

# Information on Status of Nuclear Power Plants in Fukushima



Japan Atomic Industrial Forum, Inc.

## Policy on information and compilation

This JAIF-compiled information chart represents the situation, phenomena, and operations in which JAIF estimates and guesses the reactors and related facilities are, based on the latest data and information directly and indirectly made available by the relevant organizations when JAIF's updating works done. Consequently, JAIF may make necessary changes to descriptions in the chart, once (1) new developments have occurred in the status of reactors and facilities and (2) JAIF has judged so needed after reexamining the prior information and judgments.

JAIF will do its best to keep tracks on the information on the nuclear power plants quickly and accurately.

**Status of nuclear power plants in Fukushima as of 12:00, May 9th (Estimated by JAIF)**

| Power Station   | Fukushima Dai-ichi Nuclear Power Station  |  |  |  |   |   |
|---|---|--|--|--|---|---|
|   | 1   | 2  | 3  | 4  | 5   | 6   |
| Unit  | 1   | 2  | 3  | 4  | 5   | 6   |
| Electric / Thermal Power output (MW)                                      | 460 / 1380  | 784 / 2381   | 784 / 2381   | 784 / 2381   | 784 / 2381  | 1100 / 3293   |
| Type of Reactor   | BWR-3   | BWR-4  | BWR-4  | BWR-4  | BWR-4   | BWR-5   |
| Operation Status at the earthquake occurred                               | In Service → Shutdown   | In Service → Shutdown  | In Service → Shutdown  | Outage   | Outage  | Outage  |
| Fuel assemblies loaded in Core  | 400   | 548  | 548  | No fuel rods   | 548   | 764   |
| Core and Fuel Integrity (Loaded fuel assemblies)                          | Damaged (55%*1)   | Damaged (35%*1)  | Damaged (30%*1)  | No fuel rods   | Not Damaged   | Not Damaged   |
| Reactor Pressure Vessel structural integrity                              | Unknown   | Unknown  | Unknown  | Not Damaged  | Not Damaged   | Not Damaged   |
| Containment Vessel structural integrity                                   | Not Damaged (estimation)  | Damage and Leakage Suspected                                   | Not damaged (estimation)   | Not Damaged  | Not Damaged   | Not Damaged   |
| Core cooling requiring AC power 1 (Large volumetric freshwater injection) | Not Functional  | Not Functional   | Not Functional   | Not necessary  | Functional  | Functional  |
| Core cooling requiring AC power 2 (Cooling through Heat Exchangers)       | Not Functional  | Not Functional   | Not Functional   | Not necessary  | Functioning (in cold shutdown)                                  | Functioning   |
| Building Integrity  | Severely Damaged (Hydrogen Explosion)   | Slightly Damaged   | Severely Damaged (Hydrogen Explosion)                                    | Severely Damaged (Hydrogen Explosion)  | Open a vent hole on the rooftop for avoiding hydrogen explosion | Open a vent hole on the rooftop for avoiding hydrogen explosion |
| Water Level of the Rector Pressure Vessel                                 | Fuel exposed partially or fully   | Fuel exposed partially or fully                                | Fuel exposed partially or fully  | Safe   | Safe  | Safe  |
| Pressure / Temperature of the Reactor Pressure Vessel                     | Gradually increasing / Decreased a little after increasing over 400°C on Mar. 24th  | Unknown / Stable   | Unknown / Gradually increasing   | Safe   | Safe  | Safe  |
| Containment Vessel Pressure   | Decreased a little after increasing up to 0.4Mpa on Mar. 24th   | Stable   | Stable   | Safe   | Safe  | Safe  |
| Water injection to core (Accident Management)                             | Continuing (Switch from seawater to freshwater)   | Continuing (Switch from seawater to freshwater)                | Continuing (Switch from seawater to freshwater)                          | Not necessary  | Not necessary   | Not necessary   |
| Water injection to Containment Vessel (AM)                                | Feed water to fill up the CV (started 4/27)   | Feed water to fill up the CV (planned)                         | Feed water to fill up the CV (planned)                                   | Not necessary  | Not necessary   | Not necessary   |
| Containment Venting (AM)  | Temporally stopped  | Temporally stopped   | Temporally stopped   | Not necessary  | Not necessary   | Not necessary   |
| Fuel assemblies stored in Spent Fuel Pool                                 | 292   | 587  | 514  | 1331   | 946   | 876   |
| Fuel Integrity in the spent fuel pool                                     | Unknown   | Unknown  | Damage Suspected   | some of the spent fuel may have been damaged*3   | Not Damaged   | Not Damaged   |
| Cooling of the spent fuel pool  | Water spray continues (freshwater)  | water injection continues (Switch from seawater to freshwater) | Water spray and injection continues (Switch from seawater to freshwater) | Water spray and injection continues (Switch from seawater to freshwater), Hydrogen from the pool exploded (3/15) | Pool cooling capability was recovered                           | Pool cooling capability was recovered                           |
| Main Control Room Habitability & Operability                              | Poor due to loss of AC power (Lighting and parmaeter monitoring restored in the control room at Unit 1 and 3 on Mar. 24th, at Unit 2 on Mar. 26th, at Unit 4 on Mar. 29th)  |  |  |  | Not damaged (estimate)  |   |
