

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 18th (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 (most part*4)	Damaged (35%*1)	Damaged (30%*1)	No fuel rods	Not Damaged	Not Damaged
Reactor Pressure Vessel structural integrity	Damage and Leakage estimated	Unknown	Unknown	Not Damaged	Not Damaged	Not Damaged
Containment Vessel structural integrity	Damage and Leakage estimated	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 (in cold shutdown)
Building Integrity	Severely Damaged (Hydrogen Explosion)	Partly opened	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	Lower than the bottom of fuels	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 parameter 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 Radiation level: 396 μSv/h at the south side of the office building, 15 μSv/h at the West gate, as of 00:00, May 16th, 43 μSv/h at the Main gate, as of 11:30, May 12th. Some radioactive nuclides (I, Cs, Pu, Am Cm and Sr) has been detected in soil sampled at the Fukushima site. Radioactive materials continues to be detected in samples collected from underground water and sea water at or near the site. Environmental monitoring has been enhanced. 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 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. Radioactive iodine, exceeding the provisional legal limit for drinking water, was detected from tap water sampled in some prefectures. All the restrictions of intake of the water, which was once issued by the govrnment, have been lifted by May 10th. Radioactive cesium was detected in the sludge from a sewage treatment plants, one of which is 50 km far from the power station. Small amount of strontium was detected in some samples of soil and plants collected in the area 20-80 km away from the power station.</p>					
Evacuation	<p><1> Shall be evacuated for within 3km from NPS, Shall stay indoors for within 10km from NPS (issued at 21:23, Mar. 11th) <2> Shall be evacuated for within 10km from NPS (issued at 05:44, Mar. 12th) <3> Shall be evacuated for within 20km from NPS (issued at 18:25, Mar. 12th) <4> 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 <5>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. 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 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) 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 continues. Works inside the reactor bldg becomes available after radiation inside were forcibly decreased through air purification. 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. The damaged containment vessel of unit 2 is need to be repaired before the work to restore reactor cooling function. TEPCO developed the plan to cool the reactor through filling the containment vessel with water up to the top of fuel level. The operation of pumping more water into No1 reactor in line with this plan continues. TEPCO estimated that fuel pellets would have melted and fallen to the bottom of the reactor at Unit 1 in its tentative assessment released on May 15. TEPCO also predict that an event associated with large amount of radioactive material release will not happen, since reactor have been cooled by means of water injection.*4</p> <p>●Function of containing radioactive material It is presumed that radioactive material inside the reactor vessel may leaked outside. Nitrogen gas injection into the Unit 1 containment vessel to prevent hydrogen explosion started on April 6th and continues. Preparation work for covering the reactor building was started at Unit 1 (5/13). Operation for Installing the the cover over the building is scheduled to start in June.</p> <p>●Cooling the spent fuel pool (SFP) Injecting and/or spraying water to the SFP continues for the purpose of cooling and making up water evaporated. Corrosion inhibitor, Hydrazine (H2NNH2), has been injected into the SFP (5/9-). 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: TEPCO announced the plans to prevent radioactively contaminated water, dust and soil and radioactive material itself existing on site from spreading on Apr 17. Full operation of spraying synthetic resin to contain contaminated dust started on Apr. 26th and continues.</p> <p>●Worker's exposure dose: 30 workers has been exposed to radiation more than 100 mSv as of 5/11. *Emergency exposure dose limit has been set to 250mSv.</p>					

[Source]
Government Nuclear Emergency Response Headquarters:
News Release (-5/13 17:00), Press conference
NISA: News Release (-5/15 14:00), Press conference
TEPCO: Press Release (-5/16 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.
*4 TEPCO announced its tentative assessment on the status of the core of Unit 1 on May 15th.

