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

[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.

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 of 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; 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 NERHQr 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].

(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 eradiation 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

[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.

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 originatingt from he 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 events concerning the disposal of 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 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 isotope 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 mSv/h	Iodine 131 Bq/cm3	Cesium 134 Bq/cm3	Cesium 137 Bq/cm3	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 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) Process 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 trod 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 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 collection & decontamination team" (renamed to "Radioactive accumulated water collection & 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 lifted 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 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

117 The following options were considered as alternatives for the storing space: water treatment device tank (19,450t), barge ship (3,000t), pool dug 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).

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 who was measuring the air radiation level found that highly contaminated water with a surface dose 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 chemical solution 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 at 05:38 on April 6 to have stopped.

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 barscreen (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 within the contaminated water that had flowed out were 5.4^10^{6}Bq/cm^3 of iodine 131, 1.8^10^{6}Bq/cm^3 of cesium 134, 1.8^10^{6}Bq/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

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 of 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

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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 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.

the centralized RW/B to the Unit 4 T/B had been stopped because it caused the increase 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 leaking 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 and become compromised if no measures were taken. 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

[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.

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 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

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

to other countries and international organizations, see 9 (1) below.

(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, 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 the same day. 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 the isotopes 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 document

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 1.5^10^{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.

"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 resonse 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 Discharge of Water in which the Concentration of Radioactive Materials Exceeds the Emission Standards 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 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 sea

TEPCO discharged the subdrain water in Units 5 and 6 into the ocean during the period

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

from April 4 to 9. However, the leakage into the MC room continued afterwards. Furthermore, there was new leakage on March 15 into other areas through the wall of the 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 then transferred since May 1 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 leaking was detected and it was discovered in CCD 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 effluent 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 route of the flow. TEPCO compiled the results of the examination on aspects such as the impact on the ocean and the route of the flow, as well as the prevention measures for recurrence and dispersal 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].

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

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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 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 circulating injection cooling 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.

treat the contaminated water became an 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 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 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 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 part conducting oil separation and desalination from domestic companies, and the part conducting clean-up from 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

[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 decontamination itself. Kurion submitted a proposal for a decontamination 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

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.

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 leaking 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 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

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consultation. On this occasion, the water treatment team informed Areva of the needs of TEPCO for the decontamination system. Then, Areva officially submitted a proposal for the decontamination 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.

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.

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 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.

137 Sarry is capable of separating oil from water and decontaminating the radioactive materials without separating 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 decontamination systems manufactured by Kurion and Areva.

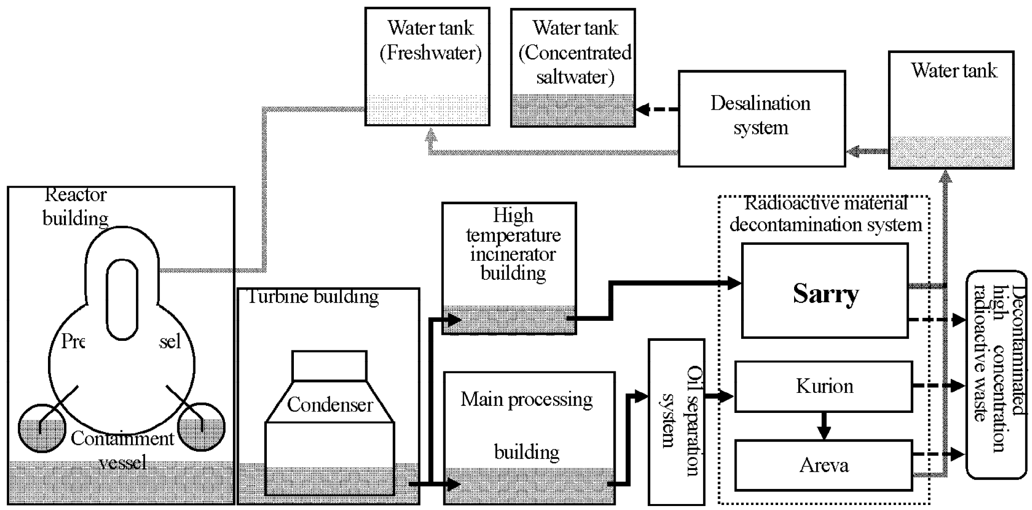

Fig V-1 Outline of the flow of circulating injection cooling (after August 19) (compiled from materials supplied by TEPCO)

