Main decommissioning works and steps

Fuel removal from Unit 4 SFP has been completed and preparatory work to remove fuel from Unit 1-3 SFP and fuel debris (Note 1) removal is ongoing.

(Note 1) Fuel assemblies melted through in the accident.

Fuel Debris Removal

Rubble removal & dose reduction
Installing a Fuel-Handling Machine
Fuel removal
Storage and handling

Capturing the status inside the PCV/ examination of the fuel debris removal method, etc. (Note 2)

Fuel debris removal
Storage and handling

Dismantling Facilities

Scenario development & technology consideration
Design and manufacturing of devices / equipment
Dismantling

Three principles behind contaminated water countermeasures

Countermeasures for contaminated water are implemented in accordance with the following three principles:

1. Eliminate contamination sources
   - Multi-nuclide removal equipment, etc.
   - Remove contaminated water from the trench (Note 3)
   - (Note 3) Underground tunnel containing pipes.

2. Isolate water from contamination
   - Pump up groundwater for bypassing
   - Pump up groundwater near buildings
   - Land-side impermeable walls
   - Waterproof pavement

3. Prevent leakage of contaminated water
   - Enhance soil by adding sodium silicate
   - Sea-side impermeable walls
   - Increase the number of (welded-joint) tanks

Multi-nuclide removal equipment (ALPS), etc.
- This equipment removes radionuclides from the contaminated water in tanks and reduces risks.
- Treatment of contaminated water (RO concentrated salt water) was completed in May 2015 via multi-nuclide removal equipment, additional multi-nuclide removal equipment installed by TEPCO (operation commenced in September 2014) and a subsidy project of the Japanese Government (operation commenced in October 2014).
- Strontium-treated water from equipment other than ALPS is being re-treated in ALPS.

Land-side impermeable walls
- Land-side impermeable walls surround the buildings and reduce groundwater inflow into the same.
- Freezing started on the sea side and part of the mountain side from March 2016 and on 95% of the mountain side from June 2016. From December 2016, freezing started for two of seven unfrozen sections on the mountain side.
- On the sea side, the underground temperature declined below 0°C throughout the scope requiring freezing except for the unfrozen parts under the seawater pipe trenches and the areas above groundwater level in October 2016.

Sea-side impermeable walls
- Impermeable walls are being installed on the sea side of Units 1-4, to prevent the contaminated groundwater from flowing into the sea.
- The installation of steel pipe sheet piles was completed in September 2015 and they were connected in October 2015. These works completed the closure of the sea-side impermeable walls.
Progress Status and Future Challenges of the Mid- and Long-Term Roadmap toward Decommissioning of TEPCO Holdings’ Fukushima Daiichi Nuclear Power Station Units 1-4 (Outline)

**Results of investigation inside the Unit 2 PCV**

To investigate the status inside the Unit 2 Primary Containment Vessel (PCV) pedestal* including the fall of fuel debris, prior investigation inside the PCV using a guide pipe was conducted on January 26 and 30, deposit on the access route of the self-propelled investigation device was removed on February 9, and an investigation inside the PCV using the device was conducted on February 16.

The results of this series of investigations confirmed fallen and deformed gratings and a quantity of deposit inside the pedestal.

The evaluation results of the collected information will be utilized when considering the policy for fuel debris removal.

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**Towards investigation inside the Unit 1 PCV**

To investigate the status of debris spreading to the basement floor outside the pedestal, based on the results of an investigation conducted on the 1st floor grating in April 2015, a self-propelled investigation device will be injected in March.

In the investigation, a camera, etc. will be suspended from the 1st floor grating to inspect the status of the basement floor.

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**Operation start of the partner company building**

From February 20, partner companies started to transfer sequentially to the partner company building established on site. This measure creates an environment where staff members of partner companies and TEPCO work together in neighboring locations to be involved in decommissioning as an integrated organization of the power station.

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**Reduction of water injection volume to the Unit 3 reactor and data disclosure**

To facilitate purification of contaminated water in buildings, the water injection volume to the Unit 3 reactor was reduced from 4.5 m³/h as was done for Unit 1, and reached the target volume of 3.0 m³/h on February 22. Temperatures in the Reactor Pressure Vessel (RPV), etc. remained within the anticipated range.

Prior to reducing the Unit 3 reactor water injection volume, real-time data disclosure of plant parameters such as Unit 1-3 RPV bottom temperatures started from February 7. The graphs of temperature changes, etc. are updated hourly.
Data of Monitoring Posts (MP1-MP8)

Data (10-minute value) of Monitoring Posts (MPs) measuring airborne radiation rate around site boundaries show 0.503 – 2.100 μSv/h (January 25 – February 21, 2017).

We improved the measurement conditions of monitoring posts 2 to 8 to measure the air dose rate precisely. Construction works, such as tree-clearing, surface soil removal and shield wall setting, were implemented from February 10 to April 18, 2012. Therefore monitoring results at these points are lower than elsewhere in the power plant site. The radiation shielding from trees and other materials around monitoring post 6, which is one of the instruments used to measure the radiation dose of the power station site boundary, were taken off from July 10-11, 2013, since the surrounding radiation dose has largely declined due to further deforestation, etc.
I. Confirmation of the reactor conditions

1. Temperatures inside the reactors

Through continuous reactor cooling by water injection, the temperatures of the Reactor Pressure Vessel (RPV) bottom and the Primary Containment Vessel (PCV) gas phase were maintained within the range of approx. 15 to 25°C for the past month, though varying depending on the unit and location of the thermometer.

