Unit 1 Primary Containment Vessel (PCV) Investigation at Fukushima Daiichi Nuclear Power Station

Tokyo Electric Power Company Holdings, Inc.
1. Work steps for Unit 1 PCV investigation

**STEP1. Removal of a thermometer and water gauge and replacement of a guiding pipe**

A guiding pipe will be replaced after a thermometer and water gauge is removed by the cable drum.

**STEP2. PCV investigation using a self-propelled device**

A deposit sampling unit will be installed and deposits inside PCV will be sampled using a pump.

**STEP3. Deposit sampling and re-installation of a thermometer and water gauge**

*Deposit: floating materials within the retained water and their precipitate*
2. Step 2: Overview of PCV investigation using a self-propelled device (1/4)

**Presence of fuel debris will be estimated from the comparison and evaluation of measurement results.**

- Presence of fuel debris will be estimated from the comparison of radiation doses and distances subtracted from the background data.
- **It is necessary to compare and evaluate digital images and radiation data** because radiation levels can increase locally around the pipes connected to the reactor. **Evaluation results will be provided later after organizing the data.**

**Measurement items: digital images and radiation doses**

<table>
<thead>
<tr>
<th>Measurement points</th>
<th>Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Spreading of fuel debris from drain sump</td>
</tr>
<tr>
<td>BG</td>
<td>Background levels against D0-D3 measurements</td>
</tr>
<tr>
<td>D1, D2</td>
<td>Spreading of fuel debris from opening</td>
</tr>
<tr>
<td>D3</td>
<td>Possibility of fuel debris reaching to PCV shell</td>
</tr>
</tbody>
</table>

**Investigation plan**  
Day 1: D0  ⇒  Day 2: BG  ⇒  Day 3: D2, D3  ⇒  Day 4: D1
Investigation with a self-propelled device will be conducted **without influencing the surrounding environment with leakage of air from PCV.** A boundary will be created by installing a sealed box with a self-propelled device to a guiding pipe and then inserting the device into the PCV.

To check the air leakage, **dust concentrations will be monitored with a dust sampler during the investigation.**
2. Step 2: Overview of PCV investigation using a self-propelled device 3/4)

Appearance of a self-propelled investigation device

- Laser guide
- Storage space for a camera and dosimeter
- When capturing digital images and measuring radiation doses

When inserted into a guiding pipe

- Inner diameter of a guiding pipe: φ100mm
- About 700mm
- Traveling direction

When traveling on 1st floor metal grating inside PCV

- Sensor unit integrating a camera and dosimeter
- Traveling direction

Cable specification
- Composite cable including optical fiber

Measurement unit (dosimeter & underwater camera)
- About Φ20mm × about 40mm

Dosimeter measurement range: $1 \times 10^{-1} \sim 1 \times 10^4$ Gy/h
- Underwater camera: 350,000 pixel
- Radiation resistance: 1000Gy
### Challenge and response based on the investigation results in April 2015

<table>
<thead>
<tr>
<th>Unit 1 PCV investigation (conducted in April 2015)</th>
<th>Challenge</th>
<th>Things reflected to this investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The device got stuck in the grating ditch and could not move any more.</td>
<td>Information about the conditions of the floor was not enough.</td>
<td>・<strong>Laser guides will be installed</strong> in front of the device to improve the spatial ability as well as to enable the device to travel while checking obstacles and openings.</td>
</tr>
<tr>
<td>Camera screen could not be checked any more because it was affected by radiation.</td>
<td>Measures against radioactive degradation were not enough.</td>
<td>・When the investigation is not conducted, <strong>the monitoring camera will be retrieved into the guiding pipe</strong>.</td>
</tr>
</tbody>
</table>

### Other challenge and response

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Things reflected to this investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are many structures within the retained water, such as scaffolds and pipes, which can pose obstacles to the device.</td>
<td>The measurement unit will be hung down and pulled up carefully.</td>
</tr>
<tr>
<td>Visibility within the retained water could be poor because it was observed in the previous investigation (B1) that floating deposits flew up in the retained water.</td>
<td>The measurement unit will be hung down <strong>carefully no to let floating deposits fly up</strong>.</td>
</tr>
<tr>
<td>When floating deposits in the retained water adhere to the measurement unit, radiation doses may not be measured accurately.</td>
<td>The measurement unit will be hung down <strong>carefully no to touch the bottom of the basement floor</strong>.</td>
</tr>
</tbody>
</table>

- To prioritize the acquisition of site data, such as conditions of the pedestal opening of the basement floor and radiation doses, for the eventual removal of fuel debris, **it will be determined whether to retrieve the device depending on the situation**.
It was observed that floating deposits flew up within the PCV retained water when a permanent monitoring instrument was reinstalled after the previous investigation (April 2015).

Sampling of the deposits at the bottom of PCV will be conducted to identify them and determine how to remove and treat them because they can pose obstacles to the future investigation and fuel debris removal.

The sampled deposits will be analyzed with the simple X-ray fluorescence in a glove box to find the component.

*When the amount of the sampled deposits is large and radiation level is too high to deal with, a part of the deposits will be returned into the PCV.
Deposits near the X-100B penetration will be sampled with the retained water after a boundary is created by attaching a sealed box with a deposit sampling unit to a guiding pipe, so that the surrounding environment will not be affected with air leakage from the PCV.

To check the leakage, dust concentrations will be monitored with a dust sampler during the investigation.

After the sampling, a thermometer and dosimeter will be reinstalled inside the PCV.
3. Step 3: Overview of deposit sampling (3/3)

Drum for a hose and deposit sampling unit

Deposit sampling unit

Drum for a hose

Water sucking hose

To PCV

View from A direction

Deposit sampling unit

Receiver tank

Pump

Sampling bottle
### 4. Schedule (tentative)

<table>
<thead>
<tr>
<th>Work steps</th>
<th>Year of 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>February</td>
</tr>
<tr>
<td>Preparation</td>
<td>Training</td>
</tr>
<tr>
<td>Removal of a thermometer and dosimeter</td>
<td>3/2 (conducted)</td>
</tr>
<tr>
<td>Replacement of a guiding pipe</td>
<td>3/6~ (underway)</td>
</tr>
<tr>
<td>PCV investigation</td>
<td></td>
</tr>
<tr>
<td>Deposit sampling</td>
<td></td>
</tr>
<tr>
<td>Reinstallation of a thermometer and dosimeter</td>
<td></td>
</tr>
</tbody>
</table>

Today
5. Impact to the surrounding environment

- Relatively high radiation may be measured due to the proximity to fuel debris expected to exist at the bottom of PCV.
- In the case of measuring radiation levels more than several hundreds of Sievert per hour in the PCV, the levels will be reduced by the shielding of PCV concrete walls and steels.
- A boundary will be created during the investigation not to let the air from the PCV leak to the outside.
- Real-time data of monitoring posts and dust monitors along the site boundary are available on the website.

6. Monitoring of the plant parameters

- In the case of measuring radiation levels more than several hundreds of Sievert per hour in the PCV, it does not mean that a new event has occurred but rather the area that has not been investigated since the March 2011 accident was investigated for the first time.
- Plant parameters are monitored all the time during the investigation.
- Temperature data inside the PCV are available on the website.