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 21:00 March 30 (Estimated by JAIF)

<table>
<thead>
<tr>
<th>Power Station</th>
<th>Fukushima Dai-ichi Nuclear Power Station</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit</strong></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td><strong>Type of Reactor</strong></td>
<td>BWR-3</td>
</tr>
<tr>
<td><strong>Operation Status at the earthquake occurred</strong></td>
<td>In Service -&gt; Shutdown</td>
</tr>
<tr>
<td><strong>Fuel assemblies loaded in Core</strong></td>
<td>400</td>
</tr>
<tr>
<td><strong>Core and Fuel Integrity (Loaded fuel assemblies)</strong></td>
<td>Damaged</td>
</tr>
<tr>
<td><strong>Containment Vessel structural integrity</strong></td>
<td>Not Damaged (estimation)</td>
</tr>
<tr>
<td><strong>Core cooling requiring AC power 1</strong></td>
<td>Not Functional</td>
</tr>
<tr>
<td><strong>Building Integrity</strong></td>
<td>Severely Damaged (Hydrogen Explosion)</td>
</tr>
<tr>
<td><strong>Water Level of the Rector Pressure Vessel</strong></td>
<td>Fuel exposed partially/or fully</td>
</tr>
<tr>
<td><strong>Pressure / Temperature of the Reactor Pressure Vessel</strong></td>
<td>Gradually increasing / Decreased a little after increasing over 400°C on 24th</td>
</tr>
<tr>
<td><strong>Containment Vessel Pressure</strong></td>
<td>Decreased a little after increasing up to 0.4Mpa on 24th</td>
</tr>
<tr>
<td><strong>Water injection to core (Accident Management)</strong></td>
<td>Continuing (Switch from seawater to Freshwater)</td>
</tr>
<tr>
<td><strong>Water injection to Containment Vessel (AM)</strong></td>
<td>To be decided (Seawater)</td>
</tr>
<tr>
<td><strong>Containment Venting (AM)</strong></td>
<td>Temporarily stopped</td>
</tr>
<tr>
<td><strong>Fuel assemblies stored in Spent Fuel Pool</strong></td>
<td>292</td>
</tr>
<tr>
<td><strong>Fuel Integrity in the spent fuel pool</strong></td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Cooling of the spent fuel pool</strong></td>
<td>Water injection to be considered</td>
</tr>
<tr>
<td><strong>Main Control Room Habitability &amp; Operability</strong></td>
<td>Poor due to loss of AC power</td>
</tr>
</tbody>
</table>

### Environmental effect

- **Radiation level**: 1.005Sv/h at the south side of the office building, 1453μSv/h at the Main gate, 75μSv/h at the West gate, as of 15:00, Mar. 30th.
- **Radioactive material**: 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**: Detected from tap water sampled at some prefecture. Level of iodine in tap water temporarily exceed the provisional legal limit for infant consumption.
- **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](http://www.nsc.go.jp/info/110323_top_siryo.pdf)
- **Plutonium**: 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.

### Remarks

- **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 1** | **Level 2** | **Level 3** |
- **Level 1** | **Level 2** | **Level 3** |

### [Source]

Government Nuclear Emergency Response Headquarters: News Release (~3/30 19:00), Press conference
NISA: News Release (~3/30 16:30), 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)
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<tr>
<th>Power Station</th>
<th>Fukushima Dai-ji Nuclear Power Station</th>
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<tbody>
<tr>
<td>Electric / Thermal Power output (MW)</td>
<td>1100 / 3293</td>
</tr>
<tr>
<td>Type of Reactor</td>
<td>BWR-5</td>
</tr>
<tr>
<td>Operation Status at the earthquake occurred</td>
<td>In Service -&gt; Automatic Shutdown</td>
</tr>
<tr>
<td>Status</td>
<td>All the units are in cold shutdown.</td>
</tr>
<tr>
<td>INES (estimated by NISA)</td>
<td>Level 3</td>
</tr>
<tr>
<td>Remarks</td>
<td>Unit 1, 2, 3 &amp; 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 μSv/h at 15:00, Mar. 30 at NPS border.</td>
</tr>
</tbody>
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<th>Power Station</th>
<th>Onagawa Nuclear Power Station</th>
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<tr>
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</tr>
<tr>
<td>Status</td>
<td>All the units are in cold shutdown.</td>
</tr>
<tr>
<td>Remarks</td>
<td>Safe</td>
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<tr>
<th>Power Station</th>
<th>Tokai Dai-ji</th>
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<tr>
<td>Operation Status at the earthquake occurred</td>
<td>In Service -&gt; Automatic Shutdown</td>
</tr>
<tr>
<td>Status</td>
<td>In cold shutdown.</td>
</tr>
<tr>
<td>Remarks</td>
<td>Safe</td>
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Parameters in the Table
JAIP 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 those parameters in the table to nuclear power plant safety.