- Operation of groundwater bypass
  - From April 9, 2014, the operation of 12 groundwater bypass pumping wells commenced sequentially to pump up groundwater. The operation started from May 21, 2014 in the presence of officials from the Intergovernmental Liaison Office for the Decommissioning and Contaminated Water Issue of the Cabinet Office. Up until February 21, 2017, 258,866 m³ of groundwater had been released. The pumped-up groundwater was temporarily stored in tanks and released after TEPCO and a third-party organization had confirmed that its quality met operational targets.
  - Pumps are inspected and cleaned as necessary based on their operational status.

2. Release of radioactive materials from the Reactor Buildings

As of January 2017, the density of radioactive materials newly released from Reactor Building Units 1-4 in the air and measured at the site boundary was evaluated at approx. 3.5×10⁻¹² Bq/cm³ for Cs-134 and 1.0×10⁻¹¹ Bq/cm³ for Cs-137 at the site boundary. The radiation exposure dose due to the release of radioactive materials was less than 0.00029 mSv/year at the boundary.

- Note: Different formulas and coefficients were used to evaluate the radiation dose in the facility operation plan and monthly report. The evaluation methods were integrated in September 2012. As the fuel removal from the spent fuel pool (SFP) commenced for Unit 4, the radiation exposure dose from Unit 4 was added to the items subject to evaluation since November 2013. The evaluation has been changed to a method considering the values of continuous dust monitors since FY2015, with data to be evaluated monthly and announced the following month.

- Operation of groundwater bypass
  - From April 9, 2014, the operation of 12 groundwater bypass pumping wells commenced sequentially to pump up groundwater. The operation started from May 21, 2014 in the presence of officials from the Intergovernmental Liaison Office for the Decommissioning and Contaminated Water Issue of the Cabinet Office. Up until February 21, 2017, 258,866 m³ of groundwater had been released. The pumped-up groundwater was temporarily stored in tanks and released after TEPCO and a third-party organization had confirmed that its quality met operational targets.
  - Pumps are inspected and cleaned as necessary based on their operational status.

- Water treatment facility special for Subdrain & Groundwater drains
  - To reduce the groundwater flowing into the buildings, work began to pump up groundwater from wells (subdrains) around the buildings on September 3, 2015. The pumped-up groundwater was then purified at dedicated facilities and released from September 14, 2015. Up until February 21, 2017, a total of 276,441 m³ had been drained after TEPCO and a third-party organization had confirmed that its quality met operational targets.

- Due to the level of the groundwater drain pond rising since the sea-side impermeable walls were closed, pumping started on November 5, 2015. Up until February 21, 2017, a total of approx. 119,000 m³ had been pumped up. Approx. 30 m³/day is being transferred from the groundwater drain to the Turbine Buildings (average for the period January 19 - February 15, 2017).

- The effect of groundwater inflow control by subdrains is evaluated by both correlations: the “subdrain water levels” and the “difference between water levels in subdrains and buildings”, for the time being.

3. Other indices

- As of February 16, 2017
  - An area is being constructed to install additional water collection tanks and temporary water storage tanks.

- Construction status of the land-side impermeable walls
  - As for the land-side impermeable walls (on the mountain side), freezing and closure of seven unfrozen sections have been advanced with a phased approach. Regarding two of the seven sections, as a result of freezing started on December 3 and a supplementary method implemented (completed on February 8), the temperature declined below 0°C in the area to which the supplementary method was applied. In the next phase, freezing of four of the remaining five sections will start. Prior to the freezing, a supplementary method has been implemented from February 22.
- The effect of the land-side impermeable walls (on the mountain side) will be evaluated in terms of groundwater level, inflow volume into the buildings, groundwater volume pumped from subdrains and groundwater volume transferred to the area 4 m above sea level.
- The effect of the land-side impermeable walls (on the sea side) will continue to be evaluated.

Regarding the multi-nuclide removal equipment (existing, additional and high-performance), hot tests using radioactive water were underway (for existing equipment, System A: from March 30, 2013, System B: from June 13, 2013, System C: from September 27, 2013; for additional equipment, System A: from September 17, 2014, System B: from September 27, 2014, System C: from October 9, and for high-performance equipment, from October 18, 2014).

As of February 16, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 331,000, 321,000 and 103,000 m³ respectively (including approx. 9,500 m³ stored in the #1(D) tank, which contained water with a high density of radioactive materials at the System B outlet of existing multi-nuclide removal equipment).

To reduce the risks of strontium-treated water, treatment using existing, additional and high-performance multi-nuclide removal equipment has been underway (existing: from December 4, 2015; additional: from May 27, 2015; high-performance: from April 15, 2015). Up until February 16, approx. 304,000 m³ had been treated.

