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 20:00, April 19th (Estimated by JAIF)

<table>
<thead>
<tr>
<th>Power Station</th>
<th>Unit</th>
<th>Electric / Thermal Power output (MW)</th>
<th>Type of Reactor</th>
<th>Operation Status at the earthquake occurred</th>
<th>Core and Fuel Integrity</th>
<th>Reactor Pressure Vessel structural integrity</th>
<th>Containment Vessel structural integrity</th>
<th>Core cooling requiring AC power 1</th>
<th>Core cooling requiring AC power 2</th>
<th>Building Integrity</th>
<th>Water Level of the Rector Pressure Vessel</th>
<th>Fuel assemblies loaded in Core</th>
<th>Fuel Integrity in the spent fuel pool</th>
<th>Water in to core (Accident Management)</th>
<th>Water injection to Containment Vessel (AM)</th>
<th>Containment Venting (AM)</th>
<th>Main Control Room Habitability &amp; Operability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>460 / 1380</td>
<td>BWR-3</td>
<td>In Service  →  Shutdown</td>
<td>Not Damaged</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Severely Damaged</td>
<td>Fuel exposed partially or fully</td>
<td>Unknown / Stable</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Damaged (70%*)</td>
<td>Temporarily stopped</td>
<td>Poor due to loss of AC power</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>784 / 2381</td>
<td>BWR-4</td>
<td>In Service  →  Shutdown</td>
<td>Not Damaged</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Severely Damaged</td>
<td>Fuel exposed partially or fully</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Not damaged</td>
<td>Not necessary</td>
<td>Poor due to loss of AC power</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>784 / 2381</td>
<td>BWR-4</td>
<td>In Service  →  Shutdown</td>
<td>Not Damaged</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Severely Damaged</td>
<td>Fuel exposed partially or fully</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Not damaged</td>
<td>Not necessary</td>
<td>Poor due to loss of AC power</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>784 / 2381</td>
<td>BWR-4</td>
<td>Outage</td>
<td>Not Damaged</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Severely Damaged</td>
<td>Fuel exposed partially or fully</td>
<td>Unknown / Stable</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not damaged</td>
<td>Not necessary</td>
<td>Poor due to loss of AC power</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>784 / 2381</td>
<td>BWR-5</td>
<td>Outage</td>
<td>Not Damaged</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Severely Damaged</td>
<td>Fuel exposed partially or fully</td>
<td>Unknown / Stable</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not damaged</td>
<td>Not necessary</td>
<td>Poor due to loss of AC power</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1100 / 2933</td>
<td>BWR-5</td>
<td>Outage</td>
<td>Not Damaged</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not Functional</td>
<td>Not Functional</td>
<td>Severely Damaged</td>
<td>Fuel exposed partially or fully</td>
<td>Unknown / Stable</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Not damaged</td>
<td>Not necessary</td>
<td>Poor due to loss of AC power</td>
</tr>
</tbody>
</table>

#### Remarks

- **Progress of the work to recover injection function**
  - High radiation circumstance hampering the work to restore originally installed pumps for injection at unit-1, 2, and 3. Efforts have been made to remove radioactive water in the basement of the buildings of Unit 1 through 3 to improve this situation.

- **Evacuation**
  - On Apr. 17th, TEPCO announced that it plans to expand the evacuation area and then evacuate the houses and soils in the area to reduce the level of radioactive materials within about 3 to 6 months.

- **INES (estimated by NISA)**
  - Level 7/92 (Cumulative amount of radioactivity from Fukushima Daiichi NPS has reached the level to be classified as level 7/92. NISA has evaluated the situation of the core at the NPS through the execution of the in situ measurements inside the reactor building and has estimated the amount of radioactive materials in the reactor core.)

### Environmental effect

- TEPCO and MEXT have expanded the monitoring for the surrounding sea area since Apr 4th.

- Radioactive material was detected from milk and agricultural products from Fukushima and neighboring prefectures. The government issued order to limit shipment (3/21-3/22) and intake (3/23-) for some products.

- Small fish caught in waters off the coast of Ibaraki on Apr. 4 have been found to contain radioactive cesium and iodine above the legal limit (4/5).

- Evacuation area is to be expanded so as to include the area, where annual radiation exposure is expected to be above 20mSv. People in the expanded zone are ordered to evacuate within a month or so. People living in the 20 to 30km and other than the expanded evacuation area have been advised to stay indoors or evacuation is an emergency (issued on Apr. 19th).