| Environmental effect  | <p>●Status in Fukushima Dai-ichi NPS site<br/>Radiation level: 408 μSv/h at the south side of the office building, 44 μSv/h at the Main gate, 17 μSv/h at the West gate, as of 09:00, May 9th.<br/>Small amounts of Radioactive nuclides(I, Cs, Pu(3/28), Am and Cm(4/27)) has been detected in soil sampled at the Fukushima site.<br/>Radioactive materials continues to be detected in samples corrected from underground water and sea water at or near the site. Environmental monitoring has been enhanced.<br/>Radioactive Iodine and cesium have been detected in the seabed samples taken 15-20 km far from the plant from 15-20m deep. Level of radiation is 100 to 1,000 times above normal. (5/4)</p> <p>●Influence to the people's life<br/>Radioactive material was detected from milk, agricultural products and seafood from Fukushima and neighboring prefectures. The government issued order to limit shipment and intake of some products.<br/>Radioactive iodine, exceeding the provisional legal limit for drinking water, was detected from tap water sampled in some prefectures.<br/>Radioactive cesium was detected in the sludge from a sewage treatment plant 50 km far from the power station.<br/>Small amount of strontium was detected in some samples of soil and plants corrected in the area that is 20-80 km far from the power station.</p>  |  |  |  |   |   |
| Evacuation  | <p>&lt;1&gt; Shall be evacuated for within 3km from NPS, Shall stay indoors for within 10km from NPS (issued at 21:23, Mar. 11th) &lt;2&gt; Shall be evacuated for within 10km from NPS (issued at 05:44, Mar. 12th)<br/>&lt;3&gt; Shall be evacuated for within 20km from NPS (issued at 18:25, Mar. 12th) &lt;4&gt; Shall stay indoors (issued at 11:00, Mar. 15th), Should consider leaving (issued at 11:30, Mar. 25th) for from 20km to 30km from NPS &lt;5&gt;The 20km evacuation zone around the Fukushima Daiichi NPS is to be expanded so as to include the area, where annual radiation exposure is expected to be above 20mSv. People in the expanded zone are ordered to evacuate within a month or so. People living in the 20 to 30km and other than the expanded evacuation area mentioned above, are asked to get prepared for staying indoors or evacuation in an emergency (announced on Apr. 11th and issued on Apr. 22nd).</p>  |  |  |  |   |   |
| INES (estimated by NISA)  | Level 7*2 ※Cumulative amount of radioactivity from Fukushima Daiichi NPS has reached the level to be classified as level 7.<br>Total amount of radioactive materials released to the environment in this accident is one tenth as much as one in the Chernobyl accident so far.   |  |  | Level 3 *2   |   | —   |
| Remarks   | <p>●Progress of the work to restore cooling function<br/>TEPCO announced its plan to bring the damaged reactors to a stable condition known as a "cold shutdown" in about six to nine months, a situation in which water temperatures inside the reactors have been stably brought below 100 C.(4/17)<br/>High radiation circumstance hampering the work to restore reactor cooling function at unit-1,2 and 3. Operation to discharge radioactive water in the basement of the buildings and concrete tunnels outside the buildings of all Unit 1, 2, 3, started with unit 2 on April 19 and counties. Blocking the concrete tunnel was started at Unit 2.(5/1-) Ventilators were installed at Unit 1(5/5), to clean the highly radioactive air inside the reactor building for improving working environment. The doors of the building were opened (5/8) and workers entered the building (5/9).<br/>Emergency power generators were moved to higher ground in order to prevent the reactors' cooling systems from failing in case a major tsunami hits the plant again. External power source becomes more reliable after connecting 3 power lines with each other, which are for Unit 1/2, for Unit 3/ 4 and for Unit 5/6.<br/>The damaged containment vessel of unit 2 is need to be repaired before the work to restore reactor cooling function.<br/>TEPCO developed the plan to cool the reactor through filling the containment vessel with water up to the top of fuel level. NISA accepted TEPCO`s safety evaluation for this plan for unit 1 such as impact of increased dead weight of water.(5/5)<br/>The operation of pumping more water into No1 reactor in line with this plan continues.</p> <p>●Function of containing radioactive material<br/>It is presumed that radioactive material inside the reactor vessel may leaked outside. NISA estimated that the reactor pressure vessel of Unit 2 and 3 may have lost air tightness.<br/>Nitrogen gas injection into the Unit 1containment vessel to prevent hydrogen explosion started on April 6th and continues.</p> <p>●Cooling the spent fuel pool (SFP)<br/>Injecting and/or spraying water to the SFP continues for the purpose cooling and make up water evaporated.<br/>The walls of the reactor building supporting the pool were severely damaged by an explosion on March 15th at unit-4. Work for structural reinforcement to support the SFP is necessary.</p> <p>●Prevention of the proliferation of radioactively contaminated substance:<br/>TEPCO announced the plans to prevent radioactively contaminated water, dust and soil and radioactive material itself existing on site from spreading on Apr 17.<br/>Full operation of spraying synthetic resin to contain contaminated dust started on Apr. 26th and continues.</p> <p>●Worker's exposure dose: 21 workers has been exposed to between 100 and 250mSv as of 4/30. *Emergency exposure dose limit has been set to 250mSv.</p> |  |  |  |   |   |

