an emergency power source to higher ground, and the establishment of temporary sea wall; and that even if the nuclear reactor cooling system did fail, the effect of radiation on the emergency evacuation preparation zones might be sufficiently lower than the index provided in the NE Guideline.

Based on "the Radiation Monitoring Action Plan for Homecoming regarding Evacuation Prepared Areas in Case of an Emergency" which was established on July 25, MEXT conducted various monitoring activities in Minami-soma-city, Tamura-city, Kawauchi-village, Hirono-town and Naraha-town. As a result, it was discovered that measurement points, including main spots near schools, in all of the municipalities did not exceed 1.9μSv/h[45]. MEXT made an announced this on August 9[46].

Additionally, on September 19, all cities, towns and villages in the emergency evacuation preparation zones created disaster recovery programs and submitted them to the NERHQ.

Based on these disaster recovery programs, the NERHQ decided that conditions (i) to (iii) for lifting the emergency evacuation preparation zones were met.

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[45] Areas in some parts of Minami-soma-city, Tamura-city and Kawauchi-village showed measured values of air radiation dose rates exceeding 3.0μSv/h. However, it was established that the measured values were only found in limited areas and that lifting the emergency evacuation preparation zones should not be dependent on them.

[46] A brief announcement was promptly made on August 9. A more detailed version was published on August 16.

The NERHQ exchanged opinions on the lifting of emergency evacuation preparation zones and disaster recovery with the leaders of the cities, towns and villages concerned and then, on September 30, asked the NSC its advice on the lifting of emergency evacuation preparation zones. On the same day, the NSC replied that it had no objection to the NERHQ' ideas with conditions that appropriate measures should be taken on radiation monitoring as well as decontamination activities. On the same day, the NERHQ issued a directive and statement that the emergency evacuation preparation zones of the cities, towns and villages should be lifted.

4. Measures taken to address the risk of radiation exposure

(1) Radiation control standards

a. International Commission on Radiological Protection (ICRP)

ICRP is an international nonprofit organization made up of a committee of experts that was founded by the International Society of Radiology and provides radiological practitioners with recommendations and guidance on radiation protection. It was restructured to be responsible for a wider range of radiation protection outside the medical science and given its present name in 1950.

ICRP has established a framework for radiological protection based on data derived from actual facts and the impact of radiation exposure collected and scrutinized by the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and provides advice on radiation exposure limits for radiation control. ICRP has established a concept of radiation exposure dose to correlate with risks of human health and also provides recommendations on how to estimate the radiation exposure dose for various situations. ICRP works together with UNSCEAR, the World Health Organization (WHO) and the IAEA. For example, the IAEA respects ICRP recommendations and assists member countries to participate in consensus-building efforts and establishes the international basic safety standards for radiation protection to be implemented in member countries.

The first IAEA publication (Pub. 1) containing its recommendations, which were approved in the previous year of 1958, was issued in 1959. The IAEA's general basic recommendations that succeeded the first one were Pub. 6 (1964), Pub. 9 (1966), Pub. 29

(1977), Pub. 60 (1990) and Pub. 103 (2007).

b. ICRP standards

ICRP recommendations classify the harmful effects of radiation exposure on human health into two categories: "deterministic effects" and "stochastic effects." A "deterministic effect" is an effect or serious impact such as death or cell malfunction that deterministically occurs with high radiation dose. A "stochastic effect" is an occurrence of cancer or hereditary effects (hereinafter referred to as "cancer, etc.") that is induced by the gene (DNA) mutation and stochastically caused by relatively low radiation dose (refer to Pub. 103, (55)). No cases of the occurrence of a deterministic effect were confirmed by the nuclear accident at the Fukushima Dai-ichi NPS. The ICRP concept is briefly described only in terms of "stochastic effects" as follows:

Epidemiological data, on which ICRP recommendations are based, have mainly been collected and analyzed from a life span study (hereinafter referred to as "Life Span Study") of atomic bomb survivors in Hiroshima and Nagasaki conducted by the Japan-US joint Radiation Effects Research Foundation (RERF, the Atomic Bomb Casualty Commission, or ABCC until 1975) since 1950 (refer to Pub. 103, A.4.4). The results of this research study based on that data show that, with regards to nuclear atomic bomb survivors who were exposed to more than 100mSv of radiation dose from an atomic bomb, there is a statistically significant relationship between radiation dose and cancer rates (the higher the radiation dose, the higher the cancer rate). On the other hand, with regards to atomic bomb survivors who were exposed to less than 100mSv of radiation dose from an atomic bomb, it has not yet been concluded due to insufficient data as to whether there is a clear relationship between the radiation dose and cancer rate. The ICRP recommendation, however, is based on a model (hypothetical theory) that, from a conservative standpoint, there is a proportional relationship between the radiation doses and cancer rates (a recommendation in 2007, Pub. 103, 3.2.1). Additionally, a recommendation in 1990 (Pub. 60, 3.4.2) was also based on the premise of a proportional relationships both for low radiation doses and low radiation dose rates. This model, which is not based on the so-called threshold theory that low radiation dose has no radiation effect, is called a

linear-non-threshold dose-response (LNT) model, or linear model (hereinafter referred to as "LNT model"[47]). Additionally, according to the LNT model, in high radiation dose radiation dose as well as well as in low radiation dose, cancer rates increase or decrease depending on radiation dose. Hence, if radiation exposure does not have any other merits (for example, economic or medical), then radiation exposure is not justified. And, even if the radiation exposure is justified, such radiation doses should be controlled to be as low as reasonably achievable ("Principle of Justification," "Principle of Optimization of Protection", Pub. 103, 5.6).

Based on this concept, the ICRP classifies situations where people might be exposed to radiation from a nuclear reactor accident into two types: "radiation emergency situations"[48] and "existing exposure situations,"[49] and provides the recommendation for the "radiation emergency situation" that: (i) for occupational exposure, the reference level of life-saving operations (informed volunteers only) should be "no restrictions on exposure", the reference level[50] for other urgent rescue operations should be 1,000mSv or below 500mSv[51], and the reference level of other rescue operations should be "below 100mSv"; and (ii) for public exposure, the reference level should be 20mSv to 100mSv per year[52].

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47 The "LNT" in "LNT model" stands for "Linear-Nonthreshold Dose-Response."

48 A "radiation emergency situation" is described as one that arises as the result of an unexpected event and requires prompt action in order to avoid or reduce any adverse consequences to public health (refer to ICRP Pub. 103, 5.2).

49 An "existing exposure situation" is described as a situation where exposure already exists at a higher level than usual and a decision on the need for control needs to be taken, including risking long-term exposure to residual radioactive material from a nuclear or radiological emergency after the emergency exposure situation has been declared to be over. Exposure to residual radioactive material from a nuclear reactor accident is cited as an example (Pub. 103, 6.3).

50 A "reference level" is as follows: In emergency or existing controllable exposure situations, this represents the level of dose or risk, above which it is judged to be inappropriate to plan to allow exposure to occur (e.g., implementation of evacuation zones), and below which optimization of protection should be implemented (Pub. 103, 5.9.2.).

51 The ICRP recommendation issued in 1990 (Pub. 60, 6.3.2) states that it should be below 500mSv (5,000mSv for skin). The ICRP recommendation issued in 2007 states that "below 1,000mSv" should be one option.

52 ICRP publication 63, which preceded the ICRP 2007 recommendations , states that, in terms of public exposure in an emergency, (i) if a exposure dose more than 50mSv is avoidable in a temporary stay-indoors evacuation, (ii) if a exposure dose more than500mSv is avoidable in a temporary stay-indoors evacuation (within a week), (iii) if a exposure dose more than 1,000mSv is avoidable in an permanent relocation (over a week), (iv) if 500mSv of thyroid exposure is avoidable through the distribution of stable iodine, then these actions shall be nearly always justified. However, if only less than one-tenth of the exposure dose (relocation in (iii) should be less than 100mSv/month of the exposure dose) is avoidable, then they shall not be always optimized. In terms of food, if the dose rate more than 10mSv/year is avoidable in the prescribed action, then that action should nearly always be justified.

Additionally, the ICRP provides a recommendation that in an "existing exposure situation," reference levels should be established within the range of 1mSv to 20mSv per year depending on the situation (Pub. 103, 6.5).

Additionally, a normal situation that does not fall under "radiation emergency situations" or "existing exposure situations" shall come under "planned exposure situations." An exposure limit in the case of public exposure[53] is 1mSv/year.

Radiation exposure is classified into two kinds: "external exposure" and "internal exposure." External exposure occurs when the body is exposed to radiation from the radioactive source outside the body. Internal exposure occurs when the body is exposed to radiation from the radioactive source inside the body. In the Life Span Study described above, the exposure dose received by individuals was estimated based on a radiation dose of direct irradiation from the exploding atomic bomb, in other words, the primary external exposure, derived from a relationship between the distance between the point where each individual affected by radiation exposure and the center of the explosion, with or without shelters, and the characteristic of the atomic bomb dropped. Hence, neither the secondary external exposure from radioactive fallout from the explosion nor the internal exposure that each individual received from the radioactive fallout were taken into consideration. Thus, if the radiation exposure (the secondary external exposure and internal exposure) that each individual actually would have been affected by was taken into consideration, the actual exposure radiation dose may have actually been higher than the estimated exposure dose. Thus, it is likely that the cancer rates that were based on the data from the Life Span Study were overestimated against the estimated exposure dose.

External exposure occurs when the radioactive source is outside the body while internal exposure occurs continuously until the radioactive source decays out through radioactive disintegration or it is excreted from the body. When radioactive material is taken in and remains in a specific part of the body, the surrounding cells of the radioactive material are intensively exposed to radiation[54] (Pub. 103, 4.3.2). This does not occur in external

[53] An "exposure limit" is an amount that an individual would not be allowed to receive in a planned exposure situation.

[54] In the current nuclear accident, most of the radioactive material was released as gas. Thus it seems that there is less of a need to take into consideration the effect of radioactive materials ingested by the organism as solid matter.

exposure[55]. The ICRP recommends that internal exposure should also be evaluated based on the predicted dose (committed dose) which is expected to receive over a period of 50 years (for a minor, until he or she is 70 years old) from the time that the radioactive material is taken into the body. As described above, the effect of internal exposure cannot be clearly defined using the epidemiological data in the Life Span Study. Various studies are currently being conducted, but the mechanism of how internal exposure affects an organism has not yet been clarified using factual data.

c. Standards in Japan

In Japan, the following standards have been established based on the ICRP recommendations (Pub. 60) issued in 1990.

Firstly, the NSC has set up the NE Guideline (refer to Section 2 (3) b above) as emergency countermeasures against accidents in nuclear facilities.

This NE Guideline formulated the "indices of stay-indoors evacuation and evacuation". A stay-indoors evacuation should be conducted if a predicted effective dose from external exposure (predicted exposure to radioactive material or radiation while being outdoors during a period of a release of radioactive materials) is 10 to 50mSv, and evacuation (or a stay-indoors evacuation into concrete buildings) should be carried out if the external radiation dose is more than 50mSv.

Secondly, the NE Guideline formulated the "indices of protective measures concerning the intake of stable iodine tablets" as a guideline for taking stable iodine tablets to protect the thyroid gland from radiation exposure. The stable iodine tablets should be applied when a predicted equivalent dose of infant thyroid gland exposure to radioactive iodine is more than 100mSv (in principle for people under 40 years old).

In addition, with regards to food, the NERHQ formulated the "Index for restrictions on the intake of food and beverages" in the table below as a guideline for discussions on whether or not it is necessary to take measures to restrict food and beverages[56].

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[55] The ICRP also points out that the evaluation of internal exposure is much more difficult than that of external exposure (Pub. 103, 4.5).

[56] The "Index for restrictions on the intake of food and beverages" sets two criteria: (i) 50mSv/year of thyroid gland equivalent dose for radioactive iodine, and (ii) 5mSv/year of effective dose for radioactive cesium. Index

Table V-1 Index for restrictions on the intake of food and beverages, unit Bq/kg

Target	Radioactive iodine	Radioactive cesium
Drinking water	300	200
Milk and other dairy products	300	200
Vegetables (excluding root vegetables and tubers)	2,000	-
Vegetables	-	500
Cereals	-	500
Meat, eggs, fish, others	-	500

Prepared based on the guidelines of "Emergency Preparedness for Nuclear Facilities" (first published in June 1980 and last revised on August 23, 2011)

Next, concerning workers engaged in radiation work in radiation controlled areas (hereinafter referred to as "radiation workers"), Japan has formulated "Ionization Radiation Injury Prevention Rules" (hereinafter referred to as "Ionization Rules"), "Rules for Commercial Nuclear Power Reactors concerning Installation, Operation, etc." (hereinafter referred to as "Commercial Reactor Rules"), "Notice on Exposure Limits Based on Provisions of Commercial Power Reactor Rules" (hereinafter referred to as "Commercial Reactor Notice"), and "National Personnel Authority Rules 10-5 (Prevention of Radiation Injuries in Staff)", which states that the radiation exposure dose (hereinafter referred to as "Dose Limit") of radiation workers should be less than or equal to 100mSv/5 years and less than or equal to 50mSv/year[57] based on ICRP recommendations. In this regard, however, it is stipulated that, in emergency situations[58], the exposure limit shall be

values in the Table V-1 are set for neither of which exceed the criteria.

[57] Article 4, Paragraph (1) of Ionization Rules; Article 9, Paragraph (1) of Commercial Reactor Rules; Article 6, Paragraph (1) of Commercial Reactor Notice; and Article 4, Paragraph (1) of National Personnel Authority Rules 10-5.

[58] These rules define situations of "emergency operation" as: "those where a disaster occurs or is likely to occur, where urgently necessary action should be taken to handle the damage to nuclear power reactor facilities that might otherwise seriously disrupt the operation of a nuclear reactor" (Commercial Reactor Rules); "those where an accident that is relevant to the provisions of Article 42, Paragraph (1) occurs and emergency operation is required to prevent health problems in workers from radiation in zones relevant to said paragraph" (Ionization

100mSv, in Article 7, Paragraph 2 of Ionization Rules; Article 9, Paragraph 2 of Commercial Reactor Rules; Article 8 of Commercial Reactor Notice; and Article 4, Paragraph 3 of National Personnel Authority Rules 10-5.

(2) Radiation dose limit for radiation workers in an emergency

a. Raising the exposure limit to 250mSv

TEPCO executives, who had been staying at the Prime Minister's Office since the accident at the Fukushima Dai-ichi NPS, were informed by corporate headquarters that radiation levels at the site were rising. The TEPCO executives recognized that it might be impossible to continue operations to manage the nuclear accident if they insisted on the current legal exposure limit and asked the NSC and NISA for their advice. In response to this request, at the Prime Minister's Office in the afternoon of March 14, it was decided that the exposure limit for emergency operations should be increased from 100mSv to 250mSv. At that time, consideration was given to the fact that ICRP Pub. 103 stipulates that the exposure limit for emergency workers should be 500mSv to 1,000mSv, 250mSv[59] is half the lower limit, and the "Regulatory Guide for Reviewing Nuclear Reactor Site Evaluation and Application Criteria" developed by the Japan Atomic Energy Commission in 1964 describes that the exposure to be temporarily allowed based on the recommendations of the guide is 250mSv.

In response to this implementation, on the same day, the Ministry of Health, Labor and Welfare and METI worked together to prepare a ministry order and a notice to the effect that from the date when a nuclear emergency is declared to the date when the nuclear emergency is lifted in a zone where emergency countermeasures must be taken the exposure limit should, in unavoidable circumstances, be 250mSv[60]. Sometime after

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Rules); and "those where an accident that is relevant to provisions of Article 20, Paragraph (1) occurs, and emergency operation is required to prevent problems from radiation" (National Personnel Authority Rules 10-5).

[59] Pub. 103 has not yet been incorporated into Japanese law. The Radiation Council Basic Committee, however, implemented a "Second Interim Report on the Introduction of the 2007 Recommendations (Pub. 103) of the International Commission on Radiological Protection (ICRP) into Domestic Systems" in January 2011, stating that the exposure limit in an emergency in Japan should be brought into line with the recommended value that is internationally accepted.

[60] The Minister of Health, Labor and Welfare received a report to that effect from a Labor Standards Bureau officer. The Ministry, under the Minister's direction, advised the Prime Minister's Office stating that the prescribed

midnight the same day, they asked MEXT Radiation Council[61] for advice. The Council debate the proposed exposure limit by email throughout the day until just before dawn the following day and replied that it was reasonable. In response to this advice, the Ministry of Health, Labor and Welfare and METI formulated a ministry order[62] and a notice to that effect, dated April 14 and the ministry order and notice were issued (published in an official gazette) on March 15.

b. Discussion on raising the exposure limit to 500mSv

On March 17, three days after raising the exposure limit for emergency workers from 100mSv to 250mSv, a discussion was held at the Prime Minister's Office to raise the exposure limit even further to 500mSv. In response to this, the Ministry of Health, Labor and Welfare and METI started to prepare a plan to that effect within the Ministries. However, there was ultimately no instruction to that effect from the Prime Minister's Office.

c. Lowering the exposure limit to 100mSv

On August 30, the Ministry of Health, Labor and Welfare started discussing lowering the exposure limit for emergency operations back to 100mSv. The Ministry, under mutual arrangement with TEPCO, METI, and other organizations, excluding staff who had already been involved in this arrangement before the exposure limit was raised, started to implement a ministry order[63] where the phrase "in unavoidable circumstances" should be

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exposure limit should not be raised immediately to 250mSv, but rather to 200mSv. And, finally, at the government affairs level, it was discussed and decided that the exposure limit should be raised to 250mSv.

61 The Radiation Council discussed this subject in an advisory meeting. They reached a consensus based on the "Second Interim Report and replied that the exposure limit suggested in the ministry order and notice was reasonable. Additionally, the discussion continued until 03:00 the following day, but the date of the reply was, as per both Ministries' intention, posted as March 14, which is when the participants started their discussion by email.

62 The "ministry order on the special rules of Ordinance on the Prevention of Ionizing Radiation Hazards for responding to events resulting from the 2011 Tohoku District-off the Pacific Ocean Earthquake" and "the notice on exposure limits based on the Rules for Commercial Nuclear Power Reactors concerning Installation and Operation" were exclusively for the unavoidable urgent activities necessary for responding to events resulting from the 2011 Tohoku District-off the Pacific Ocean Earthquake.

63 The Ministry order revised, as per a ministry order, "the special rules of Ordinance on the Prevention of Ionizing Radiation Hazards for responding to events resulting from the 2011 Tohoku District-off the Pacific Ocean Earthquake."

changed to “in unavoidable circumstances and in circumstances the Minister of Health, Labor and Welfare deems unavoidable" for the "ministry order on the special rules of Ordinance on the Prevention of Ionizing Radiation Hazards to respond to the events resulted from the 2011 Tohoku District-off the Coast of Pacific Ocean Earthquake", and asked the Council of Labor Policy for advice on October 24[64]. The Council replied that it was reasonable. The ministry order became effective as of November 1.

(3) Organizational framework for radiation control at TEPCO

a. Organizational framework for radiation control before the nuclear accident

(a) Organizational framework for radiation control before the nuclear accident

The Ionization Rules define a controlled area as an area where the level of radiation may reach beyond a specified amount (Article 3)[65]. The Rules stipulate that concerning nuclear power station operators who are involved in radiation work: (i) the designated area shall be clearly marked with a sign that shows access to the area is restricted to those individuals who require access in order to perform their duties (Article 3), (ii) radiation workers shall not be exposed to more than a specified radiation exposure dose (Article 4 to 6), (iii) radiation workers shall be equipped with measuring instruments designed to measure exposure dose (Article 8), and (iv) radiation workers shall be educated about the effects of ionizing radiation on organisms (Article 52 (7) and agree to undergoing a physical examination (Article 56). In addition, as an agreement among operators who are involved in nuclear operations, which is not a statutory regulation, TEPCO shall have radiation workers registered as professional radiation operators with a radiation worker certificate provided by the Central Registration Center of Radiation Workers located at the Radiation Effects Association.

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[64] The "ministry order on the special rules of Ordinance on the Prevention of Ionizing Radiation Hazards to respond to events resulting from the 2011 Tohoku District-off the Pacific Ocean Earthquake" was originally a temporary special ministry order. Hence, the Ministry of Health, Labor and Welfare did not bother asking the Radiation Council for advice.

[65] Article 3, Paragraph (1) of Ionization Rules defines a "controlled area" as an area where the total of effective dose from external radiation and effective dose from radioactive material in the air may reach more than 1.3mSv every 3 months, and where the surface density of radioactive material may reach more than one tenth of the limit value designated in table 3 of the Rules.

(b) Control of radiation doses

TEPCO controlled exposure doses based on in-house manuals including the "Radiation Work Control Manual" in order to protect its radiation workers from radiation exposure as follows: a TEPCO radiation worker was supposed to equip themselves with a rental alarm pocket dosimeter (APD) in the access control zone of the controlled area before they entered that controlled area to perform their duties. The external exposure dose that individual radiation workers received was measured with an APD and combined with data, which included the individual's name, hours worked and duties, using a mechanical control to measure the exposure. In addition, TEPCO nuclear power station staff were supposed to be tested to measure the level of internal exposure using a whole body counter (WBC) once every three months.

TEPCO partner companies, too, were expected to follow a similar exposure control program for their staff in the same way TEPCO did for its staff.

b. Organizational framework for radiation control after the nuclear accident

(a) Establishment of radiation controlled zones

After the nuclear accident at the Fukushima Dai-ichi NPS, radiation levels increased throughout the entire premises of the nuclear power station. However, TEPCO was not initially willing to redefine a controlled area as stipulated in its in-house safety regulations[66]. On April 27, however, as described in Section c (b) below, based on the fact that a female radiation worker received radiation dose greater than the allowed dose limit, NISA instructed TEPCO to validate its organizational framework for radiation control and implement measures to rectify this situation. In response to this, on May 2, TEPCO designated the entire premises of the Fukushima Dai-ichi NPS as a temporary and emergency radiation controlled zone to be controlled in the same manner as a radiation controlled zone. It was decided that the temporary and emergency controlled zone should be treated as a controlled zone stating that it would be marked with a sign showing that access to the designated area is restricted to those individuals who do not

[66] This is expected to be determined by a licensee of reactor operations based on Article 37, Paragraph (1) of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors.

require access in order to perform their duties, other necessary signs would be installed, and that radiation workers must be equipped with a rental APD and other protective equipment[67].

(b) Registration as a radiation worker

At the Fukushima Dai-ichi NPS, from the date of the nuclear accident through to May 10, radiation workers were allowed to carry out their duties inside the temporary and emergency radiation controlled zone after receiving a brief 30-minute explanation about how to protect themselves from radiation and how to wear protective equipment. In addition, (although there is no legal obligation to do this) there was a delay in radiation workers getting registered as professional radiation workers with a radiation worker certificate provided by the Central Registration Center of Radiation Workers and so some radiation workers performed their duties without a radiation worker certificate.

(c) APD (alarm pocket dosimeter)

TEPCO had about 5,000 APDs installed at the entrance to the controlled zone of Units 1 to 6 and at the entrance to the centralized waste treatment facilities, but most of them were covered in water and damaged by the tsunami. Hence, as a temporary arrangement, it was decided to perform radiation control measures using about 320 APDs that had been kept in a Seismic Isolation Building. Sometime between March 12 and 13, 500 APDs (200 of them from the Fukushima Dai-ni NPS) were provided as aid supplies from Kashiwazaki-Kariwa Nuclear Power Station. Unfortunately, however, there was a lack of communication between the pickup window personnel that received the APDs and the health physics team that desperately needed them, and these APDs were simply stored, unused until April 1. Many workers left the Fukushima Dai-ichi

[67] TEPCO designated the entire premises of the Fukushima Dai-ichi NPS as a temporary and emergency radiation controlled zone, but no signs have been installed to indicate this. Additionally, the following measures were taken inside the Seismic Isolation Building: from March 12, air dose rates were measured; from March 24, the concentration of radioactive material in the air was measured; on March 26, an air ventilator was installed; on March 27, radiation lead shields were placed on windows; and between April 1 and 8, floor mats were replaced. Because of these measures, from April 4, the concentration of radioactive material in the air of the Seismic Isolation Building fell below regulation limits (Ionization Rules and Commercial Reactor Rules). It was then decided to treat the inside of the Seismic Isolation Building as an uncontaminated area.

