June 6, 2011
Nuclear and Industrial Safety Agency

Regarding the Evaluation of the Conditions on Reactor Cores of Unit 1, 2 and 3 related to the Accident at Fukushima Dai-ichi Nuclear Power Station, Tokyo Electric Power Co. Inc.

This is to inform the public as attached on this subject.

Attached: Regarding the Evaluation of the Conditions on Reactor Cores of Unit 1, 2 and 3 related to the Accident at Fukushima Dai-ichi Nuclear Power Station, Tokyo Electric Power Co. Inc.

(Contact Person)
Mr. Toshihiro Bannai
Director, International Affairs Office,
NISA/METI
Phone: +81-(0)3-3501-1087
1. Background

Nuclear and Industrial Safety Agency issued written instructions dated April 25, 2011 to Tokyo Electric Power Co. Inc. (TEPCO) to submit a report on the record of operations as well as the accident record relating to the accident at TEPCO’s Fukushima Dai-Ichi Nuclear Power Station (NPS) pursuant to Article 67 paragraph 1 of the Act on the Regulations of Nuclear Source Materials, Nuclear Fuel Materials and Reactors. In response, TEPCO submitted a report dated May 16, 2011 on the record recovered from the main control room and other information.

Based on this report, Nuclear and Industrial Safety Agency (hereafter referred to as “NISA”) issued a written instruction dated May 16 to TEPCO to submit a report on the result of nuclear reactor facilities safety assessment that takes into account results of an analysis of records from before and after the occurrence of the 2011 off the Pacific coast of Tohoku Earthquake. TEPCO complied with the instruction in a report submitted on May 23.

On May 24, based on this report, NISA issued the points of notice as well as NISA’s evaluation regarding the May 23 report. At the same time, NISA determined that given the time-consuming nature of NISA’s evaluation, the analysis and evaluation of reactor core condition would be put together following the completion of the evaluation.

2. Overview of TEPCO’s Assessment

The plant condition was assessed using MAAP, a code for analyzing severe accidents, based on objectively-recorded data and equipment operation status such as record of operations starting from just before the quake occurrence, alarms and plant behavior during transient events, all submitted in the May 16 report. The results are as follows:
Unit 1

- Since a calibration of the reactor water level gauge confirmed that water level was in fact not maintained, and that the isolation condenser had been functioning until tsunami hit, analysis was performed taking into account condenser operation until the time of tsunami hit. The analysis assumes leak in primary containment vessel (PCV) from the point at which the reactor pressure vessel (RPV) was damaged and the CV pressure showed a large increase. (Coincides with the May 15 analysis released by TEPCO)
- Even though the conclusion states that the RPV was damaged by melted fuel, the assessment, based on measurements of the RPV temperature to date, is that most of the fuel has in fact been cooled in the lower portion of the RPV.
- In addition, plant behavior in the hypothetical event that the isolated condenser continued to function following tsunami hit was also analyzed. Melting resulted in this case also.
- The assessment assumes that facilities such as the isolated condenser were not functioning, and fuel exposure began approximately 2 hours after tsunami hit or approximately 3 hours following the occurrence of the quake, and core damage began approximately 1 hour later.
- At this time, the operator was working to recover and maintain emergency condenser function, and no water injection into the core was being performed. As a result, fuel melting continued, and by the time water injection began around 6 o'clock on March 12, the melted fuel is surmised to have already moved into the lower portion of the RPV and flowed into the PCV.
- The radioactive material packaged in the fuel is assumed to have been released into the RPV as fuel was damaged and melted, moved into the suppression chamber and absorbed into the suppression chamber pool water. In cases when melted fuel flowed out into the PCV, radioactive material is also assessed to have moved into the drywell. The iodine discharge proportion is assessed as approximately 1%.

Unit 2
Since it was found that the reactor core isolation cooling system was functioning even after tsunami hit, analysis was performed taking into account operation until 13:25 on March 14, 2011, when reactor core isolation cooling system was determined to have stopped functioning.

Since the containment pressure measured was lower than the value yielded by analysis, the analysis result assumes a leak in the containment vessel after the 21-hour mark following the earthquake. It also assumes a leak in the suppression chamber after the point at which an explosion was heard in the vicinity of the suppression chamber.

Since the reactor water level cannot be determined with certainty, analysis was performed assuming both a water level indicated by the water level gauge and failure to maintain the water level, as with Unit 1.

In the case where water level was maintained, the result shows melting, but limited to the fuel area. In the case where water level was not maintained, the result shows damage to the RPV due to the melted fuel.

Based on the measurements to date of the RPV temperatures in addition to these analysis results, majority of the fuel is assessed to be in fact being cooled in the lower portions of the RPV.

The assessment assumes that fuel exposure began approximately 4 hours after 13:25 on March 14, when the reactor core isolation cooling system was determined to have stopped functioning, or approximately 75 hours following the occurrence of the quake, and core damage began approximately 2 hours later.

At this time, the operator was performing seawater injection into the core using fire extinguishing line, but injection could not be verified due to fire truck pump malfunction and other issues. Assuming that the injection volume was insufficient even after 19:54 on March 14, when injection was considered assured, fuel melting is assumed to have continued, and the melted fuel is surmised to have moved into the lower portion of the RPV.

The radioactive material packaged in the fuel is assumed to have been released into the RPV as fuel was damaged and melted, moved
into the suppression chamber and absorbed into the suppression chamber pool water. The iodine discharge proportion is assessed as approximately 1% in either case.

