文部科学省 MINISTRY OF EDUCATION, CULTURE, SPORTS, SCIENCE AND TECHNOLOGY JAPAN

The 2011 off the Pacific coast of Tohoku Pacific Earthquake and the seismic damage to the NPPs

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CRPPH-69 (17th – 19th May, 2011)

Contents

Note:1. Some data in this material may not be correct. Especially, all the plant parameters were lost during some period in the accident and some parameters are apparently inconsistent among them.
2. Source of information in this presentation is informed by NISA

SUMMARY OF ACCIDENT EVENTS AND RADIOLOGICAL RELEASE

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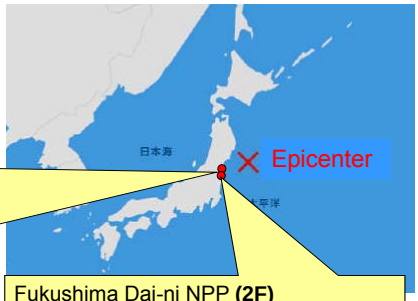
1. Outline of earthquake and nuclear reactors

1-1. 2011 off Tohoku Pacific Earthquake

Fukushima Dai-ichi NPP **(1F)**



Fukushima Dai-ni NPP **(2F)**

- **Occurred 14:46 March 11, 2011**
- **Magnitude:9.0 Mw**
- **Epicenter location: 38° 6''N and 142° 51''E, and 24km in depth**
- **It is said that the height of tsunami attacked Fukushima Dai-ichi was more than 14m**

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1-2. Tsunami after the earthquake

- **East coast of northern area in the main island of Japan is seriously damaged**
- **As of May 12, 14,998 people are dead and 9,761 people are missing**

Source: Fire and Disaster Management Agency

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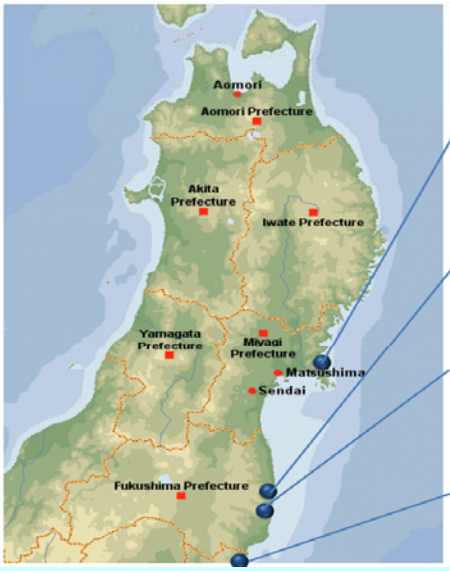
1-3. Nuclear reactors near epicenter of the earthquake

Location of the Nuclear Installations



Onagawa
Unit1: 524 MW, 1984-
Unit2: 825 MW, 1995-
Unit3: 825 MW, 2002-

Fukushima Ⅰ
Unit1: 460 MW, 1971-
Unit2: 784 MW, 1974-
Unit3: 784 MW, 1976-
Unit4: 784 MW, 1978-
Unit5: 784 MW, 1978-
Unit6: 1,100 MW, 1979-

Fukushima Ⅱ
Unit1: 1,100 MW, 1982-
Unit2: 1,100 MW, 1984-
Unit3: 1,100 MW, 1985-
Unit4: 1,100 MW, 1987-

Tokai Ⅱ (1,100 MW, 1978-)

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1-4. Automatic shut-down of nuclear reactors

●11 reactors were automatically shut-down safely after the earthquake

- Onagawa Unit 1,2,3
- Fukushima Dai-ichi (I) Unit 1,2,3
- Fukushima-Dai-ni (II) Unit 1,2,3,4
- Tokai Dai-ni (II)

●3 reactors were under periodic inspection

- Fukushima Dai-ichi (I) Unit 4,5,6

-After the automatic shut-down, the Unit 1-3 at Onagawa Nuclear Power Station, the Unit 3 at Fukushima II Nuclear Power Station, and the Unit at Tokai II Nuclear Power Station have been cold shut down safely.

-As for the unit 1,2,4 at Fukushima II Nuclear Power Station, the operator of the station reported NISA nuclear emergency situation because the temperature of the suppression pools became more than 100 ℃, but afterward the three units have been cold shut down.

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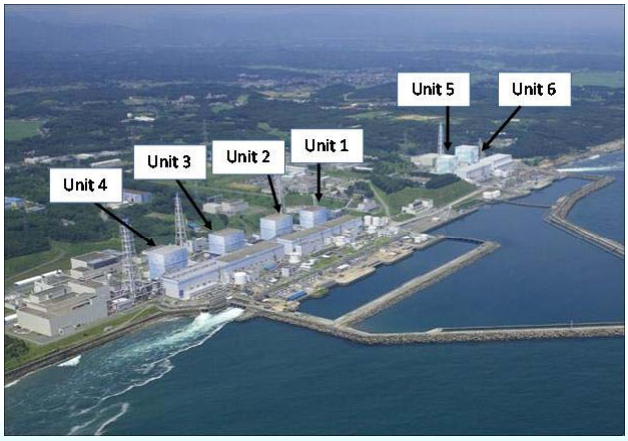
2. Outline of Fukushima Dai-ichi NPP



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2-1. Summary of Fukushima Dai-ichi NPP

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
	BWR-3	BWR-4	BWR-4	BWR-4	BWR-4	BWR-5
PCV Model	Mark-1	Mark-1	Mark-1	Mark-1	Mark-1	Mark-2
Electric Output (MWe)	460	784	784	784	784	1100
Max. pressure of RPV	8.24MPa	8.24MPa	8.24MPa	8.24MPa	8.62MPa	8.62MPa
Max. Temp of the RPV	300℃	300℃	300℃	300℃	302℃	302℃
Max. Pressure of the CV	0.43MPa	0.38MPa	0.38MPa	0.38MPa	0.38MPa	0.28MPa
Max. Temp of the CV	140℃	140℃	140℃	140℃	138℃	171℃(D/W) 105℃(S/C)
Commercial Operation	1971,3	1974,7	1976,3	1978,10	1978,4	1979,10
Emergency DG	2	2	2	2	2	3*
Electric Grid	275kV × 4				500kV × 2	
Plant Status on Mar. 11	In Operation	In Operation	In Operation	Refueling Outage	Refueling Outage	Refueling Outage

* One Emergency DG is Air-Cooled

Source: Application document of license for establishment of NPP

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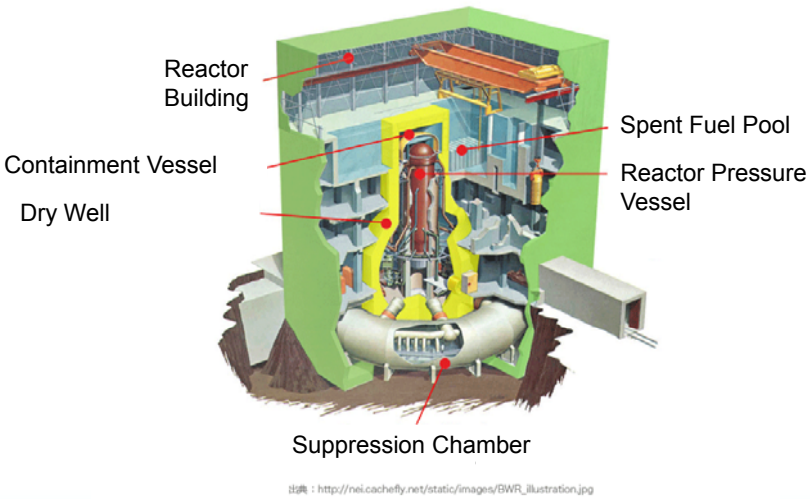
2-2. Overview of Mark-1 Type BWR (Unit 1,2,3 and 4)



出典：http://nei.cachefly.net/static/images/BWR_illustration.jpg

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3. Accident progression & countermeasures

3A. Reactor related accident

3B. Accident at Spent Fuel Pools

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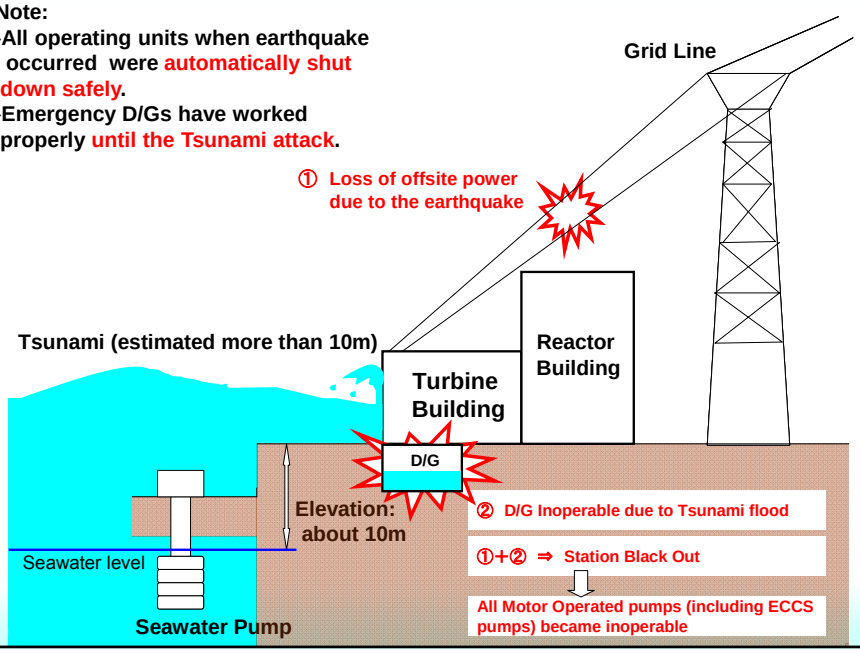
3A-1. Major root cause of the damage

Note:
- **All operating units when earthquake occurred were automatically shut down safely.**
- **Emergency D/Gs have worked properly until the Tsunami attack.**



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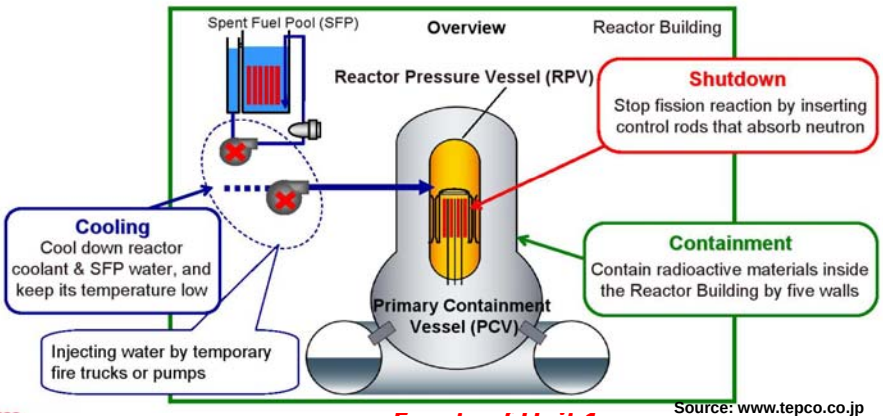
3A-2. Events of Unit 1 in the immediate aftermath of the earthquake



Source: www.tepco.co.jp

Events of Unit 1

March 11th
- Under operation, **Automatic shutdown by the earthquake**
- **Loss of A/C power**
- **Loss of water injection function**

12th
- **Unusual increase of Primary Containment Vessel (PCV) pressure**
- **Started to vent to reduce the pressure of PCV**
- **Sound of explosion**
- **Started of injection of seawater and borated water to the core**

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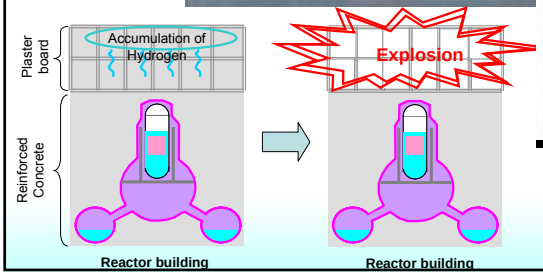
3A-3. Accident progression at Unit1

Hydrogen explosion in the operation floor



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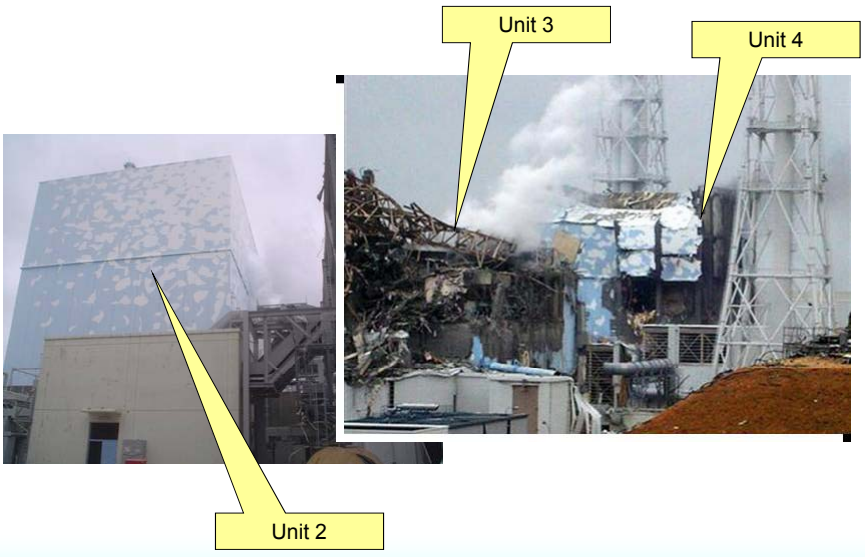
3A-4. Accident Progression at Unit2 through 6



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3A-5. Chronology of Unit2,3 in the immediate aftermath of the earthquake

● *Unit 2*

March

11th ●Under operation, **Automatic shutdown by the earthquake**
- **Loss of A/C power**
- **Loss of water injection function**

14th
- **Loss of water cooling function**
- **Unusual increase in Primary Containment Vessel (PCV) pressure**

15th
- **Sound of explosion**

● *Unit 3*

March

11th ●Under operation, **Automatic shutdown by the earthquake**
- **Loss of A/C power**

13th
- **Loss of water injection function**
- **Started to vent**

14th ●**Unusual increase in PCV pressure**

●**Sound of explosion**

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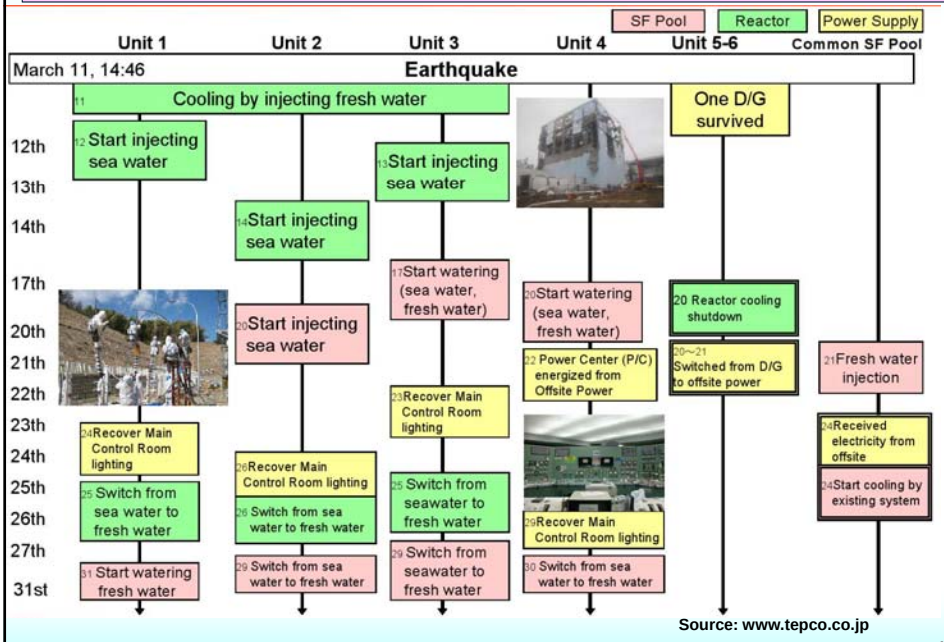
3A-6. Chronology of Fuel Cooling