NPS after the earthquake and initially very few remained to perform their duties. Gradually more and more joined them until there were not enough APDs and by March 15 not every worker was able to wear an APD. In response to this situation, Mr. Masao Yoshida, head of the Fukushima Dai-ichi NPS (hereinafter referred to as "site superintendent Yoshida") decided to let only the leaders of an operational group wear APDs on behalf of the entire group as long as the following conditions were met: (i) the assumed total radiation dose per job is not great (less than about 10mSv), (ii) air radiation dose rates at the work site are known, (iii) environmental dose rates gradient (difference between air radiation level rates in the same space) is not great, and (iv) all members of an operational group always together at a work site. This decision was made based on the following assessment: the provisory clause, which states that "however, if it is considerably difficult to perform the said measurement with the said radiation measuring instrument, the said dose from external exposure may be computed using the measured dose equivalent rate, and if it is also considerably difficult to compute it, then the said value may be obtained through calculations," of Article 8, Paragraph 3 of Ionization Rules stipulating that "the measurement of radiation dose from external exposure according to Article 1 shall be performed by wearing radiation measuring instrument on parts of the body specified in the following items", was applicable to this case. As described above, a sufficient number of APDs was finally obtained on April 1. TEPCO decided to have all of its workers wear APDs from the same day and to not allow them to work if there were not enough APDs.

(d) Managing access to and from a controlled area

After the nuclear accident, access to and from the controlled area of the management system was initially rendered inoperative for calculating the radiation dose of individual radiation workers. TEPCO decided to manually calculate the radiation dose of individual radiation workers using APDs. On April 14, TEPCO had five simplified instruments installed in the Seismic Isolation Building for gaining access to and from the controlled area management system. At the same time, they introduced a radiation work permit with bar code patterns so that the names and radiation dose of individual

workers could be automatically recorded[68].

c. Occurrence of exposed subjects and their countermeasures

(a) Subjects exposed to contaminated water from the Unit 3 turbine building

On March 24, three workers from a TEPCO partner company (male staff member A in his 30s, male staff member B in his 20s, and male staff member C in his 30s), who were installing electric cables under the surface of the basement floor of the Unit 3 turbine building, were exposed to high radiation dose while working immersed in contaminated water. In terms of radiation dose (external exposure), staff member A received 180.1mSv, staff member B received 179.34mSv and staff member C received 173mSv before they had finished working[69].

On March 24, these three staff members were informed that the air radiation dose rate at the worksite in the basement of the Unit 3 turbine building was about 2mSv/h on the previous day, March 23, before they walked down to their work site. They put on Tyvek protective suits and charcoal filter masks and also carried an APD with them. Additionally, staff members A and B put on low quarter shoes and staff member C wore high boots. Then they headed for the work site. Their APD was set to sound an alarm once each time the external radiation dose reached 4mSv and to sound a continuous alarm for three minutes to alert them that the external dose had reached 20mSv.

The three staff members found that there was a pool of water about 15cm deep covering the entire floor. They thought that it was probably only seawater and decided to start working. Their APD sounded before they started working. However, they thought that either their APD had sounded to tell them that its battery was flat[70] or that their APD had malfunctioned due to the following reasons: they had been informed in

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[68] From March 17, radiation workers who did not go through the Seismic Isolation Building were expected to attach ADPs at J village and to record the day's levels when returning the ADPs upon finishing work for the day. J village had APDs from more than one manufacturer. Hence, the Access Control Devices were implemented on June 8.

[69] These three staff members, A, B, and C, were tested to measure their internal radiation doses following the incident. In terms of internal radiation doses, staff member A received 39mSv, staff member B received 35mSv and staff member C received 0mSv.

[70] An APD sounds repeatedly when its battery is running low in the same manner as when the external radiation dose has reached the upper limit.

advance that the air radiation dose rate at the work site was about 2mSv/h, and they had heard alarms before indicating an APD malfunction or as an alert to charge a flat APD battery. Thus they proceeded with installing the electric cables. Later staff member A heard the APD sound continuously and wondered if the air radiation dose at the work site could be higher than expected. However, he thought it was important for them to complete their job to restore the power supply so they continued working.

After completing their job, it was discovered that these three staff members were all likely to have received high radiation dose. Staff members A and B in particular were at a high risk of radiation heat burns from their feet being soaked in radioactive water because they were wearing low quarter shoes thus subjecting them to continuous localized exposure. They visited Fukushima Medical University Hospital and the National Institute of Radiological Sciences to get cleaned up and have a checkup and get tested to measure their internal radiation doses. The localized radiation dose both staff members A and B received on their feet was 466mSv. Neither staff member A nor B suffered radiation heat burns on their feet.

In response to this incident, on March 25, TEPCO and its partner companies decided that if workers find something at their work sites contrary to what they are told in advance, they should report to the Station ERC to seek directions and that workers should leave their work sites immediately if they hear an APD sound its alarm. They gave their workers instructions to this effect.

(b) Subjects exposed to radiation exceeding the dose limit for female staff (5mSv for three months)

Four whole body counters (WBCs) that had been installed at the Fukushima Dai-ichi NPS were rendered inoperative due to a power blackout and an increase in air radiation dose rate. On March 22, TEPCO borrowed vehicle-mounted WBCs from JAEA and had them installed at Onahama. TEPCO started measuring the internal radiation dose of individual workers who were engaged in emergency work at the Fukushima Dai-ichi NPS using these WBCs. As a result, on April 27 and May 1, it was discovered that two

female staff had received radiation dose exceeding the dose limit[71] for women that is 5mSv for three months.

Female worker D, in her 50s, who was exposed to 17.55mSv of radiation, had mainly been engaged in firefighting related jobs at the fire station gatehouse near the Seismic Isolation Building excluding the period from March 11 to 23 when she had been temporarily evacuated to the Fukushima Dai-ni NPS. While she was working there, she refueled fire engines more than once outside the Seismic Isolation Building. Female worker D had been working at the gatehouse until she received the instruction of evacuation issued from the Fukushima Dai-ichi NPS on March 23.

Female staff member E, in her 40s, was exposed to 7.49mSv of radiation while she had been engaged in healthcare-related work as a crisis team member in the Seismic Isolation Building during the period from March 11 to 15. In the Seismic Isolation Building, she usually stayed in the emergency response control room on the second floor. Whenever someone was injured or sick, she went to the sick bay located near the entrance on the first floor to take care of him or her. She also worked near the entrance of the Seismic Isolation Building whenever emergency personnel arrived from outside. The doors of the entrance to the Seismic Isolation Building, which were bent and twisted at the time, were only temporarily sealed up. Hence, the air radiation dose rate on the first floor was higher than that on the second floor. In addition, female staff member E has not returned to the Fukushima Dai-ichi NPS since leaving there on March 15.

A common factor in both female staff members D and E, who were exposed to radiation, was that both of them had spent a long period of time near the entrance of the first floor of the Seismic Isolation Building, where the air radiation dose rate had been relatively high since the day of the nuclear accident. One factor specific to female staff member D was that she was engaged in refueling operations several times outside the Seismic Isolation Building.

On May 2, TEPCO summarized the causes of these radiation exposure incidents in which its staff received radiation dose beyond allowable dose limits and established

[71] Article 4, Paragraph (2) of Ionization Rules, Article 6, Paragraph (1), Item (3) of Commercial Reactor Notice.

measures to prevent similar incidents in the future and reported their findings to NISA. This report describes the causes of these incidents as follows: after the nuclear accident, access to and from the Seismic Isolation Building was not properly controlled initially, the double-entry doors to the Seismic Isolation Building were not airtight and the doors to the Seismic Isolation Building were bent and twisted by the hydrogen explosions in Units 1 and 3. TEPCO concluded that these factors resulted in female staff members D and E inhaling radioactive materials. Based on this conclusion, TEPCO implemented measures to prevent similar incidents in the future as follows: (i) on and after March 23, the Fukushima Dai-ichi NPS shall be managed and controlled without female workers, and (ii) the concentration of radioactive materials in the air shall be reduced in the Seismic Isolation Building by installing a local ventilation machine. In addition, TEPCO decided to implement the following additional measures for the future: (i) the entire premises of the Fukushima Dai-ichi NPS shall be treated as a controlled zone, (ii) radiation workers shall wear proper protective equipment to match their working environments, (iii) a system shall be implemented to control exposure, (iv) internal exposure doses for individual workers shall be measured more often (once a month when incidents have occurred and once every three months during normal times), (v) individual radiation workers shall be tested to measure internal radiation dose if the external radiation dose they have received exceeds 100mSv, and (vi) they shall not be allowed to work at the Fukushima Dai-ichi NPS if the external radiation dose they have received exceeds 200mSv. TEPCO reported these findings to NISA.

(c) Subjects exposed to radiation exceeding the dose limit for urgent emergency work (250mSv)

Subsequently, it was discovered that, on June 10 two workers (male staff member F in his 30s and male staff member G in his 40s), on June 20 1 worker (male staff member H in his 50s), and on July 7 three workers (male staff members I, J, and K in their 20s) had been exposed to radiation over 250mSv of the radiation dose limit, which was newly mandated by law.

Male staff members F, G, and H kept watch in the main control room of Units 3 and

4 during the period from March 11 to the evening of March 13 and subsequently they were engaged in their work several times. The exposure dose that these three staff members received were as follows: staff member F received 678.08mSv (88.08mSv of external dose and 590mSv of internal dose), G received 643.07mSv (103.07mSv of external dose and 540mSv of internal dose) and H received 352.08mSv (110.27mSv of external dose and 241.81mSv of internal dose).

Staff members F and G were engaged in collecting plant data in the main control room. Staff member H was the leader of additional staff in the same room. After the earthquake, the air radiation dose rate increased in the main control room of Units 3 and 4. Staff member H instructed the other staff in the room to wear masks. Unfortunately, there were not enough charcoal filter masks, which can screen out volatile iodine, for each staff member in the room. Some staff in the main control room wore charcoal filter masks and others wore dust filter masks, which cannot screen out volatile iodine, until charcoal filter masks were delivered from the Seismic Isolation Building in the evening of March 12. Staff members F, G, and H wore dust filter masks until the charcoal filter masks were delivered from the Seismic Isolation Building in the evening of March 12[72]. In the control room, individual staff members were in charge of specific panels and were engaged in checking their respective panels on a continual basis. Staff members F and G spent most of their time checking the meters nearest the emergency doors, which were bent and twisted by the blast of the explosion[73]. On the evening of March 13, these three staff members were replaced with backup members and then moved to the Seismic Isolation Building. At dawn on March 15, they were instructed to evacuate to the Fukushima Dai-ni NPS. Subsequently when they moved to the Seismic Isolation Building of the Fukushima Dai-ni NPS, they were grouped into teams to collect data in the same rooms in regular shifts for intervals of several hours[74]. Additionally, staff member F was engaged in vent operations with two other staff members on March 13.

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72 They shared a charcoal filter mask whenever they had to work outside the main control room.

73 Some other staff members, too, were engaged in checking meters just as staff members F and G were, but they were nowhere near the emergency doors.

74 From March 15, younger staff members were excluded from the teams to collect data in the main control room. Additionally, staff member G, who had already been found to have received a high external radiation dose at that time, was excluded from working in the main control room.

Staff member G was engaged in refueling operations with two other staff members near Unit 1 on March 12. Staff member H had not been engaged in any outdoor operations until he moved to the Seismic Isolation Building. From March 14, he was engaged in refueling operations or checking fire extinguishing pumps at his work site. In addition, these three staff members had not taken stable iodine tablets until they moved to the Seismic Isolation Building on the evening of March 13[75]. Additionally, staff member F had occasionally smoked cigarettes before the explosion in Unit 1 on March 12. Additionally, staff members F and H wore glasses.

Further, three staff members, I, J, and K, had been engaged in both restoring meters to their former state in the main control rooms of Units 1 and 2, and securing electric power supply outdoors, staying mainly in the Seismic Isolation Building since the earthquake. The radiation dose that these three staff members received was as follows: staff member I received 308.93mSv (49.23mSv of external dose and 259.70mSv of internal dose), staff member J received 475.50mSv (42.40mSv of external dose and 433.10mSv of internal dose) and staff member K received 359.29mSv (31.39mSv of external dose and 327.90mSv of internal dose).

Early in the morning of March 12, the main control room shift supervisors of Units 1 and 2 instructed the staff in the rooms to wear masks. Staff member K wore a charcoal filter mask. Staff member J, most likely wore a dust filter mask, at least in the beginning. Staff member I joined the operations in the control room from that same day and from the very beginning wore a charcoal filter mask.

Subsequently, staff members I, J, and K were engaged in restoring meters to their former state in the main control rooms of Units 1 and 2 and in carrying meters to the control rooms wearing Tyvek protective suits and charcoal filter masks.

The emergency doors to and from the main control rooms of Units 1 and 2, which had been bent and twisted by the blast from the explosion in Unit 1, were only temporarily sealed up with vinyl sheets. Meters on the side of Unit 1 were located in a stream of air flowing from the emergency doors. Staff members I, J, and K were also

[75] Staff member F says that, as far as he remembers, he did take stable iodine tablets, but there is no record showing that he did.

engaged in restoring these meters to their previous state.

Additionally, there were sweets and drinks on the tables in the main control rooms of Units 1 and 2. These three staff members sometimes ate and drank at the table without wearing masks. Moreover, staff members J and K sometimes took their masks off and spent short periods of time without them or they loosened their masks because their breath fogged up their masks or their masks were too tight giving them a headache. Additionally, staff members I and J wore glasses.

A common factor in both staff members F and K receiving radiation exposure was that both of them were engaged in their duties near the emergency doors. Moreover, a common factor in staff members F, G, H, and J receiving radiation exposure was that they wore dust filter masks instead of charcoal filter masks while they were working.

TEPCO summarized the causes of radiation exposure for staff members F and G on June 17 and those of staff members H, I, J, and K on August 12, and reported these findings to NISA. The report describes the suspected causes of radiation exposure as: (i) it was difficult to wear masks properly and implement protective measures to control radiation even more effectively, (ii) its staff had no choice but to eat and drink in the main control room, (iii) the arms of glasses created a gap between the face and the mask, and (iv) its workers were engaged in their duties near the emergency doors, where the concentration of radioactive material was estimated to be extremely high. Based on these estimations, TEPCO decided to implement the following measures to prevent similar radiation exposure in the future: (i) information shall be shared more efficiently and equipment and material including masks shall be placed in their proper location, (ii) staff shall eat and/or drink only in designated areas, (iii) staff shall learn how to use and manage protective equipment for personal protection, and (iv) staff shall complete a pre-work survey.

(d) Health care provided for staff engaged in emergency works

TEPCO conducted further evaluations on the internal exposure its staff received. Subsequently, it was discovered that some employees who had been working on the premises of the Fukushima Dai-ichi NPS quit immediately after the nuclear accident

and their whereabouts remained unknown. TEPCO collected and compiled this data and reported their findings to NISA. On July 7, NISA performed an on-site inspection to confirm that identification was not conducted properly, not even with public/official identification; that upon issuing a work permit the license was not delivered by hand; and that access to and from the nuclear power station was not managed exactly according to specific rules and regulations prescribed by nuclear power station authorities. On August 1, based on this on-site inspection, NISA reprimanded TEPCO and instructed TEPCO to provide a report summarizing how it would improve its system.

Prior to June 8, access to the Fukushima Dai-ichi NPS was possible even without a work permit. From June 8, access to the station required a work permit. However, a work permit was only issued if a partner company had confirmed the original public/official document with a photo attached. TEPCO issued copies of the work permit. Thus, TEPCO's work permit were handed out on a per partner company basis, not on a per person basis. TEPCO decided that from July 19 work permits should be handed out directly to individual workers on a per person basis.

In addition, TEPCO asked its partner companies to perform aggregate data research. As a result, it was discovered that a total of 150 workers (11 workers in March, 66 workers in April and 73 workers in May), who previously belonged to TEPCO's partner companies and worked on the premises of the nuclear power station, were unable to be contacted. On August 8, TEPCO announced this. Subsequently, TEPCO and its partner companies fully examined all lists of their employees and established their contact details. As a result, as of October 31, only 16 of the 150 workers were unable to be contacted. In addition, as of this date, employees who had worked on the premises of the station after July were all contacted.

On May 17, the NERHQ developed a "Policy for Immediate Actions for the Assistance of Nuclear Sufferers" implementing long-term health management and a database capable of tracking the exposure radiation dose over the long-term for all workers engaged in emergency operations to help control the current situation. In response to this situation, on June 27, the MHLW established an "investigative

commission for long-term health management of workers at TEPCO's Fukushima Dai-ichi NPS" lead by Mr. Yoshiharu Aizawa, vice-president of Kitasato University School of Medicine. The commission discussed how to conduct long-term health management of employees engaged in emergency work even after they left their current jobs including acquiring necessary information and conducting health checks. On September 26, the commission developed a report and issued an announcement to that effect.

(4) Radiation dose limit for government employees in an emergency

a. Radiation dose limit for government employees in emergency works

As per the description in Section (1) c above, Article 4, Paragraph 3 of the National Personnel Authority Rules 10-5 prescribes that the dose limit for government employees in emergency works shall be 100mSv, which is the same for general workers.

On the morning of March 16, a staff member of National Personnel Authority in charge of National Personnel Authority Rules learned via a news report that both the MHLW and METI had raised the radiation dose limit for workers engaged in emergency works. With regards to national government employees employed in regular government service, it is likely that, for example, Nuclear Safety Inspectors might be engaged in emergency works at a nuclear power station. Hence, a staff member immediately asked MHLW to provide him with the relevant documents. To discuss the matter, the staff member also phoned a Defense Ministry staff member in charge of a "Ministry of Defense official directives concerning staff health care" that is quoted from National Personnel Authority Rules 10-5. At approximately 18:00 on March 16, the same staff member asked the MEXT Radiation Council advice on a ministry order revision that the exposure limit should be 250mSv to respond to events resulting from the 2011 Tohoku District-off the Pacific Ocean Earthquake from the date when the nuclear emergency is declared to the date when the nuclear emergency is lifted, in a zone where emergency countermeasures must be taken in unavoidable circumstances.. The Radiation Council had a debate on the proposed dose limit by email from 18:30 to 19:30 that day. They reached a consensus and replied that it was reasonable. In response to this advice, the National Personnel Authority revised part of

the Nuclear Disaster Special Measures Law, Article 28 of the National Personnel Authority Rules 10-5, as follows: "In response to events resulting from the 2011 Tohoku District-off the Pacific Ocean Earthquake from the date when the nuclear emergency is declared (pursuant to Paragraph 2 of Article 15 of the Nuclear Disaster Special Measures Law enacted in 1999, No. 156) to the date when the nuclear emergency is lifted (pursuant to "Paragraph 4 of the Article, in a zone where emergency countermeasures must be taken prescribed in Paragraph (8) of Article 17 of the same Law), in unavoidable circumstances the exposure limit "100mSv" (prescribed in Item (3) of the same Paragraph), concerning the application of the provision of Paragraph 3 of Article 4, should be replaced with the dose limit of 250mSv." This revision was published in a government gazette the next day, March 17, and took effect that day.

Additionally, Nuclear Safety Inspectors who worked in the Fukushima Dai-ichi NPS safety inspectors' office collecting information after the nuclear accident (refer to Section III2(7) above) were not directly engaged in emergency operations in reactor buildings.

Defense Ministry staff, including Self Defense Force personnel, is government employees for special government service and they are not directly subject to National Personnel Authority Rules[76]. However, Paragraph 2 of Article 26 of "Ministry order on health care management of Defense Ministry staff" stipulates that "the limit of effective dose equivalent for directees (workers under management) who are engaged in emergency works to prevent radiation hazards shall comply with the rules of staff who are engaged in emergency works (Paragraph 3 of Article 4 of National Personnel Authority Rules 10-5. Hence, the limit for the effective dose equivalent shall comply with the rules of National Personnel Authority Rules 10-5.

In response to the declaration of the nuclear emergency state on the night of March 11, at 19:30 on the same day the Self Defense Forces issued a "Self-Defense Force action command concerning the implementation of nuclear disaster dispatch service for nuclear emergency events at the TEPCO Fukushima Dai-ichi Nuclear Power Station and Fukushima Dai-ni Nuclear Power Station." From March 17, Self-Defense Force personnel

[76] Article 2, Paragraph (3), Item (16); Article 2, Paragraph (5); Article 3, Paragraph (2); and Article 16, Paragraph (1) of the National Public Service Act

were engaged in flushing water out into a spent fuel pool, but none of them received a radiation dose exceeding 100mSv, which was the previous radiation dose limit prior to being changed.

b. Radiation dose limit for local government employees in emergency works

Provisions of the Industrial Safety and Health Act, rather than those of the National Personnel Authority Rules, are applied to local government employees including police officers and firemen[77]. Hence, the radiation dose limit for local government employees in emergency operations was raised to 250mSv on March 14.

A guideline on the radiation dose limit for police officers and firemen contained in the NE Guideline prepared by the NSC in June, 1980, stipulates that "the upper limit of radiation dose, especially for those who are engaged in emergency works in a nuclear accident site among those engaged in disaster prevention works (for example, staff other than radiation workers employed at the nuclear power station as well as experts dispatched from the national government, those who are employed at police or fire stations, Self-Defense Force personnel, those who are employed in urgent medical care service), shall be 100mSv in terms of effective dose for emergency works in urgent and unavoidable circumstances to prevent a disaster from worsening and to save lives. Additionally, the "Manual for firefighting activities at nuclear power facilities" prepared by the Fire and Disaster Management Agency in March 2001 stipulates that the "radiation dose limit shall be 100mSv for emergency works to save lives. There were no changes in them.

None of the mobile police officers and firemen engaged in flushing water out into a spent fuel pool was exposed to radiation doses exceeding 100mSv.

(5) Radiation exposure of citizens

a. Screening level before the nuclear accident

The "Manual for radiation emergency medical care activities in Fukushima Prefecture," which was created in 2004 fiscal year under the authority of the Fukushima prefectural government, was based on a previous manual "What should be done in radiation

[77] Article 58 of the Local Public Service Act.

emergency medical care and how," which was prepared by the NSC in July 2001 and stipulated that the screening level for residents[78] (a criterion of comprehensive outer body clean up) should be 40Bq/cm^2 [79]. The Fukushima prefectural government, which initially decided that the value was equivalent to 13,000cpm (counts/minute), used 13,000cpm as a criterion for comprehensive entire body clean up.

b. Raising the screening level after the nuclear accident

The Local NERHQ at the Off-site Center, which started discussions on screening level settings on March 12, asked the ERC advice on the criterion of 40Bq/cm^2 or 6,000cpm on the morning of March 13. The ERC asked the NSC for feedback and the NSC responded saying that stable iodine should be given to those who experienced radiation dose rates of more than 10,000cpm, further adding that 6,000cpm should be replaced with 10,000cpm[80]. However, this response was not communicated from the ERC to the Local NERHQ. Instead, a message submitted to the Local NERHQ merely stated that the Local NERHQ opinion should be respected[81].

