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.
<table>
<thead>
<tr>
<th>Power Station</th>
<th>Fukushima Dai-ichi Nuclear Power Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>1</td>
</tr>
<tr>
<td>Electric / Thermal Power output (MW)</td>
<td>466 / 1390</td>
</tr>
<tr>
<td>Type of Reactor</td>
<td>BWR-3</td>
</tr>
<tr>
<td>Operation Status at the earthquake occurred</td>
<td>In Service</td>
</tr>
<tr>
<td>Fuel assemblies loaded in Core</td>
<td>548</td>
</tr>
<tr>
<td>Core and Fuel Integrity (Loaded fuel assemblies)</td>
<td></td>
</tr>
<tr>
<td>Reactor Pressure Vessel structural integrity</td>
<td></td>
</tr>
<tr>
<td>Core cooling requiring AC power 1</td>
<td></td>
</tr>
<tr>
<td>Functioning through Heat Exchangers</td>
<td></td>
</tr>
<tr>
<td>Core cooling requiring AC power 2</td>
<td></td>
</tr>
<tr>
<td>Building Integrity</td>
<td></td>
</tr>
<tr>
<td>Water Level of the Reactor Pressure Vessel</td>
<td></td>
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<tr>
<td>Pressure / Temperature of the Reactor Pressure Vessel</td>
<td></td>
</tr>
<tr>
<td>Containment Vessel Pressure</td>
<td></td>
</tr>
<tr>
<td>Water injection to core (Accident Management)</td>
<td></td>
</tr>
<tr>
<td>Water injection to Containment Vessel (AM)</td>
<td></td>
</tr>
<tr>
<td>Main Control Room Habitability &amp; Operability</td>
<td></td>
</tr>
</tbody>
</table>

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**Environmental effect**

- **Status in Fukushima Dai-ichi NPS site at the West gate, as of 15:00, Apr. 13th**
  - Plutonium was detected from the soil sampled at Fukushima Dai-ichi NPS site on Mar. 21st, 22nd, 25th and 26th. The amount is so small that the Pu is not harmful to human body.
  - Radioactive materials were detected from underground water sampled near the turbine buildings on Mar. 30th.
  - Radioactive 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, or trench, on Mar. 27th.
  - 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, 1.3 million times the legal limit of radionuclide on the seawater, which had been sampled near the water intake of Unit 1 to 6. It was found on Apr. 2nd that there was high radioactive (more than 1000Sv/h) 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 around the pit. Release of some 10,000 tons of low level radioactive wastewater into the sea began on Apr. 9th in order to make room for the high radioactive water mentioned above. According to the influence of the low level radioactive waste release, TEPCO evaluated that eating fish and seaweed caught near the plant every day for a year would add some 25% of the dose that the general public receive from the environment for a year.
  - TEPCD and MEXT has expanded the monitoring for the surrounding sea area since Apr. 4th.

**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 (issued at 05:44, Mar. 12th)
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. 25th) for from 20km to 30km from NPS
5. The 20km evacuation zone around the Fukushima Daiichi NPS is to be expanded so as to include the area, where annual radiation exposure is expected to be above 20Sv. The expanded zone is to be evacuated within a month or so. People living in the 20 to 30km from NPS are also asked to get staying indoors or evacuation in an emergency (issued on Apr. 11th).

**INES (estimated by NISA)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The reactor pressure vessel pressure is below 150 bar.</td>
</tr>
<tr>
<td>2</td>
<td>The reactor core is contained within the reactor pressure vessel.</td>
</tr>
<tr>
<td>3</td>
<td>The fuel is contained within the fuel assemblies in the reactor core.</td>
</tr>
<tr>
<td>4</td>
<td>The containment vessel is intact and intact containment.</td>
</tr>
</tbody>
</table>