Source: www.tepco.co.jp

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4. Radiological release to the environment

4A. Release of radioactive gas into the atmosphere

4B. Leakage of radioactive water

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4A-1. Release of radioactive gas into the Atmosphere

●Main event with the release of radioactive gas occurred during Mar. 12th – 15th

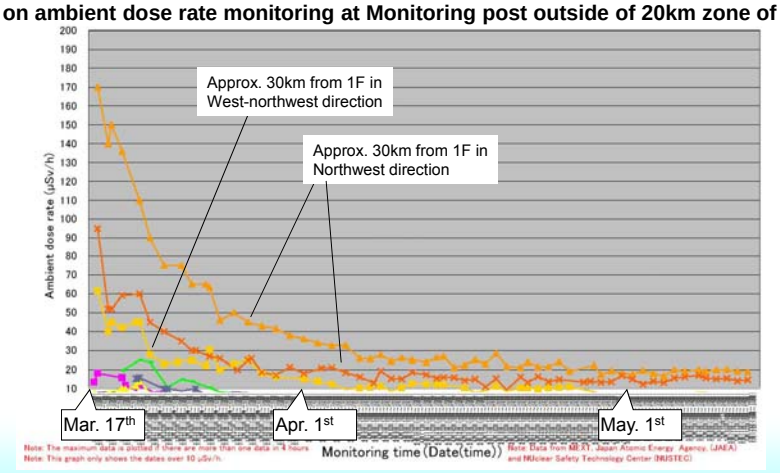
Unit 1
・Start to vent, Sound of explosion (Mar. 12th)

Unit 2
・Sound of explosion (Mar. 15th)

Unit 3
・Start to vent (Mar. 13th),
・Sound of explosion (Mar. 14th)

Unit 4
・Damage of wall (Mar. 15th)

Trend on ambient dose rate monitoring at Monitoring post outside of 20km zone of 1F



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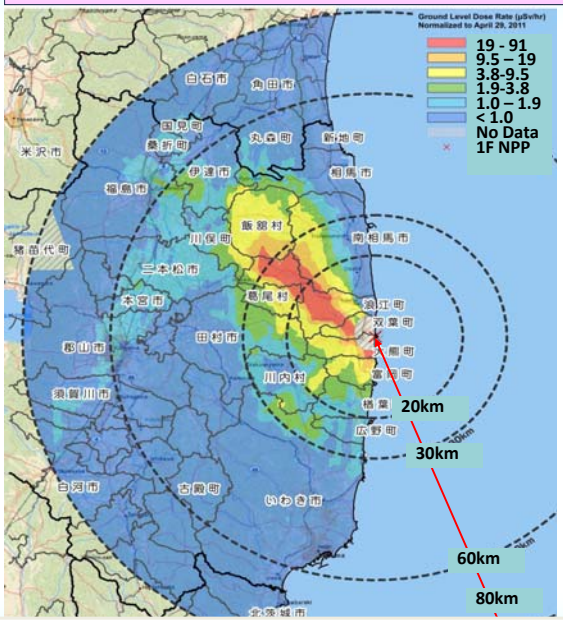
4A-2. Release of radioactive gas into the Atmosphere



Results of ambient dose rate inside the zone of 80km of 1F

Source: MEXT

- MEXT and DOE assessed the ambient dose rate on 1m from the ground surface inside the zone of 80 km of 1F was carried out with a aerial monitoring system.
- The map was prepared based on results obtained from April 6th to 29th by a small airplane and two helicopters, in total 42 flights.
- Decay of radioactive substances was considered and actual readings were converted into values as of the last survey date of April 29th.

4A-3. Release of radioactive gas into the Atmosphere (INES Rating)

- **NISA issued provisional INES ratings , based on "What is known" at the time.**
- **At first, following units were rated as Level 3 based on "Defense in Depth" criteria about 10 hours later from the earthquake.**
  - **1F unit 1, 2 and 3, 2F Unit 1, 2 and 4**
- **In the evening on March 12, the rating of 1F Unit 1 was re-evaluated to Level 4 base on the "Radiological Barriers and Control" criteria.**
- **On March 18, 1F Unit 1, 2 and 3 were re-rated to Level 5 based on "Radiological Barriers and Control" criteria because the fuel damage was highly possible. 1F Unit 4 was evaluated to Level 3 based on the "Defense in Depth" criteria.**
- **On April 12, 1F NPP was revised Level 7 based on the "People and Environment" criteria, as a result of discharged estimation.**
- **Official rating will be done after cause and countermeasures are identified.**

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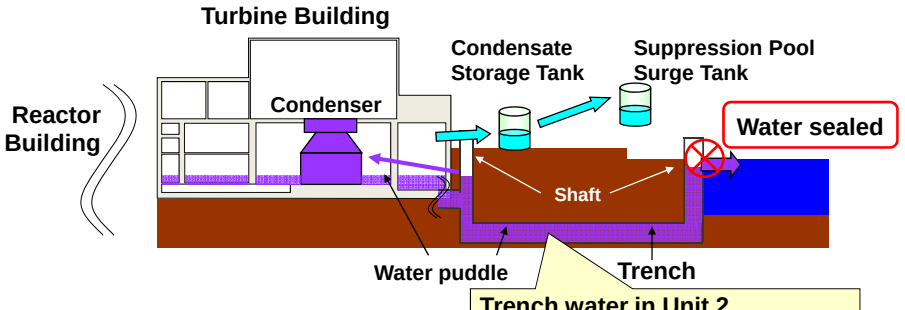
4A-3. Release of radioactive gas into the Atmosphere (INES Rating)

	Assumed amount of the discharge from Fukushima Dai-ichi (1F)		(Reference) Amount of the discharged from the Chernobyl accident
	NISA's estimation *1	NSC's estimation*2	
^{131}I…(a)	$1.3*10^{17}$Bq	$1.5*10^{17}$Bq	$1.8*10^{18}$Bq
^{137}Cs	$6.1*10^{15}$Bq	$1.2*10^{16}$Bq	$8.5*10^{16}$Bq
(Converted value to ^{131}I)*3 …(b)	$2.4*10^{17}$Bq	$4.8*10^{17}$Bq	$3.4*10^{18}$Bq
(a)+(b)	$3.7*10^{17}$Bq	$6.3*10^{17}$Bq	$5.2*10^{18}$Bq

(notes)
*1: Estimation by NISA is based on the numerical analysis of accident transient
*2: NSC calculated backward of monitoring data to estimate the amount of discharge
*3: multiplication factor of radiological equivalence to ^{131}I is 40

4B-1. Water leakage in turbine buildings and trenches

-Radioactive water was found in turbine building and trenches at Unit1, 2 and 3



Source: TEPCO

Trench water in Unit 2
I-131 6.9×10^{6} Bq/cm^3
Cs-137 2.0×10^{6} Bq/cm^3
(As of 3/30 at 8:50)

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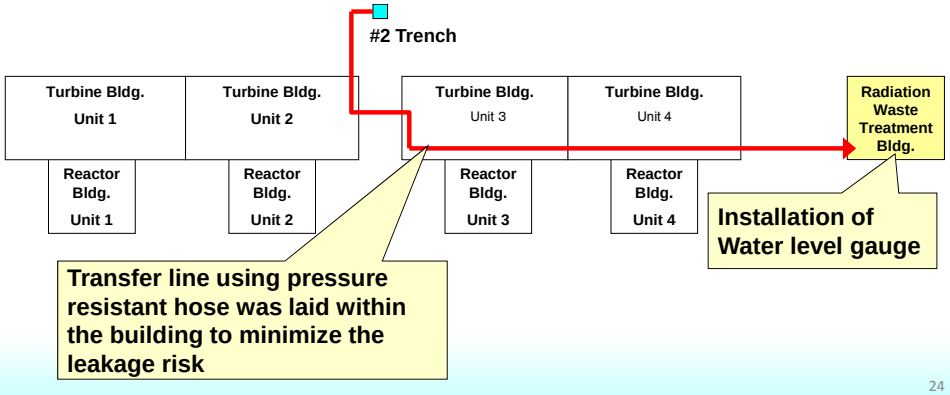
4B-2. Transferring radioactive water to the radiation waste bldg

-Highly radioactive water in the turbine building of Unit 2 has been transferred to the radiation waste treatment building.
-To execute this operation, radioactive water originally stored radiation waste treatment building and was discharged into the sea. (Total Quantity of radioactivity : 0.15 TBq, and **Radioactivity in 10,000 tons of the low level water is equivalent to 10 litters of high level water in Unit 2**)



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4B-3. Leakage of highly radioactive water from Unit2

On April 2nd, the outflow from the crack with a length of around 20 cm in the concrete portion of the lateral surface of the pit into the sea was confirmed.

TEPCO's estimation;
Amount of spilled water: 520 tons
Quantity of radioactivity : 4700 TBq
I-131: 2800 TBq
Cs-134: 940 TBq
Cs-137: 940 TBq

Countermeasures
-Drilled a hole into the pit and injected water glass (sodium silicate) into the pit.
-On April 6, the outflow was confirmed to stop.

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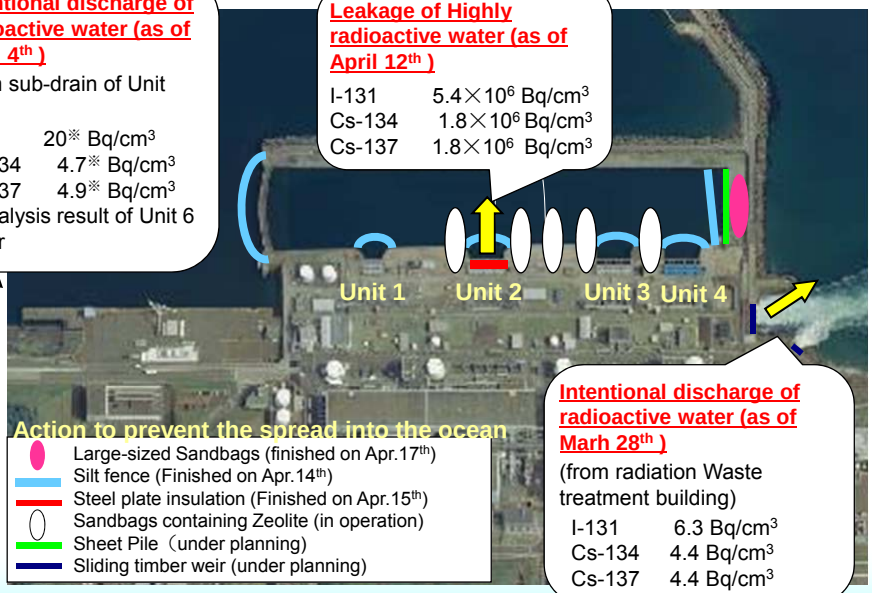
4B-4. Measures to prevent the spread of radioactive water

Intentional discharge of radioactive water (as of April 4th)
(from sub-drain of Unit 5&6)
I-131 20※ Bq/cm3
Cs-134 4.7※ Bq/cm3
Cs-137 4.9※ Bq/cm3
※analysis result of Unit 6 water

Leakage of Highly radioactive water (as of April 12th)
I-131 5.4×10^6 Bq/cm3
Cs-134 1.8×10^6 Bq/cm3
Cs-137 1.8×10^6 Bq/cm3



Intentional discharge of radioactive water (as of Marh 28th)
(from radiation Waste treatment building)
I-131 6.3 Bq/cm3
Cs-134 4.4 Bq/cm3
Cs-137 4.4 Bq/cm3

→The ocean area monitoring has been strengthened

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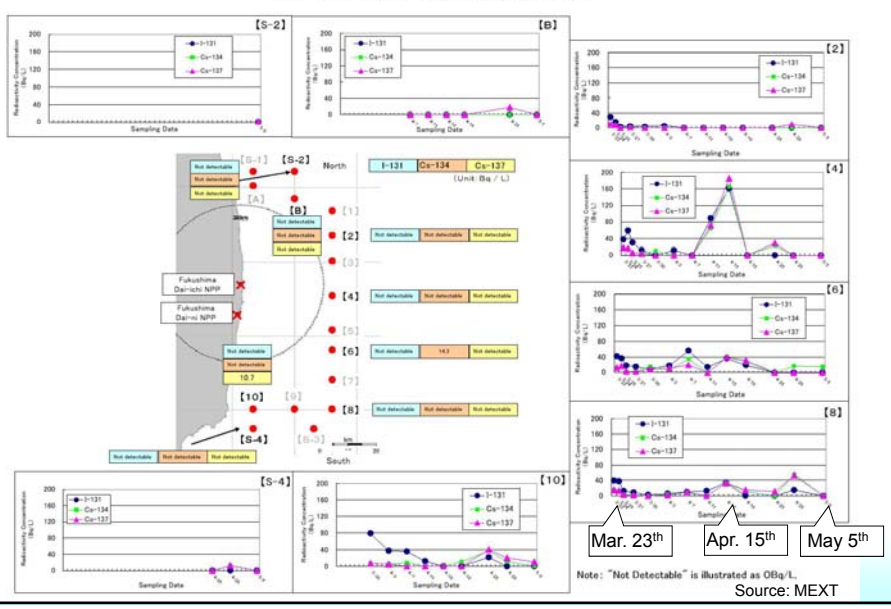
4B-5. Results of Sea area monitoring at post out of 1F

Radioactivity concentration in the Sea (1 m from the sea surface)



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RADIOLOGICAL CONSEQUENCES

5. Impacts on public & environment
6. Radiation monitoring

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5. Impacts on public & environment

5A. Evacuation & Sheltering during the accident

5B. Radiation exposure to residents and workers

5C. Directives on foods and drinks

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5A. Evacuation & Sheltering during the accident(1/4)

- At 21:23 on March11, residents within 3km radius from Unit1 of 1F NPP shall evacuate by the Prime Minister Directive.
- At 5:44 on March 12, residents within 10km radius from Unit1 of 1F NPP shall evacuate by the Prime Minister Directive.
- At17:39 on **March 12**, Prime Minister directed **evacuation of the residents** within the **10 km radius from 2F NPP**.
- At18:25 on **March 12**, Prime Minister directed **evacuation of the residents** within the **20 km radius from 1F NPP**.
- On March 15th, the Local Emergency Response Headquarter issued "the direction to administer the stable Iodine during evacuation from the evacuation area (20 km radius)" to the Prefecture Governors and the heads of cities, towns and villages.
- Regarding the **evacuation as far as 20 km from 1F NPP** and **10 km from 2F NPP**, necessary measures have already been taken.
  - The **sheltering stay in the area from 20km to 30km from 1F NPS** is made fully known to the residents concerned.
  - Cooperating with Fukushima Prefecture, livelihood support to the residents in the sheltering area are implemented.
- On March 25th, Chief Cabinet Secretary, Edano promoted voluntary evacuations for the residents within the area from 20 km to 30 km from 1F NPS in a press conference.