At 14:20 on March 13, the head of the Local NERHQ issued instructions based on Paragraph 3 of Article 15 of the Act on Special Measures Concerning Nuclear Emergency Preparedness to the heads of Fukushima Prefecture, Okuma-town, Futaba-town, Tomioka-town, Namie-town, Naraha-town, Hirono-town, Katsurao-village, Minami-soma-city, Kawauchi-village and Tamura-city to the effect that the screening level should temporarily be adjusted to 40Bq/cm^2, or 6,000cpm. The Fukushima prefectural

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[78] Screening would mean the monitoring service that determines whether or not a monitoring subject has been contaminated by radioactivity and thus needs to be decontaminated. Screening monitoring is conducted by holding radiation dose measurement equipment over the subject being monitored to measure the level to which he or she has been contaminated. The screening level is the level that indicates whether a screening subject needs to be decontaminated if his or her level should exceed the limit.

[79] The value is equal to the value defined as a screening level by the Nuclear Safety Research Association in "Knowledge of radiation emergency medical care" (in March 2003) in radiation measurement for initial exposure medical care. Additionally, a note is attached to this criterion stating that this value is subject to change at any given time that the government decides it needs to be changed.

[80] 10,000cpm is a value that the NSC has decided is equal to 40Bq/cm^2 and is used, as a criterion from a safer side (conservative) point of view.

[81] The NSC investigated why and how their feedback had not been communicated to the Local Emergency Response Center. As a result, it was discovered that the comment was faxed to the ERC and that it was received by a staff member who had been dispatched from the NSC Secretariat and that no one had seen it since. It still remains a mystery.

government decided to use the criterion value of 40Bq/cm^2, which was originally a criterion value defined in the "Manual for radiation emergency medical care activities in Fukushima Prefecture" stating that 40Bq/cm^2 was equivalent to 13,000cpm, and started screening based on a screening level of 13,000cpm

On March 13, a team of radiology experts[82] was dispatched to visit the Fukushima prefectural government office to provide radiation emergency medical care. The regional medical division of the Fukushima prefectural government, which was in charge of screening activities, asked the team for advice on how to most effectively conduct screening. The team of experts discussed this amongst themselves and, as a result, decided to implement a special "Fukushima version" screening program for external whole body cleansing for the following reasons: there was not sufficient water due to water supply suspension; the night temperature was below freezing, thus it was risky, especially for sick or ill people, to be decontaminated outdoors; and it was necessary to take care of people swiftly and safely with limited staff. All of these factors made it difficult to conduct screening and total external body cleansing. Also, they provided the regional medicine section with advisory instructions. One of the advisory instructions was to raise the screening level to 100,000cpm equivalent to 1μSv/h (an exposure rate at 10cm from body surface)[83], which is prescribed as a screening level for the general public receiving a body surface contamination check in the "Manual for First Responders to a Radiological Emergency, 2006 " developed by IAEA. Contrary to instructions from the head of the Local Headquarters, the Fukushima government office accepted this advisory instruction and decided to use 100,000cpm as the screening level for external whole body cleansing. Additionally, Fukushima Medical University Hospital, providing screening services of its own to its patients from March 12, also used 100,000cpm as a screening level due to a lack of water. This fact was also taken into consideration when the Fukushima prefectural government raised the screening level to 100,000cpm.

In the early morning of March 14, having learned via an ERC medical treatment team's report that the Fukushima prefectural government had raised the screening level, the NSC

82 Dispatched from Fukui University, Hiroshima University and NIRS.
83 When measured with the GM Survey Meter "Aloka TGS-136" (5cm window diameter).

held a discussion on the notion that if the entire 13,000cpm should be from iodine resulting in internal exposure, whether it might be equal to an equivalent dose of 100mSv[84], which is the criterion of stable iodine administration. At 04:30 the same day, the NSC provided the ERC with advice to the effect that "screening criterion should not be raised to 100,000cpm, but instead remain at the current value of 13,000cpm". However, the Fukushima prefectural government continued to use 100,000cpm for its screening service.

Subsequently, the NSC held further discussions based on opinions from municipalities that were engaged in providing screening services at their local sites and at 14:40 on March 19, provided the ERC with the revised piece of advice "regarding screening criterion of radiation emergency medical care," which stated that screening criterion should be raised to 100,000cpm.

c. Implementation of screening

"What should be done in radiation emergency medical care and how" stipulates that relevant local governments, under mutual cooperation with their partner organizations, are specifying places where to conduct rescue and evacuation operations as well as planning to conduct screening services , if necessary. In response to this situation, the "Manual for radiation emergency medical care activities in Fukushima Prefecture" stipulates that a medical treatment team shall be established, which will be led by the divisional councilor of the hygiene services division of the department of health and welfare services in the Nuclear Emergency Response Center and that a screening team shall be established and will consist of health and welfare service staff, core-city healthcare center staff, doctors from the prefectural hospital and the medical association, and radiology technicians from the Fukushima Regional Association of Radiological Technologists, which will conduct body-surface contamination monitoring with survey meters to determine if monitored individuals or subjects need decontamination.

In response to the declaration of a nuclear emergency state by the Japanese government on the night of March 11, the Fukushima prefectural government decided to implement

[84] This assumption stands on a safer side (conservative) point of view, although much of the actual contamination appears on the outer surface of clothes and other wearable items.

screening services and started doing so the next day, on March 12. However, there were far more monitoring subjects than expected so there were not enough staff members within the prefecture to allow them to adequately handle all screening services[85]. The Fukushima prefectural government asked the national government, local governments, universities and the Federation of Electric Power Companies for their cooperation in conducting screening services at evacuation facilities and permanent facilities designed for community use. More than a total of 200,000 monitoring subjects representing over 10% of the prefectural population received screening services. The count rate of those monitoring subjects was between 13,000 and 100,000 cpm. The number of subjects who needed partial external cleansing was 901, and the number of subjects whose measured count rates was higher than 100,000cpm and needed whole body cleansing was 102. However, the count rates of those monitoring subjects whose measured exposure was higher than 100,000cpm was below the designated level when they removed their clothing.

d. Medical checks conducted for the citizens of Fukushima Prefecture

On May 19, the Fukushima prefectural government established the Fukushima Prefecture Health Monitoring Survey Research Committee to discuss how to conduct medical checks for the citizens of Fukushima Prefecture. In response to those committee discussions, on June 30, the Fukushima prefectural government began delivering sets of inquiry forms, which dealt mainly with dietary and behavioral records from March 11, to individual evacuees from Namie-town, Iitate-village and Yamakiya district of Kawamata-town, who were subjects participating in the survey. The same set of inquiry forms was delivered to all remaining citizens of the prefecture on and after August 26. The survey included forms for entering basic survey details as well as medical checkup, Q&A survey, and thyroid gland examination results. The results of the survey are to be managed and maintained in a database on a long-term basis.

[85] The maximum number of facilities used for screening services was 42 on March 19 (including 30 evacuation facilities and twelve permanent facilities meant for community use).

e. Distribution of stable iodine

Stable iodine is a chemical that mainly consists of non-radioactive iodine. Taking iodine for radiation exposure can help prevent radioactive iodine from being incorporated into the thyroid gland even after radioactive iodine has entered the body. Thus stable iodine is used to prevent thyroid gland cancer from occurring.

The "guidelines concerning the preventive intake of stable iodine tablets" prepared by the NSC in April 2002, describes how to determine whether or not stable iodine tablets should be taken stating that "various protective measures can be implemented, including shelter, evacuation and preventive intake of stable iodine tablets, in accordance with the NERHQ' judgment." Additionally, while addressing concerns regarding the side effects of stable iodine, these guidelines also stipulate that great care should be taken to ensure residents take stable iodine tablets as safely and as soon as possible in an emergency situation where it is predicted that the infantile thyroid gland equivalent dose due to radioactive iodine will reach 100mSv, and if the NERHQ instructs residents to take stable iodine as a preventive measure.

The NE Response Manual prescribes that the "Technical Advisory Organization in an Emergency" staff shall provide a technical advice in the "Joint Council for Nuclear Emergency Response" established in the Off-site Center and that a draft of protective intake policy implemented by the Urgent Emergency Measures Policy-making Committee should be reported to the NERHQ, that the NERHQ' decision on the intake of stable iodine tablets should then be communicated by the head of the NERHQ to the head of the Local NERHQ, who should convey this information to the governors of local governments, and finally that the governors of local governments should then provide this information to their residents[86].

At 13:15 on March 12, the Local NERHQ issued a written order to the leaders of the prefectural government and respective municipalities (Okuma-town, Futaba-town, Tomioka-town, Namie-town) to the effect that "if instructions are issued for residents to

[86] The manual for radiation emergency medical care activities in Fukushima Prefecture stipulates that the intake of stable iodine tablets should be communicated by the leader of the Local Emergency Response Center to the leader of prefectural local headquarters, to the leaders of medical treatment teams of prefectural local headquarters, and finally to the leaders of the respective municipalities.

take stable iodine tablets, it should be decided by all possible means that stable iodine tablets be distributed to evacuation facilities and that a sufficient number of pharmacists and doctors should be stationed at these evacuation facilities.

Moreover, as described in b above, the Local NERHQ asked the ERC for advice and its comments on a draft that the screening level should be changed to 40Bq/cm^2, or 6,000cpm. In response to this request, the NSC told the ERC that instructions should be given at their screening services to the effect that stable iodine tablets should be provided to those who had radiation dose of more than 10,000cpm. However, this information was not communicated to the Local NERHQ.

On the night of March 14, the ERC medical treatment team was informed that the evacuation of hospitalized patients within a 20km radius had not yet been completed and they provided this information to the NSC. In response, a few hours later at 3:10 on March 15, the NSC provided the ERC advice to the effect that the hospitalized patients should have taken stable iodine tablets when they were evacuated according to a provision concerning "Rules on the intake of stable iodine tablets in the evacuation of hospitalized patients from an evacuation zone (within a 20km radius)." The ERC sent this advice to the Local NERHQ by fax. However, that same day, the Local NERHQ was busy relocating to the Fukushima Prefectural Office building. It was not until later that evening, after they had completed their move, that they discovered the fax conveying this advice. The Local NERHQ, which considered it highly likely that in addition to hospitalized patients many elderly citizens living in local communities and hospital staff still remained, created an instruction draft to the effect that subjects who should take stable iodine should include residents other than hospitalized patients. That night, the Local NERHQ provided the ERC with its instruction draft stating that residents who should take stable iodine tablets should include all citizens that still remained within a 20km radius. In response to this, the ERC asked the NSC for advice on this instruction draft. At 01:25 on March 16, the NSC distributed advice to the ERC to the effect that all of those who remained within a 20km radius should take stable iodine tablets while being evacuated according to the "Rules on having those who remain in evacuation zones (within a 20km radius) take stable iodine tablets when being evacuated." The Local NERHQ, which confirmed this advice via the

ERC, issued a written order at 10:35 the same day to the leaders of the Fukushima prefectural government and 12 affected municipalities to "have those who are evacuated from evacuation zones (within a 20km radius) take stable iodine tablets." However, the Fukushima prefectural government did not follow this instruction on the intake of stable iodine tablets because the government had already confirmed that there were no subjects who remained within a 20km radius.

Additionally, the Basic Disaster Prevention Plan stipulates that the "National Government (MEXT and MHLW), Japan Red Cross, local governments and nuclear operators shall cooperate with each other in storing and maintaining radiation measuring materials and equipment, decontamination materials and equipment, stable iodine tablets, medicinal chemicals and equipment for emergency relief activities, as well as materials and equipment for medical services." Six regional municipalities surrounding the Fukushima Dai-ichi NPS and Fukushima Dai-ni NPS (Hirono-town, Naraha-town, Tomioka-town, Okuma-town, Futaba-town and Namie-town), as per the advice in the "Manual for radiation emergency medical care activities in Fukushima Prefecture," already had 136,000 stable iodine tablets on hand, which corresponded to three doses for the estimated population of intake subjects (below 40 years old) in an EPZ (Emergency Planning Zone), which is a regional zone within a 10km radius requiring enhanced comprehensive disaster prevention planning. Additionally, Iwaki-city and Koriyama-city, which were not designated as EPZ, also stored and maintained stable iodine tablets.

Moreover, the Fukushima prefectural government stored and maintained 68,000 stable iodine tablets in the Environmental Medical Research Institute located in Okuma-town for tourists and other visitors to the prefecture. The local Government also asked the ERC and other organizations to help secure stable iodine tablets and were able to obtain approximately 1,360,000 stable iodine tablets from a major stable iodine manufacturer and from the Ibaraki prefectural government.

On March 14, the Fukushima prefectural government discussed whether or not stable iodine tablets should be distributed to all municipalities within an approximate radius of 50km of the nuclear power station and reached the decision to distribute two tablets to each resident of younger than 40 years old within these zones in each municipality. By

March 20, the Fukushima prefectural government had distributed approximately 1,000,000 stable iodine tablets to residents living in municipalities in the Hama-dori and Naka-dori districts.

Additionally, around and after March 15, some regional municipality offices surrounding the Fukushima Dai-ichi NPS distributed stable iodine tablets to their residents of their own accord. For example, on March 15, the Miharu-town town office not only distributed stable iodine tablets to its residents, but also instructed them to take the tablets. In the middle of the night of March 13, Miharu-town town officials learned that the radiation level had increased at the Onagawa Nuclear Power Station. Weather forecasts predicted rain with an easterly wind for the following day, March 15. Miharu-town town officials were afraid that its residents might be exposed to radiation and decided to distribute stable iodine tablets to its residents and instructed them to take the tablets. At 13:00 that day, Miharu-town town officials, using a municipal disaster management radio communication network, made sure that each and every resident was informed of this decision. They distributed stable iodine tablets to approximately 95% of object residents under supervision of the local pharmacists. Later, health and welfare service section staff of the regional medical division of the Fukushima prefectural government learned that the Miharu-town town office had distributed stable iodine tables and instructed intake subjects to take them without directives from either the national or local governments. In the evening of the same day, the section staff instructed Miharu-town officials to stop distributing stable iodine tablets and to recover all of them as there had been no instructions from the national government. Miharu-town town officials did not obey this demand.

(6) Damage to radiation emergency medical facilities

"What should be done in radiation emergency medical care and how" (refer to Section (5) a above) states it is critical that an radiation emergency medical care service system shall be implemented with integrated and organized operations and with mutual complementary roles of the following medical facilities to provide effective and efficient radiation exposure medical care: "medical facilities for primary radiation emergency medical treatment" to

provide initial medical care and emergency treatment, "medical facilities for secondary radiation emergency medical treatment" to provide professional treatment, and "medical facilities for tertiary radiation emergency medical treatment" to provide highly specialized treatment. In the manual for radiation emergency medical care activities in Fukushima Prefecture, the Fukushima prefectural government has designated the following five locations as medical facilities for primary radiation emergency treatment: (i) Fukushima Prefectural Ono Hospital in Okuma-town, Futaba-gun; (ii) Fukushima Prefecture Agricultural Cooperatives Futaba Welfare Hospital in Futaba-town, Futaba-gun; (iii) Imamura Hospital in Tomioka-town, Futaba-gun; (iv) Fukushima Rosai Hospital in Iwaki-city; and (v) Minami-soma City General Hospital in Minami-soma-city; and one location, as a medical facility for secondary radiation emergency medical treatment: Fukushima Medical University Hospital in Fukushima-city[87].

Three of the five medical facilities designated for primary radiation emergency medical treatment in Fukushima prefecture, Ono Hospital, Futaba Welfare Hospital, and Imamura Hospital, are located in Futaba-gun within a 10km radius of the Fukushima Dai-ichi NPS. These three hospitals were all exposed to large amounts of radioactive materials discharged from the Fukushima Dai-ichi NPS. According to an order issued by the head of the NERHQ at 05:44 on March 12, each of the three hospitals was in an evacuation zone, which prevented the hospitals from functioning as medical facilities for primary radiation emergency medical treatment. The other two medical facilities for primary radiation emergency medical treatment are located in Iwaki-city and Minami-soma-city. Minami-soma City General Hospital located in Minami-soma-city was located in what became a deliberate evacuation zone on April 22.

Additionally, as described above, pre-designated medical facilities for radiation emergency medical treatment and other medical organizations were not able to function at full capacity. Some of those who were injured at the Fukushima Dai-ichi NPS did not have their injuries

[87] "What should be done in radiation emergency medical care and how" states that medical facilities for primary radiation emergency treatment should be located "near nuclear facilities", and medical facilities for secondary radiation emergency treatment should be at a location "where patients or individuals exposed to radiation can be transferred from nuclear facilities or medical facilities for primary radiation emergency treatment in a proper manner and in a relatively short time." Additionally, MEXT has designated NIRS, in Chiba-city, as a medical facility for tertiary radiation emergency treatment for the eastern Japan block.

treated for three days. For example, a TEPCO staff member, who was near the reactor building of Unit 1, suffered a broken left arm during an explosion on March 12 and required an operation. He was initially transported in a TEPCO business vehicle to Ono Hospital, which had been designated as a medical facility for primary radiation emergency medical treatment. As per the description above, the hospital, which was in a deliberate evacuation zone, had already transferred all hospital functions to another location. After being transferred to another hospital he was denied the operation due to a lack of water. To make matters worse, he was separated from TEPCO staff who had been assisting him and thus was left alone without any money. Subsequently, this staff member was moved from one evacuation facility to another. En route to another evacuation facility, he was told that his clothes had been contaminated with radioactivity. Finally he had to surrender his contaminated clothes. It was at yet another evacuation facility that he was able to be supplied extra clothes to wear. Lists of evacuees helped this staff member learn of his family's whereabouts and he was finally able to get in touch with them. On March 14, he flew from Fukushima to Tokyo after his family reserved a flight for him. The next day, March 15, he visited NIRS to have radiation testing. Subsequently, he was able to have an operation on his left arm at a hospital in Tokyo.

5. Contamination of agricultural, livestock, marine products, the air, soil and water

(1) Contamination of water, beverages and food, and the response taken

a. Criteria on the restriction of shipment (before the nuclear accident)

Prior to the nuclear accident there was no criteria by which food and beverages contaminated with radioactive material was directly restricted. The only criteria on food and beverages contaminated with radioactive material was the Index[88] for restrictions on the intake of food and beverages indicated[89] by the NSC (refer to Section 4 (1) c above). The index is a guideline for discussions on whether or not it is necessary to take measures

[88] The National Basic Disaster Prevention Plan states that the NE Guideline established by the NSC shall be fully respected to determine professional and/or technical matters.

[89] The index for restrictions on the intake of food and beverages was established in 1998 based on guidelines from the NSC Environmental Working Group Specializing in Disaster Prevention Measures for Nuclear Power Stations.

to restrict food and beverages, but does not provide criteria for taking measures to restrict their shipment.

This index provides a guideline for each of the following five food categories: (i) drinking water, (ii) milk and dairy products, (iii) vegetables, (iv) grains, and (v) meat, eggs, fish, and other; in terms of: (i) radioactive cesium, (ii) uranium, and (iii) plutonium and three alpha-isotopes of transuranium elements; but only provides a guideline for radioactive iodine for the following three food categories: (i) drinking water, (ii) milk and dairy products, and (iii) vegetables (excluding root vegetables and tubers)[90].

The National Basic Disaster Prevention Plan stipulates that the national government shall conduct research on food and beverages contaminated with radioactive material to determine effective and useful measures and, if necessary, instruct relevant organizations to restrict shipment and/or intake of such contaminated food and beverages, and the local government implement the measures.

The Radiation Monitoring Guidelines[91] established by the NSC states that the air radiation dose rate, the atmospheric concentration of radioactive materials and the radioactivity concentration of environmental samples (drinking water, leafy vegetables, raw milk and rainwater) shall be measured as soon as possible immediately after a nuclear emergency and decisions regarding protective measures of what should be done and how it should be done shall be determined based on the measured cumulative dose. In addition, the manual for radiological environmental monitoring in an emergency, prepared by the Fukushima prefectural government, states that as soon as the government is informed of the occurrence of a specific incident, an emergency monitoring project shall be developed and implemented to determine the necessity of urgent actions and that the following items shall be measured: radioactive iodine and radioactive cesium included in environmental samples (drinking water, leafy vegetables, raw milk and rainwater), the air radiation dose rate and the concentration of radioactive iodine in the air.

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[90] It is explained that any food that involves an extended period of time between the incorporation of radioactive materials and the time of shipment was excluded.

[91] The National Basic Disaster Prevention Plan states that the NE Guideline established by the NSC shall be fully respected to determine professional and/or technical matters.

b. Detecting a high level radioactivity in plants

In response to the current nuclear accident, from March 12, emergency monitoring activities to measure the air radiation dose rates and perform dust sampling were conducted at local sites. However, there was no monitoring of leafy vegetables or raw milk[92].

On March 15, the Fukushima prefectural government collected weeds and measured them. As a result, radioactive materials that far exceeded the index values for placing restrictions on the intake of food and beverages were detected in weeds that had been collected at a location beyond a 30km radius of the Fukushima Dai-ichi NPS.

In response to this, the Fukushima prefectural government was worried about food and beverages contaminated with radioactive materials. During that time, however, there were only two germanium semi-conductor detectors available to measure the radioactivity, and local government officials were not ready to monitor a wide range of food and beverages. Hence, the local government asked the Local NERHQ to perform monitoring of food and beverages, which, under ordinary circumstances, they should have done themselves. In response to this request, the Local NERHQ decided to ask the Japan Chemical Analysis Center (JCAC) to perform monitoring of food and beverages. Thus through the mutual cooperation of both the Local NERHQ and the Fukushima prefectural government, full-scale implementation of food and beverage monitoring began in Fukushima Prefecture.

The Ministry of Agriculture, Forestry and Fisheries (MAFF) designed a framework[93] in which the full cost of monitoring would be borne by MAFF and all food products produced in local municipalities other than Fukushima Prefecture would be transported to and measured by Japan Food Research Laboratories and/or the National Institute for Agro-Environmental Sciences (NIAES). Municipalities successively started to contact measurement institutions themselves seeking cooperation in performing monitoring of food and beverages.

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[92] The Fukushima prefectural government staff in charge of this matter explained that this was because "we thought we had to analyze air dust first due to the very limited number of measurement instruments and equipment available."

[93] Initially, the two monitoring institutes were able to test a total of about forty samples a day.

c. Provisional regulation value for food and beverages

The MHLW, which is in charge of the Food Sanitation Act, had never examined the adequacy of existing criteria for strategies on what to do with food and beverages distributed within Japan if they were contaminated with radioactive materials.

On March 15, as described above, a high concentration of radioactive materials was detected in weeds that had been collected in Fukushima Prefecture. The MHLW staff in charge of this matter thought some action should be taken with regard to the radioactive contamination of food. They determined, however, that any action should be consistent with the Act on Special Measures Concerning Nuclear Emergency Preparedness. In other words, they did not imagine that any action could be taken on the basis of the Food Sanitation Act. Meanwhile, MAFF was worried that agricultural products might be seriously impacted by rumors. Hence, they determined that in order to prevent agricultural products from being negatively affected by rumors, it was necessary to develop general criteria for deciding whether or not any food in question should be allowed to be distributed within disaster-affected regions as well as to non-affected regions. On March 16, MAFF strongly urged the MHLW to implement criteria for food exposed to radioactive materials in accordance with the Food Sanitation Act. In addition to this urgent request from MAFF, the MHLW itself determined that it was necessary to examine food distributed in a wide range of areas on the basis of the Food Sanitation Act and decided to examine the adequacy of criteria for radioactive material as prescribed in the Act. Finally, the MHLW decided that the index for restrictions on the intake of food and beverages, which the NSC had implemented based on the simulation of a nuclear accident within Japan, should be adopted in order to take swift and appropriate action and solve the current emergency situation. The MHLW decided to adopt the Index as the provisional regulation value for food and beverages in accordance with the Food Sanitation Act. The MHLW naturally took into consideration the significant potential effects of radioactive iodine on childhood thyroid cancer and adopted the Codex Index[94] (100Bq/kg as the criterion for all

[94] Codex Standards, which include food standards, guidelines and codes of practice to protect the health of consumers and ensure fair trade practices in food trade, are implemented by the Codex Alimentarius Commission established by the United Nations, FAO and WHO.

food and beverages in terms of radioactive iodine). The MHLW also decided that milk and dairy products exceeding the criterion of 100Bq/kg should not be used for modified dry milk for infant or for milk to be directly consumed. Additionally, on March 17, the MHLW issued a notice to all prefectural governments to the effect that the index value indicated by the NSC should be adopted as a temporary provisional regulation value (hereinafter referred to as "provisional regulation values") and that any food or beverages exceeding this criteria should not be provided for human consumption pursuant to Paragraph 2 of Article 6 of the Food Sanitation Act.

