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 10:00 April 1 (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	
Reactor Pressure Vessel structural integrity	Unknown	Unknown	Unknown	Not Damaged	Not Damaged	
Containment Vessel structural integrity	Not Damaged (estimation)	Damage and Leakage Suspected	Not damaged (estimation)	Not Damaged	Not Damaged	
Core cooling requiring AC power 1 (Large volumetric freshwater injection)	Not Functional	Not Functional	Not Functional	Not necessary	Functional	
Core cooling requiring AC power 2 (Cooling through Heat Exchangers)	Not Functional	Not Functional	Not Functional	Not necessary	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	
Pressure / Temperature of the Reactor Pressure Vessel	Gradually increasing / Decreased a little after increasing over 400℃ on 24th	Unknown / Stable	Unknown	Safe	Safe	
Containment Vessel Pressure	Decreased a little after increasing up to 0.4Mpa on 24th	Stable	Stable	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	
Water injection to Containment Vessel (AM)	(To be confirmed)	to be decided (Seawater)	(To be confirmed)	Not necessary	Not necessary	
Containment Venting (AM)	Temporally stopped	Temporally stopped	Temporally stopped	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	
Cooling of the spent fuel pool	Water spray started (freshwater)	Continued water injection (Switch from seawater to freshwater)	Continued water spray and injection (Switch from seawater to freshwater)	Continued water spray and injection (Switch from seawater to freshwater) Hydrogen from the pool exploded on 15th	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	●Status in Fukushima Dai-ichi NPS site Radiation level: 0.94mSv/h at the south side of the office builiding, 148 μ Sv/h at the Main gate, 70 μ Sv/h at the West gate, as of 21:00, Mar. 31st Radiation dose higher than 1000 mSv was measured at the surface of water accumulated on the basement of Unit 2 turbine building and in the tunnel for laying piping outside the 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 nvironment, 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. Radioactive materials exceeding the regulatory limit have been detected from seawater sample collected in the sea surrounding the Fukushima Dai-ichi NPS since Mar. 21st. Radioactive Iodine, I-131, 4,385 times higher than regulatory limit was detected on Mar. 30th. Radioactive materials were detected from the subdrainage sampled near the turbine buildings at Fukushima Dai-ichi NPS on Mar. 30th . ●Influence to the people's life Radioactive material was detected from milk and agricultural products from Fukushima and neighboring prefectures. The government issue d order to limit shipment (21st-) and intake (23rd-) for some products. Radioactive iodine, exceeding the the provisional legal limit, was detected from tap water sampled in some prefectures from Mar. 21 to 27. It was advised not to drink the water in those regions. The advice was then lifted by Mar. 28th, except for four cities and villages in Fukushima prefecture. Nuclear Safety Commission of Japan released prediction of radioactive material spread caused by the accident (Mar. 23rd). 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					
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 installed pumps were switched from seawater to freshwater at Unit 1, 2 and 3. High radiation circumstance hampering the work to restore originally installed pumps for injection. Discharging radioactive water in the basement of the buildings of Unit 1through 3 continue to improve this situation. To find a place the water to go becomes a problem. ●Function of containing radioactive material It is presumed that radioactive material inside the reactor vessel may leaked outside at Unit 1, 2 and Unit 3, based on radioactive material found outside. NISA announced that the reactor pressure vessel of Unit 2 and 3 may lost airtightness because of low pressure inside the pressure vessel. NISA told that it is unlikely that these are cracks or holes in the reactor pressure vessels at the same occation. ●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 . ●Prevention of the proliferation of contaminated dust: there is a plan to spray syntetic resin to contain contaminated dust.					

[Source]
Government Nuclear Emergency Response Headquarters: News Release (-4/1 07:30), Press conference
NISA: News Release (-3/35 15:00), Press conference
TEPCO: Press Release (-3/31 21:00), 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)