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**Figure 2:** Closure of part of the land-side impermeable walls (on the mountain side)

**Figure 3:** Status of accumulated water storage

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**Table:**

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<tr>
<th>Date</th>
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<td>January 19 - 26</td>
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<tr>
<td>January 26 – February 2</td>
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<tr>
<td>February 2 - 9</td>
<td>approx. 145 m³/day</td>
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<tr>
<td>February 9 – 16</td>
<td>approx. 158 m³/day</td>
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</tbody>
</table>

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1. Water amount at which water-level gauge indicates 0% or more
2. Since September 10, 2015, the data collection method has been changed.
   (Evaluation based on increase in storage in buildings and tanks)
   → Evaluation based on increase/decrease in storage in buildings

3. Since April 23, 2015, the data collection method has been changed.
   (Increase in storage (1)-(2) → (1)-(2)+(3))


5. "Increase/decrease of water held in buildings" used to evaluate "Inflow of groundwater/rainwater into buildings" and "Storage increase" is calculated based on the data from the water-level gauges. During the following evaluation periods, when the gauge was calibrated, these two values were evaluated lower than anticipated.

6. For rainfall, data of Namie (from data published by the Japan Meteorological Agency) is used. However, due to missing values, data of Tomioka (from data published by the Japan Meteorological Agency) is used alternatively (April 14-21, 2016).
3. Removal of fuel debris

Status toward investigation inside the Unit 1 PCV
- To investigate the status of fuel debris inside the primary containment vessel (PCV) (the basement floor outside the pedestal), a self-propelled investigation device will be injected into the Unit 1 PCV in March.
- A camera and dosimeter will be suspended from the 1st floor grating outside the pedestal to inspect the status of the basement floor outside the pedestal and the opening.

Status toward investigation inside the Unit 2 PCV
- To investigate the status inside the PCV pedestal including the fall of fuel debris, prior investigation inside the PCV was conducted on January 26 and 30, deposit on the access route of the self-propelled investigation device was removed on February 9 and the inside of the PCV was investigated using the device on February 16.
- The results of this series of investigations confirmed fallen and deformed gratings and a quantity of deposit inside the pedestal.

Progress of accumulated water treatment at Unit 1 T/B
- Accumulated water of the Unit 1 Turbine Building (T/B) will be treated down to the lowest floor surface by the end of FY2016 as part of efforts to reduce the risk of accumulated water leakage from buildings.
- Following the completion of work to reduce the dose and remove obstacles, installation of transfer equipment is underway. Inspection and test operation will start sequentially from the end of February. Furthermore, as a measure to reduce dust, sludge, which may float in the air as dust, was collected from February 1 before the floor surface was exposed.

2. Fuel removal from the spent fuel pools

Main work to help remove spent fuel at Unit 1
- The status of rubble under the fallen roof is being investigated (from September 13, 2016 and scheduled for completion at the end of February, 2017) to collect data, which will then be used when considering rubble removal methods for the Unit 1 Reactor Building operating floor. No significant variation associated with the work was identified at monitoring posts and dust monitors. The building cover is being dismantled, with anti-scattering measures steadily implemented and safety first.
- An annual inspection of cranes used in the work to dismantle the Unit 1 building cover is underway (from November 23, 2016 and scheduled for completion at the end of February, 2017).
- Pillars and beams of the building cover will be modified and windbreak sheets installed on the beams from March 2017. The pillars and beams (covered by windbreak sheets) will be restored in the 1st half of FY2017.

Main work to help remove spent fuel at Unit 2
- To help remove the spent fuel from the pool of the Unit 2 Reactor Building, construction has been underway from September 28, 2016 on the west side of the Reactor Building to install a gantry and a front chamber accessing the operating floor. Installation of the gantry was completed on February 21, Preparatory work for installation of the front chamber is underway (the installation will be completed in late April 2017).

Main work to help remove spent fuel at Unit 3
- From January 17, work started to install the cover for fuel removal, etc. (stoppers*: hanging was completed on February 13; FHM girder*: work will start from early March).

Management status of rubble and trimmed trees
- As of the end of January 2017, the total storage volume of concrete and metal rubble was approx. 200,400 m³ (+1,900 m³ compared to at the end of December, with an area-occupation rate of 72%). The total storage volume of trimmed trees was approx. 79,300 m³ (-3,600 m³, with an area-occupation rate of 75%). The total storage volume of used protective clothing was approx. 46,700 m³ (-2,300 m³, with an area-occupation rate of 91%). The increase in rubble was mainly attributable to facing. The decrease in trimmed trees was mainly attributable to transfer to temporary storage areas. The decrease in used protective clothing was mainly attributable to the incineration of used clothing.

Management status of secondary waste from water treatment
- As of February 16, 2017, the total storage volume of waste sludge was 597 m³ (area-occupation rate: 85%) and that of concentrated waste fluid was 9,262 m³ (area-occupation rate: 87%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment, etc. was 3,519 (area-occupation rate: 56%).

Suspension of the Radioactive Waste Incinerator for inspection
- On February 12, 2017, operation of the Radioactive Waste Incinerator was suspended. Along with the annual inspection, additional measures will be implemented for the pitting corrosion and stress corrosion cracking detected in August 2016 and operation will resume by the end of June 2017.

5. Reactor cooling

The cold shutdown condition will be maintained by cooling the reactor by water injection and measures to complement the status monitoring will continue.

