# 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 16th (Estimated by JAIF)

Power Station		portor plante in i dica	Fukushima Dai-ichi Nuclear Power Stati	-				
Unit	1	2	3	4	5	6		
Electric / Thermal Power output (MW)	460 / 1380	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 (35%*1)	Damaged (30%*1)	No fuel rods		amaged		
Reactor Pressure Vessel structural integrity	Damage and Leakage Suspected	Unknown	Unknown	Not Damaged		amaged		
Containment Vessel structural integrity	Damage and Leakage Suspected	Damage and Leakage Suspected	Not damaged (estimation)	Not Damaged	Not Da	amaged		
Core cooling requiring AC power 1 (Large volumetric freshwater injection)	Not Functional Not Functional Not Functional Not Functional Functional							
Core cooling requiring AC power 2 (Cooling through Heat Exchangers)	Not Functional	Not Functional Not Functional Not Functional Not Functional Not necessary Functioning (in cold shutdown)						
Building Integrity	Severely Damaged (Hydrogen Explosion)	Partly opened	Severely Damaged (Hydrogen Explosion)	Severely Damaged (Hydrogen Explosion)	Open a vent hole	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		afe		
Pressure / Temperature of the Reactor Pressure	Gradually increasing / Decreased a little							
Vessel	after increasing over 400°C on Mar. 24th	Unknown / Stable	Unknown / Gradually increasing	Safe	Sa	afe		
Containment Vessel Pressure	Decreased a little after increasing up to 0.4Mpa on Mar. 24th	Stable	Stable	Safe	Sa	afe		
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 ne	cessary		
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		cessary		
Containment Venting (AM)	Temporally stopped	Temporally stopped	Temporally stopped	Not necessary	Not ne	cessary		
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 water spray and injection continues (Switch from	Not Da	amaged		
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)  Water spray and injection continues (Switch from seawater to freshwater)  Pool cooling capab				ility was recovered			
Main Control Room Habitability & Operability	Poor due to loss of AC power(	Lighting and parmaeter monitoring restore	d in the control room at Unit 1 and 3 on Mar. 24th, a	t Unit 2 on Mar. 26th, at Unit 4 on Mar. 29th)	Not damage	ed (estimate)		
Environmental effect	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 govedrment, 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.							
Evacuation	Small amount of strontium was detected in sor <1> Shall be evacuated for within 3km from NF <3> Shall be evacuated for within 20km from NF around the Fukushima Daiichi NPS is to be exp 30km and other than the expanded evacuation	me samples of soil and plants collected in the PS, Shall stay indoors for within 10km from NIPS (issued at 18:25, Mar. 12th) <4> Shall spanded so as to include the area, where annuarea mentioned above, are asked to get pre	te area 20–80 km away from the power station.  NPS (issued at 21:23, Mar. 11th) <2> Shall be evacuated that is the control of	ted for within 10km from NPS (issued at 05:44, Mar. 12th) er leaving (issued at 11:30, Mar. 25th) for from 20km to 30km People in the expanded zone are ordered to evacuate with cy (announced on Apr. 11th and issued on Apr. 22nd).				
INES (estimated by NISA)	Level 7*2 **Cumulative amount of radioact			Level 3 *2	_	_		
Remarks	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 counties.  Works inside the reactor blig becomes available after radiation inside were forcibly decreased through air purification.  Instrumental reading of the water gage of the reactor No1 went off the scale on the lower side after adjusting the gage.  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 har for Unit 1/2, for Unit 1/							
1	Full operation of spraying synthetic resin to co  Worker's exposure dose: 30 workers has been		th and continues. as of 5/11. *Emergency exposure dose limit has been	set to 250mSv				
[Source]	[Abbreviations]				[Significance judge			

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

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 1on May 15th.

Low

Severe (Need immediate action)