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5A. Evacuation & Sheltering during the accident(2/4)

<1F NPPs>

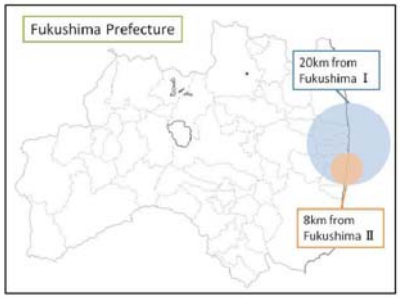
(April 21st)

- The Prime Minister issued the following instruction to the Governor of Fukushima prefecture, and relevant heads of towns in accordance with the Act on Special Measures Concerning Nuclear Emergency Preparedness.
  - Instruction to **establish a restricted area as the area within 20km radius from 1F NPP to prohibit the access to the area** or
  - to order to leave the area to any persons other than those engaged in emergency response measures, excluding the case that the mayor of the city or town or the head of the village permits the temporary access.

＜2F NPP>

(April 21st)

- The Prime Minister issued the following instruction to the Governor of Fukushima prefecture, and heads of towns in accordance with the Act on Special Measures Concerning Nuclear Emergency Preparedness
  - Instruction to change the evacuation area from within 10km radius to within **8km radius from 2F NPS.**



Source: METI

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5A. Evacuation & Sheltering during the accident(3/4)

<1F NPPs>

(April 22nd)

- The Prime Minister issued the following instruction pertaining to the Governor of Fukushima prefecture, and relevant heads of towns in accordance with the provisions of the Act on Special Measures Concerning Nuclear Emergency Preparedness.

- Instruction to lift the area of in-house stay which had been established for the sphere within 20km to 30km radius from 1F NPS

- Instruction to establish **Deliberate Evacuation Area** as well as **Evacuation-Prepared Area** in case of Emergency for the residents and others to make a preparation to enable deliberate leaving, or evacuation or in-house stay all the time in case of emergency, in the subject area.

Source: METI

Deliberate Evacuation Area
Evacuation-Prepared Area

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5A. Evacuation & Sheltering during the accident(4/4)

A) Deliberate Evacuation Area

①Basic Viewpoint

- As there is **a threat that the accumulated dose reaches 20mSv in one year since the occurrence of the accident**, it is requested the residents and others to evacuate to other areas by roughly one month later.
- The reference level of the radiation protection in the situation of emergency exposure of ICRP and IAEA (From **20 to 100mSv**) was considered.

②The Sphere of the Area

Iitate Village (whole sphere), Part of Kawamata Town (Yamagiya district), Katsurao Village (whole sphere excluding the area within a 20km radius), Namie Town (whole sphere excluding the area within a 20km radius), Parts of MinimiSoma City

B) Evacuation-Prepared Area in Case of Emergency

①Basic Viewpoint

- Since the situation caused by the accident of Fukushima Dai-ichi Nuclear Power Station (NPS) **has not yet reached stable, the possibility of requiring actions such as evacuation or in-house stay in cases of emergency cannot be denied hereafter.**
- Therefore in the Evacuation-Prepared Area in case of Emergency, **it is required for the residents to enable in-house stay or evacuation by themselves urgently all the time.**

②The Sphere of the area

Hirono Town, Naraha Town (whole sphere excluding the area within a 20km radius), Kawauti Town (whole sphere excluding the area within a 20km radius), Parts of Tamura City, Parts of Minimisoma City

5B. Radiation exposure to residents and workers (1/2)

(Residents)

- Fukushima Prefecture has started the screening from 13th March.
- It is carried out at the evacuation sites and the 11 places (set up permanently) such as health offices.
- Up until 11th May, the screening was done to **185,633 people**.
- Among them, **102 people** were above the 100,000 cpm , but when measured these people again without clothes, etc., the counts decreased to 100,000 cpm and below, and there was no case which affects health. (all the people who were above the value of counting rates were confirmed during 13th – 31st March.)

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5B. Radiation exposure to residents and workers（2/2)

- Regulation on **the dose limit for emergency workers** was changed from 100 mSv to **250 mSv** on Mar. 14th

For the 2011 great east Japan earthquake, effective dose limit for emergency workers is 250 mSv, inside the emergency response measures implementation area during the period from the date of the declaration of a nuclear emergency situation to the date of the declaration of the cancellation of the situation.

(Exposure of Workers)

- To date a total of **30 people** have registered exposure dose **above 100mSv.** Below is some case of exposure to workers:

<Laying cables operation>

- On March24, dosage above **approx.170mSv was confirmed on 3 workers** who were laying cables on 1st floor and basement of Unit3 Turbine Bldg. Attachment of radioactive substances on the skin of both legs was confirmed on two of them.
- Examination showed that none of the 3 had any major systemic risk. **Exposure dose on the legs of the 2 was estimated to be 2～3Sv.**
- While the level of leg and internal exposure did not require treatment, they were hospitalized. They were discharged on March 28.

5C-3. Directives on foods and drinks

(1) Agricultural Goods (as of 12:00, 13th of May)

- Directive from the DG of the Government Nuclear Emergency Response Headquarters to the prefectural governments was issued to suspend shipment and so on of the following products for the time being:
  - Fukushima Pref.（spinach, kakina, raw milk, etc.）
  - Some areas in Ibaraki Pref.（spinach）

(2) Drinking Water (as of 12:00, 13th of May)

Scope under restriction	Water service (Local governments requested for restriction)
All residents	None
Babies ・Water services that continue to respond to the directive	None
・Tap-water supply service that continues to respond to the directive	None

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6. Radiation Monitoring

6A. Overview of radiation monitoring around the 1F NPP

6B. On-site monitoring

6C. Off-site monitoring

6D. Aerial monitoring

6E. Sea monitoring

6F. Strengthening of Monitoring in the future

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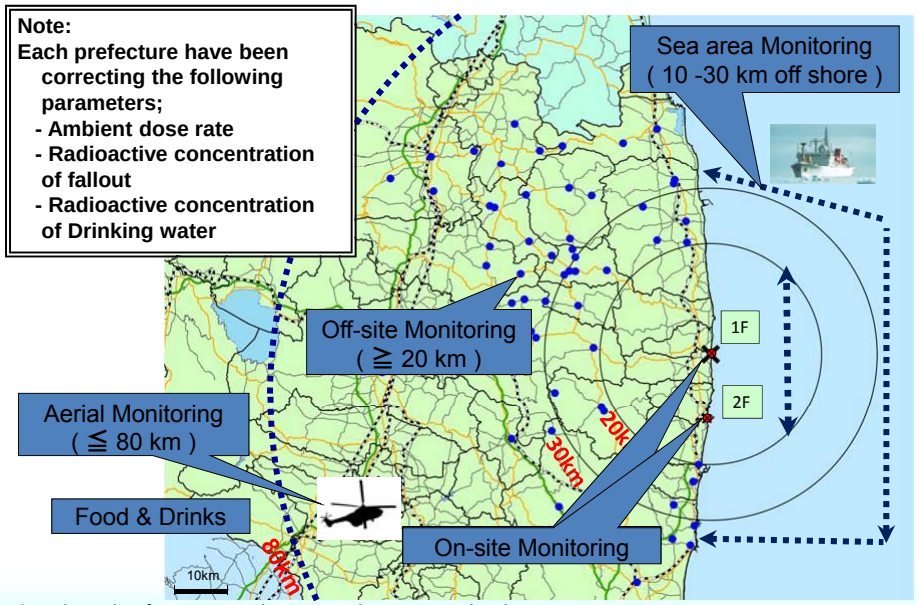
6A. Overview of radiation monitoring around the 1F NPP

Note:
Each prefecture have been correcting the following parameters;
- Ambient dose rate
- Radioactive concentration of fallout
- Radioactive concentration of Drinking water

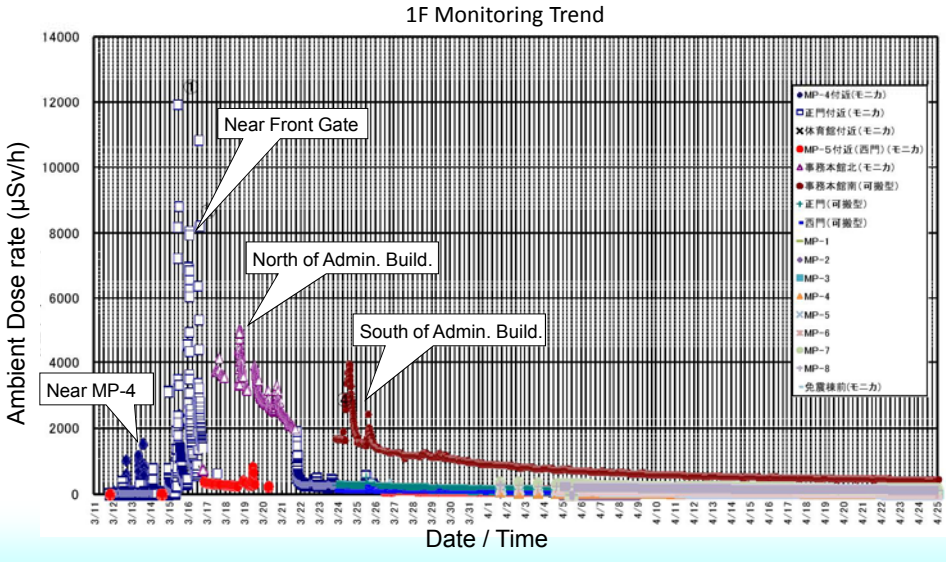


- Daily results of environmental monitoring by MEXT is updated at http://www.mext.go.jp/english/incident/1303962.htm

6B. On-site Monitoring (1/6)

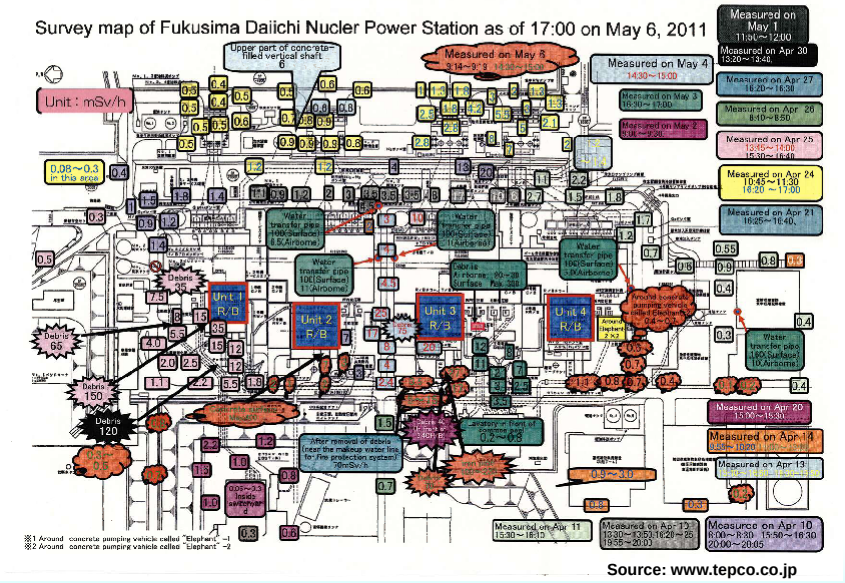
① Trend of on-site radiation level

- Registered 11930 μSv/h around front gate on March 15th.



6B. On-site Monitoring (2/6)

② Survey map of 1F NPS

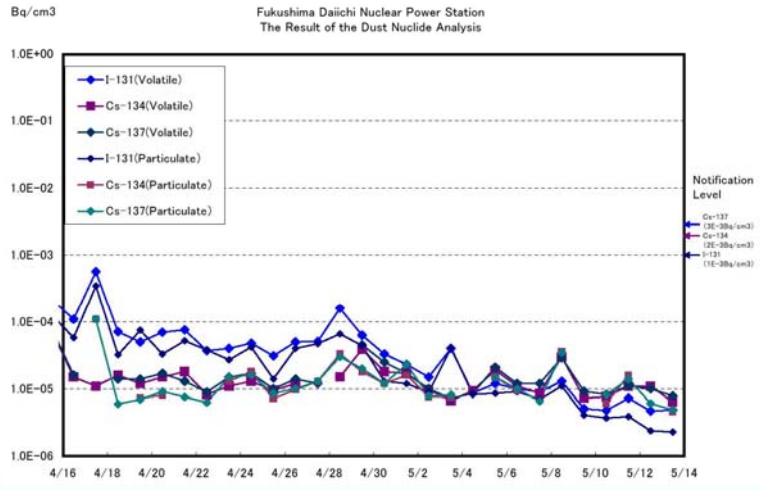


Source: www.tepco.co.jp

6B. On-site Monitoring (3/6)

③ Radioactive concentration in the air

- TEPCO conducted nuclide analyses of radioactive materials contained in the air which were collected at the site of 1F NPS.



Source: www.tepco.co.jp

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6B. On-site Monitoring (4/6)

④ Radioactive concentration in soil samples

- Detected densities of Pu-238 is the same level as that of the measured fallouts in Japan in the cases of previous nuclear tests in the atmosphere.
  However, this can be considered to be caused by the nuclear accident of this time.
  Meanwhile, in the "playground", although Pu-238, 239, and Pu-240 are detected from the samples taken on and after March 21, those values have not been greatly changed.

(Unit: Bq/kg・Dry soil)

Sampling spot ( ): Distance from the stack of Unit 1, 2	Date of sampling/ Analyses organization	Pu-238	Pu-239, Pu-240
①Playground (west-northwest approx. 500m)	April 25/ JCAC	$(1.1 \pm 0.12) \times 10^{-1}$	$(4.6 \pm 0.74) \times 10^{-2}$
②Forest of wild birds (west approx. 500m)		N.D.	N.D.
③Adjacent to industrial waste disposal facility (South-southwest approx. 500m)		N.D.	N.D.
Soil in Japan *		N.D.～1.5×10^{-1}	N.D.～1.5×10^{-1}

*: Ministry of Education, Culture, Sports, Science and Technology "Environmental Radiation Database," 1978 - 2008

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6B. On-site Monitoring (5/6)

⑤ Radioactive concentration in subsurface water near the turbine building of 1F

- In order to verify any leakages to underground and sea, and safety, TEPCO have been implementing the sampling survey of subsurface water and seawater.

1F NPS : Results of Nuclide Analysis of Sub-drain

(Data summarized on May 12)

Place of sampling	Sub-drain of Unit1, Fukushima Daiichi	Sub-drain of Unit2, Fukushima Daiichi	Sub-drain of Unit3, Fukushima Daiichi	Sub-drain of Unit4, Fukushima Daiichi	Sub-drain of Unit5, Fukushima Daiichi	Sub-drain of Unit6, Fukushima Daiichi	Deep well, Fukushima Daiichi
Time and Date of sample collection	14:03, May 11th , 2011	14:08, May 11th , 2011	14:16, May 11th , 2011	14:25, May 11th , 2011	13:35, May 11th , 2011	13:23, May 11th , 2011	10:10, May 11th , 2011
Detected Nuclides (Half-life)	Radioactivity Density of Sample（Bq/cm3)						
I-131 (about 8 days)	2.5E+00	8.7E+01	1.4E-01	ND	ND	2.2E-02	ND
Cs-134 (about 2 years)	8.8E+00	1.3E+01	2.8E-01	2.5E-02	ND	4.6E-02	ND
Cs-137 (about 30 years)	1.0E+01	1.5E+01	2.7E-01	4.5E-02	2.2E-02	5.6E-02	ND

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6B. On-site Monitoring (6/6)

⑥ Out flow of fluid containing radioactive materials to the ocean from areas near intake canal of 1F Nuclear Power Station Unit 2

- At around 9:30 am on April 2nd, 2011, TEPCO detected water containing radiation dose over 1,000 mSv/h in the pit* where power supply cables are stored near the intake channel of Unit 2. Furthermore, there was a crack of about 20 cm length on the concrete lateral of the pit, from where the water in the pit was out flowing to the
- At around 5:38 am on April 6th, TEPCO have observed stoppage of spilling of water to the ocean from the crack on the concrete lateral of the pit.