[Source]  
Government Nuclear Emergency Response Headquarters:  
News Release (-5/8 17:00), Press conference  
NISA: News Release (-5/8 12:00), Press conference  
TEPCO: Press Release (-5/9 09:00), Press Conference

[Abbreviations]  
MEXT: Ministry of Education, Culture, Sports, Science and Technology  
INES: International Nuclear Event Scale  
NISA: Nuclear and Industrial Safety Agency  
TEPCO: Tokyo Electric Power Company, Inc.  
NSC: Nuclear Safety Commission of Japan

\*1 TEPCO's estimation revised on April 27  
\*2 Correction: Rating was raised from 5 to 7 for the accident of Unit 1 through 3  
\*3 It is presumed that some of the spent fuel may have been damaged based on radioactive substance detected from the water sample taken from the pool of Unit 4.

[Significance judged by JAIF]  
■ Low  
■ High  
■ Severe (Need immediate action)

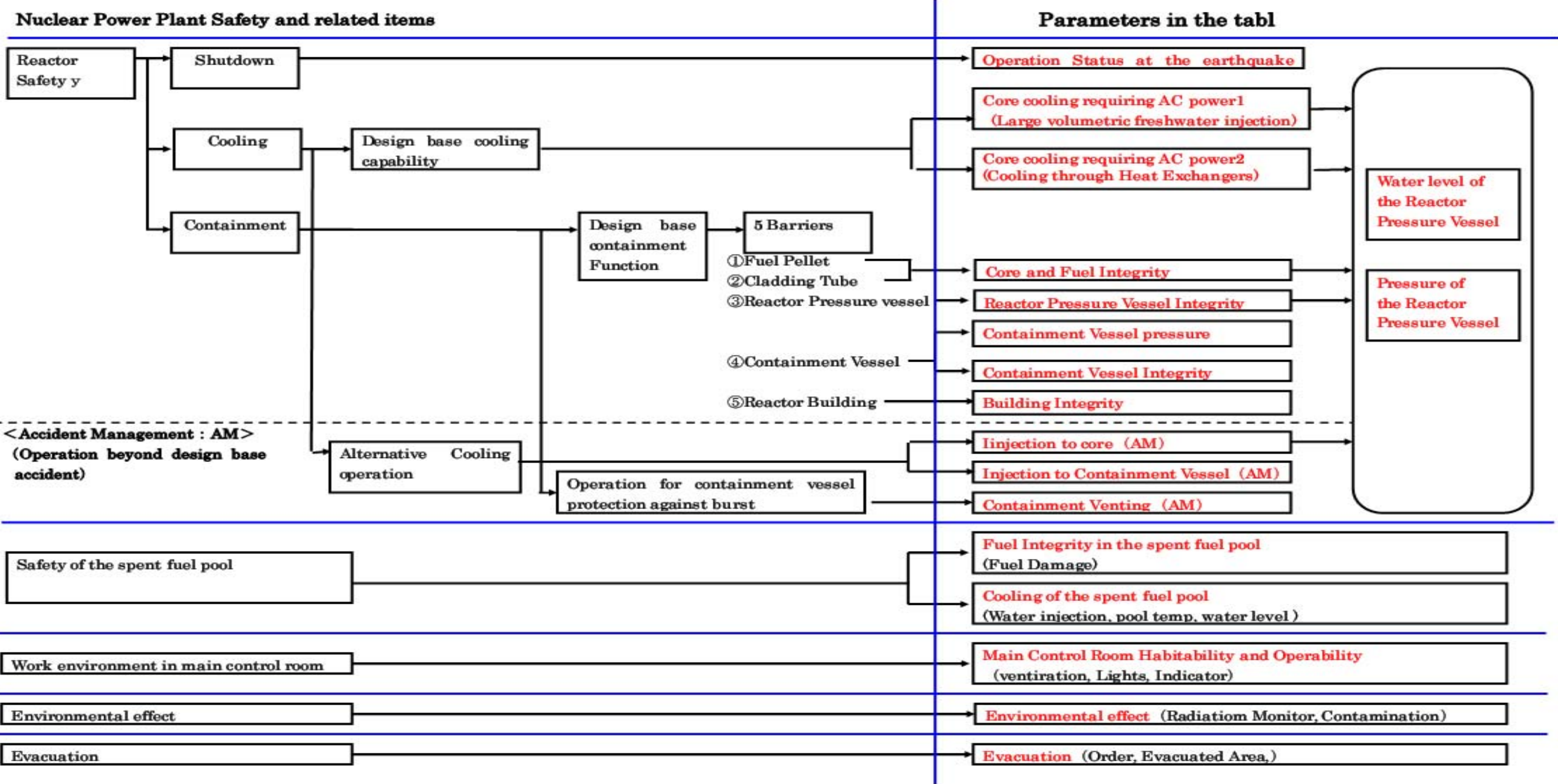
| Power Station                               | Fukushima Dai-ni Nuclear Power Station   |         |       |         |
|---|--|---------|-------|---------|
| Unit  | 1  | 2       | 3     | 4       |
| Electric / Thermal Power output (MW)        | 1100 / 3293  |         |       |         |
| Type of Reactor                             | BWR-5  | BWR-5   | BWR-5 | BWR-5   |
| Operation Status at the earthquake occurred | In Service -> Automatic Shutdown   |         |       |         |
| Status                                      | All the units are in cold shutdown.  |         |       |         |
| INES (estimated by NISA)                    | Level 3  | Level 3 | —     | Level 3 |
| Remarks                                     | <p>Unit-1, 2, 3 &amp; 4, which were in full operation when the earthquake occurred, all shutdown automatically.</p> <p>External power supply was available after the quake. While injecting water into the reactor pressure vessel using make-up water system, TEPCO recovered the core cooling function and made the unit into cold shutdown state one by one.</p> <p>No parameter has shown abnormality after the earthquake occurred off an shore of Miyagi prefecture at 23:32, Apr. 7th.</p> <p>Latest Monitor Indication: <u>1.7 <math>\mu</math> Sv/h</u> at 21:00, <u>May 7th</u> at NPS border</p> <p>Evacuation Area: 3km from NPS(3/12 7:45), 10km from NPS(3/12 17:39), 8km from NPS(4/21)</p> |         |       |         |

