Information on Status of Nuclear Power Plants in Fukushima

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 16:00, April 6th (Estimated by JAIF)

<table>
<thead>
<tr>
<th>Power Station</th>
<th>Unit 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric / Thermal Power output (MW)</td>
<td>460 / 1380</td>
<td>784 / 2381</td>
<td>784 / 2381</td>
<td>784 / 2381</td>
<td>784 / 2381</td>
<td>1100 / 3293</td>
</tr>
<tr>
<td>Type of Reactor</td>
<td>BWR-3</td>
<td>BWR-4</td>
<td>BWR-4</td>
<td>BWR-4</td>
<td>BWR-5</td>
<td></td>
</tr>
<tr>
<td>Operation Status at the earthquake occurred</td>
<td>In Service → Shutdown</td>
<td>In Service → Shutdown</td>
<td>In Service → Shutdown</td>
<td>Outage</td>
<td>Outage</td>
<td>Outage</td>
</tr>
<tr>
<td>Fuel assemblies loaded in Core</td>
<td>400</td>
<td>548</td>
<td>548</td>
<td>No fuel rods</td>
<td>548</td>
<td>764</td>
</tr>
<tr>
<td>Core and Fuel Integrity (Loaded fuel assemblies)</td>
<td>Damaged</td>
<td>Damaged</td>
<td>Damaged</td>
<td>No fuel rods</td>
<td>Damaged</td>
<td></td>
</tr>
<tr>
<td>Reactor Pressure Vessel structural integrity</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Damaged</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Containment Vessel structural integrity</td>
<td>Not Damaged</td>
<td>Damaged and Leakage Suspected</td>
<td>Damaged and Leakage Suspected</td>
<td>Not damaged</td>
<td>Not damaged</td>
<td></td>
</tr>
<tr>
<td>Core cooling requiring AC power 1</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Not necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core cooling requiring AC power 2</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Not necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Integrity</td>
<td>Severely Damaged (Hydrogen Explosion)</td>
<td>Slightly Damaged (Hydrogen Explosion)</td>
<td>Severely Damaged (Hydrogen Explosion)</td>
<td>Open a vent hole on the rooftop for avoiding hydrogen explosion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Level of the Reactor Pressure Vessel</td>
<td>Fuel exposed partially or fully</td>
<td>Fuel exposed partially or fully</td>
<td>Fuel exposed partially or fully</td>
<td>Safe</td>
<td>Safe</td>
<td></td>
</tr>
<tr>
<td>Pressure / Temperature of the Reactor Pressure Vessel</td>
<td>Gradually increasing / Decreased a little after increasing over 400°C on Mar. 24th</td>
<td>Unknown / Stable</td>
<td>Unknown</td>
<td>Stable</td>
<td>Stable</td>
<td>Safe</td>
</tr>
<tr>
<td>Containment Vessel Pressure</td>
<td>Decreased a little after increasing up to 0.4Mpa on Mar. 24th</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Safe</td>
</tr>
<tr>
<td>Water injection to core (Accident Management)</td>
<td>Continuing (Switch from seawater to freshwater)</td>
<td>Continuing (Switch from seawater to freshwater)</td>
<td>Continuing (Switch from seawater to freshwater)</td>
<td>Not necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water injection to Containment Vessel (AM)</td>
<td>(To be confirmed)</td>
<td>(To be confirmed)</td>
<td>(To be confirmed)</td>
<td>Not necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Containment Venting (AM)</td>
<td>Temporarily stopped</td>
<td>Temporarily stopped</td>
<td>Temporarily stopped</td>
<td>Not necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel assemblies stored in Spent Fuel Pool</td>
<td>292</td>
<td>587</td>
<td>514</td>
<td>1331</td>
<td>946</td>
<td>876</td>
</tr>
<tr>
<td>Fuel Integrity in the spent fuel pool</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Damaged</td>
<td>Not Damaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling of the spent fuel pool</td>
<td>Water spray started (Freshwater)</td>
<td>Continued water injection (Switch from seawater to freshwater)</td>
<td>Continued water spray and injection (Switch from seawater to freshwater)</td>
<td>Continued water spray and injection (Switch from seawater to freshwater)</td>
<td>Pool cooling capability was recovered</td>
<td></td>
</tr>
<tr>
<td>Main Control Room Habitability &amp; Operability</td>
<td>Prior due to loss of AC power (Lighting working in the control room at Unit 1 and 2)</td>
<td>Prior due to loss of AC power (Lighting working in the control room at Unit 3 and 4)</td>
<td>Not damaged (estimate)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Environmental effect

- **Status in Fukushima Dai-ichi NPS site**
  - Radiation level: 0.71mSv/h at the south side of the office building, 110 µSv/h at the Main gate, 52 µSv/h at the West gate, as of 09:00, Apr. 6th.
  - 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 amount is so small that the Pu is 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. On Apr. 5th, 7.5 million times the legal limit of radioactive iodine, 1.131, was detected from the seawater, which had been sampled near the water intake of Unit 2 on Apr. 2nd. It was found on Apr. 2nd that there was highly radioactive (more than 1000mSv/m³) water in the concrete pit housing electrical cables and this water was leaking into the sea through cracks on the concrete wall. It was confirmed on Apr. 6th that the leakage of water stopped after injecting a hardening agent into holes drilled in the concrete pit. The leakage of water into the sea began on Apr. 4th, in order to make room for the highly radioactive water mentioned above. TEPCO evaluated that eating fish and seaweed caught near the plant every day for a year at 20 µSv would be safe.

