Information on Status of Nuclear Power Plants in Fukushima



Japan Atomic Industrial Forum, Inc.

Policy on information and compilation

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

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.

Status of nuclear power plants in Fukushima <u>as of 10:00, April 10th</u> (Estimated by JAIF)

			nima as of 10:00, April 10th	-	
Power Station		0	Fukushima Dai−ichi Nuclear Pov		<u> </u>
Unit Electric / Thermal Power output (MW)	460 / 1380	2 784 / 2381	3 784 / 2381	4 784 / 2381	<u> </u>
Type of Reactor	BWR-3	BWR-4	BWR-4	BWR-4	
Operation Status at the earthquake occurred	In Service -> Shutdown	In Service -> Shutdown	In Service -> Shutdown	Outage	
Fuel assemblies loaded in Core	400	548	548	No fuel rods	<u>—</u>
Core and Fuel Integrity (Loaded fuel assemblies)	Damaged (70%*)	Damaged (30%*)	Damaged (25%*)	No fuel rods	
Reactor Pressure Vessel structural integrity	Unknown	Unknown	Unknown	Not Damaged	
Containment Vessel structural integrity	Not Damaged (estimation)	Damage and Leakage Suspected	Not damaged (estimation)	Not Damaged	
Core cooling requiring AC power 1 (Large volumetric freshwater injection)	Not Functional	Not Functional	Not Functional	Not necessary	
Core cooling requiring AC power 2 (Cooling through Heat Exchangers)	Not Functional	Not Functional	Not Functional	Not necessary	
Building Integrity	Severely Damaged (Hydrogen Explosion)	Slightly Damaged	Severely Damaged (Hydrogen Explosion)	Severely Damaged (Hydrogen Explosion)	Оре
Water Level of the Rector Pressure Vessel	Fuel exposed partially or fully	Fuel exposed partially or fully	Fuel exposed partially or fully	Safe	
Pressure / Temperature of the Reactor Pressure Vessel	Gradually increasing / Decreased a little after increasing over 400°C on Mar. 24th	Unknown / Stable	Unknown	Safe	
Containment Vessel Pressure	Decreased a little after increasing up to 0.4Mpa on Mar. 24th	Stable	Stable	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	
Water injection to Containment Vessel (AM)	(To be confirmed)	to be decided (Seawater)	(To be confirmed)	Not necessary	
Containment Venting (AM)	Temporally stopped	Temporally stopped	Temporally stopped	Not necessary	
Fuel assemblies stored in Spent Fuel Pool	292	587	514	1331	[
Fuel Integrity in the spent fuel pool	Unknown	Unknown	Damage Suspected	Possibly damaged	
Cooling of the spent fuel pool	Water spray started (ffreshwater)	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 Mar. 15th	
Main Control Room Habitability & Operability	Poor due to loss o (Lighting working in the contro			o loss of AC power control room at Unit 3 and 4.)	
Environmental effect	Plutonium was detected from the soil sample Radioactive materials exceeding the regulato radioactive iodine, I–131, was detected from concrete pit housing electrical cables and thi drilled around the pit. Release of some 10,00 low level radioactive waste release, TEPCO et TEPCO and MEXT has expanded the monitor Radioactive materials were detected from un Influence to the people's life Radioactive material was detected from milk Radioactive iodine, exceeding the provisional Small fish caught in waters off the coast of II amount for vegetbles should be applied to fis	easured at the surface of water accum d at Fukushima Dai-ichi NPS site on l ry limit have been detected from seav the seawater, which had been sampled s water was leaking into the sea throu 00 tons of low level radioactive waster evaluated that eating fish and seaweed ing for the surrounding sea area since derground water sampled near the tur and agricultural products from Fukush legal limit, was detected from tap wat baraki on Apr. 4 have been found to co hery products for the time being.	nulated on the basement of Unit 2 turbine Mar. 21st, 22nd, 25th and 28th. The amo vater sample collected in the sea surroun d near the water intake of Unit 2 on Apr. ugh cracks on the concrete wall. It was of vater into the sea began on Apr. 4th, in o d caught near the plant every day for a ye e Apr. 4th. bine buildings on Mar. 30th. hima and neighboring prefectures. The gov er sampled in some prefectures from Mai ontain radioactive cesium above the legal	e building and in the tunnel for laying piping outsi unt is so small that the Pu is not harmful to hun ding the Fukushima Dai-ichi NPS since Mar. 21 2nd. It was found on Apr. 2nd that there was hi confirmed on Apr. 6th that the leakage of water s rder to make room for the highly radioactive wat ear would add some 25% of the dose that the get vernment issued order to limit shipment (21st-) r. 21st to 27th. I limit on Apr. 5th. It was decided on Apr. 5th th	nan st. ghly stop ter 1 nera and at a
Evacuation	<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 (<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 ※NSC is suggesting the government revise the currrent radioactive standards for evacuation, according to which evacuation is only considered when radiation levels reach 50 that evacuation advisory should be issued to prevent residents from exposed to a total of 20 mSv a year.				
INES (estimated by NISA)	Level 5	Level 5	Level 5	Level 3	
Remarks	transfer work is being made to secure a place Function of containing radioactive material It is presumed that radioactive material inside have lost air tightness because of low pressu TEPCO started to inject nitrogen gas into the Cooling the spent fuel pool	el by temporally installed pumps were ork to restore originally installed pump e the water to go. Lighting in the turb e the reactor vessel may leaked outsid ire inside the pressure vessel. NISA to e Unit 1 containment vessel to reduce n the reactor building at Unit 1, 2, 3 an	os for injection. Discharging radioactive w nine buildings became partly available at de at Unit 1, 2 and Unit 3, based on radio old that it is unlikely that these are crack the possibility of hydrogen explosion on a nd 4 has been observed. Injecting and/or	rater in the basement of the buildings of Unit 1th Unit 1through 4. active material found outside. NISA announced t s or holes in the reactor pressure vessels at the Apr. 6th. The same measure will be taken for Un spraying water to the spent fuel pool has been	that e sa nit 2
[Source] Government Nuclear Emergency Response Head NISA: News Release (-4/9 09:00), Press conferen TEPCO: Press Release (- <u>4/9 15:00</u>), Press Confe	quarters: News Release (<u>-4/8 19:00</u>), Press co nce	[Abbreviations] onference INES: International Nuclear NISA: Nuclear and Industr TEPCO: Tokyo Electric P NSC: Nuclear Safety Com	*TEPCO's r Event Scale ial Safety Agency ower Company, Inc.	estimation based on the radiation level in the C	V