| Power Station                               | Onagawa Nuclear Power Station   |   |   |
|---|---|---|---|
| Unit  | 1   | 2 | 3 |
| Operation Status at the earthquake occurred | In Service -> Automatic Shutdown  |   |   |
| Status                                      | All the units are in cold shutdown.   |   |   |
| Remarks                                     | <p>3 out of 4 external power lines in service with another line under construction broke down after an earthquake occurred off the shore of Miyagi prefecture at 23:32, Apr. 7th. All 5 external power lines have become available by Apr. 10th. Monitoring posts' readings have shown no abnormality. All SFP cooling systems had been restored after shutting down due to the earthquake.</p> |   |   |

| Power Station                               | Tokai Dai-ni  |
|---|---|
| Operation Status at the earthquake occurred | In Service -> Automatic Shutdown  |
| Status                                      | In cold shutdown.   |
| Remarks                                     | No abnormality has been found after an earthquake occurred off the shore of Miyagi prefecture at 23:32, Apr. 7th. |

**Parameters in the Table**

JAIF picks up these parameters to evaluate safety condition of the nuclear plants during this accident from the view point of the principles of nuclear power plant safety, which are "Shutdown", "Cooling" and "Containment". Then we create the chart. The following diagram is to show the correspondence relation of these parameters in the table to nuclear power plant safety.







1. Latest Major event and response

May 6th

- 09:00-16:00 Operation to remove rubble by remotely controlled heavy machines conducted today.
- 09:00-16:00 Operation of spraying synthetic resin to prevent contaminated dust and soil from spreading was conducted.
- 12:38-17:51 Operation of spraying water to the Unit 4 SFP was conducted
- 14:00-17:00 Water accumulated in the basement of Unit 6 was transferred to makeshift storage tanks.

May 7th

- 09:00-16:00 Operation to remove rubble by remotely controlled heavy machines conducted today.
- 10:30-14:00 Operation of spraying synthetic resin to prevent contaminated dust and soil from spreading was conducted.
- 14:05-17:30 Operation of spraying water to the Unit 4 SFP was conducted
- 10:00-15:00 Water accumulated in the basement of Unit 6 was transferred to makeshift storage tanks.