Unit 3

- In addition to the operation of the reactor core isolation cooling system even after tsunami hit, an automatic activation of high-pressure water injection system at 12:35 on the 12th was verified after the reactor core isolation cooling system stopped at 11:36 on the 12th. An analysis was performed taking this situation into account.
- Since reactor pressure and containment pressure dropped during the time that high-pressure water injection was in operation, an analysis assuming a leak in the main steam system of the high-pressure water injection system during that time was also performed.
- Analysis was performed assuming two cases regarding the reactor water level, as with Unit 2.
- In the case where water level was maintained, the result shows melting, but limited to the fuel area. In the case where water level was not maintained, the result shows damage to the RPV due to the melted fuel.
- Based on the measurement to date of the RPV temperatures in addition to these analysis results, majority of the fuel is assessed to be in fact being cooled in the lower portions of the RPV.
- The assessment assumes fuel exposure began approximately 4 hours after 2:42 on March 13, when the high-pressure water injection system was determined to have stopped functioning, or approximately 40 hours following the occurrence of the quake, and core damage began approximately 2 hours later.
- At this time, the operator was attempting water injection by reactor core isolation cooling system but was unable to activate it, and later performed the PCV spraying using the fire extinguishing line and operated the PCV vent from the suppression chamber. At 9:25 on March 13 when the injection was considered assured, fuel damage is assumed to have resulted.
- The radioactive fuel packaged in the fuel is assumed to have been
released in the RPV as fuel was damaged and melted, moved into the suppression chamber and absorbed into the suppression chamber pool water. The iodine discharge proportion is assessed as approximately 0.5% in either case.

3. Assessment by NISA

Below are the results of assessments by NISA based on cross-check analysis results by J NES.

Overall
- In addition to verifying TEPCO’s analysis conditions, the J NES cross-check analysis also uses similar conditions to analyze basic cases as performed by TEPCO. Furthermore, degree of impact was verified by performing analysis under different conditions from those defined as TEPCO assumptions. In that case, an analysis code (MELCOR) different from that employed by TEPCO was used for the cross-check analysis, but an examination was carried out by performing analysis using the same analysis code while being cognizant of the impact of the difference in analysis codes.
- Moreover, current plant data among others was carefully reviewed, and the situation of the RPV and the PCV were examined as well.

Unit 1
- The overall trend was similar to TEPCO’s analysis results but the timing of the RPV damage came earlier than TEPCO’s results despite using the same analysis code, and it is surmised that this is an effect of variations in defined conditions such as decay heat. In the cross-check analysis results, the containment pressure behavior matched real measurements, and in terms of how events developed, it is surmised that the leakage from the PCV occurred as the RPV was damaged and the PCV pressure and temperature increased substantially even before 23:00 on the 11th, when there is information, among others, of the rise in radiation level in the turbine building.
- In a similar vein, regarding information of the rise in radiation monitor indication at 17:50 on the 11th described on the white board in the main control room (inside the exterior air lock) among others,
it is surmised that core damage had occurred by that time.

- Based on the RPV temperature measurements to date, it is believed that there is some rationale to the point that fuel moved from the fuel area is assumed to being cooled at the lower portion of the RPV. However, since a portion of the measurements shows higher temperature than the saturated temperature, it is surmised that a part of the fuel is being cooled by steam.

- Based on the balance between the volume of water injection and that of steam generation, leakage of not only steam but also of liquid is considered possible, and assuming that fuel is being cooled, it is surmised that leakage is occurring at the bottom of the RPV.

- The reactor pressure was high at the time of tsunami hit, and as it is important to reduce the pressure effectively, the operator carried out operations to revive and to maintain functions of the Isolated Condenser. However, given later developments, functions were not believed to have recovered. For that reason, at a stage shortly after the shutdown when time is short, it is believed to be important to enhance reliability by taking into account common causes of malfunctions among others of power source equipment and compression air systems and such in order to have an accurate grasp of the situation and to quickly implement response actions.

- The discharge of radioactive materials from Unit 1 is believed mainly due to the assumed leakage from the PCV in the morning of March 12 as well as release from the PCV vent. The cross-check analysis results show that the discharge proportion of iodine is approximately 0.7% and approximately 0.3% for cesium. However, discharge proportion varies not only by differences attributed to analysis codes but also by defined conditions such flow rate of sea water injection, and as operating conditions are unclear, it may also vary by operating conditions.

**Unit 2**

- The overall trend was similar to TEPCO’s analysis results but the timing of the RPV damage came earlier than TEPCO’s results despite using the same analysis code, and it is surmised that this is an effect of variations in defined conditions such as decay heat. In the
cross-check analysis results, the containment pressure behavior matched real measurements, and in terms of how events developed, it is surmised that the RPV was damaged at the time when there was a substantially elevation of containment pressure as recorded around 0:00 on the 15th, hence a large elevation in the containment pressure and temperature.

- Based on the RPV temperature measurements to date, it is believed that there is some rationale to the point that fuel moved from the fuel area is assumed to be being cooled at the lower portion of the RPV. However, since a portion of the measurements shows higher temperature than the saturated temperature, it is surmised that a part of the fuel is being cooled by steam.

- Based on the balance between the volume of water injection and that of steam generation, leakage of not only steam but also of liquid is considered possible, and assuming that fuel is being cooled, it is surmised that leakage is occurring at the bottom of the RPV.

- Regarding Unit 2, operation of the reactor core isolation cooling system controlled developments of events for long-term, but it is believed that securing alternative water injection functions with certainty is necessary in instances when the reactor water level drops due to depressurization and other operations of the reactor.