In terms of the Basic Food Safety Act, the MHLW did not have to ask the Food Safety Commission for advice (hereinafter referred to as "Advice") on the effects of the implemented provisional regulation values on food security and health. However, the MHLW decided that it was proper to ask for arbitrary advice in accordance with Paragraph 3 of Article 24 of the same Act. On the other hand, Article 11 of the Act stipulates that in a situation where the MHLW must ask the Food Safety Commission for advice, the MHLW does not have to comply in the event of an exceptionally urgent case. The MHLW implemented the provisional regulation values after deciding that they had to take urgent action on food and beverages contaminated with radioactive materials[95].

Additionally, on March 20, the MHLW minister asked the Food Safety Commission for advice on the index value (provisional regulation value) for radioactive material in food and beverages. On October 27 of the same year, the Food Safety Commission issued a notice addressed to the MHLW minister on the effects of the implemented provisional regulation value on food security and health in which no evaluation results per radionuclide were provided.

d. Provisional regulation value for seafood

On April 4 of the same year, 4,080Bq/kg of iodine 131 was detected in young sand eels that were caught off the coast of Ibaraki Prefecture on April 1. Detailed data was sent to the MHLW.

[95] Thus the provisional regulation value, which had been implemented without advice from the Food Safety Commission, is called a "provisional regulation value."

As described above, the NSC Indices for restricting the intake of food and beverages contain no criteria for the restriction of seafood contaminated with radioactive materials nor do the provisional regulation values based on the Indices for restricting the intake of food and beverages. Hence, the MHLW decided that it was necessary to implement temporary regulation values for seafood in terms of radioactive iodine and thus began an urgent discussion with the NSC. As a result of the discussion, the MHLW decided to adopt 2,000Bq/kg as a criterion value for seafood in terms of radioactive iodine, with the understanding that a criterion value of 300Bq/kg for drinking water, milk and dairy products, and a criterion value of 2,000Bq/kg for vegetables in terms of radioactive iodine were already implemented as regulation values and could be used as references, and because both seafood and vegetables were classified as solid food,. On April 5, on the basis of the advice[96] of the NSC, the MHLW issued a notice to all local governments to the effect that provisional regulation values for seafood in terms of radioactive iodine should be 2,000Bq/kg and that any seafood exceeding this criterion should not be provided for human consumption pursuant to Paragraph 2 of Article 6 of the Food Sanitation Act.

e. Provisional regulation values for tea

Tea was classified as "other" in the Index for restricting the intake of food and beverages. The provisional regulation value for tea was 500Bq/kg. On May 11 of the same year, radioactive cesium exceeding the provisional regulation value of 500Bq/kg was detected in green tea leaves produced in Kanagawa Prefecture. In response to this, the MHLW asked fourteen local governments to perform more intensive monitoring of green tea leaves. Additionally, on May 13, radioactive cesium exceeding the provisional regulation value was detected in unrefined (dried) tea leaves produced in Kanagawa Prefecture. In response to this, on May 16, the MHLW asked fourteen local governments to perform monitoring

[96] The NSC has maintained one-third of 50mSv of thyroid gland equivalent dose (refer to Section 4 (1) c above), which has been the intervention radiation dose level for food outside the three categories as defined in the Index for restrictions on the intake of food and beverages, since the NSC first developed the Index values. The NSC obtained calculation results indicating that radiation dose would be within the maintained value even if an additional 2,000Bq/kg were ingested from seafood for one year. Thus, the NSC replied to the effect that a criterion value of 2,000Bq/kg for vegetables could provisionally and safely be applied to the index value for seafood in terms of radioactive iodine using the Index for restricting the intake of food and beverages as a reference.

of unrefined tea leaves to restrict the distribution of unrefined tea leaves that exceeded the provisional regulation value (500Bq/kg).

Because unrefined tea leaves were monitored with the same criteria as green leaves, there was a consensus among the relevant local governments[97] and within the national government that monitoring unrefined tea leaves according to the same criteria as green leaves did not fit reality based on the following reasoning: unrefined tea leaves may have a concentration of radioactive cesium five times greater than that of green leaves because they are dry-processed; and tea, which is nearly always for drinking, is prepared by steeping tea leaves in hot water reducing concentration levels. However, on June 2 of the same year, the MHLW issued a notice to the effect that the same temporary regulation value should be applied to all types of tea leaves including unrefined tea leaves on a regular basis. Relevant industry groups, worried that tea products might be negatively affected by rumors, strongly recommended the monitoring of tea leaves. Ultimately, all local governments decided to perform monitoring of unrefined tea leaves.

f. Restriction of tap water intake

With the exception of the Index developed by the NSC (300Bq/kg for radioactive iodine and 200Bq/kg for radioactive cesium), no provisional regulation value has been defined for tap water.

On March 18 of the same year, 170Bq/kg of radioactive iodine was detected in tap water that had been collected in Fukushima-city on March 16. In response to this, the MHLW started to discuss developing criterion values for tap water just as they had for food and beverages. On March 19, the MHLW notified all municipalities of "Measures to be taken for tap water to protect citizens from radiation exposure resulting from the Fukushima Dai-ichi NPS and Fukushima Dai-ni NPS," which included: (i) refraining from drinking tap water exceeding index values indicated by the NSC (300Bq/kg of radioactive iodine, 200Bq/kg of radioactive cesium); (ii) tap water may be used for domestic use

[97] Some municipalities, which had believed that monitoring unrefined tea leaves according to the same criteria as green leaves had little scientific basis, initially refused to monitor unrefined tea leaves. However, relevant industry groups strongly urged them to reconsider and eventually each of them decided to comply.

without any concern; and (iii) drinking tap water is not restricted if there is no access to alternative drinking water[98].

This notice did not mention drinking water for infants. Subsequently, more than 100Bq/kg of radioactive iodine was detected in tap water in Fukushima-city. On March 21, the MHLW notified municipalities to the effect that water suppliers should promptly inform citizens to refrain from providing tap water to infants if their tap water exceeded 100Bq/kg of radioactive iodine.

Additionally, the monitoring of tap water was strengthened. On March 18, MEXT notified all local governments of the "Strengthening of monitoring of environmental radioactivity levels nationwide in an emergency at the Fukushima Dai-ichi NPS and Fukushima Dai-ni NPS" to the effect that nuclide analysis of clean water (tap water) should be performed and the results should be reported to MEXT. Moreover, on March 21, the MHLW asked all local governments to provide the ministry with tap water monitoring information that had been requested by MEXT as well as any additional tap water monitoring information, if available.

Subsequently, based on the results of that monitoring, the MHLW asked municipalities to restrict the intake of tap water if their tap water supply was found to contain levels exceeding the index value[99].

On April 4 of the same year, based on up-to-date monitoring results, the MHLW issued a "Future monitoring policy on radioactive materials in tap water[100]," in which monitoring

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[98] The notice provided by the MHLW states that criterion values for radiological protection established by the International Commission on Radiological Protection (ICRP) on which the index values indicated by the NSC are based, took into consideration the effects of long -term exposure to radiation; the temporary intake of water exceeding the ICRP index may not have any effect on human health; and the intake of tap water based on the ICRP Pub. 63 "Principles for Intervention for Protection of the Public in a Radiological Emergency" may not be restricted in a situation where safe alternative drinking water is not easily available and there is serious concern for human health as a result.

[99] On March 21, the MHLW asked Iitate-village village office in Fukushima Prefecture to restrict the intake of tap water and then asked the Fukushima, Ibaraki, Chiba, and Tokyo prefectural governments to restrict the intake of tap water by infants in certain areas in each prefecture.

[100] The MHLW: (i) requested local governments to carry out monitoring of tap water mainly in Fukushima Prefecture and its neighboring ten prefectures more than once a week; (ii) requested water operators to implement intake restrictions and notify affected residents of these restrictions if radioactive material in the tap water exceeded the guideline values for three consecutive days; (iii) decided to lift restrictions if monitoring findings averaged below the provisional limit values for three consecutive days and if monitoring results indicated that monitoring findings showed signs of decreasing.

policy, intake restrictions and guidelines for lifting restrictions were stipulated (this policy was revised on June 30 of the same year, based on the premise that the effects of the Fukushima Dai-ichi NPS accident were going stabilize.

g. Shipping restrictions

The National Basic Disaster Prevention Plan stipulates that the national government shall conduct research on the radioactivity contamination of food and beverages to determine effective and useful measures and, if necessary, instruct relevant organizations to restrict the shipment and/or intake of any contaminated food and beverages.

On March 15, a high concentration of radioactive material was detected in weeds that had been collected (refer to b above). On March 17 of the same year, the NERHQ started[101] a discussion on measures to be taken for contaminated food and beverages

On March 19 and 20, radioactive material exceeding the temporary regulation value was detected in: (i) raw milk from Fukushima prefecture; (ii) spinach from Ibaraki, Tochigi and Gunma prefectures; and (iii) leafy vegetables from Gunma prefecture. In response to this, on March 21, head of the Government Emergency Response Center provided the leaders of the Fukushima, Ibaraki, Tochigi, and Gunma prefectural governments with instructions to restrict shipment based on Paragraph 3, Article 20 of the Act on Special Measures Concerning Nuclear Emergency Preparedness, of (i) raw milk from Fukushima prefecture, and (ii) spinach and leafy vegetables from Ibaraki, Tochigi and Gunma prefectures[102]. Additionally, on March 22, it was discovered that a high concentration of radioactive material was detected in some vegetables from Fukushima Prefecture. On March 23, the

[101] The framework designed within the national government to issue instructions to restrict the shipment of food and beverages was as follows: local municipalities are to perform monitoring of food and beverages; monitoring results are to be collected, aggregated, and unified by the MHLW; unified monitoring results are to be reported to the NERHQ; the NERHQ will evaluate monitoring results to determine whether or not provisional regulation values of Food Sanitation Act have been exceeded; and if exceeded, the NERHQ will ask the NSC for advice, and, if necessary, the head of the NERHQ will issue instructions to all relevant municipalities to restrict the shipment and intake of food and beverages, based on Paragraph 3, Article 20 of the Act on Special Measures Concerning Nuclear Emergency Preparedness.

[102] The range of monitoring results was not always consistent with shipment restrictions. For example, if the shipment of spinach from three other prefectures were restricted, then spinach from Fukushima was also restricted even if its monitoring results were not arrived „ as it was presumed to have a higher level of radioactivity, because of its proximity to the Fukushima Dai-ichi NPS.

Government Emergency Response Center provided the head of Fukushima prefectural government with instructions to restrict the shipment and intake of certain vegetables. Subsequently, instructions to restrict shipment were successively issued.

Subsequently, on April 4 of the same year, the NERHQ issued a notice for "Strategies for monitoring planning, shipping restrictions and abolishing shipping restrictions on the basis of products and regions" for the following reasons: many municipalities asked the NERHQ to restrict shipment on a per-region basis rather than on a per-prefecture basis, and the NERHQ determined that it was necessary to establish requirements to abolish shipping restrictions. This notice states that: (i) shipment of a product shall be restricted if it is anticipated that a significant quantity of the product exceeds a temporary regulation value within a wider range of regions and intake of a product shall be restricted if a significantly high concentration of radioactive material is detected in the product; (ii) regions shall be established on a per-prefecture-basis, however, regions shall be established on a per-block basis if the relevant prefectural or municipal office can afford to manage and maintain them; and (iii) shipping restrictions shall be lifted on a per-region basis by dividing a prefecture into more than one region, monitoring shall be performed weekly on a per-region basis in more than one municipality, and if inspection findings register below provisional limit values three consecutive times, then restrictions shall be lifted if an application is made by the relevant municipal office.

From the same day, each of the municipalities planned and performed monitoring of food and beverages according to the policy described above. The NERHQ instructed them to restrict shipment or lift shipping restrictions accordingly.

It was discovered that lower levels of radioactive iodine were detected in food and beverages while radioactive cesium exceeding provisional regulation values was detected in some food products. Based on this finding, on June 27 of the same year, the NERHQ revised their previous policy, which had gone into effect on April 4 of the same year, to include the following new provisions: (i) a product with limited shipping time shall be monitored at least three days before it is due to be shipped; and (ii) restrictions on shipment shall be lifted according to the following conditions: restrictions on shipment based on the detection of radioactive iodine shall be managed as per the conditions described above

while restrictions on shipment based on radioactive cesium shall be managed on a per-region basis; and restrictions on shipment shall be lifted if all monitoring results gathered from more than three locations per municipality within the previous month are below provisional regulation values.

On August 4 of the same year, the NERHQ revised their notice of "Monitoring planning, developing shipping restrictions and abolishing shipping restrictions on the basis of products and regions" for the following reasons: radioactive cesium exceeding provisional regulation values was detected in beef, and the time for harvesting rice was approaching (refer to Section h(b) above).

h. Other problems concerning shipping restrictions

(a) Farm animals (cattle) feed

On March 19 of the same year, MAFF provided cattle farmers with a "Notice on farming management" (hereinafter referred to as "Notice on Farming Management") via prefectural governments in the Tohoku and Kanto[103] districts to the effect that in order to prevent or reduce contamination of livestock products with radioactive material, cattle raised in regions where airborne radiation levels higher than normal have been detected shall be fed with hay from grass that has been cut, gathered and stored prior to the date of the nuclear accident in Fukushima Prefecture and stored indoors beyond that date; drinking water for cattle shall be kept in a sealed water tank to prevent falling dust particles from entering; and cattle will not be sent to graze until further notice.

Additionally, on April 14 of the same year, MAFF provided cattle farmers with a notice via prefectural governments in the Tohoku and Kanto districts to the effect that in order to prevent or reduce the contamination of cattle with radioactive material via farm coarse feed (including pasture grass and straw), a provisional permissible value[104] of

[103] This notice was sent to six prefectural governments in the Tohoku district under the jurisdiction of the Tohoku Regional Agricultural Administration Office (Aomori, Iwate, Miyagi, Akita, Yamagata and Fukushima) and ten prefectural governments in the Kanto district under the jurisdiction of the Kanto Regional Agricultural Administration Office (Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Nagano, Yamanashi and Shizuoka). It was also sent to other prefectural governments from the Agricultural Administration Offices as a reference. Therefore, this notice was only meant as a reference for cattle farmers in Niigata Prefecture.

[104] The notice also prescribes that, in terms of dairy cattle feed, the provisional permissible value of radioactive

radioactive material contained in farm coarse feed (including pasture grass and straw) would be established, and that values of radioactive material contained in farm coarse feed that is produced hereafter shall, if used for cattle, be below the prescribed provisional permissible value.

Additionally, on August 1 of that year, prior to the upcoming rice and wheat fall harvest season, MAFF notified all prefectural governments that in order to prevent contamination of cattle with radioactive material via rice bran and wheat bran, a provisional permissible value[105] of radioactive material contained in farm coarse feed as well as in cattle feed including rice bran and wheat bran shall be established. MAFF also notified all prefectural governments that the use, production, or distribution of cattle feed exceeding provisional permissible values shall be avoided.

(b) Measures for beef

On July 8 of the same year, radioactive cesium exceeding the temporary regulation value (500Bq/kg) was detected in beef shipped from Fukushima Prefecture. Subsequently, radioactive cesium exceeding the temporary regulation value was detected in beef shipped from prefectures other than Fukushima Prefecture.

The root of this problem was that the Notice on Farming Management was only addressed to cattle farmers. The Notice was not communicated to grain farmers, who produced rice straw. Furthermore, information and guidance provided to cattle farmers was inadequate and it was discovered that cattle farmers had fed their cattle rice straw that had been stored outdoors and most likely contaminated with radioactive material.

On July 19, the NERHQ instructed the Fukushima prefectural government to restrict the shipment of commercial cattle and subsequently, on August 2, instructed the Miyagi, Iwate, and Tochigi prefectural governments to restrict the shipment of commercial cattle.

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iodine and radioactive cesium shall be 70Bq/kg and 300Bq/kg, respectively, in terms of commercial cattle feed, the radioactive cesium value will be 300Bq/kg, and in terms of cattle feed for cattle other than dairy cattle and commercial cattle, the radioactive cesium value will be 5,000Bq/kg.

[105] The notice also prescribes that the maximum provisional permissible value of radioactive cesium contained in feed for commercial cattle, horses, pigs, domestic fowls and other domestic animals shall be 300Bq/kg and 100Bq/kg in feed for cultured fishes.

On August 4 the NERHQ updated their notice on "Strategies for monitoring planning, developing shipping restrictions and abolishing shipping restrictions, on the basis of products and regions" (established on April 4 of the same year, revised on June 27 of the same year (refer to Section g above)) and agreed to partially lift shipping restrictions based on the premise that all cattle or all cattle farms would be tested[106].

On and after August 19 of the same year, the local governments that had been instructed to restrict the shipment of beef developed a policy to test and ship commercial cattle, and submitted an application to the NERHQ requesting that shipping restrictions be lifted. In response to their request, the NERHQ lifted shipping restrictions on commercial cattle that had been raised and managed according to the government policy for testing and shipping commercial cattle.

(c) Measures for rice harvested in 2011

On April 8 of the same year, the head of the NERHQ obtained a transfer coefficient (0.1) of radioactive cesium transferred from soil to unpolished rice based on the results of analyses performed by the National Institute for Agro-Environmental Sciences on rice fields and harvested rice. The NERHQ issued a policy to the effect that the upper limit of radioactive cesium shall be 5,000Bq/kg so that the concentration of radioactive cesium contained in unpolished rice would be below the provisional regulation value (500Bq/kg) pursuant to the Food Sanitation Act, and that planting restrictions should be ordered to prohibit the planting of rice seedlings in regions where radioactive cesium contained in freshly harvested rice would most likely exceed the provisional regulation value.

On April 22, the NERHQ issued a planting restriction order to the head of the Fukushima prefectural government to restrict the planting of rice seedlings within a 20km radius of the Fukushima Dai-ichi NPS as well as in deliberate evacuation zones and emergency evacuation preparation zones.

In August of the same year, MAFF released a plan to conduct a two-stage research process due to the following circumstance: rice is a staple food, a large amount of rice is

[106] One or more of the commercial cattle first shipped is tested on a per-farm based.

grown and eaten in Japan and there are various types of distribution systems in Japan. In the first stage, prior to the upcoming rice fall harvest season in 2011, a preliminary survey[107] should be conducted to study the trends in the concentration of radioactive material. In the second stage, a main survey[108] should be conducted to determine whether or not shipping restrictions are required after the rice harvest. In the main survey, the provisional regulation value was not exceeded in any region. However, on and before November 30 of the same year, radioactive cesium exceeding the provisional regulation value was detected in unpolished rice (not tested by direct sampling in the main survey) that was produced in Fukushima-city (formerly Oguni-village) and Date-city (formerly Oguni-village and Tsukidate-village). In response to this situation, the NERHQ instructed the Fukushima prefectural government to restrict the shipment of rice produced in these aforementioned regions in 2011.

(2) Contamination of soil, etc.

a. Schoolyards and the other educational facilities in Fukushima Prefecture

Fukushima Prefecture requested the Local NERHQ to indicate the criteria for reopening the schools and the other educational facilities in the prefecture. In response to the request, MEXT began to consider the criteria.

From April 6 to 7, MEXT requested the Nuclear Safety Commission to deliberate on the criteria for reopening by presenting the results of the air radiation dose rate measurements that Fukushima Prefecture took in the schoolyards of elementary and junior high schools, preschools and nursery schools within the prefecture (except those in the evacuation area within a 20km radius of the Fukushima Dai-ichi NPS). However, the Commission, as an advisory agent, replied to the Ministry that some planned criteria should be proposed first.

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[107] The following decisions were made: (i) municipalities that have been instructed to restrict shipment, (ii) their neighboring municipalities, and (iii) those cities, towns and villages of other municipalities where radioactive cesium contained in farmland soil exceeds 1,000Bq/kg as well as where air radiation dose rates exceed 0.1μSv/h, should perform a similar survey for three consecutive days, one week prior to harvesting. Those municipalities whose results indicate a value exceeding 200Bq/kg shall be "regions requiring an intensive survey" for the main survey and those whose results indicate a value below 200Bq/kg shall be "regions requiring a basic survey."

[108] In "regions requiring an intensive survey" one sample was collected per approximately 15ha and in "regions requiring a basic survey" samples were collected per city, town, or village based on previous smaller populations, which preceded the merging of many villages and towns into larger cities (an average of seven samples per municipality).

On April 8, MEXT was directed by the Prime Minister's Office to deliberate on the criteria for the use of school facilities as a matter of the whole Government. Therefore MEXT began consulting on the criteria of use with the Nuclear Safety Commission.

At the time, MEXT believed that it was necessary to consider the consistency of the criteria for the establishment of the planned evacuation area, which was deliberated within the Government, and the contribution of internal exposure. On April 11, the NERHQ specified the area where the cumulative radiation dose may exceed 20mSv as the planned evacuation area based on the criteria of 20-100mSv that had been established by the ICPR in the event of an emergency when evacuation is required (a reference level for public exposure in the event of an "radiation emergency situation" in the recommendation issued in 2007). MEXT decided 20mSv/year, which is the upper limit established by the ICPR for a situation after an accident has stabilized (a reference level for public exposure in the event of an "exiting exposure situation" in the recommendation issued in 2007) as the criterion[109・110]. Further, MEXT estimated that the contribution of the internal radiation dose to the whole radiation dose is 0 to 5.6% (2.2% on average). Because this contribution was small, the Ministry decided not to take the effect of internal exposure into consideration and to calculate the total exposure as external exposure. Assuming a student stays indoors for 16 hours and outdoors (in schoolyard) for eight hours a day, an air radiation dose rate of 3.8μSv/h corresponds to 20mSv/year of exposure. Therefore MEXT decided to adopt this value as a guide. Furthermore, the Ministry considered that "it is appropriate to decrease the dose rate that students are exposed to as much as possible while adopting the criterion of 1 - 20mSv/year as the reference level after an emergency situation has stabilized as a tentative guideline," and "even if an air radiation dose rate exceeding 3.8μSv/hour is measured, the level that students are exposed to can be limited to 20mSv/year by taking countermeasures to ensure activities are mainly done indoors." Based on this consideration, MEXT established the "Provisional view regarding the judgment of the use of schoolyards

[109] When establishing the criterion of 20mSv/year, MEXT took the risk of confusing the local governments when the national government indicated a criterion that was too low into consideration because the Fukushima Radiation Health Risk Adviser explained that exposure below 100mSv does not affect health.

[110] The Education Minister explained in parliament that 20mSv/year, which is the lower limit of the reference level of 20 - 100mSv/year, was the starting point of the deliberation on the criterion. It is now under investigation as to why such an explanation was made.

and educational facilities in Fukushima Prefecture" indicating that: (1) activities in the schoolyard should be restricted to approximately one hour a day when an air radiation dose rate exceeding 3.8μSv/h is detected in the schoolyard, and (2) the schoolyard can be used as usual when an air radiation dose rate below 3.8μSv/h is detected. MEXT submitted this provisional view to the NSC via the NERHQ and asked for its advice on April 19. This view meant that no upper limit was established on the air radiation dose rate for schoolyards that can be used as per (1) above, and the schoolyard can be used without any limitation when the air radiation dose rate is less than 3.8μSv/h as per (2).