<Fukushima Daiichi Nuclear Power Station>
the shallow draft quay, Unit 1 – 4 screen, and the water intake canal of Unit 1-4
(Data summarized on May 13)

Place of Collection	Shallow Draft Quay of 1F		Inside of north water intake canal of 1F's Unit 1-4 (outside the silt fence)		Screen of 1F's Unit 1 (outside the silt fence)		Screen of 1F's Unit 1 (inside the silt fence)		Scree of 1F's Unit 2 (outside the silt fence)		②Density limit by the announcement of Reactor Regulation (Bq/cm3) (the density limit in the water outside of surrounding monitored areas in the section 6 of the appendix 2)
Time and date of sample collection	6:55, May 12th , 2011		7:09, May 12th, 2011		6:20, May 12th , 2011		6:15, May 12th , 2011		7:18, May 12th , 2011		
Detected nuclide (half-life)	Density of sample (Bq/cm^3)	Scaling factor (①/②)	Density of sample (Bq/cm^3)	Scaling factor (①/②)	Density of sample (Bq/cm^3)	Scaling factor (①/②)	Density of sample (Bq/cm^3)	Scaling factor (①/②)	Density of sample (Bq/cm^3)	Scaling factor (①/②)	
I-131 (about 8 days)	1.6E-01	4.0	3.0E+00	75	3.1E+00	78	2.2E+00	55	4.1E+00	100	4E-02
Cs-134 (about 2 years)	3.7E-01	6.2	1.2E+01	200	1.2E+01	200	7.9E+00	130	1.4E+01	230	6E-02
Cs-137 (about 30 years)	3.6E-01	4.0	1.3E+01	140	1.3E+01	140	8.5E+00	94	1.5E+01	170	9E-02

* In addition to above place of collection, Data are summarized for other Units.

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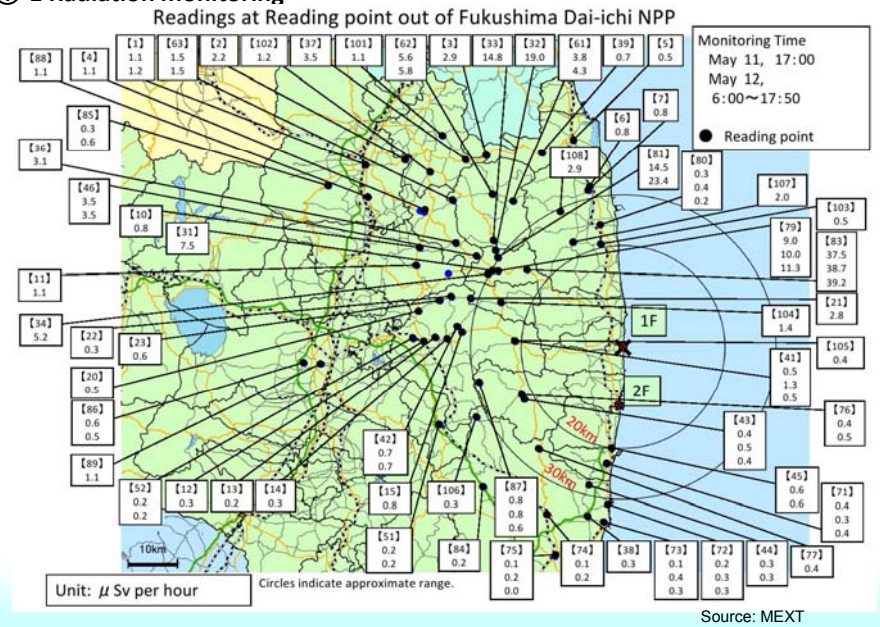
6C. Off-site Monitoring (1/5)

①-1 Radiation monitoring



Source: MEXT

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6C. Off-site Monitoring (2/5)

①-2 Radiation monitoring

- Overall radiation level trending down since March 17th.
- The highest value recorded at Monitoring Point #32 has peaked out at approx. 170μSv/h and has been declining since, rendering no immediate health hazard.

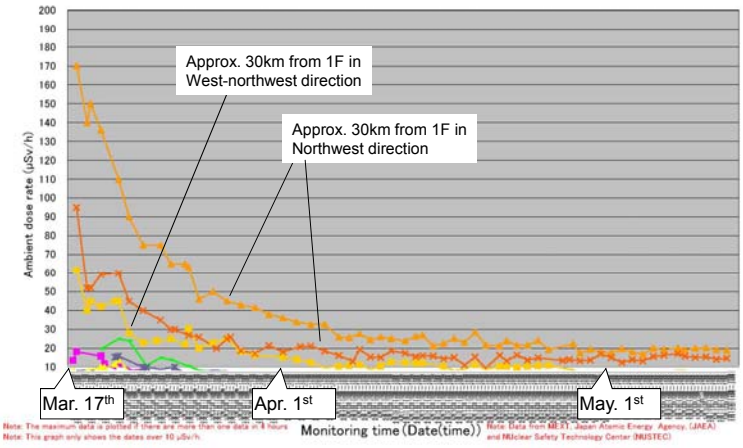


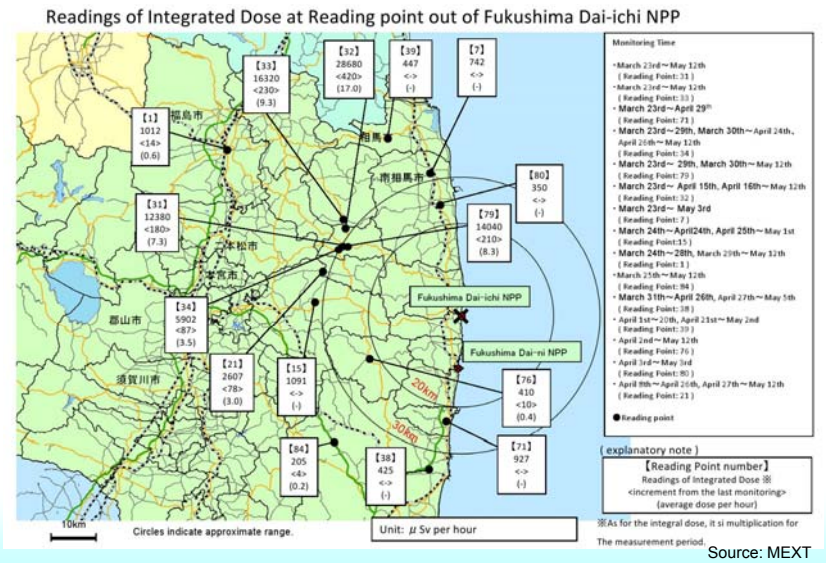
Fig. Trend on ambient dose rate monitoring at Monitoring post outside of 20km zone of 1F

Source: MEXT

6C. Off-site Monitoring (3/5)

②Cumulative doses measured

- Radiation level cumulatively measured since March 23th topped 28,680μSv at #32, approximately 30km North West from 1F.



Source: MEXT

6C. Off-site Monitoring (4/5)

③-1 Radioactive concentration of Land samples (Weed, Soil, pond water)

Sampling Point		Sample	Sort or Region	Sampling Time and Date	Radioactivity Concentration (Bq/kg) ^{131}I	Radioactivity Concentration (Bq/kg) ^{137}Cs	Air dose rate (μSv/h)	Note
【2-1】(About40kmNorth/West)	Soma county Iidate village Yagisawa	Weed	Leaf Vegitable	3/18 12:20	2,520,000	1,800,000	Over 30	
		Weed	Leaf Vegitable	3/19 11:40	845,000	1,010,000	26.5	
		Weed	Leaf Vegitable	3/20 12:40	2,540,000	2,650,000	25.8	
		Weed	Leaf Vegitable	3/21 12:32	1,330,000	1,240,000	20.4	
		Weed	Leaf Vegitable	3/22 12:00	1,110,000	1,600,000	15.3	
		Weed	Leaf Vegitable	3/23 11:30	819,000	1,620,000	16.8	
		Weed	Leaf Vegitable	3/24 13:05	805,000	1,050,000	13.2	
		Weed	Leaf Vegitable	3/25 12:20	400,000	398,000	12.3	
		Weed	Leaf Vegitable	3/26 12:00	1,030,000	2,870,000	10.2	
		Weed	Leaf Vegitable	3/27 11:40	508,000	910,000	11.2	
		Weed	Leaf Vegitable	3/28 11:50	381,000	480,000	9.6	
		Weed	Leaf Vegitable	3/29 11:10	330,000	311,000	9.2	
		Weed	Leaf Vegitable	3/30 12:25	576,000	1,890,000	8.5	
		Weed	Leaf Vegitable	3/31 11:30	303,000	1,620,000	8.0	
		Weed	Leaf Vegitable	4/1 11:30	219,000	725,000	7.7	
		Weed	Leaf Vegitable	4/2 11:24	171,000	863,000	8.6	
		Weed	Leaf Vegitable	4/3 10:55	301,000	1,420,000	7.7	
		Weed	Leaf Vegitable	4/4 10:05	192,000	275,000	7.2	
		Weed	Leaf Vegitable	4/5 11:31	297,000	1,440,000	10.6	
		Weed	Leaf Vegitable	4/6 11:23	161,000	1,070,000	9.5	
		Weed	Leaf Vegitable	4/7 11:07	107,000	627,000	9.08	
		Weed	Leaf Vegitable	4/8 11:30	186,000	567,000	10.20	
		Weed	Leaf Vegitable	4/9 11:15	55,700	313,000	7.84	
		Weed	Leaf Vegitable	4/10 11:20	10,100	29,200	9.5	
		Weed	Leaf Vegitable	4/11 12:05	30,900	329,000	3.85	
		Weed	Leaf Vegitable	4/12 11:42	18,900	104,000	6.4	
		Weed	Leaf Vegitable	4/13 11:04	109,000	941,000	7.23	
		Weed	Leaf Vegitable	4/14 11:15	24,100	257,000	7.74	
		Weed	Leaf Vegitable	4/15 11:30	30,900	329,000	9.42	
		Weed	Leaf Vegitable	4/16 10:55	9,180	158,000	7.31	
		Weed	Leaf Vegitable	4/17 11:20	3,160	22,500	8.4	
		Weed	Leaf Vegitable	4/18 11:05	7,090	43,500	8.5	
		Weed	Leaf Vegitable	4/19 11:23	41,200	377,000	7.4	

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6C. Off-site Monitoring (5/5)

③-2 Radioactive concentration of Dust samples

Sampling Point		Sampling Time and Date		Radioactivity Concentration (Bq/m^3) ^{131}I	Radioactivity Concentration (Bq/m^3) ^{137}Cs	Air dose rate (μSv/h)
【2-1】(About40kmNorth/West)	Soma county Iidate village Yagisawa	3/21	13:00～13:20	12.80	2.37	4.1
		3/22	12:26～12:46	5.87	Not Detectable	4.2
		3/23	12:50～13:10	2.99	Not Detectable	16.8
		3/24	13:30～13:50	5.80	1.51	10.0
		3/25	12:45～13:05	5.87	Not Detectable	12.3
		3/26	12:26～12:46	5.39	1.33	7.8
		3/27	12:06～12:26	2.22	Not Detectable	11.2
		3/28	12:05～12:25	1.66	Not Detectable	9.6
		3/29	12:07～12:27	2.42	6.79	9.2
		3/30	13:22～13:42	3.47	Not Detectable	8.5
		3/31	11:50～12:10	1.74	Not Detectable	8.0
		4/1	12:00～12:20	1.78	1.69	7.7
		4/2	11:46～12:06	0.84	Not Detectable	8.6
		4/3	11:18～11:38	Not Detectable	0.78	7.7
		4/4	11:07～11:27	Not Detectable	1.36	7.2
		4/5	11:55～12:15	Not Detectable	Not Detectable	4.1
		4/6	11:45～12:05	Not Detectable	Not Detectable	3.9
		4/7	11:29～11:49	Not Detectable	Not Detectable	4.07
		4/8	11:45～12:05	0.995	Not Detectable	4.50
		4/9	11:40～12:00	1.26	Not Detectable	4.14
		4/10	14:10～14:30	Not Detectable	Not Detectable	4.2
		4/11	12:32～12:52	2.12	Not Detectable	3.85
		4/12	12:04～12:24	Not Detectable	Not Detectable	4.7
		4/13	11:25～11:45	Not Detectable	Not Detectable	3.35
		4/14	11:35～11:55	Not Detectable	0.960	4.40
		4/15	11:50～12:10	5.95	1.470	4.37
		4/16	11:17～11:37	Not Detectable	Not Detectable	4.07
		4/17	11:42～12:02	Not Detectable	0.671	3.8
		4/18	11:23～11:43	Not Detectable	Not Detectable	4.1
		4/19	11:43～12:03	Not Detectable	Not Detectable	3.7

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6D. Air-borne monitoring by MEXT and U.S. DOE (1/2)

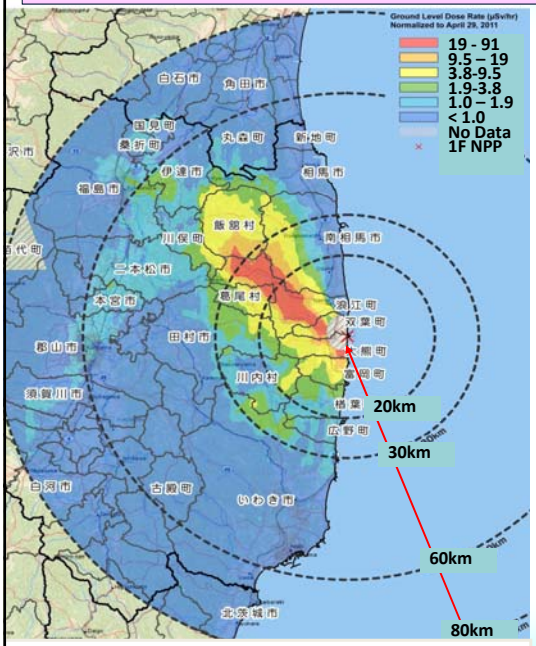


Fig. Results of ambient dose rate

- Assessment of ambient dose rate on 1m from the ground surface and Cesium deposition inside the 80 km zone of 1F was carried out.
- The map was prepared based on results obtained from April 6th to 29th by a small airplane and two helicopters, in total 42 flights.

- Decay of radioactive substances was considered and actual readings were converted into values as of the last survey date of April 29th.

Source: MEXT

6D. Air-borne monitoring by MEXT and U.S. DOE (2/2)

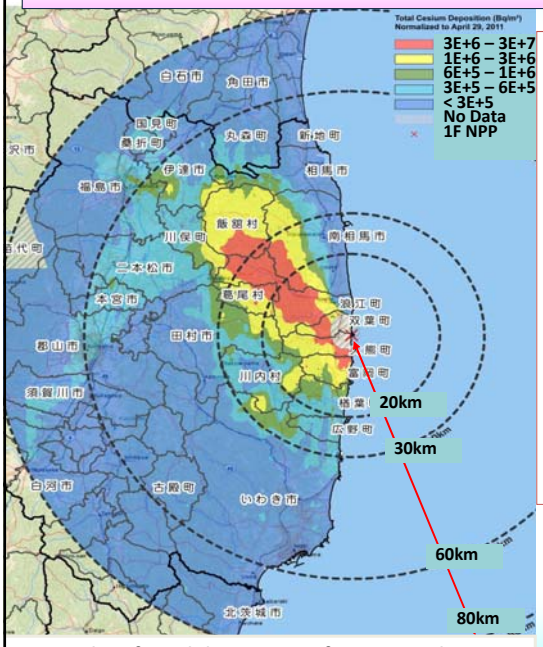


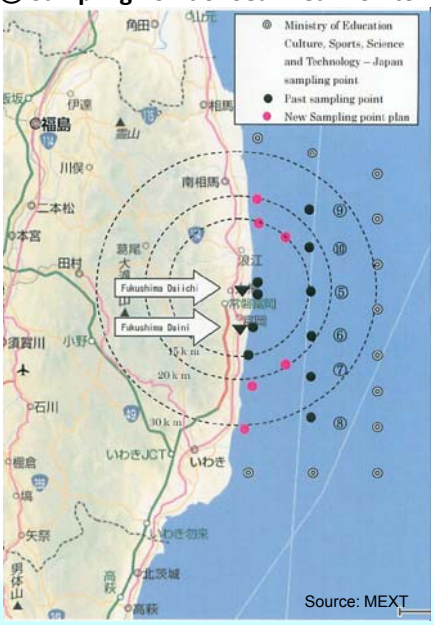
Fig. Results of total deposition of Cs-134 and Cs-137

- Decay of radioactive substances was considered and actual readings were converted into values as of the last survey date of April 29th.
- The deposition of Cs-134 in the ground was calculated based on the results of air-borne monitoring and of measurements which the DOE took on the ground using a gamma-ray analysis.
- Based on the results of DOE measurements of Cs-134 on the ground using a gamma-ray analysis, and analysis values of Cs-137, the deposition of Cs-137 in the ground was calculated from results of accumulated Cs-134.