### Remarks

- **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: Testing the spraying synthetic resin to contain contaminated dust began on Apr. 1st.**
### Power Station

<table>
<thead>
<tr>
<th>Power Station</th>
<th>Unit</th>
<th>Electric / Thermal Power output (MW)</th>
<th>Type of Reactor</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1100 / 3293</td>
<td>BWR-5</td>
<td>Level 3</td>
<td>All the units are in cold shutdown.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>BWR-5</td>
<td>Level 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td>BWR-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>BWR-5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Tokai Dai-ii

- **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: 3.3 μSv/h at 09:00, Apr. 6th at NPS border**
- **Evacuation Area: 10km from NPS**

### Onagawa Nuclear Power Station

<table>
<thead>
<tr>
<th>Power Station</th>
<th>Unit</th>
<th>Operation Status at the earthquake occurred</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>In Service → Automatic Shutdown</td>
<td>Safe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Tokai Dai-ii

- **In Service → Automatic Shutdown**
- **In cold shutdown.**
- **Safe**
JAIP picks up those parameters to evaluate safety condition of the nuclear plant during this accident from the viewpoint 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.

### Nuclear Power Plant Safety and related items

- **Shutdown**
- **Cooling**
  - Design base cooling capability
- **Containment**
  - Design base containment function
  - **6 Barriers**
    - Fuel Poilot
    - Cladding Tube
    - Reactor Pressure vessel
    - Containment Vessel
    - Reactor Building

### Parameters in the Table

- **Operation Status at the earthquake**
  - Core cooling requiring AC power1 (Large volumetric freshwater injection)
  - Core cooling requiring AC power2 (Cooling through Heat Exchanger)

- **Water level of the Reactor Pressure Vessel**
- **Core and Fuel Integrity**
- **Reactor Pressure Vessel Integrity**
- **Containment Vessel pressure**
- **Containment Vessel Integrity**
- **Building Integrity**
- **Injection to core (AM)**
- **Injection to Containment Vessel (AM)**
- **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 Operability (ventilation, lights, indicator)

- **Environmental effect**
  - Environmental effect (Radiation Monitor, Contamination)

- **Evacuation**
  - Evacuation (Order, Evacuated Area)
1. Latest Major event and response

April 5th:
About 7.5 million times the legal limit of radioactive iodine, I-131, was detected from samples of seawater, which had been collected at 11:50 on Apr. 2nd, near the water intake of Unit 2.
13th 05:20 Start venting at feed water line nozzle
13th 11:00 Start venting
13th 05:10 Event falling under Article 15*

April 6th:
3:38 It was confirmed that the highly radioactive water flow mentioned above stopped.

2. Chronology of Nuclear Power Stations

(1) Fukushima Dai-ichi NPS

11th 15:42 Report IAW Article 10* (Loss of power)
11th 15:42 Report IAW Article 10* (Loss of water)
11th 16:36 Event falling under Article 15* occurred (Incappability of water injection by core cooling function)
12th 00:49 Event falling under Article 15* occurred (Abnormal rise of CV pressure)
12th 14:30 Start venting
12th 15:36 Hydrogen explosion
12th 20:20 Seawater injection to RPV
22nd 19:41 All power source was switched to external power sources
22nd 11:20 RPV temperature increased
23rd 22:50 Report IAW Article 15* (Abnormal rise of CV pressure)
25th 15:37 Freshwater injection to the reactor started
26th 02:33 Seawater injection through feed water line started in addition to fire extinguishing
24th 11:30 lights in the main control room becomes available
25th 15:37 Freshwater injection to the reactor started
27th 23:30 Continuing to transfer the water in the basement of the turbine building
31st 09:20-11:25 Work to remove the water in the trench
31st 12:00 Start to transfer the water in the CST to the surge tank (-15:27, Apr. 2)
31st 13:03 Start water injection to SFP
21st 19:22 White, steam-like smoke erupted from the top of the ractor building.
31st 15:55 Slightly gray smoke erupted (18:02 settled)
3rd 12:47 Poured a polymer absorbent as a measure for stopping the water leakage from the (not effect)
4th 11:05 Start water injection to SFP using temporary motor driven pump

(2) Fukushima Dai-ni NPS

All units are cold shutdown (Unit-1, 2, 4 have been recovered from a event falling under Article 15*)
18th 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.

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-i-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 16:25 PM direction: for the residents within 20km radius from Fukushima I to evacuate
15th 11:08 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

5. Major Data

Reactor Water level (Apr. 06 00:00) 1650mm (B) -1650mm
Reactor pressure (Apr. 06 00:00) 0.304MpaG (A) 0.632MpaG
CV pressure (Apr. 06 00:00) 0.100Mpa

6. 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
CST: Condensate water Storage Tank

(3) Measures Concerning Nuclear Emergency Preparedness

11th 19:03 Report IAW Article 10* (Loss of power)
11th 15:42 Report IAW Article 10* (Loss of water)
11th 16:36 Event falling under Article 15* occurred (Incappability of water injection by core cooling function)
12th 00:49 Event falling under Article 15* occurred (Abnormal rise of CV pressure)
12th 14:30 Start venting
12th 15:36 Hydrogen explosion
12th 20:20 Seawater injection to RPV
22nd 19:41 All power source was switched to external AC power at Unit 5 and 6.

7. Records for the Accident

Reactor Water level (Apr. 06 00:00)  -1650mm
Water temperature of SFP. (Apr. 06 00:00) 18℃, (SFP Temp.) 26℃

8. References

For more information, refer to the official reports and press releases from the relevant authorities and organizations.
The accident that brings environmental impact is going on at several units in Fukushima Daiichi nuclear power station after the earthquake occurred on March 11th. Other nuclear power plants in Japan are in normal operation or safely shutdown.