- There is some rationale to the assumed leakage from the PCV, since containment pressure and temperature rose as operations of the reactor core isolation cooling system caused steam to flow into the suppression chamber, and the environment exceeded defined conditions ($138^\circ$C), while there were also fewer instances of pressure elevation, but further investigation by TEPCO is required together with the issue of water flow route.

- The release of radioactive materials from Unit 2 is considered mainly due to leakage caused by rise in containment pressure as melted fuel is believed to have moved beginning at 21:00 on March 14, as well as the PCV vent, and release due to leakage from the suppression chamber and other factors assumed in relation to the large impact noise in the vicinity of the suppression chamber; cross-check analysis results show iodine discharge proportion to be approximately 0.4–7%, and cesium discharge proportion to be approximately 0.3–6%.
However, discharge volume varies not only by differences attributed to analysis codes but also by defined conditions such as flow rate of sea water injection, and since operating conditions are unclear, it may also vary by operating conditions.

Unit 3
- The overall trend was similar to TEPCO’s analysis results but the timing of the RPV damage came earlier than TEPCO’s results despite using the same analysis code, and it is surmised that this is an effect of variations in defined conditions such as decay heat. In the cross-check analysis results, the containment pressure behavior matched real measurements, and in terms of how events developed, it is surmised that the RPV was damaged at the time when there was a substantially elevation of containment pressure as recorded around 12:00 on the 13th, hence a large elevation in the containment pressure and temperature.
- Based on the RPV temperature measurements to date, it is believed that there is some rationale to the point that fuel moved from the fuel area is assumed to being cooled at the lower portion of the RPV. However, since a portion of the measurements show higher temperature than the saturated temperature, it is surmised that a part of the fuel is being cooled by steam.
- Based on the balance between the volume of water injection and that of steam generation, leakage of not only steam but also of liquid is considered possible, and assuming that fuel is being cooled, it is surmised that leakage is occurring at the bottom of the RPV.
- Regarding the assumption about the high pressure water injection system’s state of operation, since the reactor pressure falls to 6 MPa after 6 and a half hours after its automatic start up, and the pressure returns to 7 MPa by the shutdown of the high pressure water injection system, TEPCO did conduct analysis of assumed leakage to outside the containment vessel via the high pressure water injection system’s steam piping; however, it is difficult to evaluate what actually happened because the form of the leakage was not specified. Accordingly, TEPCO needs to conduct further investigation. On the other hand, during the operation of the high pressure water injection
system, the data secured about the water level in the reactor was confirmed and there was hardly any impact on the state of the reactor core; accordingly, notwithstanding the above, it can be concluded that there would be no impact on the evaluation for the reactor core.

- Regarding Unit 3, operation of the reactor core isolation cooling system and the high pressure injection system controlled developments of events, but it is believed that securing alternative water injection functions with certainty is necessary when problems arise with the air system and direct current power supply required for the operation of the vent line valve and the main steam safety relief valve, etc.

- The release of radioactive materials from Unit 3 is considered mainly due to the PCV vent caused by rise in containment pressure by the main steam safety relief valve opening around 9:00 on March 13, and the later decrease in pressure after the rise in containment pressure; cross-check analysis results show iodine discharge proportion to be approximately 0.3~0.8%, and cesium discharge proportion to be approximately 0.2~0.6%. However, discharge volume varies not only by differences attributed to analysis codes but also by defined conditions such flow rate of sea water injection, and since operating conditions are unclear, it may also vary by operating conditions.

Finally, the above-described amount of released radioactive materials into the environment is almost identical to the preliminary calculations and scale of the released amount NISA implemented on April 12 for INES evaluation.
### Situation of Reactor, Unit 1

**Table: Time and Operation Event**

<table>
<thead>
<tr>
<th>Time</th>
<th>Operation, etc Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 11th</td>
<td>Reactor Scram, Loss of External Power</td>
</tr>
<tr>
<td>14:46, 47</td>
<td></td>
</tr>
<tr>
<td>March 11th</td>
<td>Automatically Started of Isolation Condenser (IC)</td>
</tr>
<tr>
<td>14:52</td>
<td>(After then, valve Opened and Shut by Manual)</td>
</tr>
<tr>
<td>March 11th</td>
<td>Station Black Out (Presume IC Function Loss)</td>
</tr>
<tr>
<td>15:37</td>
<td></td>
</tr>
<tr>
<td>March 12th</td>
<td>Pressure of PCV Drywell (D/W) Exceeded Design Pressure</td>
</tr>
<tr>
<td>0:49</td>
<td></td>
</tr>
<tr>
<td>March 12th</td>
<td>Started Fresh Water injection via Fire Extinguish Line</td>
</tr>
<tr>
<td>5:46</td>
<td></td>
</tr>
<tr>
<td>March 12th</td>
<td>Vent of PCV Wet Well (W/W) (PCV Pressure Decreased)</td>
</tr>
<tr>
<td>14:30</td>
<td></td>
</tr>
<tr>
<td>March 12th</td>
<td>Explosion in Reactor Building</td>
</tr>
<tr>
<td>15:36</td>
<td></td>
</tr>
<tr>
<td>March 12th</td>
<td>Started Sew Water Injection by Fire Extinguish Line</td>
</tr>
<tr>
<td>19:04</td>
<td></td>
</tr>
</tbody>
</table>