- Total amount of radioactive materials released to the environment in this accident is one tenth as much as one in the Chernobyl accident so far.
### Power Station: Fukushima Dai-ni Nuclear Power Station

<table>
<thead>
<tr>
<th>Unit</th>
<th>Electric / Thermal Power output (MW)</th>
<th>Type of Reactor</th>
<th>Operation Status at the earthquake occurred</th>
<th>Status</th>
<th>INES (estimated by NISA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1100 / 3293</td>
<td>BWR-5</td>
<td>In Service -&gt; Automatic Shutdown</td>
<td>All the units are in cold shutdown.</td>
<td>Level 3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>BWR-5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>BWR-5</td>
<td></td>
<td>Level 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>BWR-5</td>
<td></td>
<td>Level 3</td>
<td></td>
</tr>
</tbody>
</table>

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: 2.1μSv/h at 15:00, Apr. 19th at NPS border
- Evacuation Area: 10km from NPS

### Power Station: Onagawa Nuclear Power Station

<table>
<thead>
<tr>
<th>Unit</th>
<th>Operation Status at the earthquake occurred</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In Service -&gt; Automatic Shutdown</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Power Station: Tokai Dai-ni

<table>
<thead>
<tr>
<th>Operation Status at the earthquake occurred</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Service -&gt; Automatic Shutdown</td>
<td></td>
<td>No abnormality has been found after an earthquake occurred off the shore of Miyagi prefecture at 23:32, Apr. 7th.</td>
</tr>
<tr>
<td>In cold shutdown.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 these parameters in the table to nuclear power plant safety.

Nuclear Power Plant Safety and related items

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

Parameters in the tabl

- 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
- Pressure 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)

- Fuel Integrity in the spent fuel pool
  (Fuel Damage)
-Cooling of the spent fuel pool
  (Water injection, pool temp, water level)

- Safety of the spent fuel pool

- 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 Areas)
1. Latest Major event and response

- Apr. 17th: 09:00-11:15 Seven sandbags containing absorbent named zeolite were installed near the seawater screens between Unit 1 and 2 and between Unit 2 and 3. 11:30-17:30 Investigation of the Inside of the Unit 1 and 3 R/B was conducted using a remote-controlled robot.

Tepco announced a roadmap towards restoration from the accident at Fukushima Daiichi NPS.

Apr. 19th: 10:08 Transfer of highly radiocative contaminated water accumulated in the Unit 2 turbine building to the waste processing facility began.

2. Chronology of Nuclear Power Stations

(1) Fukushima Dai-ichi NPS

- 11th 15:42 Report IAW Article 10* (Loss of power)
- 13th 08:41 Start venting
- 20th 22:14 Cooling SFP with RHR-pump started

1. Latest Major event and response

- 11th 16:36 Event falling under Article 15* occurred (Incapability of water injection by core cooling function)
- 12th 00:49 Event falling under Article 15* occurred
- 12th 05:10 Event falling under Article 15* occurred (Loss of reactor cooling functions)

2. Chronology

- 11th 16:36 Event falling under Article 15*
- 12th 20:41 Start venting
- 13th 05:10 Event falling under Article 15* occurred
- 16th 05:45 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.
- 01st 08:38 Fire occurred on 3rd floor
- 20th 14:30 Cold shutdown achieved at Unit 5
- 20th 15:36 Hydrogen explosion

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

- 12th 05:44 PM: direction: for the residents within 3km radius from Fukushima I to evacuate, within 10km radius from Fukushima I to stay in house
- 12th 17:39 PM: direction: for the residents within 10km radius from Fukushima I to evacuate
- 12th 18:25 PM: direction: for the residents within 20km radius from Fukushima I to evacuate

25th Governmental advise: for the residents within 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.genkikyo.jp/english/shokai/special_4.html".
*2 Data trend is continuously monitored.

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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**
- **AFFECTED AREA of the quake**

- **Fukushima Daiichi**
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6

- **Fukushima Daini**
  - 1
  - 2
  - 3
  - 4

- **Tokai**
  - 1
  - 2

- **Onagawa**
  - 1
  - 2
  - 3

- **Shimane**
  - 1
  - 2
  - 3
  - 4

- **Kashiwazaki Kariwa**
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7

- **Tsuruga**
  - 1
  - 2

- **Mihama**
  - 1
  - 2
  - 3

- **Ohi**
  - 1
  - 2
  - 3
  - 4

- **Tokahama**
  - 1
  - 2
  - 3
  - 4

- **Sendai**
  - 1
  - 2
  - 3

- **Genkai**
  - 1
  - 2
  - 3
  - 4

- **Shika**
  - 1
  - 2

- **Tohoku/Higashidori**
  - 1

- **Tokyo**

**Legend**:
- ■ Accident with Nuclear Fuel Damage Suspected
- △ Accident without Nuclear Fuel Damage Suspected
- □ Safe
- ☼ Safe (Not affected by the quake)