Nuclear Power Plant Safety and related items

- Reactor Safety
  - Shutdown
    - Design base cooling capability
    - 5 Barriers:
      ① Fuel Pellet
      ② Cladding Tube
      ③ Reactor Pressure vessel
      ④ Containment Vessel
      ⑤ Reactor Building
    - Alternative Cooling operation
      - Operation for containment vessel protection against burst

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)

- Pressure of the Reactor Pressure Vessel
  - 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)
2. Chronology of Nuclear Power Stations

(1) Fukushima Dai-ichi NPPs

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
<th>Unit 5 and 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Incidents and Actions</td>
<td>11th 15:42 Report IAW Article 10* (Loss of power)</td>
<td>11th 15:42 Report IAW Article 10* (Loss of power)</td>
<td>11th 15:42 Report IAW Article 10* (Loss of power)</td>
<td>14th 04:06 Water temperature in Spent Fuel Storage Pool increased to 84°C</td>
</tr>
<tr>
<td>“The Act on Special Measures Concerning Nuclear Emergency&quot;</td>
<td>11th 16:36 Event falling under Article 15* occurred (INCAPABILITY of water injection to core cooling function)</td>
<td>13th 05:10 Event falling under Article 15* occurred (Loss of reactor cooling functions)</td>
<td>15th 09:38 Fire occurred on 3rd floor (extinguished spontaneously)</td>
<td>18th Vent hole was opened on the rooftop for avoiding hydrogen explosion</td>
</tr>
<tr>
<td>12th 00:49 Event falling under Article 15* occurred (Abnormal rise of CV pressure)</td>
<td>14th 13:25 Event falling under Article 15* occurred (Loss of reactor cooling functions)</td>
<td>13th 08:41 Start venting</td>
<td>16th 05:45 Fire occurred (extinguished spontaneously)</td>
<td>16th 05:00 RHR-pump in the Unit-5 restarted.</td>
</tr>
<tr>
<td>12th 14:30 Start venting</td>
<td>14th 16:34 Seawater injection to RPV</td>
<td>13th 13:12 Seawater injection to RPV</td>
<td>Since 20th, operation of spraying water to the spent fuel pool continues.</td>
<td>19th 22:14 RHR-pump in the Unit-6 restarted.</td>
</tr>
<tr>
<td>12th 15:36 Hydrogen explosion</td>
<td>14th 22:50 Report IAW Article 15* (Abnormal rise of CV pressure)</td>
<td>14th 07:44 Event falling under Article 15* occurred</td>
<td>21st 20:00 work to restore external AC power was interrupted after black smoke rising</td>
<td>22nd 19:15 switch to external AC power from emergency Diesel generator at unit-5 and 6.</td>
</tr>
<tr>
<td>12th 20:26 Seawater injection to RPV</td>
<td>15th 05:00 Start venting</td>
<td>11th 11:01 Hydrogen explosion</td>
<td>Since 23rd, the RPV temperature has been gradually declining. (157.5°C as of 25th 06:00)</td>
<td>23rd 17:24 RHR-pump stopped automatically at unit-5.</td>
</tr>
<tr>
<td>22nd 11:20 RPV temperature increased</td>
<td>15th 06:10 Sound of explosion, Suppression Pool damage suspected</td>
<td>15th 10:22 Radiation dose 400mSv/h</td>
<td>23rd 11:50 lights in the main control room becomes available</td>
<td>24th 16:14 RHR-pump of Unit 5, which had failed, was replaced and then restarted at unit-5.</td>
</tr>
</tbody>
</table>

Since 23rd, the RPV temperature has been gradually declining. (157.5°C as of 25th 06:00)

15th 08:25 White smoke reeked

16th 08:40, 08:47 Radiation Dose 400mSv/h near building

16th 08:34, 10:00 White smoke reeked

24th 10:50 White, steam-like smoke emerged

Since 20th, operation of spraying water to the spent fuel pool continues.

24th 11:30 lights in the main control room becomes available

21st 18:22 White, steam-like smoke erupted from the top of the reactor building.

Since 17th, operation of spraying water to the spent fuel pool continues.

25th 15:37 Freshwater injection to the reactor started.

25th 09:19 There is a trace that indicates water had flown from RB to general drain via carry-in entrance.

21st 15:55 Slightly gray smoke erupted (18:02 settled)

26th 10:16 Freshwater injection to the reactor started.

22nd 22:46 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)

26th 16:46 lights in the main control room becomes available

25th 18:02 Freshwater injection to the reactor started.

23rd 16:30 external AC power becomes available

Major Data

- Reactor Water level (A) -1600mm (B) -1600mm (30th 13:00) (30th 13:00)
- Reactor Water level (A) -1500mm (B) -2250mm (30th 13:00) (30th 13:00)
- Reactor Water level (A) -1850mm (B) -2250mm (30th 13:00) (30th 13:00)
- 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) -0.019MPaG (B) -0.095MPaG (30th 13:00)
- CV pressure 0.250MPaabs (30th 13:00) 0.1064MPaabs (30th 13:00) 0.1064MPaabs (30th 13:00)
- Water temperature of SFP 48°C (30th 13:00) 26.5°C (30th 14:00) 26.5°C (30th 14:00)
- Water temperature of SFP (24th 11:00) (immeasurable) 37.0°C (30th 14:00) (immeasurable)
- Water temperature in Spent Fuel Storage Pool 37.0°C (30th 14:00)

(2) Fukushima Dai-ni NPPs

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

3. State of Emergency Declaration

11th 19:03 State of nuclear emergency was declared (Fukushima Dai-ichi NPS)
12th 07:45 State of nuclear emergency was declared (Fukushima Dai-ichi NPS)

4. Evacuation Order

11th 25:23 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 occurred on March 11th. Other nuclear power plants in Japan are in normal operation or safely shutdown.

- **EPICENTER**
- **AFFFECTED AREA of the quake**
- **Onagawa**
- **Fukushima Daiichi**
- **Fukushima Daini**

**Legend:**
- Red: Accident with Nuclear Fuel Damage Suspected
- Orange: Accident without Nuclear Fuel Damage Suspected
- Green: Safe
- Pink: Safe (Not affected by the quake)