Source: MEXT

6E. Sea Area Monitoring (1/4)

① Sampling Point of Sea Area Monitoring



- MEXT have conducted seawater sampling surveys at 12 points, from surface water (1m from the sea surface) and sub-surface (10m above the sea bottom) around 30km off-shore Fukushima Pref.
- TEPCO have conducted seawater sampling surveys at 4 points, off the shore and 6 points, 15 km off the shore of 1F.
- Since April 17, TEPCO have also conducted sampling surveys at 4 points, 3 km off the shore and two points, 8 km off the shore of 1F.

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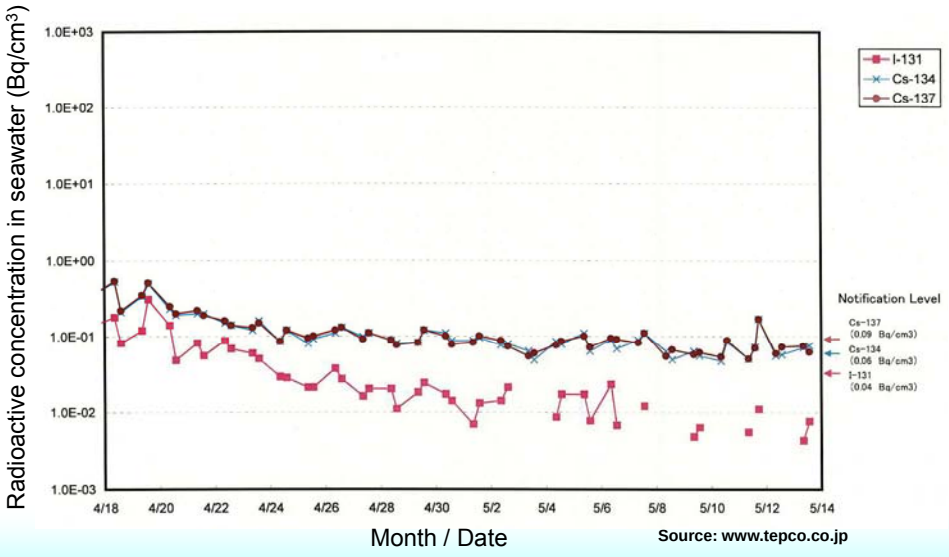
6E. Sea Area Monitoring (2/4)

②Radioactive Concentration of Seawater at South Discharge Channel of 1F (Bq/cm³)

- Overall Radioactivity concentration trending down since March.



Source: www.tepco.co.jp

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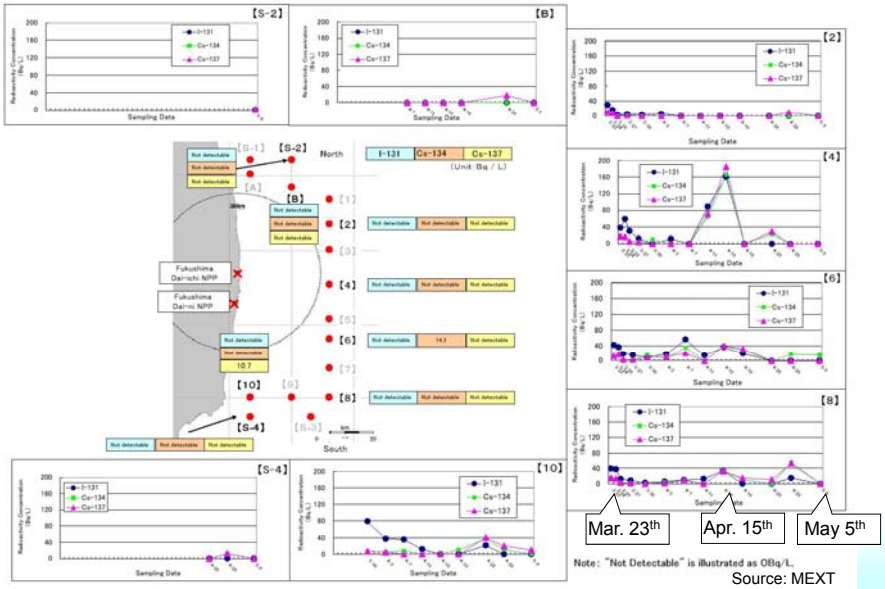
6E. Sea Area Monitoring (3/4)

④-1 Radioactivity concentration in the Sea (1 m from the sea surface)

- Radioactivity concentration I-131 at location #4 peaked out at approx.161Bq/L on April 15th



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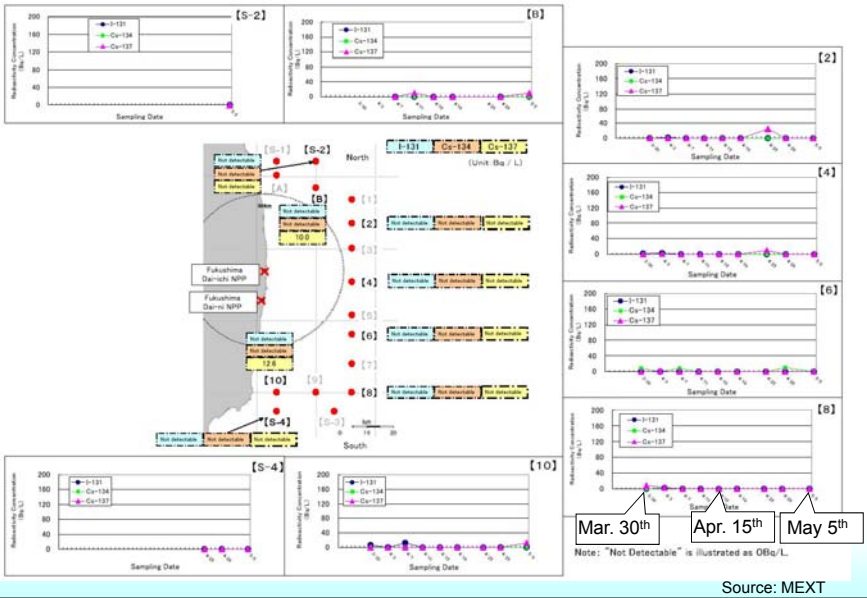
6E. Sea Area Monitoring (4/4)

④-2 Radioactivity concentration in the Sea (10m above the sea bottom)



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6F. Strengthening of monitoring in the future

- **Main Analytical Body in the Monitoring by MEXT.**

National Institute of Radiological Sciences,
Japan Atomic Energy Agency,
Japan Agency for Marine-earth Science and Tecnology,
Nuclear Safety Technology Center,
Japan Chemical Analysis Center,
Universities *etc.*
U.S. Department of Energy (Aerial monitoring)

- **Strengthening of the monitoring by MEXT in response to the "Enforced Plan on Environmental Monitoring".**

- Off-site Monitoring
- Aerial Monitoring
- Sea Area Monitoring
- Making a distribution Map for Ambient dose rate, deposition of I-131, Cs-137, and accumulated dose etc. in Fukushima Prefecture. Soil sampling and analysis of soil will be done by Ministry of Agriculture, Forestry and Fisheries, JAEA, and other relating organization of university etc.

EMERGENCY MANAGEMENT ASPECTS

7. Outline of Government Headquarters in response to the earthquake

8. Information sharing with international communities

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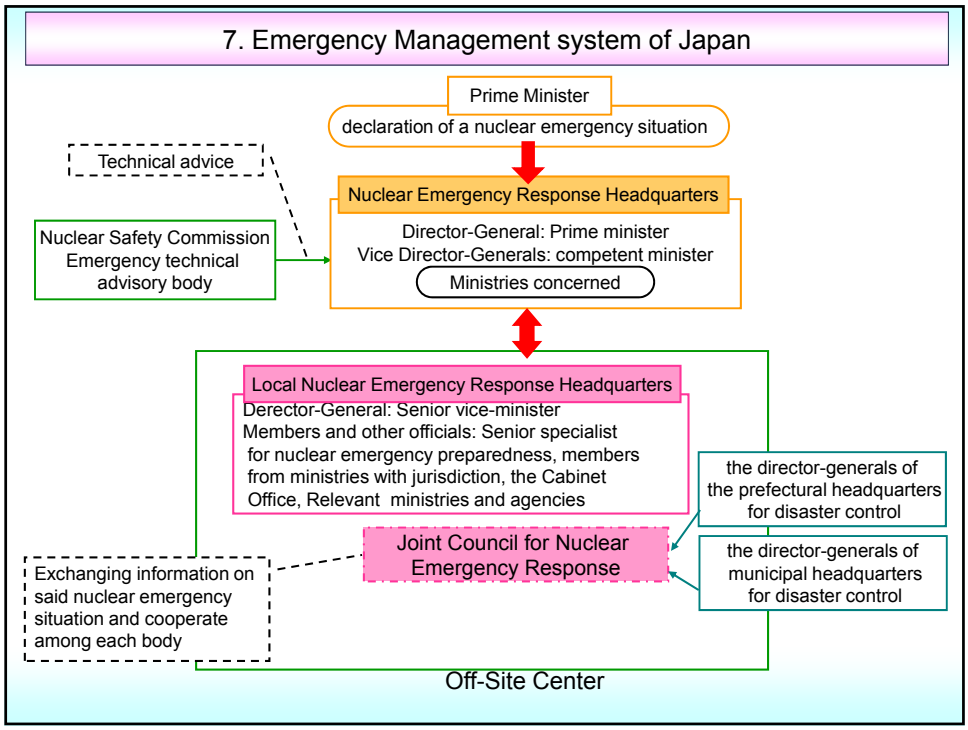

8. Information sharing with international communities

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8. Information sharing with international communities (1/2)

1. Daily Notification

(1) ENAC Website

NISA has constantly been providing facility-related and other relevant information on the Emergency Notification and Assistance Convention Website, designed for member states to exchange information on nuclear accidents.

(2) IEC (IAEA)

NISA has constantly been providing the Incident and Emergency Centre of IAEA with press releases and other relevant information, as well as responses to questions on such communication.

(3) Foreign Media Briefing

- NISA joins relevant government agencies in daily foreign media briefings at the PM's official residence on March 14, 17 and every day afterwards.
- NISA officials give account to damages suffered at Fukushima NPSs and respond to questions.

(4) Briefings for Diplomatic Representatives in Tokyo

- NISA joined the Ministry of Foreign Affairs in briefing sessions for Diplomatic representatives in Tokyo.
- Distributed press releases (English), provided explanations and answered questions.

(5) English information on the Web

- Nuclear and Industrial Safety Agency: http://www.nisa.meti.go.jp/english/index.html
- Office of Prime Minister: http://www.kantei.go.jp/foreign/index-e.html

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8. Information sharing with international communities (2/2)

2. IAEA

(1) Technical Briefing on March 21st

Following the special meeting of the IAEA Board of Governors, NISA officials briefed the member state representatives on the overview of the earthquake itself as well as the status of and ongoing measures to address the Fukushima NPS accident.

(2) Side event on the "Fukushima Daiichi Accident and Initial Safety Measures Worldwide" on April 4th

NISA and MEXT officials explained the member state representatives the Status of Fukushima Daiichi NPPs and monitoring, action taken and Future plan as well as the implementation on emergency safety measures.

3. OECD

(1) MDEP Steering Technical Committee on April27-29
(2) OECD/NEA Steering Committee on April 28-29
(3) CNRA Highlevel Senior Task Group on May 4-6
(4) OECD/NEA CRPPH meeting on May 17-19

4. ICRP

・ ICRP Main Commission Meeting on April 17 - 21

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9. Remarks

- Continue to make every possible efforts to bring the situation under full control
- Will identify the cause of the accident thoroughly and review safety assurance measures
- Offer the information as much as possible and share the lessons learned from the accident with the international community

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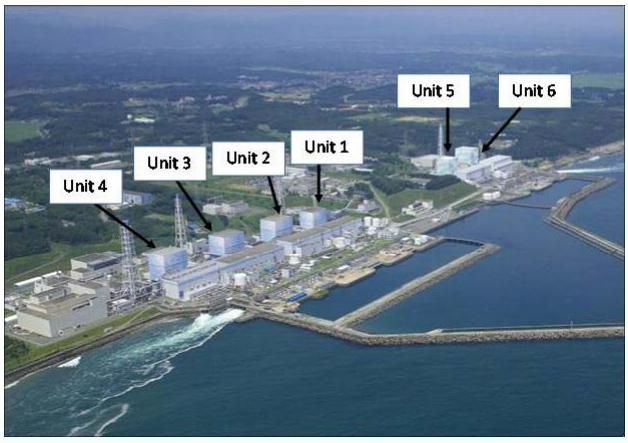
DETAILS ON ACCIDENT

(Chronology of Accident after the earthquake)
14:46 March 11th – May 13th



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A-1. Chronology of Unit 1 after the earthquake(1/4)

●*Unit 1*

March

11th
- ●Under operation, Automatic shutdown by the earthquake
- ●Loss of A/C power
- ●Loss of water injection function

12th
- ●Unusual increase of PCV pressure
- ●Started to vent
- ●Sound of explosion
- ●Started of injection of seawater and borated water to the core

22nd
- ●Rise of reactor temperature (383℃) → Drop (26th 05:00 144.3℃)

23rd
- ●Water supply line in addition to the Fire Extinguish line. Switched to water supply line only.(Flow rate: 7m^3/h)

24th
- ●Lighting in the Central Control Room was recovered.

25th
- ●Started fresh water injection

29th
- ●Switched to the water injection to the core using a temporary motor operated pump.

31st
- ●Started to transfer the stagnant water from the Condensate Storage Tank(CST) to the Surge Tank of Suppression Pool Water(SPT)

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A-1. Chronology of Unit 1 after the earthquake(2/4)

●*Unit 1(Continued)*

April

3rd
- ●The power supply to the temporary motor-driven pump was switched from the temporary power supply to the external power supply
- ● Started to transfer the water from the Condenser to CST

6th
- ●Started the operation for the injection of nitrogen to PCV

9th
- ●Started the using highly pure nitrogen generator in the injection of nitrogen to PCV

10th
- ●Completed transferring the water from the Condenser to CST

11th
- ●Loss of external supply due to an earthquake occurred and water injection to the Reactor core and nitrogen injection to PCV were suspended.⇒Resumed.

17th
- ●Confirmed the situation in the reactor building using an unmanned robot

18th
- ●Stopped the water injection into the reactor core to replace the current hose with a new one.

19th
- ●Completed the work of strengthening connection of the power supllies between Unit 1-2 and Unit3-4.