Considering that it is required to reduce the radiation dose of students as much as possible, the NSC Japan admitted in its response to the request from MEXT that the view of the NERHQ was to minimize the radiation doses of students, on condition that: (1) the results of measurements such as the consecutive monitoring should be reported to the Committee approximately once every two weeks, and (2) approximately one pocket dosimeter should be distributed to each school and provided to a faculty staff member who represents the activity pattern of the students to check the exposure condition.

On the same day, after receiving this response, MEXT notified Fukushima Prefecture of the abovementioned "Provisional view regarding the judgment of the use of schoolyards and educational facilities in Fukushima Prefecture" with the condition indicated in the NSC 's advice.

On May 11, MEXT suggested two measures for the surface soil in the schoolyard, "to intensively gather and store underground" and the "upside-down replacement method," as effective exposure reduction methods based on the result of the investigation conducted by JAEA. On May 27, the Ministry decided to provide financial support to the owners of educational facilities that implemented the exposure reduction method for the soil in their schoolyards in schools where air radiation dose rates exceeding 1μSv/h were detected.

On August 26, MEXT indicated the level that students would be exposed to should be 1mSv/year or less in schools after the summer vacation ended and the air radiation level rate of 1μSv/h or less as the guide to meeting the criterion. The Ministry also suggested that, although it is not required to restrict outdoor activities even if the air radiation dose rate exceeded the guide, it was preferable that measures such as decontamination were

taken promptly, and it was important to identify and decontaminate the area where high radiation doses were detected locally.

Additionally, after April 14, MEXT consecutively monitored the schoolyards of 52 schools where relatively high air radiation dose rates (3.7μSv/h or higher) had been detected during the monitoring performed by Fukushima Prefecture from April 5 to 7. As a result, air radiation dose rates of 3.8μSv/h or higher were detected in 13 facilities on April 14, however, an air radiation dose rates of 3.8μSv/h or higher was not detected in any school after May 12. The highest level on August 25 was 0.8μSv/h[111].

b. Criteria for disaster waste disposal

An extremely large amount of disaster waste was produced by the earthquake and tsunami. The Waste Management and Public Cleansing Act does not apply to waste that is contaminated with radioactive materials (Article 2 Clause 1 of the Act) and there is no other law that regulates the disposal of disaster waste contaminated with radioactive materials.[112] Therefore the Ministry of the Environment established the criteria for disposal in consultation with the Ministry of Health, Labour and Welfare and METI.

On May 2, the Ministry of the Environment decided in consultation with the related ministries and agencies to conduct an investigation into the concentration of radioactive materials in the disaster waste in the Hamadori and Nakadori regions of Fukushima Prefecture, then continued further studies based on the results of this investigation and presented the "Disposal Guideline for Disaster Waste in Fukushima Prefecture" on June 23. In this guideline, the Ministry indicated several criteria such as: the incinerated ash of the disaster waste may be disposed in landfill when the concentration of radioactive cesium is 8,000Bq/kg or less; when the concentration is between 8,000Bq/kg and 100,000Bq/kg, preferably the ash should be stored temporarily until the safety of disposal is confirmed;

[111] The air radiation dose rates were measured 1m above the ground in junior high schools and 50cm above the ground in elementary schools, preschools and nursery schools.

[112] The "Act on Special Measures Concerning Environmental Contamination Caused by Radioactive Materials Discharged by the Nuclear Power Station Accident Caused by the Tohoku district off- the Pacific Ocean Earthquake on March 11, 2011" was enacted on August 26 as a makeshift act for this gap (the provision related to waste disposal came into effect on January 1, 2012). This Act stipulates that the Government shall dispose of waste contaminated with radioactive materials originating from the accident at the Fukushima Dai-ichi NPS.

and preferably the ash should be stored within a facility that is capable of shielding radiation when the concentration exceeds 100,000Bq/kg.

Because radioactive materials of high concentration were detected in the incinerated ash of the waste even in prefectures other than Fukushima, the Ministry of the Environment presented the "Present Guideline for Measurement and Handling of Incinerated Ash in General Waste Incineration Facilities" as a standard for the handling of the incinerated ash according to the disposal policy for the disaster waste in Fukushima Prefecture to 16 prefectures in the Tohoku, Kanto and other districts on June 28.

On August 31, the Ministry of the Environment indicated a policy that permitted the disposal of incinerated ash with a concentration of radioactive cesium in the range of 8,000Bq/kg to 100,000Bq/kg in landfill, which had been previously been considered preferable to be stored temporarily until the safety of its disposal was confirmed, on condition that: (1) public water areas and groundwater should be protected from contamination by radioactive cesium, and (2) the landfill sites should be placed under long-term control including restrictions on the use of the site.

c. Sewage sludge

On April 30, a high concentration of radioactive cesium was detected in sewage sludge in Fukushima Prefecture. After this was reported, inspections for radioactive materials in sewage sludge were conducted in other prefectures and similarly high concentrations were detected.

There are two types of sewage treatment: (1) combined sewerage (which collects the sewage and rainwater in the same sewage pipe for transfer to a sewage treatment plant), and (2) separate sewerage (which collects the sewage and rainwater in separate pipes that transfer only the sewage to a sewage treatment plant and let the rainwater flow into a river and/or the ocean). The high concentrations were detected in the sludge in the sewage treatment plants of the combined sewerage system. Therefore it is believed that the high concentrations of radioactive materials were detected because of the dispersed radioactive materials which were carried by the rainwater to the sewage treatment plants and concentrated there.

On May 12, the NERHQ presented "Concept of Provisional Handling of Sewage By-products in Fukushima Prefecture" to indicate that the dehydrated sludge with a relatively high concentration exceeding 100,000Bq/kg should be stored appropriately after volume reduction in the prefecture whenever possible.

On June 16, at the request of other prefectures to indicate a criterion for the dehydrated sludge, the NERHQ presented "Provisional View on By-products of Sewage Treatment and the like in which a High Concentration of Radioactive Materials is Detected" to indicate that: the sludge in which radioactive cesium over 100,000Bq/kg has been detected preferably should, where possible, be stored in a facility that is capable of shielding radiation within the prefecture from where the sludge originated; sludge with radioactive cesium of 8,000Bq/kg or less may be disposed of in landfill on certain conditions, such the landfill site not be used for residential purposes; and sludge with radioactive cesium in the range of 8,000Bq/kg to 100,000Bq/kg may be disposed of in landfill under certain control conditions.

d. Disposal site for sewage sludge and the like

The Nuclear Emergency Response Center and the Ministry of the Environment indicated the disposal criteria for dehydrated sludge and incinerated ash containing radioactive materials. However, their disposal and reuse have not progressed because of opposition from the inhabitants around the disposal sites and rejection from the disposal operators, therefore some sewage treatment plants and waste incineration facilities are still being forced to store the sewage sludge and incinerated ash that has not been accepted[113].

[113] In addition, a large amount of rubble was produced by the earthquake and tsunami mainly within the Tohoku district. However, its disposal has not progressed either because parts of it may be contaminated with radioactive material. For waste that is contaminated with radioactive materials originating from the accident at the Fukushima Dai-ichi NPS, the "Act on Special Measures Concerning Environmental Contamination Caused by Radioactive Materials Discharged in the Nuclear Power Station Accident Caused by the Tohoku district – off the Pacific Ocean Earthquake on March 11, 2011" was enacted on August 26 (the provision related to waste disposal came into effect in January 1, 2012). This Act prescribes that the Government shall dispose of waste that is contaminated with radioactive materials originating from the accident at the Fukushima Dai-ichi NPS.

(3) Contamination of seawater, pool water, etc.

a. Criteria for bathing areas

On June 7, the Ministry of the Environment began to deliberate on guideline regarding the use of bathing areas in response to the directive from Chief Cabinet Secretary Edano. On June 14, the Ministry held the Roundtable Conference for Radioactive Materials in Bathing Areas to hear from experts on radioactive materials. On June 24, on the basis of advice from the NSC Japan, the Ministry presented a guideline about radioactive materials in bathing areas that indicated: (1) radioactive cesium of 50Bq/liter or less and radioactive iodine of 30Bq/liter or less should be considered as the provisional guideline for the summer of 2011; (2) managers of bathing areas preferably should monitor the concentration of radioactive materials in the water and display the result on a placard or some other means; (3) managers and users of bathing areas preferably should take measures to reduce the effective radiation dose; and (4) managers of bathing areas preferably should monitor the air radiation dose rate at the beach and the like and caution users displaying the result on a placard or some other means when an air radiation dose rate higher than the surrounding area is detected.

b. Use of outdoor swimming pools in schools in Fukushima Prefecture

On June, MEXT decided not to indicate any guidelines for assessing the use of outdoor swimming pools because radioactive iodine, cesium and other radioactive materials had not been detected in the tap water of Fukushima Prefecture and it was thought students would only be exposed to very low levels of radiation from the water in swimming pools. When using outdoor swimming pools, the levels of radiation that students will be exposed to should be estimated by monitoring the water in the pool.

(4) Measures taken to prevent the dispersal of contaminated material from the premises of the Fukushima Dai-ichi NPS

a. Scattering inhibitor

TEPCO began to deliberate on measures to inhibit the scattering of the radioactive materials originating from the Fukushima Dai-ichi NPS after the accident then decided

to disperse an inhibitor inside the Fukushima Dai-ichi NPS facilities. Then as from April 1, TEPCO began dispersal testing to check the coagulation status of the inhibitor and the impact on the electrical systems of the reactors and the spent fuel pools. As a result, it was decided that organic and inorganic solidifying agents would be used properly in each dispersal area because the organic agents flocculates with radiation exposure in water and might block the route of the fuel cooling water. Full-scale dispersal was started on April 26 conducted manually and by using water wagons and water-cannon trucks, and controlled from a remote location when high air radiation dose was detected. Until June 28, 1,150,000 liters of scattering inhibitor was dispersed over 560,000 square meters of the buildings and the site of the Fukushima Dai-ichi NPS.

b. Removal of debris at the facilities

On March 12, TEPCO began to remove the debris scattered within the premises of the power station facilities to provide access for the vehicles used in the recovery work. However, the radiation doses of workers involved in removing the debris increased because a large amount of the debris contaminated by a high concentration of radioactive materials was produced by the hydrogen explosion and other incidents. Therefore, TEPCO deliberated on the removal of debris by remote controlled heavy equipment. TEPCO started removal by remote controlled heavy equipment on April 6 in addition to the work by manned heavy equipment that had been conducted, and completed the planned debris removal work in September. Furthermore, as of August, TEPCO introduced dust collectors in places where the air radiation dose rate did not decrease even after large debris had been removed to eliminate small debris and dust that could not be removed by remote controlled heavy equipment.

To prevent workers being exposed to radiation caused by the removed debris, TEPCO is storing the debris in a place far from where the workers were involved in the tasks. The debris with high radiation doses (approx. 11,000m^3 as of the end of September) is contained in a facility or vessel that is capable of shielding radiation, and debris with low radiation doses (approx. 14,000m^3 as of the end of September) is stored outdoors under a sheet to prevent it from scattering within the premises of the Fukushima Dai-ichi NPS.

c. Installation of reactor building cover

After the explosion in the reactor buildings of the Fukushima Dai-ichi NPS, TEPCO planned to cover the reactor buildings to prevent radioactive materials from scattering which were originating from Units 1, 3 and 4, whose outer walls and the other parts of the reactor buildings were damaged. Then TEPCO decided to start the installation work at Unit 1 because its framework of the upper part of the building was not severely warped and first it was discovered that the cover could be installed. On June 28, the full-scale installation work began and it was completed on October 28. For Units 3 and 4, the removal of debris contaminated with radioactive materials and left on the upper part of the buildings is being conducted as preparatory work for the cover installation.

6. Occurrence and treatment of contaminated water

(1) Details of responses to the contaminated water

a. Responses to the flooding of groundwater in the basement of Unit 6

(a) Responses to the flooding in the Metal-Clad (MC) room of Unit 6

On March 19, TEPCO found flooding in the electricity panel room (hereinafter referred to as "MC room") on the second basement floor of Unit 6 (see Attachments V-3 and V-4). Staff cleaned it up because the amount of flooding was so small, but the flooding continued afterwards. A switchboard installed in the MC room supplied electricity to pumps of Unit 5 residual heat removal system (RHR) to cool the fuel within the reactor of Unit 5 (see Attachment V-5).

On March 21, TEPCO found that water had accumulated to a depth of 1.6m from the second basement floor of the radioactive waste treatment building (RW/B) of Unit 6 next to the MC room (See Attachment V-6). TEPCO concluded that the flooding in the MC room was caused by the accumulated water in the basement of the Unit 6 RW/B and notified NISA of their intention to discharge the accumulated water in the basement of the Unit 6 RW/B into the ocean. However, TEPCO found the concentration of radioactive materials in the water in the basement of the Unit 6 RW/B exceeded the limit specified in the notification about commercial reactors (see the section 4 (1) c) according to the radionuclide analysis conducted on March 22 (see Table V-2). TEPCO

concluded that it was difficult to discharge the accumulated water to the ocean.

TEPCO then concluded from the result of a salinity measurement conducted on March 22 that the amount of accumulated water in the basement of the Unit 6 RW/B had increased because groundwater around the building flowed into seawater that had accumulated within the building. In ordinary times the level of groundwater around the building had been maintained at a lower level by discharging the water in the subdrains installed around each building[114] to the ocean. However, the pumps within the subdrains were made inoperable because of the station blackout and the water level rose. TEPCO concluded that this was the cause of the flooding in the Unit 5 MC room.

Therefore TEPCO deliberated on discharging the water in the subdrains (herein referred to as "subdrain water") in Units 5 and 6 into the ocean to prevent flooding in the basement. However, TEPCO concluded that it was also difficult to discharge the subdrain water into the ocean because the concentration of radioactive materials in the water was found to be over the limit specified in the notification about commercial reactors according to the isotope analysis conducted on March 31.

[114] The subdrains are pits that are installed in large numbers around the buildings to decrease the level of the groundwater thus reducing the buoyant force of the groundwater to the basements of buildings and preventing the groundwater from flowing into the basement (see Attachment V-7). The subdrains have a structure into which the groundwater flows easily, and the water within the subdrains can be easily pumped out to the ocean.

Table V-2 Concentration of radioactive materials (compiled from materials supplied by TEPCO)

Location	Date collected	Concentration of radioactive and other materials				
		Surface dose rate mSv/h	Iodine 131 Bq/cm^3	Cesium 134 Bq/cm^3	Cesium 137 Bq/cm^3	Salinity ppm *
Notification about commercial reactors	—	—	4.0×10^{-2}	6.0×10^{-2}	9.0×10^{-2}	—
Unit 6 RW/B basement	3/22	Not measured	4.9	6.0×10^{-2}	6.0×10^{-2}	6,000ppm
Unit 5 subdrain	3/30	Not measured	1.6	2.5×10^{-1}	2.7×10^{-1}	Not measured
Unit 6 subdrain	3/30	Not measured	2.0×10	4.7	4.9	100ppm

* The salinity of seawater is approximately 30,000 - 38,000ppm. That of freshwater is below 500ppm.

(b) Newly found flooding and the discharge of subdrain water into the ocean

At approximately 20:06 on April 3, a staff member on duty at the Fukushima Dai-ichi NPS found that water had accumulated in a trench next to the high pressure core spray system diesel generator (HPCSDG) room on the second basement floor of the Unit 6 RW/B (See Attachment V-6). TEPCO concluded that this accumulated water originated from groundwater flooding according to the result of salinity measurement conducted the same day (see Table V-3).

After this flooding was found, site superintendent Yoshida requested, in the TV conference meeting of the Government-TEPCO integrated Response Office ("Integrated Response Office") held from 09:00 on April 4, a decision on what countermeasures to take in order to prevent Units 5 and 6 from falling into a severe situation as that of Units 1 to 3. In those Units important equipment such as electrical systems had been submerged in water because groundwater had flowed into various parts of the buildings. Site superintendent Yoshida explained that groundwater was likely to flood the basement floors of Units 5 and 6 buildings because it was impossible to drain the

subdrains in Units 5 and 6 as is described below in e (b).

In response to the request, members of NISA, NSC and TEPCO carried out procedures for discharging the accumulated water in the centralized waste disposal facilities (centralized RW/B) and the subdrain water in Units 5 and 6 into the ocean as mentioned below in e (b).

Table V-3 Concentration of radioactive materials (compiled from materials supplied by TEPCO)

Location	Date collected	Concentration of radioactive and other materials				
		Surface dose rate mSv/h	Iodine 131 Bq/cm^3	Cesium 134 Bq/cm^3	Cesium 137 Bq/cm^3	Salinity ppm *
Trench next to HPCSDG room of Unit 6	4/3	Not measured	1.6	5.3×10^{-1}	5.5×10^{-1}	170ppm

b. Discovery of highly contaminated water in the basements of Units 1 to 3

(a) Sequence of discovering highly contaminated water in the basements of Units 1 to 3

On March 24, three staff members of a subcontractor company of TEPCO who were installing power supply cabling on the first basement floor in the turbine building (T/B) of Unit 3 were exposed to radiation because they were immersed in the accumulated water (see 4(3) c (a) above).

When TEPCO measured the radiation levels of the accumulated water in the basements of each Unit T/B after the accident, it was found that the surface doses of the accumulated water in each Unit were very high: 60mSv/h in Unit 1, over 1,000mSv/h in Unit 2 and 400mSv/h in Unit 3 (see Table V-4).

Table V-4 Concentration of radioactive materials (compiled from materials supplied by TEPCO)

Location	Date collected	Concentration of radioactive and other materials				
		Surface dose rate mSv/h	Iodine 131 Bq/cm^3	Cesium 134 Bq/cm^3	Cesium 137 Bq/cm^3	Salinity ppm *
Unit 1 T/B basement	3/24	60	2.1×10^5	1.6×10^5	1.8×10^5	15,500
Unit 2 T/B basement	3/26	over 1,000	1.3×10^7	2.3×10^6	2.3×10^6	18,000
Unit 3 T/B basement	3/24	400	1.2×10^6	1.8×10^5	1.8×10^5	10,700
Unit 4 T/B basement	3/24	0.5	3.6×10^2	3.1×10	3.2×10	15,400

* The salinity of seawater is approximately 30,000 - 38,000ppm. That of freshwater is below 500ppm.

(b) Cause of highly contaminated water in the basements of Units 1 to 3

The highly contaminated water in each T/B is considered to have originated from the water that had come into contact with the melted fuel in the reactor pressure vessel or the reactor containment vessel and had flowed through some route to the T/B because at the time TEPCO had been injecting water into each reactor pressure vessel since March 12 at Unit 1, March 13 at Unit 3 and March 14 at Unit 2[115], and in addition, there had already been some abnormalities in the reactor pressure vessels and/or the containment vessels of Units 1 to 3 before March 24 as mentioned above in Chapter IV. However, the specific routes of leakage have not been identified because there are no details of the underground structure and damaged area between the reactor building (R/B) and the T/B.

In the meantime, until March 24 when the aforementioned exposure accident occurred, TEPCO had recognized the risk that the water injected into the reactor vessels

[115] The cumulative amounts of the water injected into the reactor pressure vessels until March 23 are 2,510m^3 for Unit 1, 8,234m^3 for Unit 2 and 4,155m^3 for Unit 3. The capacity of the reactor containment vessels are 8,140m^3 for Unit 1, 10,380m^3 for Unit 2 and 10,380m^3 for Unit 3.

would be highly contaminated and then leak from the reactor containment vessels and accumulate in the R/B, and eventually flow out from the R/B. However, TEPCO was not able to take any countermeasures against the water leakage from the reactor vessels and exposure prevention because of other urgent problems that were of a higher priority such as cooling the reactor.

c. Deliberation on countermeasures against the highly contaminated water in the basements of Units 1 to 3

(a) Establishment of special project teams

On March 27, the Integrated Response Office established four internal special project teams to deliberate on countermeasures against the Fukushima Dai-ichi NPS accident. One of these teams was the "Turbine building waste water retrieval & clean-up team" (renamed to" Accumulated radioactive water retrieval & treatment team" as of April 1. Herein referred to as "water treatment team") and was established to deliberate on the treatment of highly contaminated water because the need was recognized to control the highly contaminated water found in the T/Bs of Units 1 to 3 after the radiation exposure accident on March 24[116]. The members of the team included staff from NISA, TEPCO and other organizations.

(b) Deliberation on the storage space of highly contaminated water in the basements of Units 1 to 3

On March 27, the water treatment team started to deliberate on the approach to treat the contaminated water. Firstly, to prevent the highly contaminated water in the T/Bs of Units 1 to 3 from flowing into the environment, space for storing the water ("storage space") needed to be secured. The water treatment team deliberated about the possible options for the storage space before deciding to use the basement of the centralized RW/B (the estimated capacity was approximately 16,000t as of April 1) for storing the water because the facilities already existed, it had a large capacity and it was believed

[116] There were four project teams when they were established on March 27, but then increased to six and Special Advisor to the Prime Minister, Mr. Hosono, became the general leader.

that the water shielding work could be conducted rather easily[117].

It was necessary to remove first the seawater from the tsunami that had accumulated in the basement of the centralized RW/B. The water treatment team intended to discharge this accumulated seawater into the ocean and had been examining the possible impact on humans upon discharge and preparing information required for the discharge.

However, it was discovered that the concentration of radioactive materials in the water accumulated in the centralized RW/B was higher than the limit specified in the notification about commercial reactors (see Table V-5), and strong opinions insisting that "the water in the centralized RW/B is never allowed to be directly discharged into the ocean" were voiced in the general meeting of the special project teams on April 1. Therefore the plan to discharge the water into the ocean was not adopted for a while.

Then on April 2, TEPCO decided to transfer the water in the centralized RW/B to the basement of the Unit 4 T/B (expected capacity was approximately 9,000t as of April 2) and started the transfer with one pump with a capacity of 25m^3 per hour at 14:36. At 10:00 the next day, the number of pumps had increased to five.

Table V-5 Concentration of radioactive materials (compiled from materials supplied by TEPCO)

Location	Date collected	Concentration of radioactive and other materials			
		Surface dose rate, mSv/h	Iodine 131 Bq/cm^3	Cesium 134 Bq/cm^3	Cesium 137 Bq/cm^3
Notification about commercial reactors	—	—	4.0×10^{-2}	6.0×10^{-2}	9.0×10^{-2}
Basement of centralized RW/B	3/28	Not measured	6.3	4.4	4.4

d. Outflow of highly contaminated water around the water intake of Unit 2

At approximately 10:00 on April 2, just before the transfer started, a worker on duty

[117] The following options were considered as alternatives for the storing space: water treatment device tank (19,450t), barge ship (3,000t), dug pool within the premises, suppression chambers of Units 1 to 4 (10,000t), suppression pool water surge tanks of Units 1 to 4 (7,000t), suppression pool water surge tanks of Units 5 and 6 (3,000t), suppression pool of Unit 4 (capacity had not been calculated), solid waste storage (capacity had not been calculated) and pure water tank (capacity had not been calculated).

who was measuring the air radiation rates found that highly contaminated water with a surface dose rate of over 1,000mSv/h had accumulated in the pit located near the intake of Unit 2 that contained power supply cables, and that highly contaminated water was flowing out from a crack in the concrete part next to the pit into the ocean (see V-8 to 10)[118].