Reduction of volume of water injected into the Unit 1-3 reactors
- The volume of water injected into the Unit 3 reactor was reduced from 4.5 to 4.0 m³/h from February 8, from 4.0 to 3.5 m³/h from February 15 and 3.5 to 3.0 m³/h from February 22. No abnormality attributable to the reduction was detected in the cold shutdown condition.
- The volume of water injected into Unit 2 reactor will be reduced in March 2017.
- Prior to the reduction of Unit 3 reactor water injection volume, real-time disclosure of plant parameters such as RPV bottom temperature started from February 7.
Regarding radioactive materials in the groundwater near the bank between the Unit 3 and 4 intakes, though the densities of tritium and gross β radioactive materials at groundwater Observation Hole No. 3-2 had been increasing since September 2016, they have been gradually declining since the end of October from 3,000 Bq/L for tritium and 3,500 Bq/L for gross β radioactive materials and both are currently slightly higher than before the increase at around 1,500 Bq/L. At groundwater Observation Hole No. 3-3, though the tritium density had been increasing since September 2016, it has been gradually declining from 2,500 Bq/L since early November and is currently slightly higher than before the increase at around 1,500 Bq/L. At groundwater Observation Hole No. 3-4, though the tritium density had been declining since September 2016, it has been gradually increasing from 2,500 Bq/L since the end of October and currently stands at the same level before the decline at around 4,000 Bq/L. Since April 1, 2015, pumping of groundwater continued (at the well point between the Unit 3 and 4 intakes: December 18, 2013 - October 13, 2015; at the repaired well: from October 14, 2015).

Regarding radioactive materials in seawater in the Unit 1-4 intake area, densities have remained low except for the increase in cesium 137 and gross β radioactive materials during heavy rain. They have been declining following the completed installation and the connection of steel pipe sheet piles for the sea-side impermeable walls.

Regarding the radioactive materials in seawater in the area outside the port, densities have remained constant and within the same range as before.

The location of the sampling point “Near south release outlet” was shifted from approx. 330 to 280 m south of the south release outlet due to repair of the breakwater (from January 27). The location of the sampling point “North side of east breakwater” was shifted approx. 50 m south of the previous point (from February 11).
7. Outlook of the number of staff required and efforts to improve the labor environment and conditions

Securing appropriate staff long-term while thoroughly implementing workers’ exposure dose control. Improving the work environment and labor conditions continuously based on an understanding of workers’ on-site needs

- Staff management

  - The monthly average total of people registered for at least one day per month to work on site during the past quarter from October to December 2016 was approx. 12,500 (TEPCO and partner company workers), which exceeded the monthly average number of actual workers (approx. 9,700). Accordingly, sufficient people are registered to work on site.

  - It was confirmed with the prime contractors that the estimated manpower necessary for the work in March 2017 (approx. 5,950 per day: TEPCO and partner company workers) would be secured at present. The average numbers of workers per day for each month (actual values) were maintained, with approx. 4,500 to 7,500 since FY2014. (See Figure 7.)

  - Some works for which contractual procedures have yet to be completed were excluded from the estimate for March 2017.

  - The number of workers from outside Fukushima Prefecture has decreased. The local employment ratio (TEPCO and partner company workers) as of January has remained around 55%.

- Measures to prevent infection and the expansion of influenza and norovirus

  - Since November, measures for influenza and norovirus have been implemented, including free influenza vaccinations (subsidized by TEPCO Holdings) in the Fukushima Daiichi Nuclear Power Station (from October 26 to December 2) and medical clinics around the site (from November 1 to January 31, 2017) for partner company workers. As of January 31, a total of 8,206 workers had been vaccinated. In addition, a comprehensive range of other measures is also being implemented and notified to all workers, including daily actions to prevent infection and expansion (measuring body temperature, health checks and monitoring infection status) and response after detecting possible infections (control of swift entry/exit and mandatory wearing of masks in working spaces).

- Status of influenza and norovirus cases

  - Until the seventh week of 2017 (February 13-19, 2017), there were 362 influenza infections and 15 norovirus infections.
infections. The totals for the same period for the previous season showed 128 cases of influenza and ten norovirus infections.

➢ Operation start of the partner company building
  • As work to modify the new Administration Building into the partner company building was almost completed, partner companies are sequentially transferring to the building from February 20 to start operation.
  • This measure creates an environment where staff members of TEPCO and partner companies are working together in neighboring locations to be involved in decommissioning as an integrated organization of the power station.

8. Status of Units 5 and 6

➢ Water level increase at mega float No. 5VOID (north side)
  • On February 16, a periodical patrol of the mega float moored within the port detected an increase of ballast water level* at one (No. 5VOID on the north side) of nine sections, by approx. 45 cm compared to the value of the previous measurement (on January 19, 2017) to sea level.
  • To investigate the seawater inflow into No. 5VOID, ballast water inside this section was transferred to the neighboring section No. 4VOID on February 17.
  • On February 21, an investigation, conducted using an underwater camera into the status inside the section where an increase of ballast water level was detected, identified a detorted reinforcing plate in the lower part on the northwest side of the mega float. The investigation also identified a potential crack of approx. 10 cm (estimated) near the connection between the wall and floor. Repair methods will be considered.
  • Monitoring of radioactivity density in seawater around the mega float was enhanced and confirmed no significant change in temperature.