2. Chronology of Nuclear Power Stations

(1) Fukushima Dai-ichi NPS

|  | Unit 1   | Unit 2  | Unit 3   | Unit 4   | Unit-5 and 6   |
|--|--|---|--|--|--|
| Major Incidents and Actions  | 11th 15:42 Report IAW Article 10* (Loss of power)  | 11th 15:42 Report IAW Article 10* (Loss of power)   | 11th 15:42 Report IAW Article 10* (Loss of power)  | 14th 04:08 Water temperature in Spent Fuel Storage Pool increased at 84°C  | 19th 05:00 Cooling SFP with RHR-pump started at Unit 5   |
| *The Act on Special Measures Concerning Nuclear Emergency Preparedness | 11th 16:36 Event falling under Article 15* occurred (Incapability of water injection by core cooling function)   | 11th 16:36 Event falling under Article 15* occurred (Incapability of water injection by core cooling function)  | 12th 20:41 Start venting   | 15th 09:38 Fire occurred on 3rd floor (extinguished spontaneously)   | 19th 22:14 Cooling SFP with RHR-pump started at Unit 6   |
|  | 12th 00:49 Event falling under Article 15* occurred (Abnormal rise of CV pressure)   | 13th 11:00 Start venting  | 13th 05:10 Event falling under Article 15* occurred (Loss of reactor cooling functions)          | 16th 05:45 Fire occurred (extinguished spontaneously)  | 20th 14:30 Cold shutdown achieved at Unit 5.<br>20th 19:27 Cold shutdown achieved at Unit 6.                             |
|  | 12th 14:30 Start venting   | 14th 13:25 Event falling under Article 15* occurred (Loss of reactor cooling functions)   | 13th 08:41 Start venting   | Since 20th, operation of spraying water to the spent fuel pool continues.  | 22nd 19:41 All power source was switched to external AC power at Unit 5 and 6.   |
|  | 12th 15:36 Hydrogen explosion  | 14th 16:34 Seawater injection to RPV  | 13th 13:12 Seawater injection to RPV   | 29th 11:50 lights in the main control room becomes available   | Apr. 1st 13:40 Start transferring pooled water in the Unit 6 radioactive waste process facility to the Unit 5 condenser. |
|  | 12th 20:20 Seawater injection to RPV   | 14th 22:50 Report IAW Article 15* (Abnormal rise of CV pressure)  | 14th 05:20 Start venting   |  | May2 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank started.      |
|  | 22nd 11:20 RPV temperature increased   | 15th 00:02 Start venting  | 14th 07:44 Event falling under Article 15* occurred (Abnormal rise of CV pressure)               |  |  |
|  | 22nd 02:33 Seawater injection through feed water line started in addition to fire extinguish line  | 15th 06:10 Sound of explosion, Suppression Pool damage suspected  | 14th 11:01 Hydrogen explosion  |  |  |
|  | 24th 11:30 lights in the main control room becomes available   | 15th 08:25 White smoke reeked   | 15th 10:22 Radiation dose 400mSv/h   |  |  |
|  | 25th 15:37 Freshwater injection to the reactor started.  | 20th 15:05 operation of spraying water to the spent fuel pool started.  | 16th 08:34, 10:00 White smoke reeked   |  |  |
|  | 27th 08:30 Continuing to transfer the water in the basement of the turbine building  | 26th 10:10 Freshwater injection to the reactor started.   | Since 17th, operation of spraying water to the spent fuel pool continues.                        |  |  |
|  | 31st 09:20-11:25 Work to remove the water in the trench  | 26th 16:46 lights in the main control room becomes available  | 21st 15:55 Slightly gray smoke erupted (18:02 settled)   |  |  |
|  | 31st 12:00 Start to transfer the water in the CST to the surge tank (- 15:27, Apr. 2)  | 29th 16:45 Start to transfer the water in the CST to the surge tank   | 22nd 22:46 lights in the main control room becomes available                                     |  |  |
|  | 31st 13:03 Start water injection to SFP  | Apr. 2nd 16:25 Start injecting concrete to stop water leakage from the pit near the intake  | 25th 18:02 Freshwater injection to the reactor started.  |  |  |
|  | Apr. 7th 01:31 Injection of Nitrogen gas started after opening all valves through the line.  | 2nd 17:10 Start transferring water in the condenser to the CST  | 28th 17:40 Start to transfer the water in the CST to the surge tank                              |  |  |