5	6	
784 / 2381	1100 / 3293	
BWR-4	BWR-5	
Outage	Outage	
548	764	
Not Dai		
Not Dai Not Dai		
Funct	ional	
Functi (in cold sl		
Open a vent hole on the roc	oftop for avoiding hydrogen	
explo	sion	
Sat	fe	
Sat	fe	
Sat	fe	
Not nec	essary	
Not nec	-	
Not nec	essary	
946	876	
Not Da	maged	
Pool cooling capabi	lity was recovered	
Not damaged	l (estimate)	
le the building on Mar. 27th. an body. t. On Apr. 5th, 7.5 million times the legal limit of hly radioactive (more than 1000mSv/hr) water in the topped after injecting a hardening agent into holes er mentioned above. Regarding the influence of the eral pubic receive from the environment for a year. and intake (23rd-) for some products. t as a legal limit of radioactive iodine, the same 'S (issued at 05:44, Mar. 12th)		
Aar. 25th) for from 20km to 30km from NPS 50 mSv about one week after any accidents, such		
rough 3 continue to improve this situation. Water nat the reactor pressure vessel of Unit 2 and 3 may same occasion. it 2 and 3.		
onducted.		
/ [Significance jud ■ Low High ■ Severe (Need	ged by JAIF] d 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. No parameter has shown abnormality after the earthquake occurred off an shore of Miyagi prefecture at 23:32, Apr. 7th. Latest Monitor Indication: 3.0 μ Sv/h at 15:00, Apr. 8th 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	3 out of 4 external power lines in service wit off the shore of Miyagi prefecture at 23:32, / have shown no abnormality. SFP cooling sys	Apr. 7th. Now 2 external power lines a	re available. Monitoring posts' readings

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.