9. Other

➢ Applicability test of multi-copters with the ability of steric dose evaluation
  • To effectively develop plans for radiation work and check the dose reduction results, multi-copters with the ability of steric dose evaluation will be introduced. An applicability test is underway in and outside the site.

➢ FY2016 results and FY2017 plan of research and development
  • For each of the research and development projects, progress and results in FY2016 to date and the proposed plan in FY2017 were summarized, based on which FY2017 projects will start sequentially.
Status of seawater monitoring within the port (comparison between the highest values in 2013 and the latest values)

“The highest value” → “the latest value (sampled during February 13-21)”; unit (Bq/L); ND represents a value below the detection limit

Source: TEPCO website Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station http://www.tepco.co.jp/nu/fukushima-np/1/fsm/index-j.html

| Source: TEPCO website | Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station |

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</tr>
</thead>
<tbody>
<tr>
<td>Sea side</td>
<td>TEPCO website</td>
<td>2013/10/17</td>
<td>3.3</td>
<td>Bq/L</td>
<td>ND(0.64) Below 1/6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013/10/11</td>
<td>7.3</td>
<td>Bq/L</td>
<td>ND(5.1) Below 1/10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013/8/19</td>
<td>69</td>
<td>Bq/L</td>
<td>ND(16) Below 1/4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013/8/19</td>
<td>68</td>
<td>Bq/L</td>
<td>ND(1.5) Below 1/40</td>
</tr>
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<td>Bq/L</td>
<td>ND(0.69) Below 1/6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013/10/11</td>
<td>7.3</td>
<td>Bq/L</td>
<td>ND(4.8) Below 1/10</td>
</tr>
<tr>
<td></td>
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<td>2013/8/19</td>
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<td>Bq/L</td>
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<tr>
<td></td>
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<td>2013/8/19</td>
<td>60</td>
<td>Bq/L</td>
<td>ND(2.0) Below 1/30</td>
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<td>Impermeable wall</td>
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Summary of TEPCO data as of February 22

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<td>2013/10/17</td>
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<td>Bq/L</td>
<td>ND(0.28) Below 1/10</td>
</tr>
<tr>
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<td>2013/10/17</td>
<td>9.0</td>
<td>Bq/L</td>
<td>ND(0.17) Below 1/10</td>
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<tr>
<td></td>
<td></td>
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</table>

* Monitoring commenced in or after March 2014.

Note: The gross β measurement values include natural potassium 40 (approx. 12 Bq/L). They also include the contribution of yttrium 90, which radioactively balance strontium 90.

Monitoring inside the sea-side impermeable walls was finished because of the landfill.
Status of seawater monitoring around outside of the port
(comparison between the highest values in 2013 and the latest values)

Unit (Bq/L); ND represents a value below the detection limit; values in ( ) represent the detection limit; ND (2013) represents ND throughout 2013

<table>
<thead>
<tr>
<th>Location</th>
<th>Cesium-134</th>
<th>Cesium-137</th>
<th>Gross β</th>
<th>Tritium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast side of port entrance (offshore 1km)</td>
<td>ND (2013) → ND (0.71)</td>
<td>ND (2013) → ND (0.53)</td>
<td>ND (2013) → ND (18)</td>
<td>ND (2013) → ND (1.8)</td>
</tr>
<tr>
<td>East side of port entrance (offshore 1km)</td>
<td>ND (2013) → ND (0.67)</td>
<td>1.6 (2013/10/18) → ND (0.64) Below 1/2</td>
<td>ND (2013) → ND (18)</td>
<td>6.4 (2013/10/18) → ND (1.8) Below 1/3</td>
</tr>
<tr>
<td>North side of north breakwater (offshore 0.5km)</td>
<td>ND (2013) → ND (0.63)</td>
<td>ND (2013) → ND (0.68)</td>
<td>ND (2013) → ND (18)</td>
<td>4.7 (2013/8/18) → ND (1.8) Below 1/2</td>
</tr>
<tr>
<td>North side of Unit 5 and 6 release outlet</td>
<td>1.8 (2013/6/21) → ND (0.50) Below 1/3</td>
<td>4.5 (2013/3/17) → ND (0.68) Below 1/6</td>
<td>12 (2013/12/23) → 10</td>
<td>8.6 (2013/6/26) → ND (1.5) Below 1/5</td>
</tr>
<tr>
<td>Southeast side of port entrance (offshore 1km)</td>
<td>ND (2013) → ND (0.71)</td>
<td>ND (2013) → ND (0.85)</td>
<td>ND (2013) → ND (18)</td>
<td>ND (2013) → ND (1.8)</td>
</tr>
<tr>
<td>South side of south breakwater (offshore 0.5km)</td>
<td>ND (2013) → ND (0.74)</td>
<td>ND (2013) → ND (0.69)</td>
<td>ND (2013) → ND (18)</td>
<td>ND (2013) → ND (1.8)</td>
</tr>
<tr>
<td>Near south release outlet</td>
<td>ND (2013) → ND (0.71)</td>
<td>3.0 (2013/7/15) → ND (0.58) Below 1/5</td>
<td>ND (2013/12/23) → 12</td>
<td>1.9 (2013/11/25) → ND (1.6)</td>
</tr>
</tbody>
</table>

Note: The gross β measurement values include natural potassium 40 (approx. 12 Bq/L). They also include the contribution of yttrium 90, which radioactively balance strontium 90.

