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 21:00 March 30 (Estimated by JAIF)

Power Station	Fukushima Dai-ichi Nuclear Power Station					
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	Damaged	Damaged	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 (in cold shutdown)
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	
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℃ on 24th	Unknown / Stable	Unknown	Safe	Safe	Safe
Containment Vessel Pressure	Decreased a little after increasing up to 0.4Mpa on 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)	(To be confirmed)	to be decided (Seawater)	(To be confirmed)	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	Possibly damaged	Not Damaged	Not Damaged
Cooling of the spent fuel pool	Water injection to be considered	Seawater Injection continue	Seawater spray continue and certain effect was confirmed	Seawater spray continue Hydrogen from the pool exploded	Pool cooling capability was recovered	Pool cooling capability was recovered
Main Control Room Habitability & Operability	Poor due to loss of AC power (Lighting working in the control room at Unit 1 and 2.)		Poor due to loss of AC power (Lighting working in the control room at Unit 3 and 4.)		Not damaged (estimate)	
Environmental effect	Radiation level: 1.05mSv/h at the south side of the office builiding, 163 μ Sv/h at the Main gate, 75 μ Sv/h at the West gate, as of 15:00, Mar. 30th Radioactive material was detected from milk and agricultural products from Fukushima and neighboring prefectures. The government issue order to limit shipment (Mar. 21st-) and intake (Mar. 23rd-) for some products from some areas. Radioactive iodine was detected from tap water sampled at some prefecture. Level of iodine in tap water temporally exceed the provisional legal limit for infant consumption. Radioactive Iodine, Cesium, Ruthenium, and Tellurium were detected from seawater sample collected in the sea surrounding the power station. Nuclear Safety Commission of Japan released prediction of radioactive material spread caused by the accident (Mar. 24th). This prediction was based on the calculation using computer code called SPEEDI (System for Prediction of Environmental Emergency Dose Information).==> http://www.nsc.go.jp/info/110323_top_siryo.pdf Radiation dose higher than 1000 mSv was measured at the surface of water accumulated in the tunnel for laying piping outside Unit 2 turbine building on Mar. 27th. Plutonium was detected from the soil of the Fukushima Dai-ichi NPS site on Mar. 28th. The concentration of plutonium measured is as little as in normal environment, almost the same as measured in Japan when the nuclear bomb tests were conducted in the atmosphere in the past, and not harmful to human body.					
Evacuation	20km from NPS(Mar. 12) ＊People who live between 20km to 30km from the Fukushima Dai-ichi NPS shall stay in the houses or buildings Mar. 15), should consider leaving Mar. 25).					
INES (estimated by NISA)	Level 5	Level 5	Level 5	Level 3	—	—
Remarks	●Progress of the work to recover injection function Water injection to the reactor pressure vessel by temporally pumps were switched from seawater to freshwater at Unit 1, 2 and 3, since adverse effect such as erosion is concerned on Mar. 26th. High radiation makes difficult the work to restore originally installed pumps for injection. Removing water with high concentration of radioactive nuclides in the basement of buildings of Unit 1through 3 was partly begun on 26th but is considered to take time to complete. (3 workers were sent to the hospital after heavily exposed on March 24 and discharged on March 28.) ●Function of containing radioactive material It is presumed that radioactive material inside the reactor vessel would have leaked outside the containment vessel at Unit 1, 2 and Unit 3, based on the investigation of the water sampled in the turbine building from Mar. 24th to 27th. On Mar. 30th, NISA said air may be leaking from the Reactor Pressure Vessel of Unit 2 and 3 because some of their data show the pressure in the vessels is low, but there is no indication of large cracks or holes in the vessels. ●Cooling the spent fuel pool Steam like substance rose intermittently from the reactor building at Unit 1, 2, 3 and 4 has been observed. Injecting and/or spraying water to the spent fuel pool has been conducted on and off since Mar. 17th.					

[Source]
Government Nuclear Emergency Response Headquarters: News Release (-3/30 19:00), Press conference
NISA: News Release (-3/30 15:30), Press conference
TEPCO: Press Release (-3/30 16:00), Press Conference

[Abbreviations]
INES: International Nuclear Event Scale NISA: Nuclear and Industrial Safety Agency TEPCO: Tokyo Electric Power Company, Inc.