**Power Station**

- **Status of nuclear power plants in Fukushima as of 20:00, April 13th (Estimated by JAIF)**
- **Estimated by JAIF**
- **Fukushima Dai-ichi Nuclear Power Station**
- **Type of Reactor**
  - BWR-3
  - BWR-4
  - BWR-4
  - BWR-4
  - BWR-5
- **Operation Status at the earthquake occurred**
  - In Service
  - In Service
  - In Service
  - Outage
  - Outage
- **Fuel assemblies loaded in Core**
  - 400
  - 548
  - 548
  - 548
  - 764
- **Core and Fuel Integrity (Loaded fuel assemblies)**
  - No fuel rods
  - Not Damaged
  - Not Damaged
  - Not Damaged
  - Not Damaged
- **Reactor Pressure Vessel structural integrity**
  - Stable
  - Stable
  - Stable
  - Stable
  - Stable
- **Core cooling requiring AC power 1**
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
- **Functioning through Heat Exchangers**
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
- **Core cooling requiring AC power 2**
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
- **Functioning in cold shutdown**
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
- **Core cooling requiring AC power 3**
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
- **Functioning in cold shutdown**
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
  - Not necessary
- **Cooling the spent fuel pool**
  - Poor due to loss of AG power
  - Poor due to loss of AG power
  - Poor due to loss of AG power
- **Cooling the spent fuel pool (Lighting working in the control room at Unit 1 and 2)**
  - Poor due to loss of AG power
  - Poor due to loss of AG power
  - Poor due to loss of AG power
- **Cooling the spent fuel pool (Lighting working in the control room at Unit 3 and 4)**
  - Poor due to loss of AG power
  - Poor due to loss of AG power
  - Poor due to loss of AG power
- **Cooling the spent fuel pool (Lighting working in the control room at Unit 5 and 6)**
  - Poor due to loss of AG power
  - Poor due to loss of AG power
  - Poor due to loss of AG power
- **Main Control Room Habitability & Operability**
  - Poor due to loss of AG power
  - Poor due to loss of AG power
  - Poor due to loss of AG power
- **Main Control Room Habitability & Operability (Lighting working in the control room at Unit 1 and 2)**
  - Poor due to loss of AG power
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  - Poor due to loss of AG power
  - Poor due to loss of AG power
- **Main Control Room Habitability & Operability (Lighting working in the control room at Unit 7 and 8)**
  - Poor due to loss of AG power
  - Poor due to loss of AG power
  - Poor due to loss of AG power
<table>
<thead>
<tr>
<th>Power Station</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>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Service -&gt; Automatic Shutdown</td>
<td>All the units are in cold shutdown.</td>
<td>Level 3</td>
<td>No abnormality has been found after an earthquake occurred off the shore of Miyagi prefecture at 23:32, Apr. 7th.</td>
</tr>
</tbody>
</table>

**Fukushima Dai-ⅱ Nuclear Power Station**

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

**Onagawa Nuclear Power Station**

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</tr>
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<td>In Service -&gt; Automatic Shutdown</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>In Service</td>
<td></td>
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**Tokai Dai-ⅱ**

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<th>Operation Status at the earthquake occurred</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Service -&gt; Automatic Shutdown</td>
<td>In cold shutdown.</td>
</tr>
</tbody>
</table>

*Latest Monitor Indication: 2.6 μSv/h at 21:00, Apr. 12th at NPS border
Evacuation Area: 10km from NPS*
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.

Nuclear Power Plant Safety and related items

- Reactor Safety
  - Shutdown
  - Cooling
    - Design base cooling capability
  - Containment

Parameters in the tabl

- Operation Status at the earthquake
  - Core cooling requiring AC power
    - (Large volumetric freshwater injection)
  - Core cooling requiring AC power
    - (Cooling through Heat Exchangers)

- 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)

Accident Management : AM
(Or operation beyond design base accident)