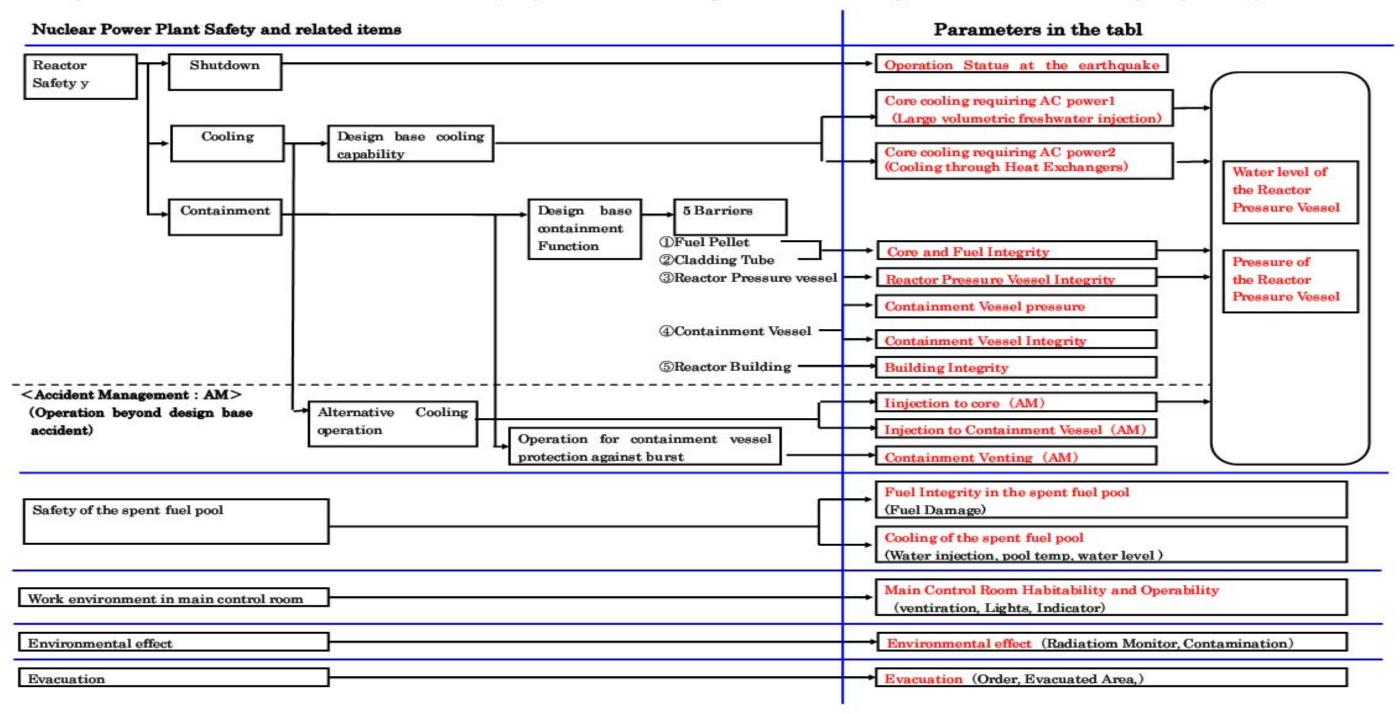
Power Station	Fukushima Dai-ni Nuclear Power Station				
Unit	1	2	3	4	
Electric / Thermal Power output (MW)	1100 / 3293				
Type of Reactor	BWR-5	BWR-5	BWR-5	BWR-5	
Operation Status at the earthquake occurred	In Service → Automatic Shutdown				
Status	All the units are in cold shutdown.				
INES (estimated 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.  No parameter has shown abnormality after the earthquake occurred off an shore of Miyagi prefecture at 23:32, Apr. 7th.  Latest Monitor Indication: 1.6 µ Sv/h at 09:00, May 16th at NPS border  Evacuation Area: 3km from NPS(3/12 7:45), 10km from NPS(3/12 17:39), 8km from NPS(4/21)				

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 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.			

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.



# **Accidents of Fukushima Daiichi Nuclear Power Stations**

# as of 14:00, May 15rd

# May 13th

16:01-17:39 Work place invironment was surveyed in the Unit 1 R/B using a remot-controlled robot.

13:00-14:37 Freshwater with corrosion inhibitor, Hydrazine (H2NNH2), was injected to the Unit 2 SFP via the SFP cooling and cleaning system.

16:04-19:04 Freshwater with Hydrazine was sprayed to the Unit 4 SFP using concrete pump vehicle

10:00-15:00 Water accumulated in the basement of Unit 6 T/B was transferred to a makeshift tank.

11:30-12:15 Water accumulated in the basement of Unit 6 was transferred to the unit waste process facility.

11:00-15:00 Operation of spraying synthetic resin was conducted to prevent scatter of radioactive materials.

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

# May 14th

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

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

10:00- Water accumulated in the basement of Unit 6 T/B was transferred to a makeshift tank.