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

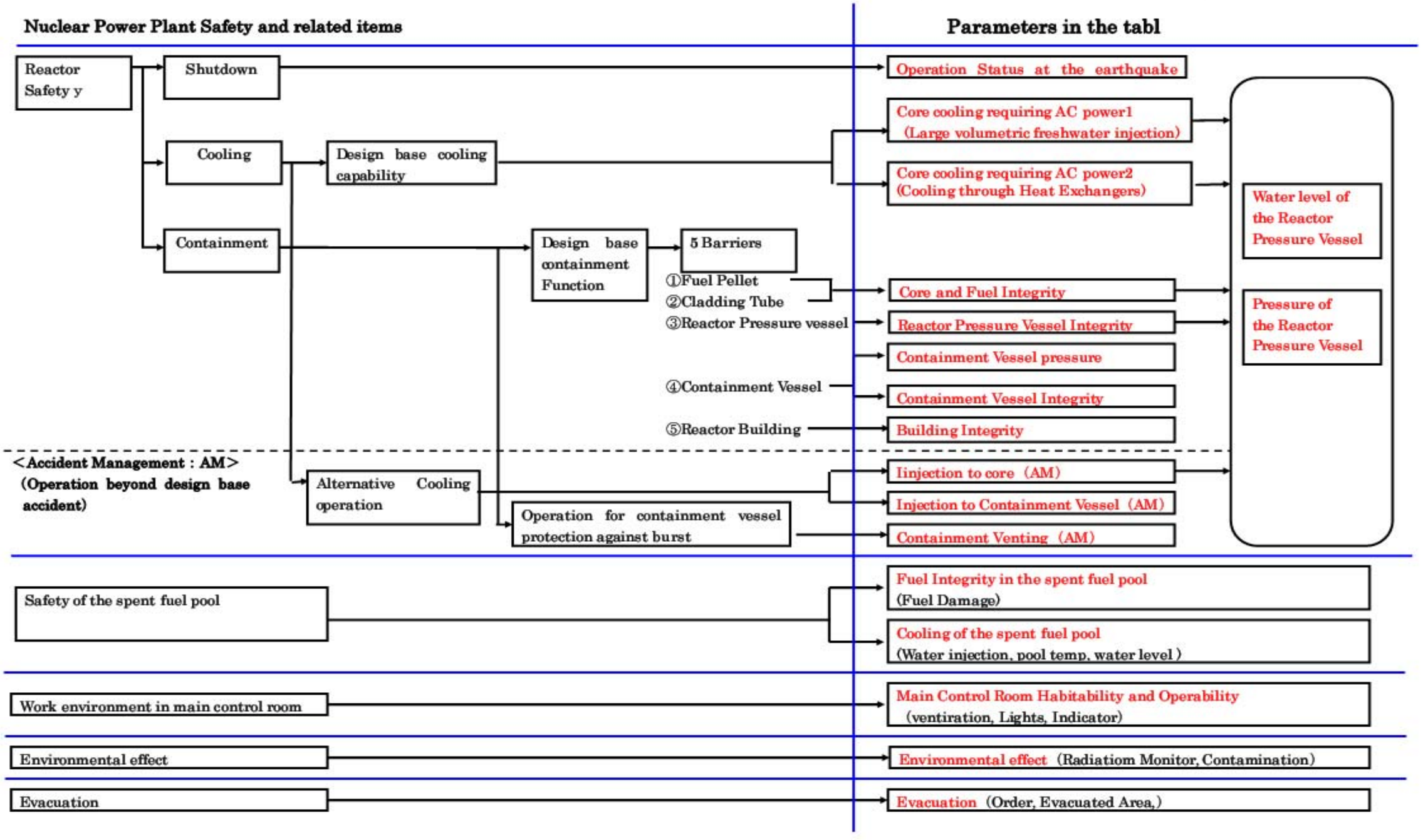
Power Station	Fukushima Dai-ni Nuclear Power Station			
Unit	1	2	3	4
Electric / Thermal Power output (MW)	1100 / 3293			
Type of Reactor	BWR-5	BWR-5	BWR-5	BWR-5
Operation Status at the earthquake occurred	In Service -> Automatic Shutdown			
Status	All the units are in cold shutdown.			
INES (estimated by NISA)	Level 3	Level 3	—	Level 3
Remarks	Unit-1, 2, 3 & 4, which were in full operation when the earthquake occurred, all shutdown automatically. 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. Latest Monitor Indication: 5.8 μ Sv/h at 15:00, Mar. 30 at NPS border Evacuation Area: 10km from NPS			

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	Safe		

Power Station	Tokai Dai-ni
Operation Status at the earthquake occurred	In Service -> Automatic Shutdown
Status	In cold shutdown.
Remarks	Safe

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.



Accidents of Fukushima Dai-ichi and Fukushima-Dai-ni Nuclear Power Stations

(March 30th, 2011 19:30)

1. Latest Major Incidents and Actions

30th High level of radioactive Iodine, I-131, which is 3,355 times higher than criterion, was detected in the seawater sampled in the vicinity of the south discharge outlet of Fukushima Dai-ichi NPS at 13:55, Mar. 29th.