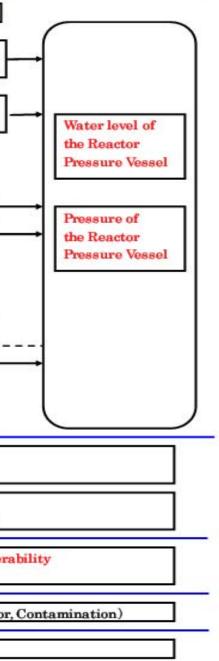
the core

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.

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Nuclear Power Plant Safety and related items	Parameters in the tabl
Reactor Shutdown Safety y	→ Operation Status at the earthquake
Cooling Design base cooling	Core cooling requiring AC power1 (Large volumetric freshwater injection)
capability	Core cooling requiring AC power2 (Cooling through Heat Exchangers)
Containment Design base 5 Barriers containment UFuel Pellet UFuel Pellet	
Cladding Tube	Core and Fuel Integrity
③Reactor Pressure vessel	Reactor Pressure Vessel Integrity
	Containment Vessel pressure
@Containment Vessel —	Containment Vessel Integrity
5 Reactor Building	Building Integrity
<accident :="" am="" management=""> (Operation beyond design base Alternative Cooling</accident>	Injection to core (AM)
(Operation beyond design base accident)	Injection to Containment Vessel (AM)
protection against burst	Containment Venting (AM)
Safety of the spent fuel pool	Fuel Integrity in the spent fuel pool (Fuel Damage)
	Cooling of the spent fuel pool (Water injection, pool temp, water level)
Work environment in main control room	 Main Control Room Habitability and Oper (ventiration, Lights, Indicator)
Environmental effect	Environmental effect (Radiatiom Monito
Evacuation	Evacuation (Order, Evacuated Area,)



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

1. Latest Major event and response

April 7th:

01:31 Injection of Nitrogen gas started after opening all valves through the line.

As of 23:52 At Fukushima Dai-ichi NPS, instruments readings of Units 1 through 6 and monitoring posts have shown no abnormality after an earthquake occurred off the shore of Miyagi prefecture at 23:32. April 8th:

As of 00:00 At Fukushima Dai-ichi NPS, instruments readings of Units 1 through 6 and monitoring posts have shown no abnormality after an earthquake occurred off the shore of Miyagi prefecture at 23:32. 17:08 Operation of spraying water into the spent fuel pool of unit-3 started **2. Chronology of Nuclear Power Stations**

(1) Fukushima Dai-ichi NPS

(1) Fukushima Dai-ichi NFS				
	Unit 1	Unit 2	Unit 3	Unit 4
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
Measures Concerning	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)
Nuclear Emergency Preparedness	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	
	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	
		Since 20th, operation of spraying water to the spent fuel pool continues.	16th 08:34, 10:00 White smoke reeked	
		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)	
		26th 16:46 lights in the main control room becomes available	22nd 22:46 lights in the main control room becomes available	
	31st 13:03 Start water injection to SEP	29th 16:45 Start to transfer the water in the CST to the surge tank	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.	Apr. 2nd 16:25 Start injecting concrete to stop water leakage from the pit near the intake	28th 17:40 Start to transfer the water in the CST to the surge tank	
		2nd 17:10 Start transferring water in the condenser to the CST		
		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 the highly radioactive water flow mentioned above stopped.)		
		ction pumps to the RPV from power supply vehicles to or	iginally equipped power source	
Major Data	(A) -1650mm (B) -1650mm	Reactor Water level (<u>Apr. 09 12:00</u>) -1500mm	Reactor Water level (<u>Apr. 09 12:25</u>) (A) <u>-1700mm</u> , (B) -2250mm	Thermography (Apr. 08 07:30) SFP: 46°C
	(A) <u>0.410MPaG</u> , (B) <u>0.825MPaG</u>	Reactor pressure (<u>Apr. 09 12:00</u>) (A) -0.020MPaG, (B) <u>-0.025MPaG</u>	Reactor pressure (<u>Apr. 09 12:25</u>) (A <u>) -0.004MPaG</u> , (B) <u>-0.081MPaG</u>	
	0.190MPaabs	CV pressure (<u>Apr. 09 12:00</u>) <u>0.095MPaabs</u>	CV pressure (<u>Apr. 09 12:25</u>) <u>0.1055MPaabs</u>	
	<u>235.2°C</u> at feed water line nozzle	RPV temperature (<u>Apr. 09 12:00</u>) <u>144.5°C</u> at feed water line nozzle Water temperature in SFP (<u>Apr. 09 12:00</u>)	RPV temperature (<u>Apr. 09 12:25</u>) <u>96.6°C</u> at feed water line nozzle	
	(to be confirmed) Thermography (Apr. 08 07:30)	<u>48.0°C</u> Thermography (Apr. 08 07:30)	(to be confirmed) Thermography (Apr. 08 07:30)	
(2) Fukushima Dai-ni NPPs	CV: 33°C, SFP: 23°C	Top of R/B: 30°C	CV: 35°C, SFP: 56°C	*SFP: Spent Fuel Storage Pool