Summary of TEPCO data as of February 22

Regarding fuel removal from Unit 1 spent fuel pool, there is a plan to install a dedicated cover for fuel removal over the top floor of the Reactor Building (operating floor). Before starting this plan, the building cover was dismantled to remove rubble from the upper part of the operating floor, with anti-scattering measures steadily implemented. All roof panels and wall panels of the building cover were dismantled by November 10, 2016. Following the investigation into the status of rubble on the operating floor, pillars and beams of the building cover will be modified and windbreak sheets installed. Thorough monitoring of radioactive materials will continue.

To facilitate removal of fuel assemblies and debris in the Unit 2 spent fuel pool, the scope of dismantling and modification of the existing Reactor Building rooftop was examined. From the perspective of ensuring safety during the work, controlling impacts on the outside of the power station, and removing fuel rapidly to reduce risks, we decided to dismantle the whole rooftop above the highest floor of the Reactor Building. Examination of the following two plans continues: Plan 1 to share a container for removing fuel assemblies and debris from the pool; and Plan 2 to install a dedicated cover for fuel removal from the pool.

In the Mid- and Long-Term Roadmap, the target of Phase 1 involved commencing fuel removal from inside the spent fuel pool (SFP) of the 1st Unit within two years of completion of Step 2 (by December 2013). On November 18, 2013, fuel removal from Unit 4, or the 1st Unit, commenced and Phase 2 of the roadmap started. On November 5, 2014, within a year of commencing work to remove the fuel, all 1,331 spent fuel assemblies in the pool had been transferred. The transfer of the remaining non-irradiated fuel assemblies to the Unit 6 SFP was completed on December 22, 2014. This marks the completion of fuel removal from the Unit 4 Reactor Building. Based on this experience, fuel assemblies will be removed from Unit 1-3 pools.

Prior to the installation of a cover for fuel removal, removal of large rubble from the spent fuel pool was completed in November 2015. To ensure safe and steady fuel removal, training of remote control was conducted at the factory using the actual fuel-handling machine which will be installed on site (February – December 2015). Measures to reduce dose on the Reactor Building top floor (decontamination, shields) were completed in December 2016. Installation of a cover for fuel removal and a fuel-handling machine is underway from January 2017.

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A part of the photo is corrected because it includes sensitive information related to physical protection.
Investigation into TIP Room of the Unit 1 Reactor Building

- To improve the environment for future investigations inside the PCV, etc., an investigation was conducted from September 24 to October 2, 2015 at the TIP Room. (Due to high dose around the entrance to the TIP Room, the investigation of dose rate and contamination distribution was conducted through a hole drilled from the walkway of the Turbine Building, where the dose was low)
- The investigative results identified high dose at X-31 to 33 penetrations (instrumentation penetration) and low dose at other parts.
- As it was confirmed that work inside the TIP room would be available, the next step will include identification of obstacles which will interfere the work inside the TIP Room and formulation of a plan for dose reduction.

Investigation in the leak point detected in the upper part of the Unit 1 Suppression Chamber (S/C(*3))

Investigation in the leak point detected in the upper part of Unit 1 S/C from May 27, 2014 from one expansion joint cover among the lines installed there. As no leakage was identified from other parts, specific methods will be examined to halt the flow of water and repair the PCV.

Status of investigation inside the PCV

Prior to fuel debris removal, an investigation inside the PCV will be conducted to inspect the status there including the location of fuel debris.

Investigative outline:
- In April 2015, an device, which entered the inside of the PCV through a narrow access opening (bore: φ 100 mm), collected information such as images and airborne dose inside the PCV 1st floor.
- Based on the knowledge obtained from the above investigation in April 2015, another investigation will be conducted in March 2017, in which a dosimeter and a camera mounted on a self-propelled investigation device will be suspended from the 1st floor grating to inspect the status on the basement floor outside the pedestal and around the workers access opening.

Capturing the location of fuel debris inside the reactor by measurement using muons

<table>
<thead>
<tr>
<th>Period</th>
<th>Evaluation results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb - May 2015</td>
<td>Confirmed that there was no large fuel in the reactor core.</td>
</tr>
</tbody>
</table>

<Investigative outline>
- Confirming the status of PCV 1st floor
- Acquiring images - Measuring air temperature and dose rate - Sampling accumulated water - Installing permanent monitoring instrumentation
- Replacing permanent monitoring instrumentation
- AC cooling water system: 0.45m³/h
- Core spray system: 0.5m³/h
- Reactor feed water system: 1.5m³/h
- Temperature inside the PCV: approx. 15°C
- PCV hydrogen concentration System A: 0.02vol%, System B: 0.00vol%
- Temperature of accumulated water in the reactor core: approx. 120°C
- Water level at the triangular corner: OP3,910-4,420 (measured on February 20, 2013)
- Water level of the Turbine Building: TP. 1,043 (as of 0:00, February 22, 2017)
- Temperature at the triangular corner: 32.4-32.6°C (measured on September 20, 2012)
- PCV hydrogen concentration: 0.05vol%
- PCV air injection flow rate: 10.6Nm³/h
- PCV water level: approx. 17.7°C (measured on February 20, 2013)
- PCV temperature of accumulated water: approx. 20-23°C (measured on February 20, 2013)
- PCV hydrogen concentration: 0.05vol%
- PCV air injection flow rate: 10.6Nm³/h
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Progress toward decommissioning: Works to identify the plant status and toward fuel debris removal