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 **The Act on Special Measures Concerning Nuclear Emergency*	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℃	Water temperature in SF Storage Pool is increasing
	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)	13th 05:10 Event falling under Article 15* occurred (Loss of reactor cooling functions)	15th 09:38 Fire occurred on 3rd floor (extinguished spontaneously)	18th Vent hole was opened on the rooftop for avoiding hydrogen explosion
	12th 00:49 Event falling under Article 15* occurred (Abnormal rise of CV pressure)	14th 13:25 Event falling under Article 15* occurred (Loss of reactor cooling functions)	13th 08:41 Start venting	16th 05:45 Fire occurred (extinguished spontaneously)	19th 05:00 RHR-pump in the Unit-5 restarted. 19th 22:14 RHR-pump in the Unit-6 restarted.
	12th 14:30 Start venting	14th 16:34 Seawater injection to RPV	13th 13:12 Seawater injection to RPV	Since 20th, operation of spraying water to the spent fuel pool continues.	20th 14:30 Reactor is in cold shutdown mode at Unit-5. 20th 19:27 Reactor is in cold shutdown mode at Unit-6.
	12th 15:36 Hydrogen explosion	14th 22:50 Report IAW Article 15* (Abnormal rise of CV pressure)	14th 07:44 Event falling under Article 15* occurred (Abnormal rise of CV pressure)	21st 20:00 work to restore external AC power was interrupted after black smoke rising	22nd 19:41 switch to external AC power from emergency Diesel generator at unit-5 and 6.
	12th 20:20 Seawater injection to RPV	15th 00:00 Start venting	14th 11:01 Hydrogen explosion	22nd 10:35 external AC power becomes	23rd 17:24 RHR-pump stopped automatically at unit-5.
	22nd 11:20 RPV temperature increased	15th 06:10 Sound of explosion, Suppression Pool damage suspected	15th 10:22 Radiation dose 400mSv/h	29th 11:50 lights in the main control room becomes available	24th 16:14 RHR-pump of Unit 5, which had failed, was replaced and then restarted at unit-5.
	Since 23rd, the RPV temperature has been gradually declining. (157.5℃ as of 25th 06:00)	15th 08:25 White smoke reeked	16th 06:40, 08:47 Radiation Dose 400mSv/h near building		
	24th 10:50 White, steam-like smoke emerged	Since 20th, operation of spraying water to the spent fuel pool continues.	16th 08:34, 10:00 White smoke reeked		
	24th 11:30 lights in the main control room becomes available	21st 18:22 White, steam-like smoke erupted from the top of the rector building.	Since 17th, operation of spraying water to the spent fuel pool continues.		
	25th 15:37 Freshwater injection to the reactor started.	25th 09:00 There is a trace that indicates water had flown from R/B to general drain via carry-in entrance.	21st 15:55 Slightly gray smoke erupted (18:02 settled)		
		26th 10:10 Freshwater injection to the reactor started.	22nd 22:46 lights in the main control room becomes available		
		26th 16:46 lights in the main control room becomes available	23rd 16:20 Black smoke erupted from Unit 3 (It was confirmed that the smoke had settled around 23:30)		
			25th 18:02 Freshwater injection to the reactor started.		
Major Data	Reactor Water level (A) -1600mm (B) -1600mm (30th 13:00)	Reactor Water level -1500mm (30th 13:00)	Reactor Water level (A) -1850mm, (B) -2250mm (30th 13:00)	Water temperature of SFP (24th 11:00) (immeasurable)	Water temperature of SFP Unit 5 37.2℃ (30th 14:00) Unit 6 26.5℃ (30th 14:00)
	Reactor pressure (A) 0.340MPaG, (B) 0.491MPaG (30th 13:00)	Reactor pressure (A) -0.023MPaG, (B) -0.023MPaG (30th 13:00)	Reactor pressure (A) 0.018MPaG, (B) -0.095MPaG (30th 13:00)		
	CV pressure 0.230MPaabs (30th 13:00)	CV pressure 0.100MPaabs (30th 13:00)	CV pressure 0.1064MPaabs (30th 13:00)		
	RPV temperature (at feed water line nozzle) 270.1℃ (30th 13:00)	Water temperature of SFP 48℃ (30th 13:00)			

(2) Fukushima Dai-ni NPPs

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

*SFP: Spent Fuel Storage Pool
EDG: Emergency Diesel Generator
RPV: Reactor Pressure Vessel
R/B: Reactor Building
RHR-pump: Residual Heat Removal

3. State of Emergency Declaration

11th 19:03 State of nuclear emergency was declared (Fukushima Dai-ni 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

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 occured on March 11th. Other nuclear power plants in Japan are in normal operation or safely shutdown.