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A-1. Chronology of Unit 1 after the earthquake(3/4)

●*Unit 1(Continued)*

April
25th
- For reinforcement work of the power supply, the power supply to the pump injecting water into the reactor core was temporarily switched from the external power supply to the temporary diesel generator.
- Suspended nitrogen injection due to reinforcement work of the power supply.
- Implemented reinforcement work of the power supply (connection of the power supplies between Units 1-2 and Units 5-6).

26th
- Confirmed the situation in the reactor building using an unmanned robot.

27th
- Started the operation of gradually changing the amount of water for injection to the Reactor Pressure Vessel, from about 6m^3/h to the maximum of about 14m^3/h. After carrying out the injection at 10m^3/h, the injection rate was changed back to 6m^3/h. (April 29th 10:14)

29th
- Confirmed the situation in the reactor building using an unmanned robot.

May
2nd
- The pump for the injection of water into the reactor core was temporarily replaced with the Fire Extinguishing Pump in order to install an alarm device in the pump.

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A-1. Chronology of Unit 1 after the earthquake(4/4)

●*Unit 1(Continued)*

May
5th – 8th
- Operated all ambient filtration systems (a total of 6 units) in order to improve the working environment in the reactor building.

6th
- Changed the rate of water injection into the Reactor Core from 6m^3/h to 8m^3/h.

8th
- Ventilation by cutting of the exhaust air duct

9th
- Opening the double-entry doors of the Reactor Building.
- Disassembly of positive pressure house.

10th
- Calibrated the reactor water level gauge.

11th
- Due to the restoration of the Okuma No.2 transmission line, the power supply for the pump for injecting water into the reactor was temporarily switched to the temporary diesel generator.
- Due to the restoration of the Okuma No.2 transmission line, the nitrogen injection was temporarily suspended.
- Confirmed the reactor water level of RPV, calibrated reactor pressure gauge of CV.

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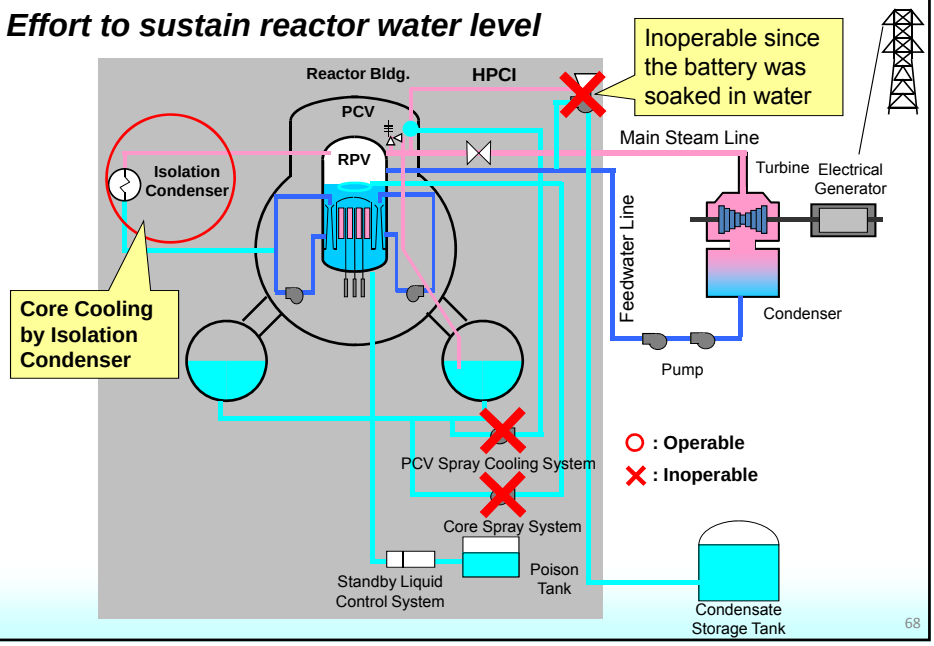
A-2. Accident progression at Unit1(1/3)

Effort to sustain reactor water level



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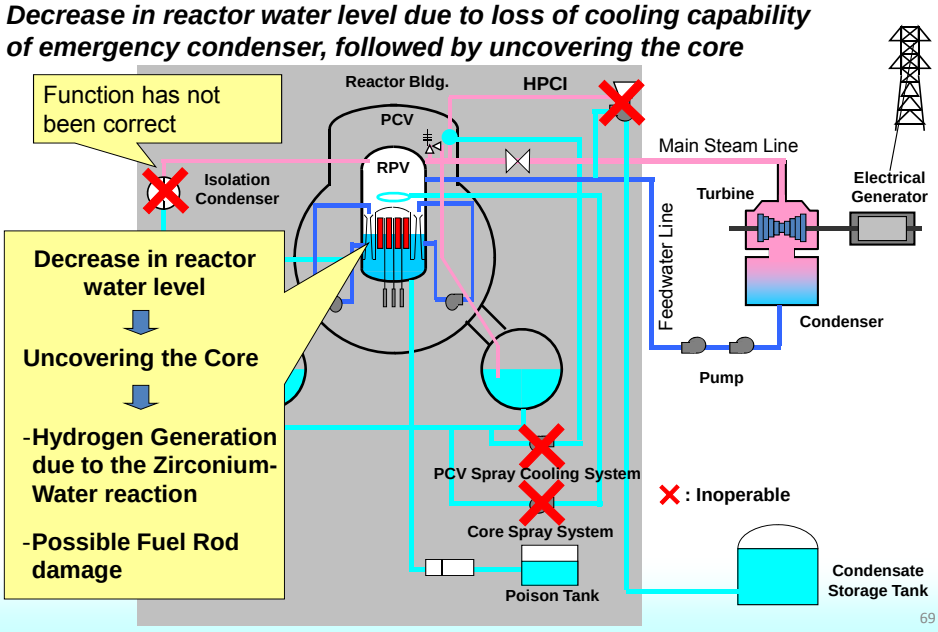
A-2. Accident progression at Unit1(2/3)

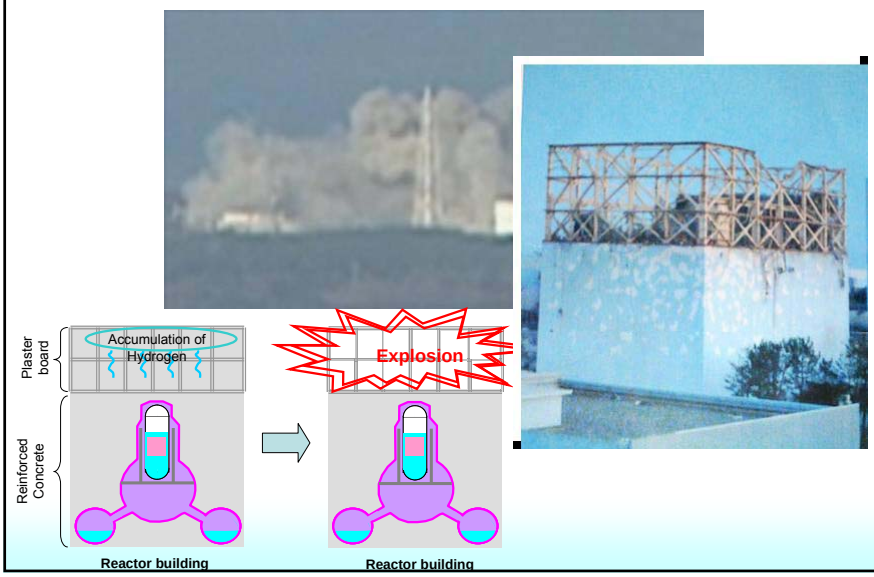
Decrease in reactor water level due to loss of cooling capability of emergency condenser, followed by uncovering the core



69

A-2. Accident progression at Unit1(3/3)

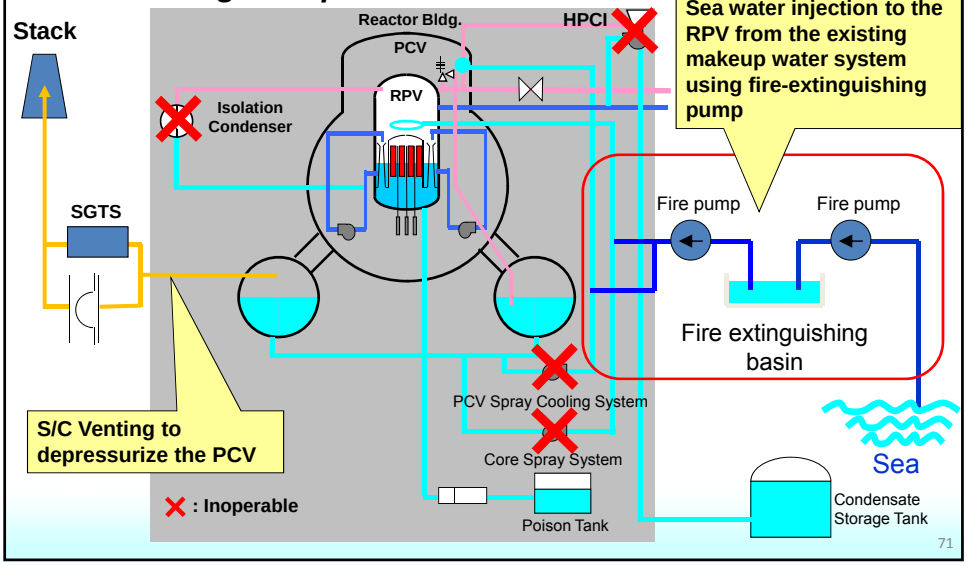
Hydrogen explosion in the operation floor



70

A-3. Countermeasures at Unit1(1/3)

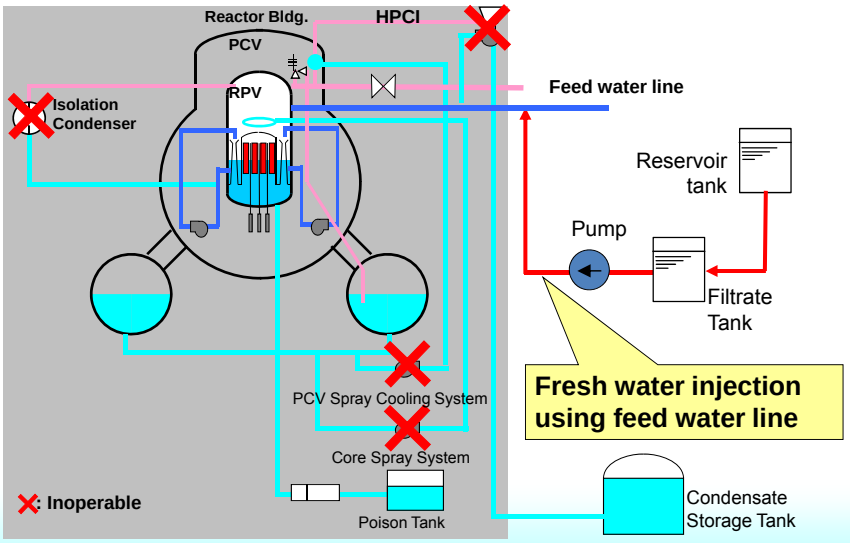
- Sea water injection using fire water pump
- S/C Venting to depressurize the PCV



71

A-3. Countermeasures at Unit1(2/3)

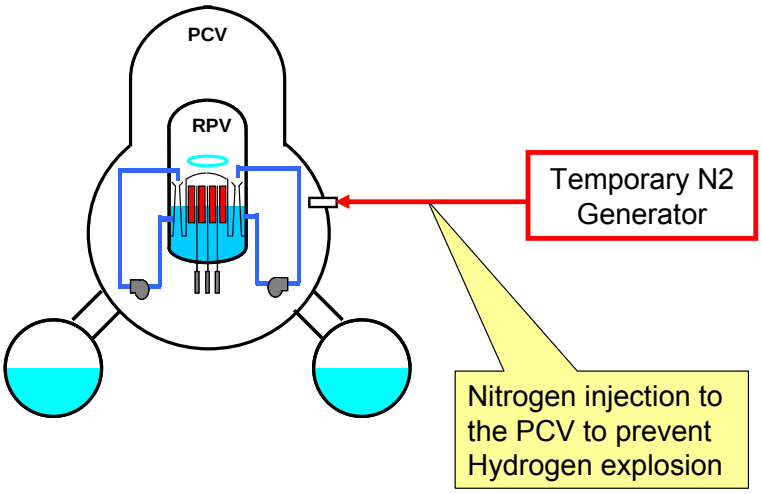
- Switched to fresh water injection on May 25th



72

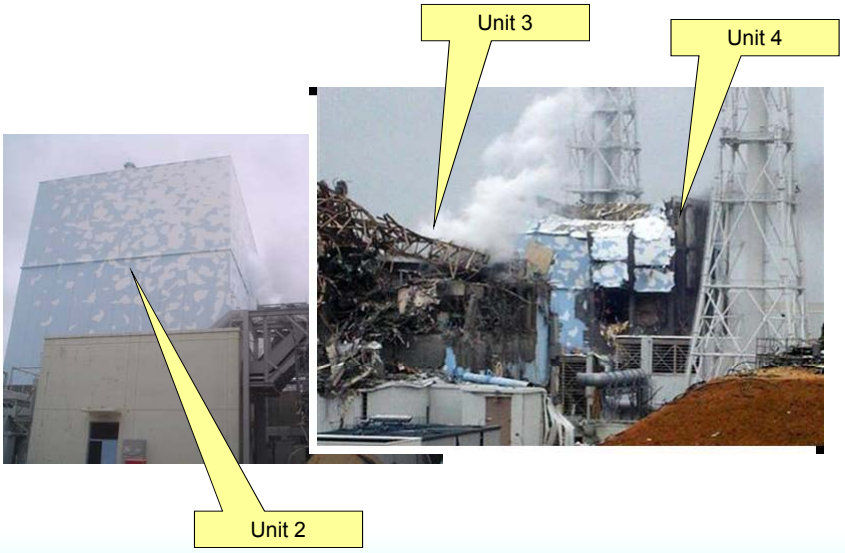
A-3. Countermeasures at Unit1(3/3)

- Nitrogen injection to the PCV (since April 6th)



73

A-4. Accident Progression at Unit2 through 6



74

A-5. Chronology of Unit2 after the earthquake(1/6)

● ***Unit 2***

March

11th
- Under operation, Automatic shutdown by the earthquake
- Loss of A/C power
- Loss of water injection function

14th
- Loss of water cooling function
- Unusual increase in PCV pressure

15th
- Sound of explosion
- Possible damage of the suppression chamber

20th
- Injection of about 40 tons of seawater into SFP through fire extinguishing system.
- Injection of seawater to the Spent Fuel Pool (SFP)

21st
- White smoke generated

22nd
- Injection of seawater to the Spent Fuel Pool (SFP)

25th
- Injection of seawater to SFP

75

A-5. Chronology of Unit2 after the earthquake(2/6)

● *Unit 2(Continued)*

26th ●Lighting in the Central Control Room was recovered

27th ●Switched to the water injection to the core using a temporary motor-driven pump.

29th ●The Seawater injection to the Spent Fuel Pool using the Fire Pump Truck was switched to the fresh water injection using the temporary motor-driven pump

●In order to prepare for transferring the stagnant water on the basement floor of turbine building to the Condenser, the water in the Condensate Storage Tank is being transferred to the Surge Tank of Suppression Pool Water.

30th ●The injection pump was switched to the Fire Pump Truck. However, because cracks were confirmed in the hose (12:47 and 13:10 March 30th), the injection was suspended. The injection of fresh water resumed at 19:05 March 30th.

31st ●White smoke was confirmed to generate continuously.

●Fresh water is being injected to the spent fuel pool and the RPV

76

A-5. Chronology of Unit2 after the earthquake(3/6)

● *Unit 2(Continued)*

April

1st ●Freshwater injection to SFP via FPC using temporary motor-driven pump

2nd ●The water, of which the dose rate was at the level of more than 1,000mSv/h ,was confirmed to be collected in the pit located near the intake Channel of Unit2.