At first TEPCO thought the source of the water was the contaminated water in the pit and injected substances such as concrete[119], water absorbing polymer[120] (see Attachment V-11 and V-12). However, the outflow could not be stopped. Then TEPCO presumed that the cause of the outflow was not the pit and the power supply cable conduit themselves, but the ballast layer under them and thus began to inject water glass-based and other materials into the ballast layer at 13:50 on April 5 (see Attachment V-13 and V-14), after which the outflow was confirmed to have stopped at 05:38 on April 6.

On April 21, TEPCO released information about the contaminated water outflow accident and the estimated amount of the water that had flowed out [121], and announced measures related to the control of dispersal and prevention of contaminated water[122]

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[118] The air radiation dose rates that were measured around the sea side of the bar screen (including the area near the pit where the inflow of the highly contaminated water was) at approximately 16:10 on April 1 were 1.5 - 4.5mSv/h, and the rates measured in the same area at approximately 09:30 on April 2 were 5.5 - 30mSv/h. Therefore TEPCO concluded that the air radiation dose rates increased because of the outflow of the highly contaminated water. Based on this fact, it is thought that the inflow to the pit and outflow to the screen area of the highly contaminated water started or rapidly increased during that period.

[119] At 16:25 on April 2, TEPCO started to inject concrete into the pit ("upstream pit"), which was located upstream next to the pit that was believed to be the source of the outflow ("downstream pit"). Then at 19:02, they also began injecting concrete into the downstream pit. At that time, there were power supply cables between the downstream and upstream pits, and debris remained in the pits. However, the concrete was injected without removing the cables and debris because the concentration of the contaminated water was very high.

[120] TEPCO presumed the reason why the outflow had not be stopped even after concrete was injected was that the contaminated water flowed continuously through the gaps in the debris in the power supply cable conduit and the pit, and thought that the gaps should be filled in. However, it was difficult to fill the gaps among the debris in the pit because the upper part of the pit had already been sealed with concrete. Therefore TEPCO decided to fill the power supply cable conduit, and thus began to pour high polymer water absorbing agent, sawdust and newspapers into the conduit through a hole bored into upstream side of the upstream pit. In spite of their efforts, the outflow could not be stopped.

[121] TEPCO estimated the amounts of the radioactive materials in the contaminated water that had flowed out were 5.4×10^6Bq/cm^3 of iodine 131, 1.8×10^6Bq/cm^3 of cesium 134, 1.8×10^6Bq/cm^3 of cesium 137 and the volume of the water had been 520m^3 in total. TEPCO also admitted that the source of the outflow was the contaminated water in the Unit 2 T/B.

[122] TEPCO installed, for example, steel plates in the screen of Unit 2, silt fences in the harbor and sandbags containing radioactive material absorbing agent in front of the screen rooms of Units 1 to 4 to absorb the radioactive materials as measures to control the dispersal. In addition, the storage of the highly contaminated water under strict control after transferring the water to the centralized RW/B, separating the trench and the building, and the

outflow (see Attachment V-15 and V-16).

In addition, on April 3 in the general meeting of the special project teams, a strong opinion insisted that "considering the leakage of highly contaminated water yesterday, even if it might be required to deliberate on the discharge of low concentration contaminated water as an urgent measure in an emergency to prevent the highly concentrated water from flowing out, it is necessary to provide an adequate explanation to convince the general public" was presented. This opinion led to the change of the policy of April 1 that had stated "never allowed to be discharged." Meanwhile, TEPCO had already started to transfer the water in the centralized RW/B to the Unit 4 T/B the same day as mentioned above in c (b).

e. Discharge of low concentration contaminated water into the ocean

(a) Water level increase in the Unit 3 T/B (in the pit)

As mentioned above, TEPCO continued to transfer the water in the centralized RW/B to the Unit 4 T/B from April 2 to secure storage space. On the morning of April 4, a rapid increase in the level of the contaminated water in the Unit 3 T/B (within the pit) next to the Unit 4 T/B was noticed (see Attachment V-17). TEPCO concluded that the water transferred to the Unit 4 T/B from the centralized RW/B was also flowing into the Unit 3 T/B through a path connecting in the underground the Unit 4 T/B and the Unit 3 T/B. TEPCO immediately stopped the transfer because it was believed that it would cause an increase in the amount of contaminated water in the Unit 3 T/B and would flow out as it had in Unit 2.

(b) Preparation for discharge into the ocean

Site superintendent Yoshida then explained in the meeting of the Integrated Response Office held at 09:00 on April 4 via TV conference system that the water transfer from the centralized RW/B to the Unit 4 T/B had been stopped because it caused the increase

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establishment of water treatment facilities for decontamination and salinity control of the contaminated water, among others, were cited as the outflow prevention measures. TEPCO also referred to the investigation on the impact to the environment and presented some measures such as increasing the number of sampling points of seawater monitoring along the coast and off the coast.

in water level found in the pits of Unit 3, and it was necessary to decide on an alternative storage space as soon as possible. He also reported that the leakage of groundwater into the buildings of Units 5 and 6 was likely because the subdrain water in Units 5 and 6 could not be discharged (see a(b) above), and pointed out that important electrical equipment would likely be submerged. He urged the Integrated Response Office to make an earliest decision on the alternative measures for these problems.

As per this request, members of NISA, NSC and TEPCO started the paperwork at the TEPCO head office for the discharge of the water in the centralized RW/B and the subdrain water in Units 5 and 6 into the ocean[123].

Specifically, they prepared materials including a report from TEPCO to METI (NISA), an advisory document from NSC in response to the consultation request for advice from METI (NISA) and a report on the evaluation of the TEPCO report by NISA. This preparation was conducted in the same room at the TEPCO head office and the provisional documents were occasionally shared and amended within the room.

TEPCO and NISA explained to Prime Minister Kan, Chief Cabinet Secretary Edano and METI Minister Banri Kaieda (hereinafter referred to as Minister of METI Kaieda), while preparing the documents and got their consent by 15:00 on April 2. At 15:00 the same day, the METI (NISA) request to TEPCO to report, the report from TEPCO to METI (NISA)[124] and the consultation request for advice from METI (NISA) to NSC were completed at the same time. Then at 15:20 on April 2, NSC advised METI (NISA) and then NISA evaluated that the discharge of the water into the ocean by TEPCO was

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123 TEPCO decided to discharge the water into the ocean as an "emergency measure" pursuant to Article 64 Clause 1 of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors. It states that the "Licensee of Nuclear Energy Related Activities, etc." has to take emergency measures immediately when a disaster occurs because of nuclear fuel material, etc., If so, METI minister may order the Licensee of Nuclear Energy Related Activities, etc. to take "necessary measures" when he/she finds it absolutely necessary in order to prevent disasters resulting from nuclear fuel material, etc. according to Article 64 Clause 3 of the Act. Therefore NISA instructed TEPCO to report first its plan of the discharge of the water into the ocean beforehand in accordance with the stipulation in Article 67 Clause 1 of the Act to judge whether it should order the discharge be stopped. Furthermore, NISA reported to NSC on the TEPCO report in accordance with Article 72-3 Clause 2, and consulted with NSC for its advice for evaluating the TEPCO report. The tasks mentioned in the text were conducted for this administration.

124 In the report, TEPCO estimated the impact of the discharge into the ocean on humans and concluded that effective exposure for adults in the event they ate fish and seaweed that had absorbed the discharged radioactive materials would be approximately 0.6mSv/year. TEPCO concluded it would not be harmful to human health because this value is within the same level of the public exposure limit of 1mSv/year.

inevitable for avoiding more severe hazards according to the advice. Thus the paperwork for discharging the water into the ocean was completed.

(c) Prior notification of water discharge into the ocean

After the paperwork was completed, TEPCO and the Local Nuclear Emergency Response Headquarters notified the parties concerned such as the municipalities[125] and the fishery cooperatives associations[126] of the water discharge into the ocean. On the other hand, since TEPCO, NISA and others started the paperwork for the discharge on the morning of April 4 until they obtained the consent of Prime Minister Kan at 15:00, they did not notify the authorities concerned (such as the Ministry of Foreign Affairs, the Ministry of Agriculture, Forestry and Fisheries, the municipalities concerned and the fishery cooperatives associations), the IAEA or other countries of the plan to discharge the contaminated water into the ocean.

At 16:00 the same day, TEPCO held a press conference to announce that it planned to discharge some of the contaminated water into the ocean as soon as the preparation got ready. At 18:30 the same day, TEPCO held another press conference to announce the planned time of the discharge into the ocean[127]. In addition, Chief Cabinet Secretary Edano announced the plan for the water discharge into the ocean in a regular press conference held at 16:03 the same day. Furthermore, NISA also announced the plan for the water discharge into the ocean in an unscheduled press conference held at 16:25 the same day.

For the notification of and other actions regarding the water discharge into the ocean to other countries and international organizations, see 9 (1) below.

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125 TEPCO started at approximately 18:43 via fax and telephone to notify the municipalities including Fukushima Prefecture, Namie-town, Futaba-town, Okuma-town, Tomioka-town and Naraha-town of the water discharge into the ocean. The Local Nuclear Emergency Response Headquarters also started at approximately 15:30 via fax to notify Minamisoma-city, Namie-town, Futaba-town, Okuma-town, Naraha-town, Hirono-town and Iwaki-city of the water discharge into the ocean.

126 TEPCO notified the Fukushima Prefecture Fishery Co-operatives Association at 15:40 via fax and telephone, and the National Fishery Co-operatives Association at 16:07 via telephone.

127 TEPCO announced that it planned to start discharging the water in the centralized RW/B at 19:00 on April 4, and the subdrain water in Units 5 and 6 at 21:00 the same day.

(d) Reaction to the discharge into the ocean

Minister of Agriculture, Forestry and Fisheries Kano regretted that there was no prior notification to the Ministry and requested METI minister Kaieda to provide strict instructions.

Fishery cooperatives associations including the National Fishery Cooperatives Association and the Fukushima Prefecture Fishery Cooperatives Association submitted a written protest about the water discharge into the ocean to TEPCO[128]. TEPCO held an explanatory meeting for the fishery cooperatives associations and the other parties concerned, and presented a comment on April 6 on the written protest from the National Fishery Cooperatives Association.

For the responses of other countries regarding the water discharge into the ocean, see 9 (1) below.

(e) Discharge into the ocean and release of the result

TEPCO started to discharge the water in the centralized RW/B into the ocean at 19:03 on April 4. The discharge was conducted using ten pumps with a capacity of 25 m^3 per hour and completed the discharge at 17:40 on April 10. TEPCO also started to discharge the subdrain water in Units 5 and 6 at 21:00 on April 4, and the discharge was completed at 18:52 on April 9.

TEPCO analyzed radionuclides in the discharged contaminated water in the centralized RW/B and the subdrains of Units 5 and 6 before the discharge and in the seawater before and after the discharge, and published on April 15[129] the results in the

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128 The written protests were submitted by the Fukushima Prefecture Fishery Cooperatives Association on April 4; the National Fishery Cooperatives Association, Ibaraki Prefecture, the heads of nine municipalities along the coast of Ibaraki Prefecture and the Ibaraki Seacoast Area Fishery Cooperatives Association on April 6; the Ibaraki Prefecture Roll Net Fishery Cooperatives Association on April 8; and the Ibaraki Prefecture Marine Product Processing Industry Cooperatives Association on April 14.

129 TEPCO estimated that the amount of the discharged low concentration contaminated water from April 4 to 10 was approximately 10,393m^3 (approx. 9,070m^3 from the centralized RW/B, approx. 1,323m^3 from the subdrains in Units 5 and 6) and the discharged amount of radioactive materials with the discharged water was approximately $1.5x10^{11}$Bq. The concentrations of radioactive materials in the low concentration contaminated water discharged into the ocean were as follows. TEPCO estimated the amount of the discharged radioactive materials based on the concentrations and the amount of the discharged water.
Water in the centralized RW/B; Iodine 131: 6.3Bq/cm^3, Cesium 134: 4.4Bq/cm^3, Cesium 137: 4.4Bq/cm^3
Water in the subdrain in Unit 5; Iodine 131: 1.6Bq/cm^3, Cesium 134: 0.25Bq/cm^3, Cesium 137: 0.27Bq/cm^3

document "Result of Low Concentration Contaminated Water Discharge into the Ocean from the Fukushima Dai-ichi NPS."

That same day, NISA instructed TEPCO to conduct a detailed evaluation on the impact on the environment of the water discharge and the other actions. In response to the instruction, TEPCO compiled the evaluation results of the impact on the environment of the contaminated water discharge from the centralized RW/B and the other facilities into the ocean, the outflow of the highly contaminated water at Unit 2 found on April 2, and the outflow of the highly contaminated water at Unit 3 found on May 11 based on the estimated amount of the discharged radioactive materials and the monitoring results. TEPCO then submitted the outcome of the evaluation to NISA on May 20 as the "Report Concerning the Impact of the Discharged Water whose Radioactive Concentration Exceeded the Discharge Limits into the Ocean."

f. Start of transfer of highly contaminated water in Unit 2

On April 10, TEPCO completed the discharge of the water in the centralized RW/B into the ocean and then finished the waterproofing work on the main processing building of the centralized RW/B on April 18. TEPCO then submitted a report to and notified NISA of its intention to transfer the contaminated water in Unit 2 T/B to the main processing building of the centralized RW/B, and to control the amount of the water transferred so as to maintain the level up to the floor level of the first basement floor. The same day, NISA notified TEPCO that the transfer plan was judged to be appropriate according to the report. TEPCO then started at 10:08 on April 19 transferring the contaminated water in the trench connected to the Unit 2 T/B to the main processing building of the centralized RW/B.

g. Measures against groundwater flooding in the basement of Unit 6 after the discharge into the ocean

TEPCO discharged the subdrain water in Units 5 and 6 into the ocean during the period from April 4 to 9. However, the leakage into the MC room continued afterwards. Furthermore, there was new leakage on April 15 into other areas through the wall of the

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Water in the subdrain in Unit 6; Iodine 131: 20Bq/cm^3, Cesium 134: 4.7Bq/cm^3, Cesium 137: 4.9Bq/cm^3

MC room and the amount of the inflow water increased. Under such circumstances, TEPCO continued to drain the water from the MC room to protect the switchboard installed there and since May 1 transferred the water in the Unit 6 T/B to a temporary tank that had been newly installed to store the contaminated water. Afterwards, the leakage into the MC room was almost eliminated.

h. Outflow of highly contaminated water around the water intake of Unit 3

At 10:30 on May 11, while the water injection into Units 1 to 3 continued, TEPCO found water leaking into a pit that was located in the vicinity of the water intake of Unit 3 and contained power supply cables. According to further investigation, the sound of water leakage was detected and it was discovered in CCD camera image at 16:05 (see Attachment V-18 to 20) that water was flowing out from the side of the pit into the screen area.

TEPCO considered that the outflow water came from the T/B in high concentration of radioactive materials similar to the outflow that had been found in the vicinity of the water intake of Unit 2 on April 2, and then started from 17:30 the same day removing the cables within the power supply cable conduit connected to the pit, filling waste cloths in the power supply cable conduit and injecting concrete into the pit. TEPCO finished these tasks at 18:40 (see Attachment V-20) and confirmed at 18:45 the outflow had stopped.

On May 11, with regards to this accident of highly contaminated water outflow in the vicinity of the water intake of Unit 3, NISA instructed TEPCO to check and report on the impact on the ocean and the routes of the inflow and outflow. TEPCO compiled the results of the examination on aspects such as the impact on the ocean and the route of the inflow and outflow, as well as the prevention measures for recurrence and dispersal of the contaminated water in the "Report Concerning the Outflow of Water Containing Radioactive Materials from the Vicinity of the Water Intake of Unit 3 of the Fukushima Dai-ichi NPS"[130] and submitted it to NISA on May 20[131].

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130 TEPCO estimated the amounts of the radioactive materials in the contaminated water that had flowed out were 3.4×10^3Bq/cm^3 of iodine 131, 3.7×10^4Bq/cm^3 of cesium 134, 3.9×10^4Bq/cm^3 of cesium 137, and the volume of water had been 250m^3 in total. TEPCO also estimated that the outflow of the contaminated water started at approximately 02:00 on May 10 by establishing the correlation by the least squares method between the periods of

i. Start of the transfer of highly contaminated water at Unit 3

On April 19, TEPCO started to transfer the contaminated water in the Unit 2 T/B to the main processing building of the centralized RW/B (see f above). On May 11, because the waterproofing works on the miscellaneous solid waste volume reduction treatment building (hereinafter referred to as "high temperature incinerator building") in the centralized RW/B was completed, TEPCO decided to start the transfer of the contaminated water in the Unit 3 T/B, too, although there was still some more space there under the high water level compared to the Unit 2 T/B and the concentration of the contaminated water was similar to that in the Unit 2 T/B. TEPCO then carried out the prescribed procedure[132] and started at 18:04 on May 17 the transfer of the water to the main processing building and the high temperature incinerator building of the centralized RW/B.

(2) Clean-up of highly contaminated water

a. Process to start operation of the system

Since the existence of the highly contaminated water that was continuously produced and increased was discovered after the radiation exposure accident on March 24, how to treat the contaminated water became a significant problem for the water treatment team. The water treatment team was deliberating on the design and the supplier of a system that cleans and desalinates highly contaminated water (hereinafter referred to as "clean-up system") in order to reuse it as cooling water in the reactors.

Meanwhile, TEPCO prepared and announced on April 17 a "Roadmap towards

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an increase and decrease in the water level in the pit of Unit 3 before and after the outflow was noticed. TEPCO also concluded that the source of the outflow had been the contaminated water in the Unit 3 T/B.

131 After this accident, NISA instructed TEPCO to prepare a plan for countermeasure construction work against leakage and to conduct monitoring of seawater. In response to the instruction, TEPCO submitted to NISA the "Plan for Outflow Prevention of Water with High a Concentration of Radioactive Materials at the Fukushima Dai-ichi NPS". Furthermore, TEPCO notified NISA of the present situation of the accumulated water in the building, the situation of the storage and treatment of the accumulated water, and the plan for treatment of the highly contaminated water by the circulating injection cooling system that was listed on the Roadmap described in (2) a below with the "Plan for the Storage and Treatment of Water with a High Concentration of Radioactive Materials at the Fukushima Dai-ichi NPS."

132 TEPCO prepared a plan for the implementation of the transfer of the highly contaminated water in the Unit 2 T/B and Unit 3 T/B to the main processing building and the high temperature incinerator building of the centralized RW/B in the "Report Regarding to Transfer of Water to Main Processing Building and High Temperature Incinerator Building" and submitted it to NISA. The same day, NISA concluded that the plan of transfer was appropriate and notified TEPCO.

Restoration from the Accident at the Fukushima Dai-ichi Nuclear Power Station" (hereinafter referred to as "Roadmap") stating the targets for the settlement of the accident at the Fukushima Dai-ichi NPS and the present efforts to achieve them. This Roadmap summarized the settlement measures that should be taken in each area, i.e. (1) cooling of the reactors and the related facilities, (2) control of the release of radioactive materials, and (3) monitoring and decontamination, and also referred to the treatment of the contaminated water within the premises of the NPS as part of the subject area (2). It listed the installation of clean-up systems and the storing of the decontaminated and desalinated highly contaminated water in tanks as the measures to be taken within the first three months (Step 1), and the continuation and enhancement of the clean-up and desalination of the highly contaminated water as well as the reuse of the processed water as reactor cooling water (hereinafter referred to as "circulating injection water for cooling") as the targets and the measures to be taken in the next three to six months (Step 2).

A clean-up system was essential to consistently conduct circulating injection cooling. For this system, TEPCO decided to order the conducting oil separation and desalination parts to domestic companies, and the conducting clean-up part to foreign companies that had a good reputation in the field. TEPCO ultimately ordered the oil separation systems from Toshiba, the radioactive material clean-up systems from Kurion[133] in the USA and Areva[134] in France, and the desalination systems from Hitachi GE Nuclear Energy. On April 27, TEPCO announced that it would introduce the clean-up systems supplied by the four companies, and then decided to install the systems and started their construction on April 30.

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133 On March 31, the Electric Power Research Institute recommended to TEPCO the companies that have records in the settlement of the accident at the Three Mile Island NPP, and Kurion was one of those companies. TEPCO asked Kurion to submit a proposal for adsorbent because the company has the technology for high-performance adsorbent. In response to the request, Kurion brought samples to Japan on April 5. While consultations were taking place, TEPCO learned that Kurion had the know-how for the system for clean-up itself. Kurion submitted a proposal for a clean-up system on April 17. The same day, the water treatment team examined the proposal and then decided to introduce the system.

134 Experts from and the then CEO of Areva came to Japan on March 29 and March 30 respectively. On March 30, the CEO and experts of Areva, Special Advisor to Prime Minister Kan and the water treatment team held a consultation. On this occasion, the water treatment team informed Areva of the needs of TEPCO for the clean-up system. Then, Areva officially submitted a proposal for the clean-up system on April 7 on the basis of those needs. The next day, April 8, the water treatment team examined the proposal and then decided to introduce the system.

b. Operation of the clean-up systems

On June 14, TEPCO started a test run of the clean-up systems and then put them into full operation on June 17. The systems were forced to stop several times due to problems such as leakage of water developed during the test run and even after the full operation started. But, countermeasures such as repairs of the devices were taken each time and the systems have been operating ever since. The amount of decontaminated water accumulated as of November 15 is approximately 161,710m^3 including the water processed by Sarry, mentioned below in d, and approximately 65,078m^3 of decontaminated water has been injected into the reactors of Units 1 to 3.

c. End of Step 1

On July 19, the Government-TEPCO Integrated Response Office at the Nuclear Emergency Response Headquarters checked the progress of the tasks in Step 1, and revised the Roadmap (revised on June 17) and published it at the end of Step 1 the same day[135]. In this revised Roadmap, with regards to the cooling of the reactors and related facilities, TEPCO signaled its intention to continue and enhance the circulating injection water for cooling during Step 2 and achieve the "cold shutdown"[136]. With regards to the control of the release of radioactive materials, TEPCO decided to conduct tasks in Step 2 such as enhancing the clean-up systems, increasing the reuse of decontaminated water by desalination, deliberating on the full-scale treatment facilities for highly contaminated water, and storing and administering the waste produced in the clean-up system.

d. New clean-up system

On August 16, TEPCO completed the installation of the new radioactive material clean-up systems (Sarry)[137] assembled by Toshiba and Shaw in the USA in addition to and

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135 TEPCO has checked the progress of the measures and the other tasks listed on the Roadmap, and published the revised Roadmap almost every month since it prepared and published its first version on April 17.

136 In the report on the progress of the Roadmap published on July 19, TEPCO defined the "cold shutdown" as the state in which the temperature at the bottom of the reactor pressure vessels is kept below 100 degrees centigrade, and the release of radioactive materials from the reactor containment vessels is under control and the radiation exposure dose of the public due to the additional release is significantly reduced.

137 Sarry is capable of separating oil from water and decontaminating the radioactive materials without separating

in conjunction with those of Areva and Kurion to consistently decontaminate the highly contaminated water. The same day, TEPCO started a test run of Sarry and on August 18 proceeded into full-scale operation (see Fig V-1). Since Sarry went into full operation, the level of the accumulated water in the T/B of Units 1 to 4 dropped considerably. As of November 15 the water level has been maintained at the present target level (O.P +3,000mm. "O.P. xx mm" indicates the height from the work reference level of Onahama Port), and it is able to adapt to conditions such as heavy rain.

Furthermore, TEPCO is now deliberating on other full-sized clean-up systems other than Sarry.