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

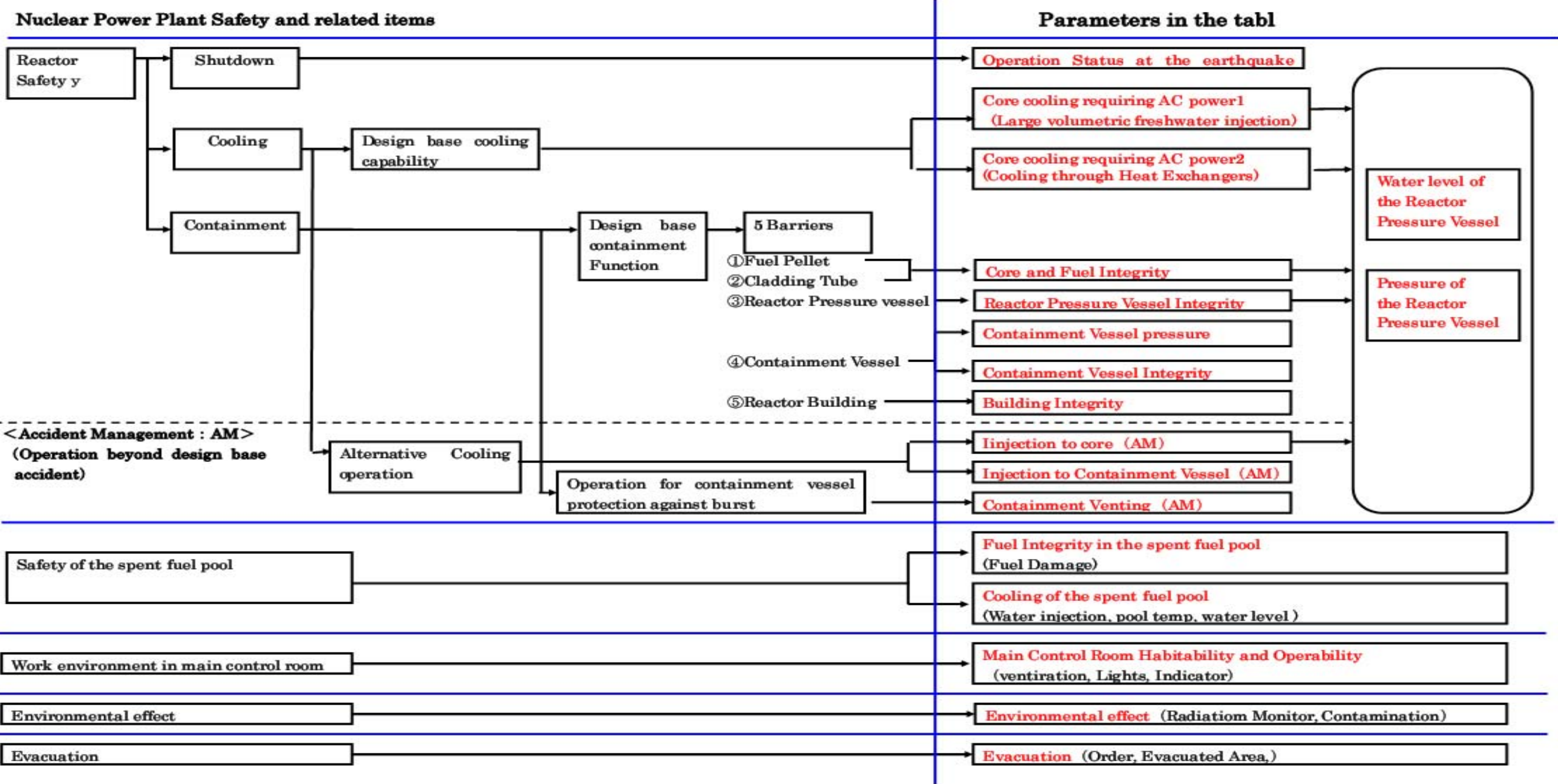
Power Station	Fukushima Dai-ni Nuclear Power Station			
Unit	1	2	3	4
Electric / Thermal Power output (MW)	1100 / 3293			
Type of Reactor	BWR-5	BWR-5	BWR-5	BWR-5
Operation Status at the earthquake occurred	In Service -> Automatic Shutdown			
Status	All the units are in cold shutdown.			
INES (estimated by NISA)	Level 3	Level 3	—	Level 3
Remarks	<p>Unit-1, 2, 3 & 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>1.6 μ Sv/h</u> at 09:00, <u>May 16th</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 14th

09:00-16:00 Operation of removing debris was conducted using remote-controlled heavy machinery.

10:30-15:00 Operation of spraying synthetic resin was conducted to prevent scatter of radioactive materials.

May 15th

05:20 A giant storage barge that will be used to hold radioactive water leaved the port of Yokohama for Fukushima.

13:28 Amount of water to be injected to the reactor was increased to 10 m³/h from 8 m³/h.

14:33 180kg of boric acid injection to No3 Reactor started.

May 16th

15:00 Water injection by temporally installed motor driven pump started.