(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 the circulating injection cooling as the measures in Step 1 to consistently cool the reactors, and published its intention in 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 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 would be created by the submergence even in the event water injection stopped and that even when the amount of leaking water from the reactor containment vessel increased there was no possibility of 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 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 leaking would increase if the injection for the submergence continued. Furthermore, it concluded that, if the amount of leaking 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 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 cooling 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 material discharged and an evaluation based on INES

(1) Total amount of radioactive material discharged

a. Estimation by NISA of total amount 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 6,000 TBq of cesium 137. These amounts correspond to 370,000 TBq 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 160,000 TBq of iodine 131 and 15,000 TBq of cesium 137. These amounts correspond to 770,000 TBq of iodine equivalent. On June 6, NISA published the result.

b. Estimation by NSC of total amount 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, SPEEDI (see 2 (1) above), etc. During this process NSC also estimated the amount of the 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 150,000 TBq of iodine 131 and 12,000 TBq of cesium 137 (corresponding to 630,000 TBq of iodine equivalent). On April 12, NSC published the result.

NSC conducted its analysis again later because it had obtained other new information

[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).

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 130,000 TBq of iodine 131 and 11,000 TBq of cesium 137 (corresponding to 570,000 TBq 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 index 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 each accident and incident at nuclear facilities.

In the practice in Japan, first NISA conducts a provisional evaluation (provisional INES evaluation) investigating the cause of an incident, and after the reoccurrence preventive measures is established, the INES Evaluation Subcommittee at 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

[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.

and trouble management office") was notified by TEPCO that it 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 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 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 including the hydrogen explosion in the Unit 3 building on March 14, the sound of an explosion that had been assumed 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

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.

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 does not indicate the release of the reactor core inventory.

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 such as that 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 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

[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.

[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.

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 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

[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.

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-machi).

(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 designated 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 likelihood of a core meltdown was believed high because (i) the values measured in the monitoring 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 likelihood 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 would now be 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 likelihood that the core has been damaged is rather high, the details of its condition have not been established yet." They explained without using the expression "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 likelihood cannot be denied because such a material (cesium) has already

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

been detected and we must keep that in mind"[148] in response to a question about the likelihood 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 likelihood 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 likelihood.

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 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

[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.

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 melting 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 3 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, TEPCO published the aforementioned provisional evaluation in the "Condition of the Reactor Core of TEPCO's Fukushima Dai-ichi NPS Unit 1" on May 15, in which it said that "it has been concluded that the fuel pellets in Unit 1 melted and fell into the bottom 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.

[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.

(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 that 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 design 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 design maximum operating pressure.

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

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

As described earlier in 1(1) b, the Local Nuclear Emergency Response Headquarters ("Local NERHQ") 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 within: (1) atmospheric suspended dust collected in Namie-machi during the period from 08:39 to 08:49 on March 12, and (2) atmospheric suspended dust collected in Minamisoma-shi 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-machi 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-machi 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 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

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 when 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.

Okuma-machi. At that time the aforementioned unpublished data were retrieved and integrated, and then published on June 3.

(7) Ambiguity concerning the negation of "immediate" effects on health

The Government often explained, "It does not have immediate effects on humans" 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 an amount 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 amount of exposure does not have immediate effects on the health of citizens (even if you briefly ingest food from which radioactive materials exceeding the provisional limit is 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 level from the ingested food is very low, 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 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].

[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

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 logical 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 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

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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.

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 other countries and the IAEA

As described above in 9 (2) b, the regular consultations initiated by the Prime Minister's Office on March 22 between Japan and the US 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 18.

157 During the consultations between Japan and the US on March 25, three project teams 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

(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 recipient of it 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 organize drivers who could operate them[158].

The equipment offered by the US was readily accepted because it was coordinated during the consultations between Japan and the US 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 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

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methods for unmanned work in areas of high radiation).

[158] The country made the offer on the condition that country supply 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.

supplies being more coordinated.

(3) Evacuation advice of foreign governments to their nationals in Japan

On March 16, the US recommended US citizens residing in Japan 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 the worst-case scenario estimate of radiation levels. In addition, that same day, the US recommended the families of US government staff evacuate voluntarily from Japan.

On April 15, the US withdrew their evacuation advice on March 16 for the families of US 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 US also published evacuation advice similar to that of the US.

(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.

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[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.