- Alternative Cooling operation
- Operation for containment vessel protection against burst
- 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
  - (Radiation, Monitor, Contamination)
- Evacuation
  - (Order, Evacuated Area)
1. Latest Major event and response
11th 17:16 An earthquake centered at Hamadori, Fukushima prefecture hit Fukushima Dichi NPS. External power supply of Unit 1 and 2 broke down, and then were restored at 17:56, and reactor water injection pumps of Unit 1 through 3 stopped and then were restarted at 18:04. Instrumental readings of plant parameters of Unit 1 through 6 and monitoring posts have shown no significant abnormality. April 12th The significance of the accident at Fukushima Dichi NPS has been tentatively reevaluated as level 7 on the International Nuclear and Radiological Event Scale, or INES. 14.07 After an earthquake centered at Hamadori, Fukushima prefecture, no abnormality was found with nitrogen gas injection facility of Unit 1, external power supply of Unit 1 through 6, reactor water injection pumps of Unit 1 through 3 and the readings of plant parameters of Unit 1 through 6 and monitoring posts in-Fukushima Dichi NPS. No abnormality was found with Fukushima Daini Unit 1 through 4 and the monitoring posts.

17:35 Transmission of highly radioactive contaminated water accumulated inside trench outside the turbine building to the condenser started at Unit 2

2. Chronology of Nuclear Power Stations

(1) Fukushima Daiichi NPS

Major Events
- **April 11th:** 17:16 An earthquake centered at Hamadori, Fukushima prefecture hit Fukushima Dichi NPS. External power supply of Unit 1 and 2 broke down, and then were restored at 17:56, and reactor water injection pumps of Unit 1 through 3 stopped and then were restarted at 18:04. Instrumental readings of plant parameters of Unit 1 through 6 and monitoring posts have shown no significant abnormality.
- **April 12th:** The significance of the accident at Fukushima Dichi NPS has been tentatively reevaluated as level 7 on the International Nuclear and Radiological Event Scale, or INES. 14.07 After an earthquake centered at Hamadori, Fukushima prefecture, no abnormality was found with nitrogen gas injection facility of Unit 1, external power supply of Unit 1 through 6, reactor water injection pumps of Unit 1 through 3 and the readings of plant parameters of Unit 1 through 6 and monitoring posts in-Fukushima Dichi NPS. No abnormality was found with Fukushima Daini Unit 1 through 4 and the monitoring posts.
- **April 15th:** 15:11 PM direction: for the residents within 20km radius from Fukushima I to evacuate.

Technical Events
- **April 11th:** 17:16 Earthquake centered at Hamadori, Fukushima prefecture hit Fukushima Dichi NPS. External power supply of Unit 1 and 2 broke down, and then were restored at 17:56, and reactor water injection pumps of Unit 1 through 3 stopped and then were restarted at 18:04. Instrumental readings of plant parameters of Unit 1 through 6 and monitoring posts have shown no significant abnormality.

(2) Fukushima Dai-ichi NPS

2. Chronology of Nuclear Power Stations

(1) Fukushima Daiichi NPS

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<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
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<tr>
<td>April 11th</td>
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(2) Fukushima Dai-ni NPPs

2. Chronology of Nuclear Power Stations

(2) Fukushima Dai-ni NPPs

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<th>Date</th>
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(3) State of Emergency Declaration
11th 17:03 State of nuclear emergency was declared (Fukushima Daini NPS) 12th 07:45 State of nuclear emergency was declared (Fukushima Dichi NPS) 11th 18:25 PM direction: for the residents within 20km radius from Fukushima I to evacuate.

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 11:36 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

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

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**Note:**
- The technical events listed above are based on the information available at the time of writing. Further updates and clarifications may be provided in subsequent reports.
- The details provided are for the purpose of understanding the sequence of events and do not necessarily represent the official stance or updates from the relevant authorities.

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**Abbreviations:**
- SFP: Spent Fuel Storage Pool
- EDG: Emergency Diesel Generator
- RPV: Reactor Pressure Vessel
- RHR: Residual Heat Removal system
- CST: Condensate water Storage Tank

**Source:**
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.