|  | Apr. 10th 09:30 Transfer of water from the main condenser to the CST completed.  | Apr. 5th 15:07 Regarding leakage from the pit that is closed to discharge outlet of unit-2, hardening agent was injected to hole dug surrounding the pit. (Apr. 6 05:38 It was confirmed that water flow stopped) | Apr. 13 13:50 Installation of silt fences in front of the Unit 3 and 4 seawater screen completed |  |  |
|  | Apr 17 16:00 Start investigation of the inside of R/B using a remote-controlled robot.   | Apr. 9th 13:10 Transfer of water from the main condenser to the CST completed.  | Apr 17 11:30 Start investigation of the inside of R/B using a remote-controlled robot.           |  |  |
|  | Apr. 29 11:36 The inside of the building was inspected. It was confirmed that there is no water significant leakage from the CV.                                   | Apr. 13th 17:04 Transfer of highly radioactively contaminated wafter accumulated in the trench outside the turbine building to the condenser completed  |  |  |  |
|  | May 2 12:58 Water feeding was temporally switched from to the reactor injection pump to the fire pump to install alarm device to the reactor injection pump.       | Apr. 15th 14:15 Installation of steel plate in front of Unit 2 seawater screen completed  |  |  |  |
|  | May 5 11:32-16:36 Ventilators to clean the highly radioactive air inside the reactor building were installed at Unit 1.  | Apr 18 13:42 Start investigation of the inside of R/B using a remote-controlled robot.  |  |  |  |
|  |  | Apr. 19 10:08 Start transferring highly radioactive water accumulated in the turbine building and the concrete tunnel to the waste processing facility  |  |  |  |
|  | Apr. 30 14:05 Start transferring highly radioactive water accumulated in the vertical part of the concrete tunnel outside the turbine BLDG to the waste processing |   |  |  |  |
|  | May 1 13:35 The work to block the vertical concrete tunnel outside the turbine bldg started.   |   |  |  |  |
|  | May 2 12:58 Water feeding was temporally switched from to the reactor injection pump to the fire pump to install alarm device to the reactor injection pump.       |   |  |  |  |
|  | Apr. 3rd 12:18 Switch power supply for water injection pumps to the RPV from power supply vehicles to originally equipped power source                             |   |  |  |  |
|  | Apr. 14 12:20 Installation of silt fences in front of the Unit 1 and 2 seawater screen and intake completed  |   |  |  |  |
| Major Data *1  | Reactor Water level (May 8 11:00)<br>(A) -1700mm, (B) -1700mm  | Reactor Water level (May 8 11:00)<br>(A) -1500mm, (B) -2100mm   | Reactor Water level (May 8 11:00)<br>(A) -2100mm, (B) -2150mm                                    | SFP water temperature measured with a concrete pump vehicle<br>Apr. 12 : about 90 °C<br>22 before spray: about 91 °C<br>23 before spray: about 83 °C<br>23 after spray : about 66 °C<br>24 before spray: about 86 °C<br>24 after spray : about 81 °C | Water temperature of SFP<br>Unit 5 40.8°C (May 8 12:00)<br>Unit 6 29.0°C (May 8 12:00)                                   |
|  | Reactor pressure (May 8 11:00)<br>(A) 0.455MPaG, (B) 1.290MPaG*2   | Reactor pressure (May 8 11:00)<br>(A) -0.020MPaG*2, (B) -0.018MPaG*2  | Reactor pressure (May 8 11:00)<br>(A) -0.081MPaG*2, (B) -0.087MPaG*2                             |  |  |
|  | CV pressure (May 8 11:00) 0.120MPaabs  | CV pressure (May 8 11:00) 0.060MPaabs   | CV pressure (May 8 11:00) 0.1015MPaabs   |  |  |
|  | RPV temperature (May 8 11:00)<br>118.4°C*2 at feed water line nozzle   | RPV temperature (May 8 11:00)<br>115.4°C at feed water line nozzle  | RPV temperature (May 8 11:00)<br>206.2°C*2 at feed water line nozzle                             |  |  |
|  | Thermography (Apr. 26 07:30)<br>CV: 25°C, SFP: 23°C  | Thermography (Apr. 26 07:30)<br>Top of R/B: 24°C  | Thermography (Apr. 26 07:30)<br>CV: 26°C, SFP: 56°C  |  |  |