**Diagram Details**

- **Time Line of 1F1**
- **IC Startup → Shutdown**
- **Tsunami Invasion → SOB**
- **IC-HPCI Start up Failure (Loss of Cooling Function)**
- **Reactor Water Level Down**
- **Core Uncovered**
- **Hydrogen Generation**
- **Core Melt - Relocation**
- **Pressure Rise of D/W**
- **PCV Leak**
- **W/W Vent**
- **Hydrogen Leak to Building**
- **Release of Radioactive Materials**
- **Sea Water Injection**
- **Pressure stabilize**
- **Fresh Water Injection**
- **Around 12nd 0:00 Coherent with High PCV Pressure (Pressure Increase with Fuel Melt)**
- **12th 5:46 (Possibly not Injected)**
- **12th 19:04**

**Events Timeline**

- March 11th 14:46: Reactor Scram, Loss of External Power
- March 11th 14:52: Automatically Started of Isolation Condenser (IC) (After then, valve Opened and Shut by Manual)
- March 11th 15:37: Station Black Out (Presume IC Function Loss)
- March 12th 0:49: Pressure of PCV Drywell (D/W) Exceeded Design Pressure
- March 12th 5:46: Started Fresh Water injection via Fire Extinguish Line
- March 12th 14:30: Vent of PCV Wet Well (W/W) (PCV Pressure Decreased)
- March 12th 15:36: Explosion in Reactor Building
- March 12th 19:04: Started Sew Water Injection by Fire Extinguish Line

**Graphs**

- **Fuel Damage**
- **Partially Move to RPV bottom**
- **Partially Move to PCV**

**Solid Line: Cross Check analysis result**

- **(○ △)Actual Measurement**
- **(○,△)Observed data**

**Press.(MPa)**

- **Water level (mm)**

**Date**

- **3/12**
- **3/13**
- **3/14**
- **3/15**

**Relative time (h)**

- **0 12 24 36 48 60 72 84 96**

**IC Startup → Shutdown**

- **TAF**

**1F1 RPV press.**

- **D/W press.**

**Water level**

- **Hydrogen Generation**
- **Hydrogen Leak to Building**
- **Core Uncovered**

**Release of Radioactive Materials**

- **Pressure stabilize**
- **Sea Water Injection**
- **Fresh Water Injection**

**IC STOP**

- **PCV Leak**
- **W/W Vent**
Situation of Reactor, Unit 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Operation, etc Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 11th 14:47</td>
<td>Reactor Scram, Loss of External Power</td>
</tr>
<tr>
<td>March 11th 15:02</td>
<td>Manual Stat Up of Reactor Isolation Cooling System (RCIC)</td>
</tr>
<tr>
<td>March 11th 15:41</td>
<td>Station Black Out</td>
</tr>
<tr>
<td>March 12nd 4:20</td>
<td>Change of RCIC Water Source (Condensate Storage tank, CST → Suppression Chamber, S/C)</td>
</tr>
<tr>
<td>March 14th 13:25</td>
<td>RCIC Shutdown (Presumption)</td>
</tr>
<tr>
<td>March 14th around 18:00</td>
<td>Reactor Depressurization (Main Steam Safety Relief Valve (S/R Valve) Open)</td>
</tr>
<tr>
<td>March 14th 19:54</td>
<td>Started of Sea Water Injection via Fire Extinguish Line (Water Level Change was not Confirmed for 16:34 Operation)</td>
</tr>
<tr>
<td>March 15th 0:02</td>
<td>PRV Drywell (D/W) Vent (Several Minutes)</td>
</tr>
<tr>
<td>March 15th around 6:00</td>
<td>Sonic Bang</td>
</tr>
</tbody>
</table>

**Time Line of 1F2**

- RCIC start manually
- SBO
- Water source change from CST to S/P
- Sea water inject.
- RPV depressurized
- S/R valve-2 open
- Impact sound

**Earthquake Occurrence → Reactor Scram**

- RCIC Shutdown (Reactor Water Level Down)
- Depressurization of Reactor Pressure Vessel (RPV)
- Hurricane Invasion → SOB
- Change of RCIC Water Source (CST → S/C)
- Core Uncovered
- Hydrogen Generation
- Hydrogen Leak to Building
- D/W Pressure Increase
- D/W Vent Explosive Sound
- Core Meltdown Relocation
- Sea Water Injection
- Coherent with High PCV Pressure around 15th 0:00
- Pressure Stabilize
- PCV Leak
- Slower Increase of PCV Pressure
- RPV depressurized
- S/R valve-2 open
- Impact sound
**Situation of Reactor, Unit 3**

<table>
<thead>
<tr>
<th>Time</th>
<th>Operation, etc Event</th>
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</thead>
<tbody>
<tr>
<td>11th</td>
<td>14:47 Reactor Scram, Loss of External Power</td>
</tr>
<tr>
<td>11th</td>
<td>15:06 Manual Start Up of Reactor Isolation Cooling System (RCIC)</td>
</tr>
<tr>
<td>11th</td>
<td>15:42 Station Black Out</td>
</tr>
<tr>
<td>12nd</td>
<td>11:36 RCIC Shut Down</td>
</tr>
<tr>
<td>12nd</td>
<td>12:35 Automatic Startup of High Pressure Coolant Injection (HPCI) (Water Level L-2)</td>
</tr>
<tr>
<td>13rd</td>
<td>2:42 HPCI Shut Down</td>
</tr>
<tr>
<td>13rd</td>
<td>9:08 Confirmation of PCV Pressure Decrease (Several time Operations of Vent Valve Open)</td>
</tr>
<tr>
<td>13rd</td>
<td>9:20 Station Black Out</td>
</tr>
<tr>
<td>13rd</td>
<td>9:25 Started Fresh Water Injection via Fire Extinguish Line</td>
</tr>
<tr>
<td>13rd</td>
<td>13:12 Started Sea Water Injection via Fire Extinguish Line</td>
</tr>
<tr>
<td>14th</td>
<td>11:01 Hydrogen Explosion in the Reactor Building</td>
</tr>
</tbody>
</table>