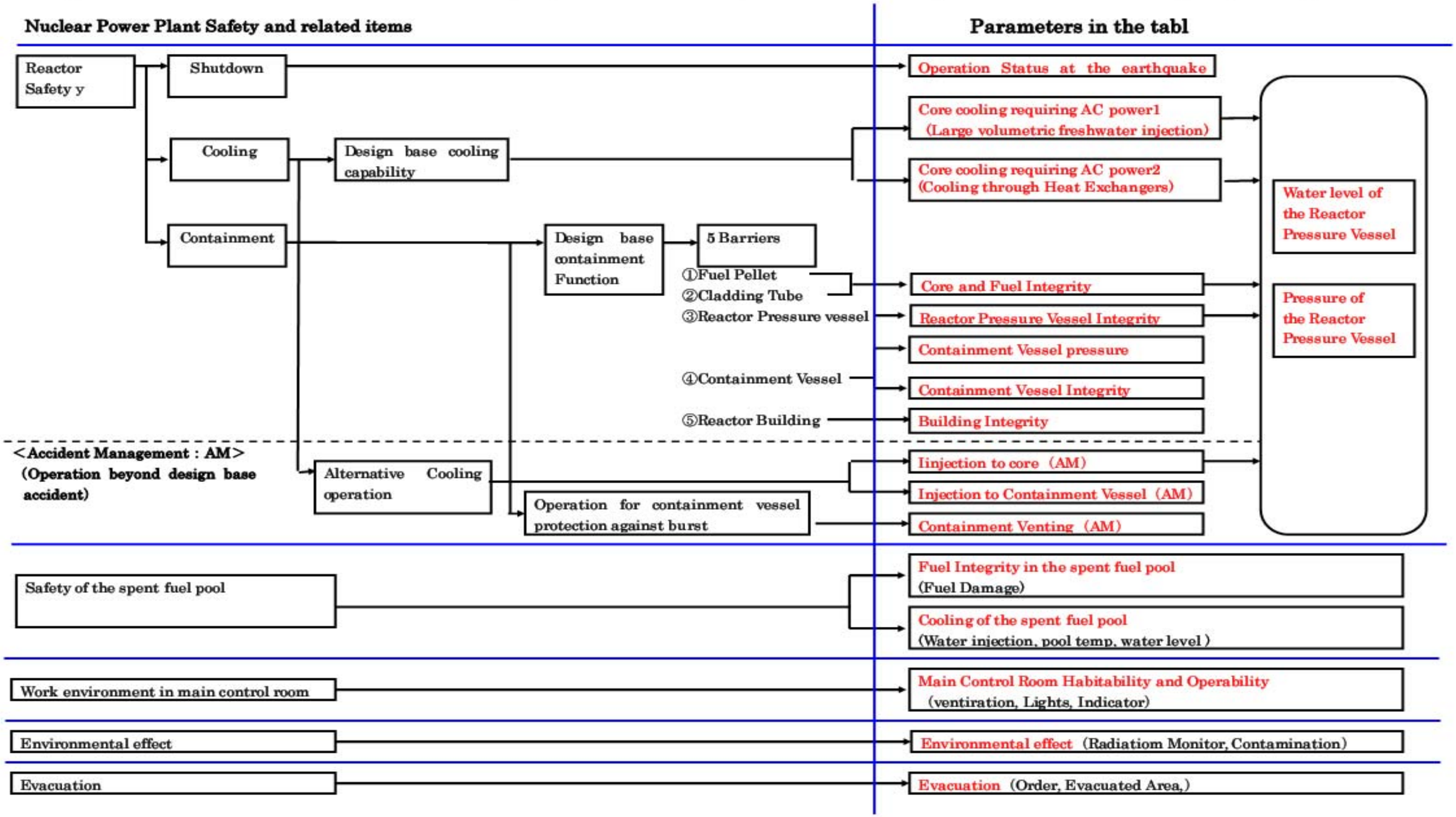
Power Station	Fukushima Dai-ni Nuclear Power Station			
Unit	1	2	3	4
Electric / Thermal Power output (MW)	1100 / 3293			
Type of Reactor	BWR-5	BWR-5	BWR-5	BWR-5
Operation Status at the earthquake occurred	In Service -> Automatic Shutdown			
Status	All the units are in cold shutdown.			
INES (estimated 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: 4.9 μ Sv/h at 21:00, Mar. 31 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

(April 01st, 2011 07:30)

1. Latest Major Incidents and Actions

Mar. 31st 08:51 High level of radioactive Iodine, I-131, which is 4,385 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. 30th.
Mar. 31st 09:20 Water level in the trench, tunnel for laying piping, decreased by one meter at Unit 1 after transferring the water using a temporary pump.

remove radioactive water pooled in the basement of the turbine buildings at the Fukushima Daiichi

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℃	19th 05:00 Cooling SFP with RHR-pump started at Unit 5 19th 22:14 Cooling SFP with RHR-pump started at Unit 6
	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)	20th 14:30 Cold shutdown achieved at Unit 5. 20th 19:27 Cold shutdown achieved 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)	22nd 19:41 All power source was switched to external AC power at Unit 5 and 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.	
	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	14th 05:20 Start venting		
	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	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.	Since 20th, operation of spraying water to the spent fuel pool continues.	16th 08:34, 10:00 White smoke reeked		
	27th 08:30 Continuing to transfer the water in the basement of the turbine building	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.		
	31st 09:20-11:25 Work to remove the water in the trench	26th 10:10 Freshwater injection to the reactor started.	21st 15:55 Slightly gray smoke erupted (18:02 settled)		
	31st 12:00 Start to transfer the water in the condensate storage tank to the surge tank	26th 16:46 lights in the main control room becomes available	22nd 22:46 lights in the main control room becomes available		
		31st 16:45 Start to transfer the water in the condensate storage tank to the surge tank	25th 18:02 Freshwater injection to the reactor started.		
			31st 16:45 Start to transfer the water in the condensate storage tank to the surge tank		
Major Data	Reactor Water level (Apr. 01st 00:00) (A) -1650mm (B) -1650mm	Reactor Water level (Apr. 01st 00:00) -1500mm	Reactor Water level (Apr. 01st 00:45) (A) -1900mm, (B) -2250mm	Water temperature of SFP (24th 11:00) (immeasurable)	Water temperature of SFP Unit 5 35.1℃ (Apr. 01st 02:00) Unit 6 24.0℃ (Apr. 01st 02:00)
	Reactor pressure (Apr. 01st 00:00) (A) 0.293MPaG, (B) 0.482MPaG	Reactor pressure (Apr. 01st 00:00) (A) -0.014MPaG, (B) -0.014MPaG	Reactor pressure (Apr. 01st 00:45) (A) 0.016MPaG, (B) -0.086MPaG		
	CV pressure (Apr. 01st 00:00) 0.175MPaabs	CV pressure (Apr. 01st 00:00) 0.110MPaabs	CV pressure (Apr. 01st 00:45) 0.1073MPaabs		
	RPV temperature (Apr. 01st 00:00) 256.2℃ at feed water line nozzle	Water temperature of SFP (Apr. 01st 00:00) 49.0℃	Water level in trench (29th 15:00) -155cm to floor level		
	Water level in trench (Mar. 31st 11:30) -114cm to floor level	Water level in trench (29th 15:00) -104cm to floor level			

(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: Residual Heat Removal system

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.