(2) Fukushima Dai-ni 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-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

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

(as of 10:00, April 10th)

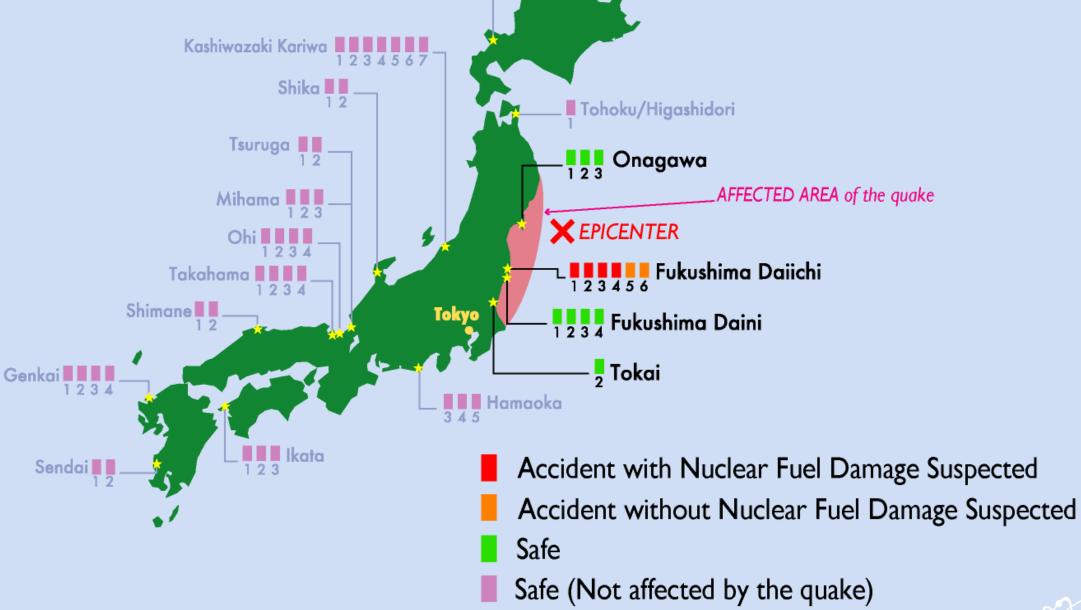
CST: Condensate water Storage Tank



	Unit-5 and 6
	19th 05:00 Cooling SFP with RHR-pump started at Unit 5 19th 22:14 Cooling SFP with RHR-pump started at Unit 6
	20th 14:30 Cold shutdown achieved at Unit 5. 20th 19:27 Cold shutdown achieved at Unit 6.
	22nd 19:41 All power source was switched to external AC power at Unit 5 and 6.
e	Apr. 1st 13:40 Start transferring pooled water in the Unit 6 radioactive waste process facility to the Unit 5 condenser.
	Water temperature of SFP
	Unit 5 34.7° C (Apr. 08 14:00) Unit 6 30.5° C (Apr. 08 08:00)

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.



Tomari **1** 2 3