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**Reason of Pressure Decrease of Reactor Vessel is not able to estimate at present**

- **12th 12:35 ~ 13th 2:42**
  - Tsunami Invasion → SOB
  - RCIC Shutdown (Reactor Water Level Down)

**Time Line of 1F3**

- ① RCIC start manually,
- ② RCIC stop,
- ③ HPCI start,
- ④ HPCI stop, ⑤ S/RV (open),
- ⑥ W/W vent (open),
- ⑦ Water inject., ⑧ W/W vent (close),
- ⑨ Sea water inject., ⑩ ~ ⑭ W/W vent (open ⇔ close)

**Analytical Result**

- 13th around 8:00
- 13th around 9:25
- 13th 13:12

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**Earquake Occurrence → Reactor Scram**

- RCIC Startup
- Tsunami Invasion → SOB
- Reactor Uncovered
- Hydrogen generation
- Core Melt - Relocation
- D/W Pressure Increase
- Fresh water Injection
- W/W Vent
- Sea Water Injection
- Pressure Stabilize
- Release of Radioactive Materials

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**Solid Line: Cross Check analysis result (○△) Actual Measurement**

**Graphs**

- Press. (MPa)
- Water level (mm)
- Relative time (h)
- Date

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**Notes**

- **Partially Move to RPV bottom**
- **Partially Move to PCV**
<table>
<thead>
<tr>
<th>Identifier</th>
<th>Analysis conditions</th>
<th>Remarks (results)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEPCO</td>
<td>Correspond to utility’s analysis</td>
<td>Table 1-1, Fig. 1-1-1~11</td>
</tr>
<tr>
<td>Case 1</td>
<td>Increasing of heat removal (restart IC-B with IC-A)</td>
<td>Table 1-2, Fig. 1-2-1~2</td>
</tr>
<tr>
<td>Case 2</td>
<td>① Amount of water injected through the fire protection line varies with RPV pressure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>② PCV leakage area at 50 hours is ca. 35 cm².</td>
<td>Table 1-3, Fig. 1-3-1~12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Identifier</th>
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<th>Remarks (results)</th>
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<tbody>
<tr>
<td>TEPCO-1</td>
<td>Correspond to utility’s analysis No.1</td>
<td>Table 2-1, Fig. 2-1-1~13</td>
</tr>
<tr>
<td>TEPCO-2</td>
<td>Correspond to utility’s analysis No.2</td>
<td>Table 2-2, Fig. 2-2-1~12</td>
</tr>
<tr>
<td></td>
<td>① Amount of water injected through the fire protection line varies with RPV pressure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>② PCV leakage area is ca. 50 cm².</td>
<td></td>
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<tr>
<td></td>
<td>③ S/C leakage area is ca. 300 cm²</td>
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<tr>
<td>Case-1</td>
<td>Based on the utility’s analysis No.1, but PCV is intact</td>
<td>Fig.2-3-1~2</td>
</tr>
<tr>
<td>Case-2</td>
<td>Based on the utility’s analysis No.1, but PCV leakage area is ca. 50 cm².</td>
<td>Fig.2-4-1</td>
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<tr>
<td>Case-3</td>
<td>Based on the utility’s analysis No.1, but S/C leakage area is ca. 300 cm²</td>
<td>Fig.2-5-1</td>
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<tbody>
<tr>
<td>TEPCO-1</td>
<td>Correspond to utility’s analysis No.1</td>
<td>Table 3-1, Fig. 3-1-1~11</td>
</tr>
<tr>
<td>TEPCO-2</td>
<td>Correspond to utility’s analysis No.2</td>
<td>Table 3-2, Fig. 3-2-1~14</td>
</tr>
<tr>
<td>Event</td>
<td>Results (this work)</td>
<td>Utility’s result</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Core exposure</td>
<td>16:40, Mar. 11</td>
<td>3 hours (relative time)</td>
</tr>
<tr>
<td>Core damage</td>
<td>18:00, Mar. 11</td>
<td>4 hours (relative time)</td>
</tr>
<tr>
<td>RPV failure</td>
<td>20:00, Mar. 11</td>
<td>15 hours (relative time)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event</th>
<th>Results (this work)</th>
<th>Utility’s result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core exposure</td>
<td>16:50, Mar. 11</td>
<td>3 hours (relative time)</td>
</tr>
<tr>
<td>Core damage</td>
<td>18:20, Mar. 11</td>
<td>4 hours (relative time)</td>
</tr>
<tr>
<td>RPV failure</td>
<td>2:50, Mar. 12</td>
<td>15 hours (relative time)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event</th>
<th>Results (this work)</th>
<th>Utility’s result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core exposure</td>
<td>16:40, Mar. 11</td>
<td>3 hours (relative time)</td>
</tr>
<tr>
<td>Core damage</td>
<td>18:00, Mar. 11</td>
<td>4 hours (relative time)</td>
</tr>
<tr>
<td>RPV failure</td>
<td>20:00, Mar. 11</td>
<td>15 hours (relative time)</td>
</tr>
</tbody>
</table>
### Table 2-1 Result of analysis on Unit 2 [TEPCO-1] and comparison to the utility’s result