●Started to transfer the water from the condenser to the CST

3rd ●The power supply to the temporary motor-driven pump was switched from the temporary power supply to the external power supply.

4th ●Freshwater injection to SFP via FPC using the temporary motor-driven pump.

5th ●Tracer is confirmed to outflow through the permeable layer around the pit into the sea.

9th ●Completed transferring the water form the Condenser to CST.

11th ●Loss of external supply was suspended.⇒Resumed

12th ●Transfer from the trench of the turbine building to the Condenser

13th ●Suspended the transfer for checking leaks, etc

●Freshwater injection to SFP via FPC using the temporary motor-driven pump

77

A-5. Chronology of Unit2 after the earthquake(4/6)

●*Unit 2(Continued)*

18th
- ●Confirmed the situation in the reactor building using unmanned robot
- ●Stopped the water injection into the reactor core to replace the current hose with a new one.
- ●Injected coagulant(soluble glass) into the power cable trench.

19th
- ●Started transfer the stagnant water with high-level radioactivity from the trench of the turbine building to the buildings of radioactive water treatment facilities.
- ●Completed the work of strengthening connection of the power supplies between Unit1-2 and Units3-4.
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump.

22nd
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump.

25th
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump.
- ●For reinforcement work of the power supply, the power supply to the pump injecting water into the reactor core was temporarily switched from the external power supply to the temporary diesel generator.
- ●Implemented reinforcement work of the power supply (connection of the power supplies between Units 1-2 and Units 5-6).

78

A-5. Chronology of Unit2 after the earthquake(5/6)

●*Unit 2(Continued)*

28th
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump.

29th
- ●Suspended the transfer of stagnant water from the Turbine Building Trench of Unit 2(Stagnanwater with high-level radioactivity) to the Radioactive Waste Treatment Facility in order to carry out inspections, etc. of the transfer facilities. The transfer was resumed. (From 14:05 April 30th) .

May

1st
- ●Started blocking the vertical shafts of Trench pit.

2nd
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump.
- ●The pump for the injection of water into the reactor core was temporarily replaced with the Fire Extinguishing Pump in order to install an alarm device in the pump.

6th
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump.

7th
- ●Suspended the transfer of stagnant water from the Turbine Building Trench of Unit 2 (Stagnant water with high-level radioactivity) to the Radioactive Waste Treatment Facility in order to carry out piping work of Reactor Feedwater System for Unit3. The transfer was resumed. (From 16:02 May 7th)

79

A-5. Chronology of Unit2 after the earthquake(6/6)

●*Unit 2(Continued)*

May

10th ●Freshwater injection to SFP via FPC using the temporary motor-driven pump.(13:19～14:35 Hydrazine was also injected).

11th ●Due to the restoration of the Okuma No.2 transmission line, the power supply for the pump for injecting water into the reactor was temporarily switched to the temporary diesel generator. (after the restoration, part of power supply is received from the line.)

80

A-6. Chronology of Unit3 after the earthquake(1/4)

●*Unit 3*

March

11th ●Under operation, Automatic shutdown by the earthquake
● Loss of A/C power

13th ● Loss of water injection function
● Started to vent

14th ●Unusual increase in PCV pressure
●Sound of explosion

16th ●White smoke generated

17th ●Water discharge by the helicopters of Self-Defense Force(4 times)
●Water spray from the ground by High pressure water-cannon trucks (Police: once, Self-Defense Force: 5 times)

18th ●Water spray from the ground by same trucks (Self-Defense Force: 6 times)Water spray from the ground by US water-cannon trucks (US armed force:1 time)

19th ●Water spray from the ground by High pressure water-cannon trucks by Hyper Rescue Unit of Tokyo Fire Department.

81

A-6. Chronology of Unit3 after the earthquake(2/4)

●*Unit 3(Continued)*

20th ●Sprayed by Hyper Rescue Unit of Tokyo Fire Department

22nd ●Lighting in the Central Control Room was recovered.

23rd ●Injection of seawater to the SFP

24th ●Injection of seawater to the SFP

25th ●Water spray (Emergency fire support team
●Started fresh water injection

27th ●Water spray by Concrete Pump Truck

28th ●Switched to the water injection to the core using a temporary motor-driven pump
●In order to prepare for transfer the stagnant water on the basement floor of turbine building to the Condenser, the water in the Condensate Storage Tank is being transferred to the Surge Tank of Suppression Pool Water

April 3rd ●The power supply to the temporary motor-driven pump was switched from the temporary power supply to the external power supply.

82

A-6. Chronology of Unit3 after the earthquake(3/4)

●*Unit 3(Continued)*

April 17th ●Confirmed the situation in the reactor building using unmanned robot.

18th ●Stopped the water injection into the reactor core to replace the current hose with a new one

19th ●Completed the work of strengthening connection of the power supplies between Units1-2 and Units3-4

22nd ●Tentatively Injected freshwater to SFP via the Fuel Pool Coolant Purification Line.

25th ●For reinforcement work of the power supply, the power supply to the pump injecting water into the reactor core was temporarily switched from the external power supply to the temporary diesel generator.

30th ●Completed reinforcement work of the power supply both Units 3, 4). (Increasing the voltage from 6.6kv to 66kv)

May 2nd ●The pump for the injection of water into the reactor core was temporarily replaced with the Fire Extinguishing Pump in order to install an alarm device in the pump.

83

A-6. Chronology of Unit3 after the earthquake(4/4)

●*Unit 3(Continued)*

May

8th
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump.
- ●Started to transfer of water in the Condenser to the underground of the Turbine Building in order to carry out piping work of Reactor Feedwater System.

9th
- ●Injected freshwater to SFP via FPC using the temporary motor-driven pump. (12:39 ～14:36 Hydrazine was also injected)

11th
- ●Due to the restoration of the Okuma No.2 transmission line, the power supply for the pump for injecting water into the reactor was temporarily switched to the temporary diesel generator.
- ●Confirmed the water flow into the pit around intake of sea water through conduit pipe of electric power cables →16:05 Confirmed the water leakage from the pit to the sea →18:45 Stopped the water leakage by casting concrete into the pit.

84

A-7. Chronology of Unit4 after the earthquake

●*Unit 4*

March

14th
- ●Water temperature in the Spent Fuel Pool, 84℃

15th
- ●Damage of wall in the 4th floor confirmed
- ●Fire occurred in the 3rd floor (12:25 extinguished)

16th
- ●Fire occurred. TEPCO couldn't confirm any fire on the ground.

20th
- ●Water spray over the spent fuel pool by Self Defense Force

21st
- ●Water spray over the spent fuel pool by Self Defense Force

22nd-24th
- ●Water spray (Concrete Pump Track (3 times)

25th
- ●Injection of seawater to SFP via the Fuel Pool Cooling Line (FPC)
- ●Water spray (Concrete Pump Truck)

27th
- ●Water spray (Concrete Pump Truck)

29th
- ●Lighting in the Central Control Room was recovered.

April 12th
- ●Sampled the water in SFP

19th
- ●Completed the work of strengthening connection of the power supplies between Units1-2 and Units3-4

85

A-7. Chronology of Unit4 after the earthquake

●*Unit 4(Continued)*

April 22th	●Measured the water level of SFP by a gauge hung on Concrete Pump Truck (62m class).
30th	●Completed reinforcement work of the power supply both Units 3, 4. (Increasing the voltage from 6.6kv to 66kv)
May 9th	●Started installation work of the supporting structure for the floor of SFP .

86

A-8. Chronology of Unit 5 after the earthquake

● *Unit 5*

March 20th	●Cold shutdown
21st	●Receiving electricity from external power supply.
23nd	●Pump for Residual Heat Removal Seawater System (RHRS) was automatically stopped when the power supply was switched from the temporary to the permanent.
24th	●Repair of the RHRS pump was competed. ●Started to cooling.
April 4th – 8th	●Discharged the groundwater with low-level radioactivity in the Sub Drain Pit to the sea (around 950 ton).
25th	●For reinforcement work of the power supply, the pump for Residual Heat Removal (RHR) was temporarily stopped.
20th	●Implemented reinforcement work of the power supply (connection of the power supplies between Units 1-2 and Units 5-6).
May 2nd	●The pump for RHR was temporarily shut off in order to test the Start-up Transformer for power reception.

87

A-9. Chronology of Unit 6 after the earthquake

● *Unit 6*

March 20th	●Cold shutdown
22st	●Receiving electricity from external power supply.
April 4th	●Discharged the groundwater with low-level radioactivity in the Sub Drain Pit to the sea (aroud 373ton).
19th	●Transferred stagnant water under the base of the turbine building to the condenser for measuring the amount of it.
20th	●The Pump for Residual heat Removal (RHR) was temporary stopped in order to change the position of the hose of the temporary RHR Seawater System.
25th	●Implemented reinforcement work of the power supply (connection of the power supplies between Units 1-2 and Units 5-6).
May 1st	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank.

88

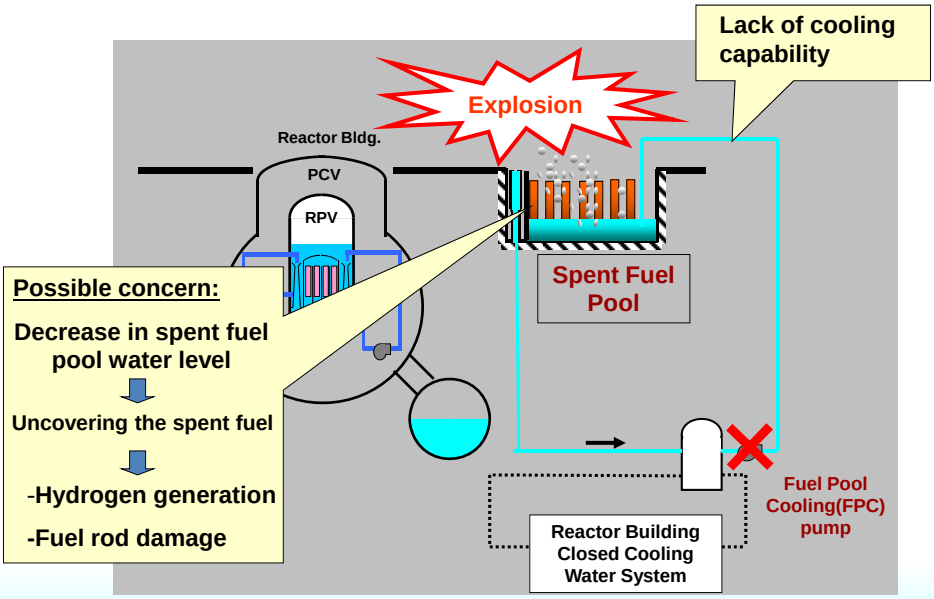
A-9. Chronology of Unit 6 after the earthquake

● *Unit 6 (Continued)*

May 2nd	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank. ●The pump for RHR was temporarily shut off in order to test the Start-up Transformer for power reception.
3rd	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank.
6th	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank.
7th	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank.
9th	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank
10th	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank.
11st	●Transferred stagnant water on the basement floor of the turbine building to the temporary tank. ●Started the transfer of stagnant water on the basement floor of the turbine building to the temporary tank.

89

B-1. Possible concerns about Spent Fuel Pool



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B-2. Status of the Fuel as of March11, 2011

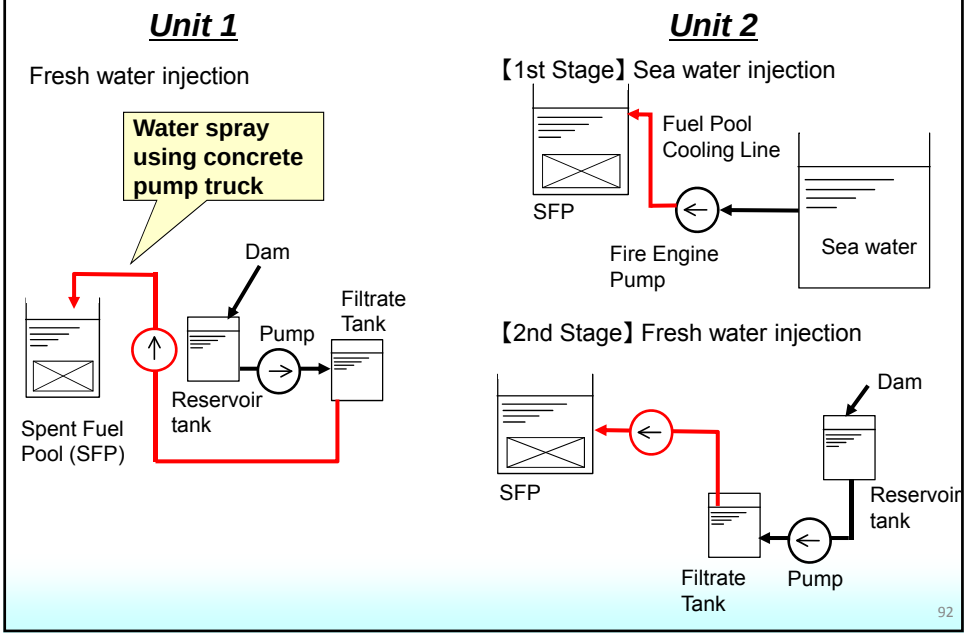
Unit	1	2	3	4	5	6
Number of Fuel Assembly in the Core	400	548	548	-	548	764
Number of Spent Fuel Assembly in the Spent Fuel Pool	292	587	514	1,331	946	876
Number of New Fuel Assembly in the Spent Fuel Pool	100	28	52	204	48	64
Water Volume (m^3)	1,020	1,425	1,425	1,425	1,425	1,497

Condition of the fuel in the Spent Fuel Pool

Unit 1	Unit 2	Unit 3	Unit 4
-Most recent shut down was on Sep.27,2010	- Most recent shut down was on Nov.18,2010	- Most recent shut down was on Sep.23,2010	-Most recent shut down was on Nov.29,2010 -All fuel assembly was removed from the core and located in the pool due to the core shroud replacement

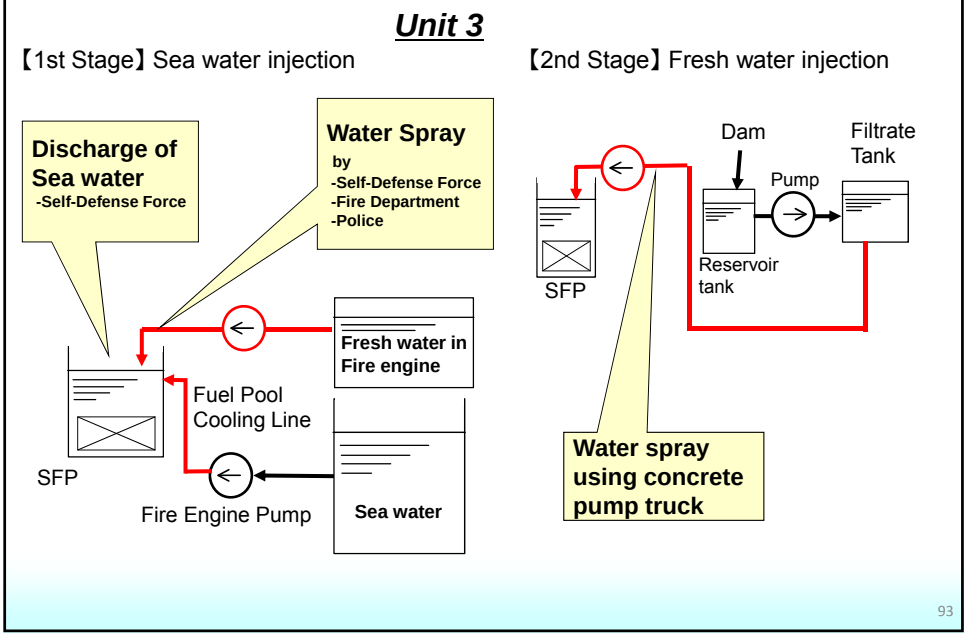
91

B-3. Measures taken to cool the Spent Fuel Pool(1/3)