05:20 A massive hollow floating platform left Yokohama Bay for Fukushima

# 2. Chronology of Nuclear Power Stations

1. Latest Major event and response

# (1) Fukushima Dai-ichi NPS

(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	19th 05:00 Cooling SFP with RHR-pump started at Unit 5
L+	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
Measures Concerning	12th 00:49 Event falling under Article 15* occurred (Abnormal	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. 20th 19:27 Cold shutdown achieved at Unit 6.
Preparedness	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
	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	power at Unit 5 and 6.
	12th 20:20 Seawater injection to RPV	14th 22:50 Report IAW Article 15* (Abnormal rise of CV pressure)	14th 05:20 Start venting	becomes available	Apr. 1st 13:40 Start transferring pooled water in the Unit 6
	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. 13 13:50 Installation of silt fences in front of the Unit 3 and 4 seawater screen completed	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 5 12:19 Operation of spraying water to the spent fuel pool with concrete pump truck	inay1 14:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift
	24th 11:30 lights in the main control room becomes available	15th 08:25 White smoke reeked	15th 10:22 Radiation dose 400mSv/h	conducted.	May2 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift
	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	M 040000 ii 6 ii 6 ii 6 ii 6 ii 6 ii 6 ii	tank conducted.  May 2 11:03 The Residual heat removal numb temporally
	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.	spent ruer poor with concrete pump truck	accumulated in Turbine bldg of unit-6 to the makeshift
	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)	oorlaadiod.	fdal/ / ገርያህር fride operation or transferring water accumulated in Turbine bldg of unit-6 to the makeshift fdal/ ያገዋታህር fride operation or transferring water
	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 7 14:05 Operation of spraying water to the spent fuel pool with concrete pump truck	accumulated in Turbine bldg of unit-6 to the makeshift
	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.	conducted.	May10 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift
	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 condencer to the CST	28th 17:40 Start to transfer the water in the CST to the surge tank	May 9 16:05 Operation of spraying water to the spent fuel pool with concrete pump truck conducted.	May10 11:00 The operation of transferring water accumulated in reactor bldg of unit-6 to the waste processing facility conducted.
		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 16:07 Operation of spraying water to the spent fuel pool with concrete pump truck conducted.	May11 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
		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		May11 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 1and 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.		May12 10:00 The operation of transferring water accumulated in Turbine bldg of unit-6 to the makeshift tank conducted.
	IANT 17 16:00 Start investigation of the inside of R/B lising a	Apr. 13th 17:04 Transfer of highly radioactively contaminated wafter 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.		May12 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 1and 2 seawater screen and intake completed	May 9 12:14 Water injected the SFP by originally installed clean up system conducted.		May13 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 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.			
	·	Apr. 19 10:08 Start transferring highly radioactive water accumulated in the turbine building and the concrete tunnel to the waste processing facility			
	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 1 13:35 The work to block the vertical concrete tunnel outside the turbine bldg started.			
		injection pump to the fire pump to install alarm device to the reactor			
		May 6 09:36 Water injected the SFP conducted			



		tunnel outside turbine bldgtto he waste processing facility temporally stopped while piping work for feeding water into the reactor being	<del>e</del>		
		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			
Major Data *1	Reactor Water level (May 15 11:00)  (A) (lower than the scale), (B) -1700mm  Reactor pressure (May 15 11:00)  (A) 0.485MPaG, (B) 1.335MPaG*2  CV pressure (May 15 11:00) 0.1221MPaabs  RPV temperature (May 15 11:00)  110.4°C*2 at feed water line nozzle	Reactor Water level (May 15 11:00) (A) -1500mm, (B) -2100mm  Reactor pressure (May 15 11:00) (A) -0.023MPaG*2, (B) -0.020MPaG*2  CV pressure (May 15 11:00) 0.055MPaabs  RPV temperature (May 15 11:00) 113.7°C at feed water line nozzle  Water temperature in SFP (May 15 11:00) 70.0°C	Reactor Water level (May 15 11:00) (A) -1950mm, (B) -2300mm  Reactor pressure (May 15 11:00) (A) -0.089MPaG*2, (B) -0.087MPaG*2  CV pressure (May 15 11:00) 0.1022MPaabs  RPV temperature (May 15 11:00)  141.1°C*2 at feed water line nozzle	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	Water temperature of SFP Unit 5
	Thermography (Apr. 26 07:30) CV: 25°C, SFP: 23°C	Thermography (Apr. 26 07:30)  Top of R/B: 24°C	Thermography (Apr. 26 07:30) CV: 26°C, SFP: 56°C	24 after spray : about 81°C	

## (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

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.