2. Chronology of Nuclear Power Stations

(1) Fukushima Dai-ichi NPS

	Unit 1	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
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)
	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)
	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.
	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
	12th 20:20 Seawater injection to RPV	14th 22:50 Report IAW Article 15* (Abnormal rise of CV pressure)	14th 05:20 Start venting	Apr. 13 13:50 Installation of silt fences in front of the Unit 3 and 4 seawater screen completed
	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)	Apr. 1st 13:40 Start transferring pooled water in the Unit 6 radioactive waste process facility to the Unit 5 condenser.
	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	May 1 14:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank started.
	24th 11:30 lights in the main control room becomes available	15th 08:25 White smoke reeked	15th 10:22 Radiation dose 400mSv/h	May 2 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
	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	May 2 11:03 The Residual heat removal pump temporarily accumulated in Turbine bldg of unit-6 to the makeshift tank.
	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.	May 3 14:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank.
	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)	May 4 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank.
	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	May 5 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank.
	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.	May 10 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank.
	Apr. 3rd 12:18 Switch power supply for water injection pumps to the RPV from power supply vehicles to originally equipped power source	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	May 10 11:00 The operation of transferring water accumulated in reactor bldg of unit-6 to the waste processing facility conducted.
	Apr. 7th 01:31 Injection of Nitrogen gas started after opening all valves through the line.	Apr. 3rd 12:18 Switch power supply for water injection pumps to the RPV from power supply vehicles to originally equipped power source	Apr. 3rd 12:18 Switch power supply for water injection pumps to the RPV from power supply vehicles to originally equipped power source	May 11 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
	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	May 11 11:00 The operation of transferring water accumulated in reactor bldg of unit-6 to the waste processing facility conducted.
	Apr. 14 12:20 Installation of silt fences in front of the Unit 1 and 2 seawater screen and intake completed	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.	May 12 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
	Apr 17 16:00 Start investigation of the inside of R/B using a remote-controlled robot.	Apr. 13th 17:04 Transfer of highly radioactively contaminated wafer accumulated in the trench outside the turbine building to the condenser completed	May 8 12:10 Water injected the SFP by temporally installed motor driven pump conducted.	May 12 10:30 The operation of transferring water accumulated in reactor bldg of unit-6 to the waste processing facility conducted.
	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. 14 12:20 Installation of silt fences in front of the Unit 1 and 2 seawater screen and intake completed	May 9 12:14 Water injected the SFP by originally installed clean up system conducted.	May 13 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
	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 15 14:33 180kg of boric acid injection to No3 Reactor started.	May 13 11:00 Water accumulated in the room for high pressure injection system room discharged to other space.
	May 5 11:32-16:36 Ventilators to clean the highly radioactive air inside the reactor building were installed and started.	Apr 18 13:42 Start investigation of the inside of R/B using a remote-controlled robot.	May 16 15:00 Water injection by temporally installed motor driven pump started.	May 14 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
	May 11 08:58 N2 injection to the CV temporally stopped while the work for restoring one of external power sources being conducted. It resumed later.	Apr. 19 10:08 Start transferring highly radioactive water accumulated in the turbine building and the concrete tunnel to the waste processing facility		May 15 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
	May 12 05:00 Instrumental reading of the water gage of the reactor No1 went off the scale on the lower side after adjusting the gage.	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 facility		May 16 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
		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.		
		May 6 09:36 Water injected the SFP conducted		

		May 7 09:22 Operation of discharging water accumulated in the concrete tunnel outside turbine bldg to the waste processing facility temporarily stopped while piping work for feeding water into the reactor being conducted.			
		May 10 13:09 Water injected the SFP conducted			
		May 12 15:20 Operation of discharging water accumulated in the concrete tunnel outside turbine bldg to the waste processing facility temporarily restarted,			
		May 14 13:00 Water injection to the SFP was done			
Major Data *1	Reactor Water level (May 16 11:00) (A) (Lower beyond lower end of the gauge , (B) -1750mm Reactor pressure (May 16 11:00) (A) 0.485MPaG, (B) 1.350MPaG*2 CV pressure (May 16 05:00) 0.1174MPaabs RPV temperature (May 16 11:00) 95.6°C*2 at feed water line nozzle Thermography (Apr. 26 07:30) CV: 25°C, SFP: 23°C	Reactor Water level (May 16 05:00) (A) -1500mm, (B) -2100mm Reactor pressure (May 16 11:00) (A) -0.020MPaG*2, (B) -0.020MPaG*2 CV pressure (May 16 11:00) 0.055MPaabs RPV temperature (May 16 05:00) 113.4°C at feed water line nozzle Water temperature in SFP (May 16 11:00) 63.0°C Thermography (Apr. 26 07:30) Top of R/B: 24°C	Reactor Water level (May 16 11:00) (A) -2000mm, (B) -2300mm Reactor pressure (May 16 11:00) (A) -0.091MPaG*2, (B) -0.091MPaG*2 CV pressure (May 16 11:00) 0.1024MPaabs RPV temperature (May 16 11:00) 143.3°C*2 at feed water line nozzle Thermography (Apr. 26 07:30) CV: 26°C, SFP: 56°C	SFP water temperature measured with a concrete pump vehicle Apr. 12 : about 90 °C 22 before spray: about 91 °C 23 before spray: about 83 °C 23 after spray : about 66 °C 24 before spray: about 86 °C 24 after spray : about 81 °C	Water temperature of SFP Unit 5 43.3°C (May 16 12:00) Unit 6 30.5°C (May 16 12:00)

(2) Fukushima Dai-ri 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-ri 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.