92

B-3. Measures taken to cool the Spent Fuel Pool(2/3)

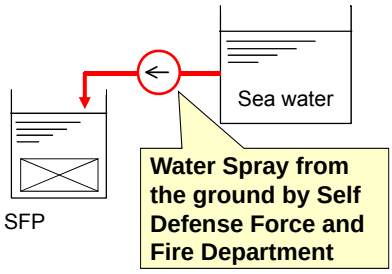


93

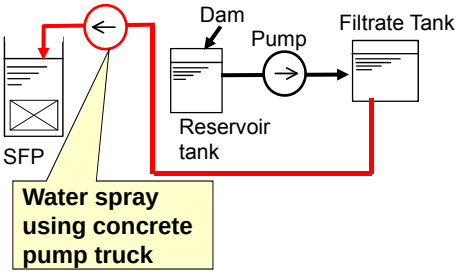
B-3. Measures taken to cool the Spent Fuel Pool(3/3)

Unit 4

【1st Stage】Sea water injection



【2nd Stage】Fresh water injection



Note: Sampling of SFP water

Analysis result of water in the SFP of Unit 4 (Date of Collection 4/12)

Detected Nuclides	Half life	Density (Bq/cm³)
Cesium 134	Approx. 2 Years	88
Cesium 137	Approx. 30 Years	93
Iodine 131	Approx. 8 Days	220

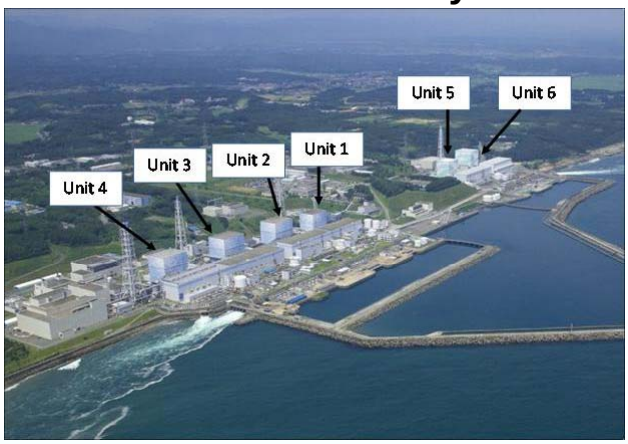
-Cause of reactor building damage to be investigated continuously

94

DETAILS ON ACCIDENT

(Chronology of Action taken by the Government)

14:46 March 11th – May 13th



95

Action Taken by the Government(1/12)

March 11th, 2011

14:46 ●Set up of the NISA Emergency Preparedness Headquarters (Tokyo) immediately after the earthquake

19:03 ●Government declared the state of nuclear emergency. (Establishment of Government Nuclear Emergency Response Headquarters and Local Emergency Response Headquarters)

21:23 ●Directives from Prime Minister to the Governor of Fukushima Prefecture and heads of towns were issued regarding the eventoccurred at Fukushima Daiichi NPS, TEPCO, in accordance with the Acton Special Measures Concerning Nuclear Emergency Preparedness as follows:
- Direction for the residents within 3km radius from Unit 1 to evacuate
- Direction for the residents within 10km radius from Unit 1 to stay in-house

24:00 ●Vice Minister of Economy, Trade and Industry, Ikeda arrived at the Local Emergency Response Headquarters

96

Action Taken by the Government(2/12)

March 12nd, 2011

05:44 ●Residents within 10km radius from Unit 1 of Fukushima Dai-ichi NPS shall evacuate by the Prime Minister Direction

07:45 ●Directives from Prime Minister to the Governor of Fukushima Prefecture and heads of towns were issued regarding the event occurred at Fukushima Dai-ni NPS, TEPCO, pursuant to Act on Special Measures Concerning Nuclear Emergency Preparedness as follows:
- Direction for the residents within 3km radius from Fukushima Dai-ni NPS to evacuate
- Direction for the residents within 10km radius from Fukushima Dai-ni NPS to stay in-house

17:39 ●Prime Minister directed evacuation of the residents within the 10 km radius from Fukushima-Dai-ni NPS

18:25 ●Prime Minister directed evacuation of the residents within the 20km radius from Fukushima Dai-ichi NPS

20:05 ●Considering the Directives from Prime Minister and pursuant to the Nuclear Regulation Act, the order was issued to inject seawater to Unit 1 of Fukushima Dai-ichi NPS and so on.

97

Action Taken by the Government(3/12)

March 13th, 2011

09:30 ●Directive was issued for the Governor of Fukushima Prefecture and heads of towns in accordance with the Act on Special Measures Concerning Nuclear Emergency Preparedness on the contents of radioactivity decontamination screening.

March 15th, 2011

05:30 ●Prime Minister, Kan expressed to establish The Joint Headquarters to Fukushima Dai-ichi NPS accident

10:30 ●According to the Nuclear Regulation Act, Minister of Economy, Trade and Industry issued the directions as follows.
-For Unit 4: To extinguish fire and to prevent the occurrence of re-criticality
-For Unit 2: To inject water to reactor vessel promptly and to vent Drywell

11:00 ●Prime Minister directed the in-house stay area. -In-house stay was additionally directed to the residents in the area from 20 km to 30 km radius from Fukushima Dai-ichi NPS considering reactor situation

22:00 ●According to the Nuclear Regulation Act, Minister of Economy, Trade and Industry issued the following direction.
- For Unit 4: To implement the injection of water to the Spent Fuel Pool.

March 20th, 2011

23:30 ●Directive from Local Emergency Response Headquarters to the Prefectural Governor and the heads of cities, towns and villages was issued regarding the change of the reference value for the screening level for decontamination of radioactivity

98

Action Taken by the Government(4/12)

March 21st, 2011

07:45 ●Directive titled as "Administration of the stable Iodine" was issued from Local Emergency Response Headquarters to the Prefectural Governor and the heads of cities, towns and villages.

16:45 ●Directive titled as "Ventilation for using heating equipments within the in-house evacuation zone" was issued from the Head of Local Emergency Response Headquarters to the Prefectural Governor and the heads of cities, towns and villages.

17:50 ●Directive from the Head of Government Nuclear Emergency Response Headquarters to the Prefectural Governors of Fukushima, Ibaraki, Tochigi and Gunma was issued, which directs the above-mentioned governors to issue a request to relevant businesses and people to suspend shipment of spinach, Kakina (a green vegetable) and raw milk for the time being.

March 25th, 2011

●NISA directed orally to the TEPCO regarding the exposure of workers at the turbine building of Unit 3 of Fukushima Dai-ichi NPS occurred on March 24th, to review immediately and to improve its radiation control measures.

99

Action Taken by the Government(5/12)

March 25th, 2011

- Since there was a mistake in the evaluation regarding the concentration measurement of radioactive materials, NISA directed TEPCO orally to prevent the recurrence of such a mistake

13:50
- Receiving the suggestion by the special meeting of Nuclear Safety Commission, NISA directed TEPCO orally to add the sea water monitoring points and carry out the groundwater monitoring.
- Regarding the delay in the reporting of the water confirmed outside of the turbine buildings, NISA directed TEPCO to accomplish the communication in the company on significant information in a timely manner and to report it in a timely and appropriate manner.

March 29th, 2011

- In order to strengthen the system to assist the nuclear accident sufferers, the "Team to Assist the Lives of the Nuclear Accident Sufferer" headed by the Minister of Economy, Trade and Industry was established

March 30th, 2011

- Directions as to implement the emergency safety measures for the other power stations considering the accident of Fukushima Dai-ichi and Dai-ni NPSs in 2011 was issued and handed to each electric power company and the relevant organization.

100

Action Taken by the Government(6/12)

March 31st, 2011

- Regarding the break-in of the propaganda vehicle to Fukushima Dai-ni NPS on 31 March, NISA directed TEPCO orally to take the carefully thought-out measures regarding physical protection, etc.
- NISA alerted TEPCO to taking the carefully though-out measures regarding radiation control for workers.

April 1st, 2011

- NISA strictly alerted TEPCO to taking appropriate measures concerning the following three matters regarding the mistake in the result of nuclide analysis.
  - -Regarding the past evaluation results on nuclide analysis, all the nuclides erroneously evaluated should be identified and the re-evaluation on them should be promptly carried out.
  - - The causes for the erroneous evaluation should be investigated and the thorough measures for preventing the recurrence should be taken.
  - - Immediate notification should be done in the stage when any erroneous evaluation results, etc. are identified.

April 2nd, 2011

- Regarding the outflow from the area around Unit2 of Fukushima NPPs, NISA directed TEPCO orally for the followings:
  - - to carry out nuclide analysis of the liquid sampled,
  - - to confirm whether there are other outflows from the same parts of the facilities
  - - to strengthen monitoring through sampling water at more points around the facilities concerned.

101

Action Taken by the Government(7/12)

April 4th, 2011

- **On the imperative execution of the discharge to the sea as an emergency measure, NISA requested the technical advice of NSC and directed TEPCO to do the followings:**
  - **to survey and confirm the impact of the spread of radioactive materials caused by the discharge, by ensuring continuity of the sea monitoring and enhancing it**
  - **to disclose required information**
  - **to enhance the strategy to minimize the discharge amount.**

April 6th, 2011

12:40 ● **On the implementation of the nitrogen injection to PCV of Unit 1, NISA directed TEPCO on the following points.**
- **Properly control the plant parameters, and take measures appropriately to ensure safety in response to changes in the parameters.**
- **Establish and implement an organizational structure and so on that will ensure the safety of the workers who will engage in the operation.**
- **Through the judicious and further enhanced monitoring, TEPCO shall survey and confirm the impact of the release and spreading of radioactive materials due to the nitrogen injection, and strive to disclose information.**

April 9th, 2011

- **NISA issued the letters of direction titled "Regarding the Treatment of Emergency Power Generating Facilities in Terms of Safety Regulations (Directions)" to each Electricity Utility and other organizations concerned.**

102

Action Taken by the Government(8/12)

April 10th, 2011

- **NISA issued the direction regarding collection of report that should include the necessity, the evaluation of safety and the policy of ensuring the permanent storage and treatment facilities for the waste water and so on, concerning the transfer of the stagnant water with high-level radioactivity in Fukushima Dai-ichi NPS to the Radioactive Waste Treatment Facilities.**

April 13th, 2011

- **Regarding the buildings of Fukushima Daiichi NPS, NISA directed TEPCO to report the result of implementation on seismic safety evaluation as well as the result of consideration on the measurement of effective seismic reinforcement work, etc.,**
- **NISA directed TEPCO to implement detailed analysis and consideration regarding the tsunami caused by the 2011 Tohoku District - off the Pacific Ocean Earthquake.**
- **NISA directed Tohoku Electric Power Co. Inc. to report the analysis of seismic data observed when the 2011 Earthquake off the Coast of Miyagi Prefecture occurred around 23:32 on 7 April and the assessment on seismic impact on the facilities that are important from the seismic safety viewpoints.**

April 14th, 2011

- **NISA directed TEPCO orally to strengthen the monitoring of the Sub Drain (the groundwater collected and controlled in the facilities) of Units 1 and 2.**

103

Action Taken by the Government(9/12)

April 15th, 2011

- **NISA directed General Electricity Utilities and other organizations concerned to consider the measures to ensure reliability on external power supply due to the temporary loss of external power supply at NPSs, etc.**

April 18th, 2011

- **Regarding the transfer of the stagnant water with high-level radioactivity to the Radioactive Waste Treatment Facilities, NISA accepted(18th) and confirmed(19th) the report from TEPCO in accordance with the direction for the collection of report issued on 10th April.**

April 21st, 2011

- **The prime Minister issued the following instruction in relation to the accident at Fukushima Dai-ni NPS to the Governer of Fukushima pref. and heads of towns:**
  - Instruction to change the evacuation area from within 10km radius to within 8km radius from Fukushima Dai-ni NPS.
- **The prime Minister issued the following instruction in relation to the accident at Fukushima Dai-ichi to the Governer of Fukushima Pref. and heads of towns:**
  - Instruction to establish a restricted area as the area within 20km radius from Fukushima Dai-ichi NPS, and to prohibit the access to the area or to order to leave the area to any persons other than those engaged in emergency response measures, excluding the case that the mayor of the city or town or the head of the village permits the temporary access.

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Action Taken by the Government(10/12)

April 22nd , 2011

- **The prime Minister issued the following instruction pertaining to the accident at Fukushima Dai-ichi NPS of TEPCO to the Governor of Fukushima Prefecture and heads of towns.**
  - Instruction to lift the area of in-house stay which had been established for the sphere within 20 km to 30 km radius from Fukushima Dai-ichi NPS, and to establish Deliberate Evacuation as well as Evacuation-Prepared Areas in Case of Emergency, for the residents and others to make preparations for deliberate leaving, or for evacuation or in-house stay at any time during an emergency, in the subject area.

April 24th , 2011

- **NISA strictly alerted TEPCO orally on the following matters, regarding TEPCO's report that some of the plant data the company provided contained errors.**
  - These parameters were data that formed the basis of appropriate and prompt actions after the accident, and it is extremely regrettable that the data that was provided contained errors.
  - Inspections shall be continued and carried out swiftly and reliably.
  - An infallible recurrence prevention measure shall be put in place.

April 25th , 2011

- **NISA directed TEPCO to report accident records etc., regarding the accident at Fukushima Dai-ichi NPS, pursuant to Article 67, paragraph 1 of the Nuclear Regulation Act, and Article 106, paragraph 3 of the Electricity Business Act.**

Action Taken by the Government(11/12)

April 27th , 2011

- **NISA received a report from TEPCO that the effective dose rate from January 1 to March 31, 2011 (4th Quarter) of 1 (female) employee who was working after the occurrence of the Tohoku-District-off-the-Pacific-Ocean Earthquake exceeded 5mSv. NISA strictly alerted TEPCO and directed the company to investigate the cause and to establish measures for preventing a recurrence, as well as to validate the radiation management system in Fukushima Dai-ichi NPS, establish measures based on the validation, and report to NISA by May 2, 2011.**

April 30th , 2011

- **NISA instructed TEPCO, pursuant to the provisions of Article 67, paragraph 1 of the Nuclear regulation Act, to submit a report on the impact on stable cooling of the reactor and the following safety evaluation regarding the implementation of the measure to fill the PCV of Unit 1 of Fukushima Dai-ichi NPS with water up to the level above the reactor fuel.**

May 2nd , 2011

- **NISA instructed TEPCO, pursuant to the provisions of Article 67, paragraph 1 of the Nuclear regulation Act, to submit a report on the necessity for implementing measures to reduce the concentration of nuclear materials inside the reactor building of UNIT 1. Fukushima Dai-ichi NPS (including future prospects for work inside the reactor building), as well as on each reduction measure (installation and use of the ambient air filtration system and opening of the double doors on the north side.) The report was received on May 3.**

Action Taken by the Government(12/12)

May 5th , 2011

- **With regard to the report received from TEPCO that the measure to fill the PCV of Unit 1 of Fukushima Dai-ichi NPS with water up to the level above the reactor fuel was implemented, NISA conducted an evaluation and gave the following instruction.**
  - Sufficient monitoring of the water level inside the PCV and water leakage from the PCV shall be implemented. In addition, the measures that specify in advance he controls, etc., for the amount of injected water shall be adequately implemented.

Outline of Government Headquarters in response to the earthquake