<table>
<thead>
<tr>
<th>Event</th>
<th>Results (this work)</th>
<th>Utility’s result (No.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core exposure</td>
<td>18:00, Mar 14 75 hours (relative time)</td>
<td>75 hours (relative time)</td>
</tr>
<tr>
<td>Core damage</td>
<td>22:30, Mar 14 80 hours (relative time)</td>
<td>77 hours (relative time)</td>
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<tr>
<td>RPV failure</td>
<td>— (RPV doesn’t fail)</td>
<td>— (RPV doesn’t fail)</td>
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### Table 2-2 Result of analysis on Unit 2 [TEPCO-2] and comparison to the utility’s result

<table>
<thead>
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<th>Event</th>
<th>Results (this work)</th>
<th>Utility’s result (No.2)</th>
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<tbody>
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<td>Core exposure</td>
<td>18:00, Mar 14 75 hours (relative time)</td>
<td>75 hours (relative time)</td>
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<tr>
<td>Core damage</td>
<td>19:50, Mar 14 77 hours (relative time)</td>
<td>77 hours (relative time)</td>
</tr>
<tr>
<td>RPV failure</td>
<td>22:50, Mar 14 80 hours (relative time)</td>
<td>109 hours (relative time)</td>
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</table>

### Table 3-1 Result of analysis on Unit 3 [TEPCO-1] and comparison to the utility’s result

<table>
<thead>
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<th>Event</th>
<th>Results (this work)</th>
<th>Utility’s result (No. 1)</th>
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</thead>
<tbody>
<tr>
<td>Core exposure</td>
<td>7:40, Mar 13 41 hours (relative time)</td>
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<tr>
<td>Core damage</td>
<td>10:20, Mar 13 44 hours (relative time)</td>
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<tr>
<td>RPV failure</td>
<td>— (RPV doesn’t fail)</td>
<td>— (RPV doesn’t fail)</td>
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### Table 3-2 Result of analysis on Unit 3 [TEPCO-2] and comparison to the utility’s result

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<th>Utility’s result (No. 2)</th>
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<td>Core exposure</td>
<td>7:40, Mar 13 41 hours (relative time)</td>
<td>40 hours (relative time)</td>
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<tr>
<td>Core damage</td>
<td>10:20, Mar 13 44 hours (relative time)</td>
<td>42 hours (relative time)</td>
</tr>
<tr>
<td>RPV failure</td>
<td>22:10, Mar 14 79 hours (relative time)</td>
<td>66 hours (relative time)</td>
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<tr>
<td>Unit</td>
<td>Identifier of analysis</td>
<td>Noble gas</td>
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<td>1</td>
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<tr>
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<td>Radionuclide</td>
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<td>Unit 2</td>
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<tr>
<td>Xe-133</td>
<td>5.2 d</td>
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<tr>
<td>Cs-134</td>
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<td>Cs-137</td>
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<td>Sr-89</td>
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<td>Te-129m</td>
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<td>Sb-127</td>
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<tr>
<td>Mo-99</td>
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</table>

※: Evaluated by using the results of case2(unit 1), TEPCO-2(unit 2), TEPCO-2(unit3) in table 4
Fig. 1-1-1  RPV pressure and water level (unit 1) [TEPCO]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)

Fig. 1-1-2  D/W pressure (unit 1) [TEPCO]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)
Fig. 1-1-3  PCV pressure and temperature (unit 1) [TEPCO]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)

Fig. 1-1-4  Maximum temperature of the core (unit 1) [TEPCO]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)
Fig. 1-1-5 Mass of the core (unit 1) [TEPCO]

1) IC stop, 2) PCV failure (assumption), 3) W/W ventilation (open), 4) W/W ventilation (close), 5) sea water inject., 6) expansion of PCV failure (assumption)
Fig. 1-1-6  Distribution of intact fuel (unit 1) [TEPCO]
Fig. 1-1-7 Hydrogen generation (unit 1) [TEPCO]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)
Fig. 1-1-8  FP release ratio to the environment (1/2) (unit 1) [TEPCO]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)
Fig. 1-1-9  FP release ratio to the environment (2/2) (unit 1) [TEPCO]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)

Fig. 1-1-10  Distribution of CsI (unit 1) [TEPCO]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)
Fig. 1-1-11  Distribution of Cs (unit 1) [TEPCO]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)
Fig. 1-2-1 RPV pressure and water level (unit 1) [case 1]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)

Fig. 1-2-2 D/W pressure (unit 1) [case 1]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)
Fig. 1-3-1  RPV pressure and water level (unit 1) [case 2]
(1) IC stop, (2) PCV failure (assumption), (3) W/W ventilation (open), (4) W/W ventilation (close), (5) sea water inject., (6) expansion of PCV failure (assumption)

Fig. 1-3-2  D/W pressure (unit 1) [case 2]
(1) IC stop, (2) PCV failure (assumption), (3) W/W ventilation (open), (4) W/W ventilation (close), (5) sea water inject., (6) expansion of PCV failure (assumption)
Fig. 1-3-3  PCV pressure and temperature  (unit 1) [case 2]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)

Fig. 1-3-4  Maximum temperature of the core  (unit 1) [case 2]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)
Fig. 1-3-5  Mass of the core  (unit 1) [case 2]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)
Fig. 1-3-6  Distribution of intact fuel (unit 1) [case 2]
Fig. 1-3-7  Hydrogen generation (unit 1) [case 2]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)

Fig. 1-3-8  FP release ratio to the environment (1/3) (unit 1) [case 2]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)
Fig. 1-3-9  FP release ratio to the environment (2/3) (unit 1) [case 2]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)