Immediate target
Identify the plant status and commence R&D and decontamination toward fuel debris removal

Installation of an RPV thermometer and permanent PCV supervisory instrumentation

1. Replacement of the RPV thermometer
   - As the thermometer installed at the Unit 2 RPV bottom after the earthquake had broken in February 2014, it was excluded from the monitoring thermometers.
   - On April 2014, removal of the broken thermometer failed and was suspended. Rust-stripping chemicals were injected and the broken thermometer was removed on January 2015. A new thermometer was reinstalled on March. The thermometer has been used as a part of permanent supervisory instrumentation since April.

2. Reinstallation of the PCV thermometer and water-level gauge
   - Some of the permanent supervisory instrumentation for PCV could not be installed in the planned locations due to interference with existing grating (August 2013). The instrumentation was removed on May 2014 and new instruments were reinstalled on June 2014. The trend of added instrumentation will be monitored for approx. one month to evaluate its validity.
   - The measurement during the installation confirmed that the water level inside the PCV was approx. 300mm from the bottom.

Investigative results on torus chamber walls

- The torus chamber walls were investigated (on the north side of the east-side walls) using equipment specially developed for that purpose (a swimming robot and a floor traveling robot).
- At the east-side wall penetrations (five points), "the status" and "existence of flow" were checked.
- A demonstration using the above two types of underwater wall investigative equipment showed how the equipment could check the status of penetration.
- Regarding Penetrations 1 - 5, the results of checking the sprayed tracer (\( ^5\) by camera showed no flow around the penetrations. (investigation by the swimming robot)
- Regarding Penetration 3, a sonar check showed no flow around the penetrations. (investigation by the floor traveling robot)

Status of investigation inside the PCV
Prior to fuel debris removal, an investigation inside the PCV will be conducted to inspect the status there including the location of fuel debris.

Investigative outline
- A robot, injected from Unit 2 X-6 penetration(*1), will access the inside of the pedestal using the CRD rail.
- As manufacturing of shields necessary for dose reduction around X-6 penetration was completed, a hole was made in December 2016 at the PCV penetration from which a robot will be injected.
- On January 26 and 30, 2017, a camera was inserted from the PCV penetration to inspect the status of the CRD replacement rail on which the robot will travel. On February 9, access on the deposit of the self-propelled investigation device was removed and on February 16, the inside of the PCV was investigated using the device.
- The results of this series of investigations confirmed fallen and deformed gratings, and a quantity of deposit inside the pedestal. The evaluation results of the collected information will be utilized in considering the policy for fuel debris removal.

Scope of investigation inside the PCV

Capturing the location of fuel debris inside the reactor by measurement using muons

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<tr>
<td>Mar – Jul 2016</td>
<td>Confirmed the existence of high-density materials, which was considered as fuel debris, at the bottom of RPV, and in the lower part and the outer periphery of the reactor core. It was assumed that a large part of fuel debris existed at the bottom of RPV.</td>
</tr>
</tbody>
</table>

* Indices related to plant is values as of 11:00, February 22, 2017

Image of the torus chamber east-side cross-sectional investigation

(Reference) Inside the Unit 5 pedestal

* (*) Penetration: Through-hole of the PCV
  - (2) PCV (Primary Containment Vessel)
  - (3) Tracer: Material used to trace the fluid flow. Clay particles

(Reference) Inside the Unit 5 pedestal

- (Reference) Inside the Unit 5 pedestal
- (Reference) Inside the Unit 5 pedestal
- (Reference) Inside the Unit 5 pedestal
- (Reference) Inside the Unit 5 pedestal
Progress toward decommissioning: Works to identify the plant status and toward fuel debris removal

**Immediate target**
Identify the plant status and commence R&D and decontamination toward fuel debris removal

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**Water flow was detected from the Main Steam Isolation Valve**

On January 18, 2014, a flow of water from around the door of the Main Steam Isolation Valve room in the Reactor Building Unit 3 1st floor northeast area to the nearby floor drain funnel (drain outlet) was detected. As the drain outlet connects with the underground part of the Reactor Building, there is no possibility of outflow from the building.

From April 23, 2014, image data has been acquired by camera and the radiation dose measured via pipes for measurement instrumentation, which connect the air-conditioning room on the Reactor Building 2nd floor with the Main Steam Isolation Valve Room on the 1st floor. On May 15, 2014, water flow from the expansion joint of one Main Steam Line was detected.

This is the first leak from PCV detected in the Unit 3. Based on the images collected in this investigation, the leak volume will be estimated and the need for additional investigations will be examined. The investigative results will also be utilized to examine water stoppage and PCV repair methods.