**(2) Fukushima Dai-ichi NPPs**

All units are cold shutdown (Unit-1, 2, 4 have been recovered from a event falling under Article 15\*)

**3. State of Emergency Declaration**

11th 19:03 State of nuclear emergency was declared (Fukushima Dai-ichi NPS)

12th 07:45 State of nuclear emergency was declared (Fukushima Dai-ichi NPS)

**4. Evacuation Order**

11th 21:23 PM direction: for the residents within 3km radius from Fukushima I to evacuate, within 10km radius from Fukushima I to stay in-house

12th 05:44 PM direction: for the residents within 10km radius from Fukushima I to evacuate

12th 17:39 PM direction: for the residents within 10km radius from Fukushima II to evacuate

12th 18:25 PM direction: for the residents within 20km radius from Fukushima I to evacuate

15th 11:06 PM direction: for the residents within 20-30km radius from Fukushima I to stay in-house

25th Governmental advise: for the residents within 20-30 km radius from Fukushima I to voluntarily evacuate

**Abbreviations:**

SFP: Spent Fuel Storage Pool

EDG: Emergency Diesel Generator

RPV: Reactor Pressure Vessel

R/B: Reactor Building

RHR: Residual Heat Removal system

CST: Condensate water Storage Tank

T/B: Turbine Building

\*1 Trend data of primary parameters are available at Japan Nuclear Technology Institute's Home Page;

"http://www.gengikyo.jp/english/shokai/special\_4.html".

\*2 Data trend is continuously monitored.

# Status of the Nuclear Power Plants after the Earthquake

The accident that brings environmental impact is going on at several units in Fukushima Daiichi nuclear power Station after the earthquake occurred on March 11th. Other nuclear power plants in Japan are in normal operation or safely shutdown.