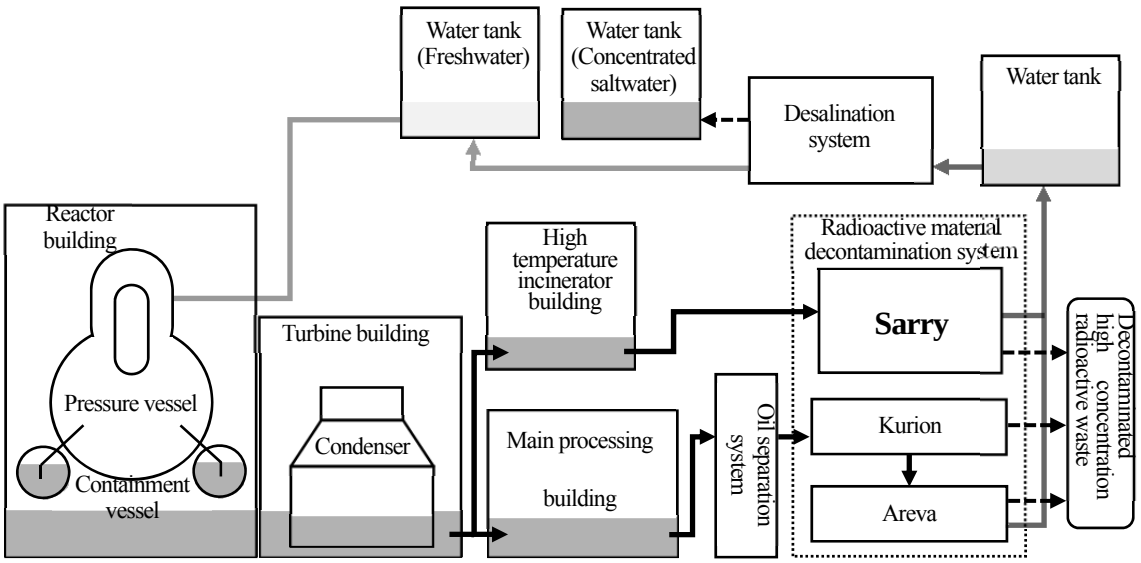

Fig V-1 Outline of the flow of circulating injection water for cooling (after August 19) (compiled from materials supplied by TEPCO)

(3) Details of events concerning the flooding of the reactor containment vessels

TEPCO decided to fill the reactor containment vessels of Units 1 and 3 with water to a level above the fuel region (herein referred to as "submergence") and circulate the injection water as the measures in Step 1 to consistently cool the reactors, and published its intention in

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oil from the contaminated water through the oil separation system (manufactured by Toshiba) beforehand because it has a filter for oil separation in the system, unlike the radioactive material clean-up systems manufactured by Kurion and Areva.

the Roadmap (April 17 edition). For Unit 2, on the other hand, TEPCO decided to seal the damaged area of the reactor containment vessel first, and then conduct the submergence and the circulating injection water as would be done at Units 1 and 3 after the damaged area was sealed, because a major leak was recognized from the reactor containment vessel and it was presumed to be severely damaged.

On May 5, TEPCO submitted the "Report Concerning the Measures to Fill up Reactor Containment Vessel to a Level above the Fuel Range at Unit 1 of the Fukushima Dai-ichi NPS" which presented the method and evaluation for submergence to NISA prior to executing the submergence at Unit 1. In the report, TEPCO showed that a time margin for a temperature increase of the fuels would be created by the submergence even when water injection stopped, and that even when the amount of leaking water from the reactor containment vessel increased there was no possibility of its release into the environment. The same day, NISA notified TEPCO that the measures were deemed to be necessary according to the report.

TEPCO increased from May 6 the amount of water injected into the reactor of Unit 1 and estimated the magnitude of the damage in the reactor containment vessel by calculating the water level there according to the pressure change in the vessel. As a result, it concluded that there were holes in the containment vessel and the leakage would increase if the injection for the submergence continued. Furthermore, it concluded that, if the amount of leakage from the reactor containment vessel to the T/B increased, the contaminated water in the T/B would increase and be likely to fill up in mid-June because the highly contaminated water in the T/B was found to have originated from the R/B. Therefore TEPCO suspended the submergence and changed their policy to cool the reactor with the circulating injection water for cooling only. In Unit 3, on the other hand, the submergence was not being conducted, but it was presumed that the increase in the highly contaminated water in the T/B was likely to accelerate by the submergence if it were done as in Unit 1, since there had been already highly contaminated water in the T/B and the amount of water in it was increasing by injecting water into the reactor. Therefore TEPCO concluded to suspend the submergence of Unit 3 and decided to cool the reactor with the circulating injection cooling only.

According to the situation, TEPCO revised the Roadmap (April 17 edition) on May 17 and

stated its policy to implement the circulating injection water before the submergence.

(4) Current situation regarding contaminated water

The amounts and the levels of the contaminated water stored in the T/Bs of each Unit at the Fukushima Dai-ichi NPS are as follows: the amount approx. 14,750m^3 and the water level in T/B O.P. 3,486mm in Unit 1; approx. 22,500m^3 and O.P. 3,155mm in Unit 2; approx. 24,200m^3 and O.P. 3,110mm in Unit 3; and approx. 18,700m^3 and O.P. 3,098mm in Unit 4. The total amount of the contaminated water stored in Units 1 to 4 is approximately 80,150m^3 (see Table V-6). After the clean-up systems came into full-operation, the water levels have dropped steadily in every Unit.

Table V-6 Amounts and levels of contaminated water stored in Units 1 to 4 (as of November 15) (compiled from materials supplied by TEPCO)

	Amount of stored contaminated water (cubic meters)	Level in T/B (O.P. mm)	Position of T/B opening (O.P. mm)
Unit 1	14,750	3,486	10,200
Unit 2	22,500	3,155	4,000
Unit 3	24,200	3,110	4,000
Unit 4	18,700	3,098	4,000

The contaminated water in Units 1 to 4 was transferred to the main processing building and high temperature incinerator building of the centralized RW/B. The amounts and levels of the water as of the same day were approximately 6,650m^3 and O.P. 1,451mm in the main processing building and approximately 3,270m^3 and O.P. 2,145 mm in the high temperature incinerator building (see Table V-7).

Table V-7 Amount and level of contaminated water stored in the main processing building and the high temperature incinerator building (as of November 15) (compiled from materials supplied by TEPCO)

	Amount of stored contaminated water (cubic meters)	Level in building (O.P. mm)	Location of building opening (O.P. mm)
Main processing building	6,650	1,451	5,600
High temperature incinerator building	3,270	2,145	4,200

The contaminated water stored in the main processing building and the high temperature incinerator building is being decontaminated with the clean-up systems. The accumulated amount of the decontaminated water was approx. 161,710m^3; the amount of waste produced by the clean-up was 581m^3 of waste sludge and 285 spent vessels as of November 15.

(5) Outlook on future arrangements concerning the disposal of contaminated water

On November 17, the Government-TEPCO Integrated Response Office at the Nuclear Emergency Response Headquarters checked the progress and other situations regarding the Roadmap and published "Progress of Roadmap towards Restoration from the Accident at the Fukushima Dai-ichi Nuclear Power Station." In this document, the Office concluded that the following measures that had been prescribed to decrease the total amount of accumulated water in Step 2 were completed:

- Decreasing the total amount of accumulated water by the consistent operation of the clean-up systems to process the accumulated water in the buildings;
- Enhancing and consistently operating the clean-up systems for highly contaminated water and increasing the reuse of the decontaminated water by desalination;
- Starting deliberation on full-sized clean-up system for highly contaminated water;
- Storing and managing the waste sludge produced by the clean-up systems for the highly contaminated water; and
- Installing steel pipe sheet piles in the harbor to prevent sea pollution.

Furthermore, the Office also concluded that the following measures that had been prescribed in Step 2 to prevent the escalation of pollution in the sea by groundwater were completed:

- Preventing the contamination of groundwater and the escalation of pollution in the sea via groundwater by controlling the water flow of the accumulated water into the groundwater; and
- Starting the installation of a cut-off wall in front of the existing seawall of Units 1 to 4.

7. Estimates of the total amount of radioactive materials discharged and an evaluation of INES levels

(1) Total amount of radioactive material discharged

a. NISA Estimation of total amount of radioactivity discharged

NISA analyzed the condition of the reactor of each Unit at the Fukushima Dai-ichi NPS, with the cooperation of the Japan Nuclear Energy Safety Organization (JNES), on the basis of the data supplied by TEPCO by using MAAP (Modular Accident Analysis Program), which is a program to analyze the condition of a reactor. As a result, the total amount of radioactive materials discharged from Units 1 to 3 of the Fukushima Dai-ichi NPS into air was estimated to be 130,000 terabecquerels (TBq) of iodine 131 and 6,000TBq of cesium 137. These amounts correspond to 370,000TBq of iodine equivalent[138]. On April 12, NISA published the result.

NISA conducted another analyses by also using MELCOR (Methods for Estimation of Leakages and Consequences of Releases) in addition to MAAP and using the new data provided by TEPCO. As a result, the total amount of the radioactive materials discharged into air was estimated to be 160,000TBq of iodine 131 and 15,000TBq of cesium 137. These amounts correspond to 770,000TBq of iodine equivalent. On June 6, NISA published the result.

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[138] This value is derived from the equation of iodine equivalent value of cesium 137 equals to the amount of cesium 137 in becquerel multiplied by 40 (IAEA "User Manual 2008 Edition", p.16).

b. NSC Estimation of total amount of radioactivity discharged

NSC estimated the integrated dose due to the radioactive materials in the vicinity of the Fukushima Dai-ichi NPS with the cooperation of JAEA by using the monitoring results, and SPEEDI (see 2 (1) above), etc. During this process NSC also estimated the amount of the radioactive materials discharged into air. As a result, the total amount of the radioactive materials discharged into air from the Fukushima Dai-ichi NPS was estimated to be 150,000TBq of iodine 131 and 12,000TBq of cesium 137 (corresponding to 630,000 Bq of iodine equivalent). On April 12, NSC published the result.

NSC conducted its analysis again later because it had obtained other new information such as environment monitoring data until March 15, which had not been obtained previously. As a result, the total amount of radioactive materials discharged into air was estimated to be 130,000TBq of iodine 131 and 11,000TBq of cesium 137 (corresponding to 570,000TBq of iodine equivalent). On August 24, NSC published the result.

(2) INES

a. What is INES?

INES stands for the International Nuclear and Radiological Event Scale and is an international index of nuclear and radiological accidents that is formulated by the IAEA and the Nuclear Energy Agency (NEA) of the Organization for Economic Co-operation and Development to concisely indicate the significance in safety of individual accidents and incidents at nuclear and other facilities.

In the practice in Japan, NISA first conducts a provisional evaluation (provisional INES evaluation) and investigation of the cause of an incident, and then establishes preventive measures for the reoccurrence of the accident. Subsequently the INES Evaluation Subcommittee of the Nuclear and Industrial Safety Subcommittee of the Advisory Committee for Natural Resources and Energy of METI examines it from a technical point of view and then formally evaluates it.

An INES evaluation is conducted by objectively judging the level of each item of three criteria that are classified into three areas of impact: "people and the environment,"

"radiological barriers and control" at the facilities and "defense-in-depth" [139] (see Attachment V-21). For an evaluation of Levels 6 and 7, only the criteria on the impact on “people and the environment" are specified based on the amount of the radioactive materials discharged into the external environment, and the other criteria are not stipulated.

b. Process of making a Level 5 provisional INES evaluation

At 16:45 on March 11, the Director of Nuclear Incident Response and Nuclear Emergency Public Relations Office of NISA (herein referred to as the "director of accident and trouble management office") was notified by TEPCO that they had found that it was impossible to inject water using the emergency core cooling systems at 16:36 that day. The director of accident and trouble management office is designated as the person responsible to make a provisional INES level evaluation of an accident that occurs at a commercial power reactor and a fast breeder reactor, etc. in Japan. He concluded that the situation had reached the state of "near accident at a nuclear power plant with no safety provisions remaining" (Level 3) of the "defense-in-depth" criteria[140], and notified the IAEA that the situation had been provisionally evaluated as Level 3. On March 12, the director of accident and trouble management office concluded from the information including the results of monitoring that the situation had reached the state corresponding to a "meltdown of or damage to the fuel resulting in the release of radioactive material of more than 0.1% of the reactor core inventory" (Level 4) of the "radiological barriers and control" criteria[141], and notified the IAEA that the situation had been evaluated as Level 4. At that time, it was expected that the fuel was severely damaged because a hydrogen explosion had occurred on March 12. However, there was no objective data indicating "a release of radioactive material from the fuel bundles equivalent to more than several percent of the reactor core

[139] The criteria on the impact on “people and the environment" are based on the amount of radioactive materials discharged into external environment, the criteria on the impact on "radiological barriers and control" are based on the extent of the damage to or meltdown of fuel, and the "defense-in-depth" criteria are based on the degree to which the safety of the facilities are secured after an accident/incident.

[140] INES "User Manual 2008 Edition" p.3

[141] INES "User Manual 2008 Edition" p.3, 32. The reactor core inventory represents the total amount of the radioactive materials within the reactor.

inventory"[142] that is stipulated as a specific criterion for "severe damage to reactor core" (Level 5). Therefore the director did not judge the situation as Level 5[143].

However, the director of accident and trouble management office considered events such as the hydrogen explosion in the Unit 3 building on March 14, the sound of an explosion that had seemed to have occurred in the vicinity of the reactor containment vessel of Unit 2 on March 15, the rapid increase in radiation levels within the premises of the Fukushima Dai-ichi NPS on March 15 in addition to the TEPCO report on the fuel damage, then concluded that the situation had reached "a release of radioactive material from the fuel bundles equivalent to or more than several percent of the reactor core inventory" in Units 1 to 3 and "severe damage to the reactor core" (Level 5) had occurred. He notified the IAEA of his conclusion on March 18 and made a public announcement.

c. Process of changing to a Level 7 provisional INES evaluation

On March 17, the director of accident and trouble management office asked JNES to analyze the condition of the reactors and conduct an assessment related to the provisional INES evaluation.

As per the request, the staff of the disaster prevention department of JNES explained the provisional results of the analysis using MAAP[144], which is a program for analyzing conditions of the reactor core, to the nuclear disaster prevention director and the director of accident and trouble management office. The provisional results included data that could be used to calculate the total amount of the released radioactive materials. However, these provisional results were supposed to have not a small deviation from the real values because they had been calculated while many of the plant parameters of the Fukushima

142 INES "User Manual 2008 Edition" p.31

143 In the period from March 14 to 15, NISA was notified by TEPCO that several tens percent of the fuel in Units 1 to 3 had been damaged. However, the director of accident and trouble management office did not adopt the information as the basis for the provisional INES evaluation on the grounds that the percentage of the damaged fuel did not indicate the release of the reactor core inventory.

144 MAAP analysis is capable of calculating the degree of damage in the fuel bundles and the amount of the radioactive materials released into the environment (outside of the building) by entering data such as (1) the shape and volume of the reactor containment vessel and design data of the reactor core, (2) data related to operation such as pressure and temperature, (3) time of scram, startup times of heat removal/cooling devices such as the isolation condenser (IC), reactor core isolation cooling (RCIC) system and high pressure core injection (HPCI) system.

Dai-ichi NPS were missing. Therefore the director of accident and trouble management office concluded that the provisional results could not be used as the basis for the provisional INES evaluation.

Meanwhile, at the beginning of April, NSC was planning to publish the results of the estimation of the total amount of radioactive materials released based on the results of SPEEDI and monitoring that NSC had conducted[145]. The estimated value exceeded the value corresponded to INES Level 7 (in the order of 10^{16}Bq, i.e. tens of thousands of terabecquerels). Because the results accorded with the data shown in (1) b above and the publication of the estimated value was directly related to the provisional INES evaluation, Special Advisor to Cabinet Office, Kenkichi Hirose (herein referred to as "Special Advisor Hirose"), who had conducted the aforementioned estimation in cooperation with the secretariat of NSC, provided the value estimated by NSC and proposed to the Deputy Director General of Nuclear and Industry Safety Agency, Koichiro Nakamura (herein referred to as "Deputy Director General Nakamura") and others that NISA should publish the provisional INES evaluation based on the results of the analysis on the provided value.

As mentioned above, the director of accident and trouble management office considered that the total amount of the radioactive materials released was derived from the provisional results of a MAAP analysis conducted by JNES at the request of NISA and was not very precise because it had been calculated while many plant parameters had not been identified. However, the director again asked the staff of the disaster prevention department of JNES[146] about the estimated value of the total amount of the radioactive materials released derived from the MAAP analysis, and it was discovered that the estimated value was in the order of several hundreds of thousands terabecquerels, the same as the calculated value which NSC had indicated (one order higher than the reference value of Level 7) (see (1) above). Therefore, the director considered that the value estimated by NISA also had certain credibility and decided to conduct and publish the provisional INES evaluation

[145] Regarding this publication, NSC published "Integrated External Exposure Level (SPEEDI trial calculation values from March 12 to April 5)" at the 22nd Meeting of the Nuclear Safety Commission held on April 10.

[146] At that time, the staff of the disaster prevention department of JNES explained to the director of accident and trouble management office that the estimated value should not be used for a provisional INES evaluation because it was not accurate enough.

using the estimated value.

On April 12, the Nuclear Disaster Management Officer of NISA, Hiroyuki Fukano, and Special Advisor Hirose reported to Prime Minister Kan that the provisional INES evaluation had been found to be Level 7 according to both of the values estimated by NISA and NSC on the total amount of the radioactive materials released. Then the director of accident and trouble management office notified the IAEA that the evaluation was deemed to be Level 7. The same day, NISA Liaison Hidehiko Nishiyama (herein referred to as "NISA Liaison Nishiyama") and Special Advisor Hirose jointly announced the respective estimated values and that the provisional INES evaluation of Level 7 had been concluded.

The INES Evaluation Subcommittee of the Nuclear and Industrial Safety Subcommittee of the Advisory Committee for Natural Resources and Energy of METI is due to finalize the official evaluation after the incident is completely resolved.

8. Details of events in areas where there may be problems with the provision of information to the public

(1) Institutional arrangements for the dissemination of information concerning the Fukushima nuclear accident

The dissemination of information about the Fukushima Dai-ichi nuclear accident was started first independently by (1) the Chief Cabinet Secretary, (2) NISA, which is the administration agency for TEPCO, (3) the Local Nuclear Emergency Response Headquarters (only after it was transferred to the Fukushima Prefectural Office on March 15), (4) Fukushima Prefecture, and (5) TEPCO. However, from March 12 the dissemination was conducted after getting the approval of the Prime Minister's Office in advance as described below, and then since April 25 the press release has been carried out under one umbrella by integrating the publicity of the Government and TEPCO as described in III 4 (2) b above.

From March 12 to 15, the Local Nuclear Emergency Response Headquarters did not deal with the press because the Off-Site Center, in which the Headquarters was established, was located within the evacuation area (Okuma-town).

(2) Review of the changes in NISA's remarks about reactor core conditions

At NISA, the Deputy Director General of NISA (in charge of nuclear safety infrastructure) and the Deputy Director-General for Safety Examination had been ruled to alternately deal with the press according to the Nuclear Disaster Countermeasures Manual and METI's Nuclear Operator Emergency Action Plan. On March 11, the Deputy Director-General Nakamura was going to hold the press conference.

At 23: 48 the same day, NISA was notified by TEPCO that a high level of radiation (1.2mSv/h) had been detected on the north side of the first floor of the Unit 1 T/B. On March 12, TEPCO also reported that the pressure in the reactor containment vessel of Unit 1 had exceeded the designed maximum operating pressure since before daybreak the same day, and the level of radiation near the main gate of the Fukushima Dai-ichi NPS had increased rapidly since that morning. At the press conference at 09:45 on March 12 (the 12th report), based on the aforementioned information, the Deputy Director-General Nakamura explained to the press that "It is possible that part of the fuel cladding tubes has started to melt because this value (the water level at 09:15 on March 12) indicates that the fuel is partly exposed", and in response to the reporter who asked "Do you mean that the fuel could have partly started to melt?", he only explained that "We cannot deny the possibility."

Before the press briefing due at approximately 14:00 on March 12 (the 14th report), Deputy Director-General Nakamura notified the Director-General of NISA, Nobuaki Terasaka (hereinafter referred to as "Director-General of NISA Terasaka"), that the possibility of a core meltdown was believed high because (i) the radiation monitoring values measured within the site of the Fukushima Dai-ichi NPS had increased, (ii) the isolation condenser (IC) was not believed to be running because a long time had passed since the total loss of power had occurred, and (iii) the water level continuously remained below the top of the fuel and was continuing to fall. In the meantime, Director-General of NISA Terasaka had been reported that morning that there must have been trouble with the fuel rods because cesium had been detected near the Fukushima Dai-ichi NPS. Therefore he told Deputy Director-General for Safety Examination Nakamura "(If the fact indicates that, we) cannot do nothing but say so".

At the NISA press conference at approximately 14:00 the same day (the 14th report),

Deputy Director-General Nakamura explained in more detail than the explanation at the earlier press conference at approximately 09:45 the same day (the 12th report), and said, "There is a possibility of a core meltdown. It looks like that a core meltdown is occurring."

After the NISA press conference at approximately 14:00 on March 12 (the 14th report), Director-General of NISA Terasaka learned that the Prime Minister's Office was concerned about the NISA announcement relating to the core conditions at the press conference and requested the information to the PMO prior to releasing it to the press[147]. He thus instructed the publicity staff of NISA to get the approval of the Prime Minister's Office before holding a press conference. NISA had held press conferences every one or two hours until then, but because of these conditions the interval between them became longer.

Furthermore, Director-General of NISA Terasaka instructed Deputy Director-General Nakamura via the other Deputy Director-General to be mindful of his remarks during press conferences because of the Prime Minister's Office's concern about NISA's press conferences.

Deputy Director-General Nakamura took charge of the publicity until the press conference at 17:50 on March 12 (the 15th report in which an explanation for the explosion in the R/B of Unit 1 at 15:36 that day was given), and then requested Director-General of NISA Terasaka to replace the spokesperson. Thus Director-General of NISA Terasaka instructed a replacement for the spokesperson for Deputy Director-General for Safety Examination Noguchi. Deputy Director-General for Safety Examination Noguchi took charge of the publicity at two subsequent press conferences.

At the press conference at 21:30 on March 12, a reporter asked, "About the core meltdown which is reported on TV and in other media to be the first case in Japan, please explain the meaning of it and whether the conclusion is correct or not from a perspective the public can understand." Deputy Director-General for Safety Examination Noguchi and other staff replied, "The condition of the core has not been clearly identified yet. We will endeavor to clarify the situation as soon as possible even though the outcome is uncertain" and "Although the possibility that the core has been damaged is rather high, the details of its condition have

[147] Further investigation shall be conducted into the process of how such information was resulted and communicated.

not been established yet." They explained without using the expression of "core meltdown."

At the press conference at 05:30 on March 13 (the 18th report), the Deputy Director-General (in charge of nuclear safety and nuclear fuel cycle) of NISA, Hisanori Nei (herein referred to as "Deputy Director-General Nei"), took charge of the publicity and explained that "The possibility cannot be denied because such a material (cesium) has already been detected and we must keep that in mind"[148] in response to a question about the possibility of a core meltdown at Unit 1.

At the press conference at 17:15 (the 20th report) on March 13 and subsequent ones, NISA Liaison Officer Nishiyama was designated as the full-time spokesperson. Deputy Director-General Nei said at the announcement of this designation that the condition of the core had not yet been established. At the subsequent press conferences, he said that "It is certain that at least the core has been damaged. It is not clear whether the core has already reached the point described by the expression 'core meltdown'" explaining without using the expression "core meltdown" and only responding that the possibility of a core meltdown was unclear.

As described above, the explanation by NISA to the press changed during the period from March 12 to 13 in two respects: it refrained from using the expression "core meltdown" and it shifted from an affirmative explanation to an indication of uncertainty about the possibility.