Fig. 1-3-10  FP release ratio to the environment (3/3) (unit 1) [case 2]
① IC stop, ② PCV failure (assumption), ③ W/W ventilation (open), ④ W/W ventilation (close), ⑤ sea water inject., ⑥ expansion of PCV failure (assumption)
Fig. 1-3-11  Distribution of CsI (unit 1) [case 2]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)

Fig. 1-3-12  Distribution of Cs (unit 1) [case 2]
①IC stop, ②PCV failure (assumption), ③W/W ventilation (open), ④W/W ventilation (close), ⑤sea water inject., ⑥expansion of PCV failure (assumption)
Fig. 2-1-1 Amount of water injection (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-1-2 RPV pressure and water level (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-1-3 D/W pressure (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-1-4 PCV pressure and temperature (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-1-5 Maximum temperature of the core (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-1-6 Mass of the core (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-1-7 Distribution of intact fuel (unit 2) [TEPCO-1]

Fig. 2-1-8 Hydrogen generation (unit 2) [TEPCO-1]

①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-1-9 FP release ratio to the environment (1/3) (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-1-10 FP release ratio to the environment (2/3) (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-1-11 FP release ratio to the environment (3/3) [TEPCO-1]
① RCIC start manually, ② SBO, ③ Water source change from CST to S/P, ④ RCIC stop, ⑤ Sea water inject., ⑥ RPV depressurized, ⑦ S/R valve-2 open, ⑧ Impact sound

Fig. 2-1-12 Distribution of CsI (unit 2) [TEPCO-1]
① RCIC start manually, ② SBO, ③ Water source change from CST to S/P, ④ RCIC stop, ⑤ Sea water inject., ⑥ RPV depressurized, ⑦ S/R valve-2 open, ⑧ Impact sound
Fig. 2-1-13 Distribution of Cs (unit 2) [TEPCO-1]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea
water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-2-1 Amount of water injection (unit 2) [TEPCO-2]
① RCIC start manually, ② SBO, ③ Water source change from CST to S/P, ④ RCIC stop, ⑤ Sea water inject., ⑥ RPV depressurized, ⑦ S/R valve-2 open, ⑧ Impact sound

Fig. 2-2-2 RPV pressure and water level (unit 2) [TEPCO-2]
① RCIC start manually, ② SBO, ③ Water source change from CST to S/P, ④ RCIC stop, ⑤ Sea water inject., ⑥ RPV depressurized, ⑦ S/R valve-2 open, ⑧ Impact sound
Fig. 2-2-3 D/W pressure (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-2-4 PCV pressure and temperature (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-2-5 Maximum temperature of the core (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-2-6 Mass of the core (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-2-7 Distribution of intact fuel (unit 2) [TEPCO-2]
Fig. 2-2-8 Hydrogen generation (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-2-9 FP release ratio to the environment (1/2) (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-2-10 FP release ratio to the environment (2/2) (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-2-11 Distribution of CsI (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-2-12 Distribution of Cs (unit 2) [TEPCO-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 2-3-1 D/W pressure (unit 2) [case-1]
① RCIC start manually, ② SBO, ③ Water source change from CST to S/P, ④ RCIC stop, ⑤ Sea water inject., ⑥ RPV depressurized, ⑦ S/R valve-2 open, ⑧ Impact sound

Fig. 2-3-2 RPV pressure and water level (unit 2) [case-1]
① RCIC start manually, ② SBO, ③ Water source change from CST to S/P, ④ RCIC stop, ⑤ Sea water inject., ⑥ RPV depressurized, ⑦ S/R valve-2 open, ⑧ Impact sound
Fig. 2-4-1 D/W pressure (unit 2) [case-2]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound

Fig. 2-5-1 D/W pressure (unit 2) [case-3]
①RCIC start manually, ②SBO, ③Water source change from CST to S/P, ④RCIC stop, ⑤Sea water inject., ⑥RPV depressurized, ⑦S/R valve-2 open, ⑧Impact sound
Fig. 3-1-1 Amount of water injection (unit 3) [TEPCO-1]


Fig. 3-1-2 RPV pressure and water level (unit 3) [TEPCO-1]

Fig.3-1-3 D/W pressure (unit 3) [TEPCO-1]
①RCIC start manually, ②RCIC stop, ③HPCI start, ④HPCI stop, ⑤S/RV(open), ⑥PCV vent (open),
⑦Water inject., ⑧PCV vent (close), ⑨Sea water inject., ⑩~⑭PCV vent (open⇔close)

Fig.3-1-4 PCV pressure and temperature (unit 3) [TEPCO-1]
①RCIC start manually, ②RCIC stop, ③HPCI start, ④HPCI stop, ⑤S/RV(open), ⑥PCV vent (open),
⑦Water inject., ⑧PCV vent (close), ⑨Sea water inject., ⑩~⑭PCV vent (open⇔close)
Fig. 3-1-5 Maximum temperature of the core (unit 3) [TEPCO-1]

1. RCIC start manually,
2. RCIC stop,
3. HPCI start,
4. HPCI stop,
5. S/RV(open),
6. PCV vent (open),
7. Water inject.,
8. PCV vent (close),
9. Sea water inject.,
10~14. PCV vent (open ⇔ close)

Fig. 3-1-6 Mass of the core (unit 3) [TEPCO-1]

1. RCIC start manually,
2. RCIC stop,
3. HPCI start,
4. HPCI stop,
5. S/RV(open),
6. PCV vent (open),
7. Water inject.,
8. PCV vent (close),
9. Sea water inject.,
10~14. PCV vent (open ⇔ close)
Fig. 3-1-7 Distribution of intact fuel (unit 3) [TEPCO-1]

Fig. 3-1-8 Hydrogen generation (unit 3) [TEPCO-1]

① RCIC start manually, ② RCIC stop, ③ HPCI start, ④ HPCI stop, ⑤ S/RV(open), ⑥ PCV vent (open), ⑦ Water inject., ⑧ PCV vent (close), ⑨ Sea water inject., ⑩~⑭ PCV vent (open ⇔ close)
Fig. 3-1-9 FP release ratio to the environment (unit 3) [TEPCO-1]

① RCIC start manually, ② RCIC stop, ③ HPCI start, ④ HPCI stop, ⑤ S/RV (open), ⑥ PCV vent (open), ⑦ Water inject., ⑧ PCV vent (close), ⑨ Sea water inject., ⑩~⑭ PCV vent (open ⇔ close)
Fig. 3-1-10 Distribution of CsI (unit 3) [TEPCO-1]
① RCIC start manually, ② RCIC stop, ③ HPCI start, ④ HPCI stop, ⑤ S/RV(open), ⑥ PCV vent (open), ⑦ Water inject., ⑧ PCV vent (close), ⑨ Sea water inject., ⑩~⑭ PCV vent (open⇔close)

Fig. 3-1-11 Distribution of Cs (unit 3) [TEPCO-1]
① RCIC start manually, ② RCIC stop, ③ HPCI start, ④ HPCI stop, ⑤ S/RV(open), ⑥ PCV vent (open), ⑦ Water inject., ⑧ PCV vent (close), ⑨ Sea water inject., ⑩~⑭ PCV vent (open⇔close)
Fig. 3-2-1 Amount of water injection (unit 3) [TEPCO-2]
①RCIC start manually, ②RCIC stop, ③HPCI start, ④HPCI stop, ⑤S/RV(open), ⑥PCV vent (open), ⑦Water inject., ⑧PCV vent (close), ⑨Sea water inject., ⑩~⑭PCV vent (open ⇔ close)

Fig. 3-2-2 RPV pressure and water level (unit 3) [TEPCO-2]
①RCIC start manually, ②RCIC stop, ③HPCI start, ④HPCI stop, ⑤S/RV(open), ⑥PCV vent (open), ⑦Water inject., ⑧PCV vent (close), ⑨Sea water inject., ⑩~⑭PCV vent (open ⇔ close)
Fig. 3-2-3 D/W pressure (unit 3) [TEPCO-2]
1. RCIC start manually, 2. RCIC stop, 3. HPCI start, 4. HPCI stop, 5. S/RV(open), 6. PCV vent (open),

Fig. 3-2-4 PCV pressure and temperature (unit 3) [TEPCO-2]
1. RCIC start manually, 2. RCIC stop, 3. HPCI start, 4. HPCI stop, 5. S/RV(open), 6. PCV vent (open),
Fig. 3-2-5 Maximum temperature of the core (unit 3) [TEPCO-2]

1. RCIC start manually,
2. RCIC stop,
3. HPCI start,
4. HPCI stop,
5. S/RV open,
6. PCV vent open,
7. Water inject.,
8. PCV vent close,
9. Sea water inject.,
10. - 14. PCV vent open ⇔ close

Fig. 3-2-6 Mass of the core (unit 3) [TEPCO-2]

1. RCIC start manually,
2. RCIC stop,
3. HPCI start,
4. HPCI stop,
5. S/RV open,
6. PCV vent open,
7. Water inject.,
8. PCV vent close,
9. Sea water inject.,
10. - 14. PCV vent open ⇔ close
① RCIC start manually, ② RCIC stop, ③ HPCI start, ④ HPCI stop, ⑤ S/RV (open), ⑥ PCV vent (open), ⑦ Water inject., ⑧ PCV vent (close), ⑨ Sea water inject., ⑩ ～⑮ PCV vent (open ⇔ close)

Fig.3-2-7 Distribution of intact fuel (unit 3) [TEPCO-2]

Fig.3-2-8 Hydrogen generation (unit 3) [TEPCO-2]
Fig. 3-2-9 FP release ratio to the environment (1/2) (unit 3) [TEPCO-2]

1. RCIC start manually, 2. RCIC stop, 3. HPCI start, 4. HPCI stop, 5. S/RV(open), 6. PCV vent (open),
Fig 3-2-10 FP release ratio to the environment (2/2) (unit 3) [TEPCO-2]
① RCIC start manually, ② RCIC stop, ③ HPCI start, ④ HPCI stop, ⑤ S/RV(open), ⑥ PCV vent (open), ⑦ Water inject., ⑧ PCV vent (close), ⑨ Sea water inject., ⑩～⑭ PCV vent (open ⇔ close)

Fig 3-2-11 Distribution of CsI (1/2) (unit 3) [TEPCO-2]
① RCIC start manually, ② RCIC stop, ③ HPCI start, ④ HPCI stop, ⑤ S/RV(open), ⑥ PCV vent (open), ⑦ Water inject., ⑧ PCV vent (close), ⑨ Sea water inject., ⑩～⑭ PCV vent (open ⇔ close)
Fig.3-2-12 Distribution of CsI (2/2)(unit 3) [TEPCO-2]


Fig.3-2-13 Distribution of Cs (1/2)(unit 3) [TEPCO-2]

Fig. 3-2-14 Distribution of Cs (2/2)(unit 3) [TEPCO-2]