On April 10, NISA started, as instructed by METI minister Kaieda, coordinating the terms to be used to explain the internal condition of the reactor and analyzing the internal condition of the reactor. Since then, NISA decided to use the expression "fuel pellet melt" instead of "core meltdown" when explaining the internal condition of the reactor, because, earlier at the Integrated Response Office there had been a strong opinion insisting that "It is better to use 'fuel pellet melt' rather than 'core meltdown'."

On April 18, NISA reported the results of an analysis and evaluation of the internal condition of the reactors of Units 1 to 3 of the Fukushima Dai-ichi NPS at the 23rd extraordinary session of the Nuclear Safety Commission (NSC), and prepared a document about the terms explaining the condition of the reactor core. In the document, the terms were

[148] Deputy Director-General Nei did not use the expression "core meltdown" in the later press conference at 10:05 that day (the 19th report) either.

defined as follows: (i) "core damage" is "a condition where a significant amount of the fuel cladding tubes are damaged because of an increase of reactor core temperatures (fuel temperatures) due to a continued lack of cooling of the reactor core or an abnormal power increase in the core; in this situation, fuel pellets do not necessarily melt"; (ii) "fuel pellet melt" is "a condition in which the fuel melts because of an increase in the reactor core temperatures (fuel temperatures) due to a continued lack of cooling of the reactor core, which consists of fuel assemblies, or an abnormal power increase in the core; in this situation, the fuel assemblies and the fuel pellets melt and the shapes of the fuel assemblies are not maintained"; and (iii) "meltdown" is "a condition in which the fuel assemblies melt and are unable to maintain their shapes, and their melt falls into the lower area of the reactor core due to gravity." Based on these definitions, NISA indicated that the "fuel pellet melt" occurred in the reactors of Units 1 to 3.

(3) TEPCO's remarks about reactor core conditions

On March 15, TEPCO published information about "core damage" indicating that the percentage of the damage in the cores was approximately 70% in Unit 1, approximately 30% in Unit 2 and approximately 25% in Unit 3 based on the data obtained by the containment vessel atmosphere monitoring system (CAMS)[149]. TEPCO always used the expression "core damage" when explaining the condition of the core at the press conferences afterwards.

At the end of April, TEPCO started the MAAP analysis (see 7(1) a above), which analyzes the condition of the internal situation of the reactor, because the data for the MAAP analysis became available. At the press briefing on May 12, TEPCO explained the condition of Unit 1 as "the fuel assemblies melted and fell into the lower area, where they are cooled" based on the provisional result of the MAAP analysis.

Furthermore, on May 15 TEPCO published the aforementioned provisional evaluation in the "Condition of the Reactor Core of TEPCO's Fukushima Dai-ichi NPS Unit 1", in which it said that "it has been concluded that the fuel pellets in Unit 1 melted and fell into the bottom

[149] The containment vessel atmosphere monitoring system (CAMS) monitors the radiation level within the reactor containment vessel after a loss of coolant accident and the measured values are used as important inputs for estimating the percentage of core damage.

of the reactor pressure vessel relatively soon after the tsunami had arrived." This description corresponded to the "meltdown" as defined by NISA.

TEPCO obtained and checked all the data required for the analysis on May 16 and then published the final results of the analysis on May 24.

(4) TEPCO's public relations activities and the involvement of the Japanese government

From March 11 to 15 the Fukushima Prefectural Emergency Response Headquarters held its meetings several times a day at the Fukushima Prefecture Jichi Kaikan ("Local Government Hall"). The Headquarters made the staff of the TEPCO Fukushima Office, who were dispatched to the Headquarters right after the earthquake, report information about the Fukushima Dai-ichi NPS at its meetings. The meetings were open to the press.

In the evening of March 12, the chief of the TEPCO Fukushima Office was requested by the Prefectural Emergency Response Headquarters to explain at the meeting of the Headquarters the explosion in the R/B of Unit 1 that had occurred at 15:36 that day.

The chief had been requested by the press agencies and others to supply photographs of the R/B of Unit 1 after the explosion. Therefore he decided to use the photograph of the R/B of Unit 1 after the explosion that had been shared within TEPCO for the explanation and showed the photograph in the meeting of the Headquarters' members that night at his own discretion.

However, on March 13, the Prime Minister's Office warned the TEPCO president, Masataka Shimizu, against publishing the photograph without first notifying the Prime Minister's Office. President Shimizu therefore instructed the manager of the Plant Siting and Regional Relations Department of TEPCO to get the consent of the Prime Minister's Office on items such as texts and materials to be published prior to releasing them to the press. Since then TEPCO got the prior consent of the Prime Minister's Office on items such as texts and materials to be published.

(5) Dissemination of information about the Unit 3 reactor conditions

In the press conference at approximately 15:30 on March 13, Chief Cabinet Secretary Edano explained that there arose a chance of a hydrogen explosion in the R/B of Unit 3

similar to the one at Unit 1 in March 12 because the injection of water temporarily became unstable and the water level in the reactor decreased during the freshwater and seawater injection into the reactor of Unit 3, and this would have led to the reactor core being insufficiently cooled, and consequently it could not be denied that a large amount of hydrogen was produced within the reactor of Unit 3 and had accumulated in the upper area of the R/B.

In the press conference at around 11:00 on March 14, Chief Cabinet Secretary Edano was explaining the following. TEPCO instructed at 06:50 the outdoor workers to temporarily evacuate because the pressure in the reactor containment vessel of Unit 3 had increased. However, the outdoor work was resumed because the pressure in the reactor containment vessel decreased after that incident. However, the R/B of Unit 3 exploded during this press conference. Chief Cabinet Secretary Edano told the press that an explosion might have occurred because white smoke was being emitted from Unit 3 at 11:05 on March 14, and the situation was under investigation.

Prior to the incident mentioned above, Fukushima Dai-ichi NPS site superintendent Yoshida notified TEPCO head office at approximately 06:00 on March 14 of a rapid increase in the pressure in the drywell of Unit 3. Then at 07:53 on March 14, site superintendent Yoshida notified TEPCO head office that the pressure in the drywell had been 460kPa abs and exceeded the designed maximum operating pressure of 427kPa abs as of 6:10 the same day, and determined that the situation corresponded to an "abnormal increase in containment vessel pressure" (stipulated in Clause 21 Section 1 of the enforcement regulations of the Act on Special Measures Concerning Nuclear Emergency Preparedness, "Large Reactor Facilities" (iii)). In response to the notification, TEPCO liaison officer to the government A at the head office instructed the staff B, who had been dispatched to the Prime Minister’s Office then, to get the consent of the Prime Minister's Office and NISA on the publication of the incident, the abnormal increase in the pressure of the containment vessel of Unit 3. Staff B explained to the NISA officials who were stationed on the 5th floor of the Prime Minister's Office about the abnormal increase in the pressure of the containment vessel of Unit 3 by indicating the draft text for release to the press that had been prepared by the TEPCO publication team. The NISA officials

instructed TEPCO staff B to wait for a while because they had to coordinate with the Prime Minister's Office. Finally the NISA officials instructed TEPCO staff B that TEPCO should not release the incident to the press ahead of the government. As a result, TEPCO did not release details to the press after all about the abnormal increase in pressure of the containment vessel of Unit 3.

On the other hand, the staff of the TEPCO Fukushima office mainly reported the condition of the plant at the meetings of the Prefectural Emergency Response Headquarters and the meetings were opened to the press as described in (4) above.

In the early morning of March 14, information on the pressure increase in the reactor containment vessel of Unit 3 was delivered to the TEPCO Fukushima office. The chief of the TEPCO Fukushima office requested TEPCO head office for their consent to explain the abnormal increase in pressure of the containment vessel of Unit 3, in the meetings of the Prefectural Emergency Response Headquarters. However, the manager of the Plant Siting and Regional Relations Department of TEPCO instructed the chief of the TEPCO Fukushima office to refrain from publishing the information because he had been instructed by NISA to wait for press release on the matter. Therefore the staff of the TEPCO Fukushima office could not explain the abnormal increase in pressure in Unit 3 in the meeting of the Prefectural Emergency Response Headquarters held at approximately 09:00 on March 14.

Later at 09:15 the same day, NISA liaison Nishiyama explained in the NISA press conference that the pressure in the reactor containment vessel of Unit 3 exceeded the designed maximum operating pressure.

(6) Announcement concerning the detection of tellurium, etc.

a. Publication of the results of the radionuclide analysis by NISA

As described earlier in 1(1) b, Fukushima prefecture conducted radiation monitoring around the Fukushima NPS during the period from March 11 to 15. As a result, radioactive materials such as iodine 131 and 132, cesium 137 and tellurium 132 were detected in samples of: (1) atmospheric suspended dust collected in Namie-town during the period from 08:39 to 08:49 on March 12, and (2) atmospheric suspended dust collected in

Minamisoma-city during the period from 13:20 to 13:25 the same day.

However, the secretariat of the Nuclear Emergency Response Headquarters did not publish immediately most of the results of the monitoring conducted during the period from March 11 to 15, and disclosed most of it for the first time[150] on June 3.

b. Process until publication on June 3

When publishing the "Results of the Emergency Monitoring in the Vicinity of the Fukushima Dai-ichi and Dai-ni NPS (conducted from March 11 to 15)" on June 3, the Local Nuclear Emergency Response Headquarters explained the process until the publication as in the following: "the Local Nuclear Emergency Response Headquarters evacuated from the Off-site Center in Okuma-town on March 15[151]. As it was necessary to check the data left at the Off-site Center, the staff of the Off-site Center visited the building of the Center in Okuma-town again to retrieve the related files and integrated the results of the monitoring on May 28. Now we can publish the results today on June 3."

However, the results of the monitoring conducted in the vicinity of the Fukushima NPS in the period from March 11 to 15 had been transmitted from the Local Headquarters to the secretariat of the Nuclear Emergency Response Headquarters. The staff of the secretariat of the Nuclear Emergency Response Headquarters who received the transmitted results published only the results of the monitoring that had been integrated in the form of tables by the Local Headquarters, and did not integrate by himself the other results into the form of tables or any other form and left them as was without publishing. Early in May, the secretariat of the Nuclear Emergency Response Headquarters started to integrate the monitoring data that had not been published and prepared them for publication as well as arranging the unpublished results of independent calculations using SPEEDI[152] for

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[150] NISA published part of the monitoring results immediately. For example, 5.8Bq/cubic meter of iodine 131 and 1.7Bq/cubic meter of tellurium had been detected in atmospheric suspended dust collected in front of the Environmental Radioactivity Monitoring Center of Fukushima during the period from 08:00 to 08:10 on March 13, and NISA published this information at the same time with the earthquake damage information (the 22nd report, as of 07:30 on March 14).

[151] See III 5 (3) above.

[152] The results of the independent calculation by NISA using SPEEDI were published gradually on May 3, June 3, 11, 28 and July 24.

publication. The secretariat instructed the Local Headquarters to arrange the unpublished monitoring data for publication. According to the instruction, the Local Headquarters integrated the monitoring data and retrieved the materials left in the Off-site Center in Okuma-town. At that time the aforementioned unpublished data were retrieved and integrated, and then published on June 3.

(7) Ambiguous expression of no " immediate" effects on health

The Government often explained, "It does not have immediate effects on health" about the influence of radiation on the human body. For example, in the Chief Cabinet Secretary's press conference at approximately 18:00 on March 16, the Government explained that "It is not values that will have immediate effects on the human body" about the monitoring results on the same day (the values over 30μSv/h had been obtained in Iitate, Minamisoma and Namie); the Government also explained in the Chief Cabinet Secretary's press conference at approximately 16:00 on March 19 that "Please understand that the radiation dose does not have immediate effects on the health of citizens (even if you temporarily ingest food from which radioactive materials exceeding the provisional limit are detected), so please act calmly" concerning the detection of radioactive materials exceeding the provisional limit prescribed in the Food Sanitation Act from the milk extracted within Fukushima Prefecture and the spinach harvested within Ibaraki Prefecture. In addition, the Consumer Affairs Agency explained on the Agency's web on March 20 that "It is not believed to have an immediate effect on your health even if you occasionally ingest food in which radioactive materials exceeding the provisional limit prescribed in the Food Sanitation Act were detected" in the message "About Delivery Restriction on Food Because of Detection of Radioactivity" from the Minister of Consumer Affairs, Mr. Renho. Similar explanations were repeated in the later messages of March 21 and 23. Furthermore, NSC also explained to the public that "Even if you continue to ingest food in which radioactive materials exceeding the prescribed limit are detected, it will not have immediate effects on your health" in the notice "To the People Living Outside the Areas where Evacuation or Sheltering Indoors is Conducted" on March 21, 2011.

It seems that the expression "immediate" effects was used on the basis of the following

scientific knowledge: the causalities between radiation exposure and the occurrence of diseases such as cancer is not clear for low-level radiation exposure; and it will take a considerably long time for cancer to occur if it ever does (see 4 (1) b above). In fact, the expression "It does not have immediate effects on the human health" may be interpreted by some people as "it is unnecessary to be anxious about the impact on the human health," while it may be interpreted by other people as "It does not immediately affect human health, however, some effects will be brought about on the human health in the longer term." However, it was not necessarily clear which one the intended meaning was of the expression and there was no detailed explanation about it.

The Consumer Affairs Agency deleted the word "immediately" from the aforementioned message on April 1. With regards to the intention to have used the expression "It cannot be considered to immediately affect..." in the "Q&A for Food and Radioactivity" page on the Agency's website, the Agency explained that acute symptoms would not develop in the human body even if food in which radioactive materials exceeding the provisional limit were detected were occasionally ingested because the radiation dose from the ingested food is very small, but that the influence in case when the ingested radioactive materials accumulate in the human body cannot be completely denied because they are radioactive.

9. Details of events in areas where there may be problems concerning the provision of information to the international community

(1) Provision of information concerning the discharge of contaminated water into the sea

a. Notification of the discharge of contaminated water into the sea to other countries and international organizations

As described above in 6 (1) e, TEPCO decided to discharge relatively less contaminated accumulated water into the sea with the consent of NISA on April 4. However, no staff at NISA who had been involved in the paperwork for the procedure required for the discharge recognized or pointed out the necessity of notifying related foreign countries. After it was decided that the discharge would be conducted, a staff member of NISA who was watching the Chief Cabinet Secretary's press conference that started at 16:03 on April 4 and recognized the need for notification, then visited the ERC to obtain the materials

related to the discharge into the sea, and then notified the IAEA of the discharge via email at 17:46 the same day.

In addition, after 15:30 on April 4, a staff member of the Ministry of Foreign Affairs, who was at the Integrated Emergency Response Office, learned that TEPCO was planning to discharge the contaminated water into the sea and notified the related divisions within the Ministry about it. The news was communicated via email from a mobile phone to the staff member of the Ministry who was in charge of publication during the regular briefing that started at 16:00 the same day. The staff member notified the diplomats of the foreign countries of the news in the briefing. The discharge of the less contaminated water within the centralized waste disposal facilities actually started at 19:03 the same day. The Ministry of Foreign Affairs was notified of the planned discharge into the sea by the Ministry staff member who had been stationed at the Integrated Emergency Response Office, then informed all the diplomatic corps via email and fax that the discharge would begin that day. However, the notification stating that the discharge would begin that day was sent at 19:05 the same day after the discharge had already started at that time.

On April 5, the Ministry of Foreign Affairs and NISA again explained the details of the discharge of the contaminated water into the sea and its impact in the regular briefing that started at 16:00 (47 countries and two international organizations attended). Furthermore, on April 6, the Ministry of Foreign Affairs explained the details of the discharge and its impact to the embassies of South Korea, China and Russia located in Tokyo.

b. Question from the view point of the fulfillment of international commitment

As mentioned earlier in 6 (1) e (b), NISA concluded that the discharge of the less contaminated water into the sea conducted on April 4 did not have a significant impact on human health because the total effective dose rate had been evaluated to be 0.6mSv/year which was below the 1mSv/year value stipulated as the dose limit in the rules and notification about commercial reactors (see 4 (1) c above). The next day, on April 5, NISA enquired the Ministry of Foreign Affairs whether the discharge into the sea complied with the treaty, and received a response that said the discharge did not fall within the scope which requires notification prescribed in Article 2 of the Convention on Early Notification

of a Nuclear Accident[153].

With regards to the obligation to notify prescribed in Article 198 of the United Nations Convention on the Law of the Sea, the Ministry of Foreign Affairs said, "the discharge does not correspond to the event 'in which the marine environment is in imminent danger of being damaged or has been damaged by pollution' prescribed in Article 198 of the United Nations Convention on the Law of the Sea" and concluded that the discharge does not fall within the scope which requires Japan to notify other countries as stipulated in the Article[154]. However, the Ministry of Foreign Affairs does not believe that there is no need for notification. Foreign Minister, Takeaki Matsumoto, said to the Committee of Foreign Affairs of the House of Representatives on April 13, "We should sincerely consider the problem presentation (from foreign countries) that requests detailed explanation in advance and also will make an effort to resolve the problem". Even if no notification obligation is stipulated in treaties, it is reasonable to consider that it is necessary to notify the related countries around Japan of the discharge in advance.

Furthermore, there are remarks that say it is not acceptable to discharge without any notification or consultation and Japan should get the agreement of neighboring countries on the discharge even if the concentration is rather low.

(2) Supply of information to other countries in the initial period after the accident

a. Framework of information provision to other countries

The Government held regular briefings regarding the Fukushima NPS accident in principle once a day during the period from March 13 to May 18 and three times a week after May 19 for the diplomatic corps residing in Tokyo. In the briefings, the explanation

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153 The Ministry of Foreign Affairs also responded to the Investigation Committee that "the discharge does not correspond to an event stipulated in Article 1 of the Convention on Early Notification of a Nuclear Accident ('from which a release of radioactive material occurs or is likely to occur and which has resulted or may result in an international transboundary release that could have radiological safety significance for another State') and it does not fall within the scope which requires notification as stipulated in Article 2 of the Convention.

154 This was presented as a response to the inquiry of the Investigation Committee. Furthermore, the discharge is also not considered to be a breach of duty (to take appropriate steps in the event that a release of radioactive materials into the environment occurs) as stipulated in Article 24 Section 3 of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management because it was conducted as a legislative measure also on the basis of opinions of the regulating agencies.

about the status and countermeasures regarding the accident was given by the staff who were in charge of the respective area and were mainly from the Foreign Ministry, but also from NSC, MEXT, the Ministry of Health, Labour and Welfare, the Ministry of Agriculture, Forestry and Fisheries, the Fishery Agency and NISA.

b. Information Provision to the USA after the accident occurred

The United States was greatly concerned about the status of the plant at the Fukushima NPS from the moment the accident had occurred. Although experts from the United States Nuclear Regulatory Commission (USNRC) and DOE contacted the agencies concerned to gather information, the United States could not get sufficient information. However, regular consultation between Japan and the US was initiated by the Prime Minister's Office on March 22, then the information and views regarding the plant were exchanged and the acceptance of relief supplies was coordinated during subsequent consultations. The consultation between Japan and the US significantly improved the flow of information regarding the plant for the US.

10. Coordination with other countries and the IAEA

(1) Coordination with USA

As described above in 9 (2) b, the regular consultations initiated by the Prime Minister's Office on March 22 between Japan and the USA were attended by the DOE and the NRC of the US, the agencies concerned in Japan and TEPCO who shared and exchanged information and views regarding the plant and coordinated the acceptance of relief supplies.

During the consultations, there were many offers of cooperation such as the provision of barges that contained freshwater[155], stationing of US experts at the Integrated Emergency Response Office, integration of the results of monitoring analysis by the DOE and the SPEEDI analysis in Japan, and consultation about the use of remote controlled robots for monitoring and removing rubbles/debris[156].[157]

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[155] A barge containing freshwater was offered by the US in the consultation between Japan and the US on March 23 and two barges supplied water to the Fukushima Dai-ichi NPS on April 1.

[156] On March 15, before the consultations between Japan and the US began, two fire engines were offered by the United States Armed Forces in Japan and used for the spraying of water on the spent fuel pool of Unit 4 on March

(2) Support from other countries and Japan's response to their support

With regards to the offers of support from foreign countries regarding to the Tohoku District - off the Pacific Ocean Earthquake, the Ministry of Foreign Affairs mainly coordinated the recipients since the day the disaster had occurred.

With regards to the Fukushima NPS accident, various equipment was offered by foreign countries such as water pumps to use for the cooling of reactors, fire engines, barges containing freshwater, remote controlled robots, gamma cameras, protective clothing, protective masks, monitoring vehicles, aerial monitoring equipment, germanium semiconductor detectors and personal dosimeters.

Furthermore, protective clothing, rubber gloves and boots came soon after the middle of March, and several countries supplied those materials at the request of Japan.

On the other hand, the Government declined offers of equipment that required training on their operation before acceptance or equipment that was plentiful in Japan. For example, the offer to supply stable iodine was declined because there were large stocks of it in Japan and the storage and transportation of the stable iodine offered was expensive because it was in the form of liquid. Further, the offer of remote controlled unmanned robots was declined because it was necessary to be trained in their operation in the country supplying the robots. In addition, one country offered to supply monitoring vehicles; however the acceptance was delayed because it took a long time to secure drivers who could operate them[158].

The equipment offered by the USA was readily accepted because it was coordinated during the consultations between Japan and the USA in which the agencies concerned attended. Furthermore, since early April, the use of a "US-Japan Nuclear-Related Assistance Tracker" was proposed, which was an integrated at-a-glance format that represents

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[157] During the consultations between Japan and the US on March 25, three project teams (PTs) were established to deliberate on issues in the respective fields: (1) the shielding PT (which deliberates on shielding methods to prevent the radioactive materials from being released), (2) the fuel rod retrieving and transfer PT (which deliberates on methods to retrieve the spent fuel from the power station), and (3) the remote control PT (which deliberates on methods for unmanned work in areas of high radiation).

[158] The country made the offer on the condition that country supplies a driver, too, because training is required to drive the monitoring vehicle. However, because of difficulties in communication, the Government requested that that country train Japanese staff to operate the measurement equipment at the embassy of that country and supply only the monitoring vehicle.

information such as an explanation about the equipment that could be supplied, the destination of the equipment and the party who would accept them. This system lead to the acceptance of the relief supplies being more coordinated.

(3) Evacuation advice of foreign governments to their nationals in Japan

On March 16, the USA recommended USA citizens residing in Japan to evacuate from the area within a 50-mile (80km) radius of the Fukushima Dai-ichi NPS. The recommended evacuation distance of 50 miles was specified by the NRC on the basis of radiation dose for the worst-case scenario. In addition, that same day, the USA recommended the families of USA government staff to evacuate voluntarily from Japan.

On April 15, the USA withdrew their evacuation advice on March 16 for the families of USA government staff. Furthermore, on October 7, the evacuation area was decreased to a 20km radius from the 50-mile radius that had been specified on March 16[159].

Some countries other than the USA also published evacuation advice similar to that of the USA.

(4) Coordination with the IAEA

Article 2 Section 4 of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency stipulates that signatory countries shall notify IAEA of experts, equipment and materials that could be made available to other signatories to assist them in the event of a nuclear accident or radiological emergency within the limits of their capabilities. On March 16, Japan asked the IAEA to provide information regarding items in the possession of other signatories such as remote controlled monitoring robots, aerial survey systems, unmanned trucks and unmanned helicopters. In response to this request, IAEA asked several countries to provide information about their respective equipment. The countries responded after March 17 and Japan accepted the equipment that those countries could supply such as the remote controlled robots.

[159] However, the US government recommended US nationals avoid entering the deliberate evacuation area and the specific areas from where evacuation was recommended by the Japanese government, even those beyond the 20km radius.

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