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**Investigative results into the Unit 3 PCV equipment hatch using a small investigation device**

- As part of the investigation into the PCV to facilitate fuel debris removal, the status around the Unit 3 PCV equipment hatch was investigated using a small self-traveling investigation device on November 26, 2015.
- Given blots such as rust identified below the water level inside the PCV, there may be a leakage from the seal to the extent of bleeding.

Methods to investigate and repair the parts, including other PCV penetrations with a similar structure, will be considered.

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**Investigation inside the PCV**

Prior to removing fuel debris, to check the conditions inside the Primary Containment Vessel (PCV) including the location of the fuel debris, investigation inside the PCV was conducted. [Steps for investigation and equipment development] Investigation from X-53 penetration(*4)

- From October 22-24, the status of X-53 penetration, which may be under the water and which is scheduled for use to investigate the inside of the PCV, was investigated using remote-controlled ultrasonic test equipment. Results showed that the penetration is not under the water.
- For the purpose of confirming the status inside the PCV, an investigation device was inserted into the PCV from X-53 penetration on October 20 and 22, 2015 to obtain images, data of dose and temperature and sample accumulated water. No damage was identified on the structure and walls inside the PCV and the water level was almost identical with the estimated value. In addition, the dose inside the PCV was confirmed to be lower than in other Units.
- In the next step, the obtained information will be analyzed to be utilized in the consideration about the policy for future fuel debris removal.

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**Indices related to plant are values as of 11:00, February 22, 2017**

<table>
<thead>
<tr>
<th>Investigations inside PCV</th>
<th>Leakage points from PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st (Oct – Dec 2015)</td>
<td>- Main steam pipe bellows (identified in May 2014)</td>
</tr>
<tr>
<td>- Acquiring images</td>
<td>- Measuring air temperature and dose rate</td>
</tr>
<tr>
<td>- Measuring water level and temperature</td>
<td>- Sampling accumulated water</td>
</tr>
<tr>
<td>- Installing permanent monitoring instrumentation (scheduled for December 2015)</td>
<td></td>
</tr>
</tbody>
</table>

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**Glossary**

- (1) SFP (Spent Fuel Pool)
- (2) RPV (Reactor Pressure Vessel)
- (3) PCV (Primary Containment Vessel)
- (4) Penetration: Through-hole of the PCV
Progress toward decommissioning: Work related to circulation cooling and accumulated water treatment line

Immediate target
Stably continue reactor cooling and accumulated water treatment, and improve reliability

Work to improve the reliability of the circulation water injection cooling system and pipes to transfer accumulated water:
- Operation of the reactor water injection system using Unit 3 Condensate Storage Tank (CST) as a water source commenced (from July 5, 2013). Compared to the previous systems, the reliability of the reactor water injection system was enhanced, e.g., by increasing the amount of water-source storage and enhancing durability.
- To reduce the risk of contaminated-water leakage, the circulation loop was shortened by installing a reverse osmosis (RO) device in the Unit 4 Turbine Building within the circulation loop, comprising the transfer of contaminated water, water treatment and injection into the reactors. Operation of the installed RO device started from October 7 and 24-hour operation started from October 20. Installation of the new RO device inside the building shortened the circulation loop from approx. 3 to 0.8 km.

Progress status of dismantling of flange tanks
- To facilitate replacement of flange tanks, dismantling of flange tanks started in H1 east/H2 areas in May 2015. Dismantling of all flange tanks (12 tanks) in H1 east area was completed in October 2015. Dismantling of all flange tanks (26 tanks) in H2 area was completed in March 2016. Dismantling of H4 flange tanks is underway.

Completion of purification of contaminated water (RO concentrated salt water)
Contaminated water (RO concentrated salt water) is being treated using seven types of equipment including the multi-nuclide removal equipment (ALPS). Treatment of the RO concentrated salt water was completed on May 27, 2015, with the exception of the remaining water at the tank bottom. The remaining water will be treated sequentially toward dismantling the tanks. The strontium-treated water from other facilities than the multi-nuclide removal equipment will be re-purified in the multi-nuclide removal equipment to further reduce risks.

Preventing groundwater from flowing into the Reactor Buildings
Reducing groundwater inflow by pumping sub-drain water
To reduce groundwater flowing into the buildings, pumping-up of groundwater from wends (subdrains) around the buildings started on September 3, 2015. Pumped-up groundwater was purified at dedicated facilities and released after TEPCO and a third-party organization confirmed that its quality meets operational targets.

Via a groundwater bypass, reduce the groundwater level around the Building and groundwater inflow into the Building
Measures to pump up groundwater flowing from the mountain side upstream of the Building to reduce the groundwater inflow (groundwater bypass) have been implemented. The pumped up groundwater is temporarily stored in tanks and released after TEPCO and a third-party organization have confirmed that its quality meets operational targets. Through periodical monitoring, pumping of wells and tanks is operated appropriately. At the observation holes installed at a height equivalent to the buildings, the trend showing a decline in groundwater levels is checked. The analytical results on groundwater inflow into the buildings based on existing data showed a declining trend.

Installing land-side impermeable walls with frozen soil around Units 1-4 to prevent the inflow of groundwater into the building
To prevent the inflow of groundwater into the buildings, installation of impermeable walls on the land side is planned. Installation of frozen pipes commenced on June 2, 2014. Construction for freezing facilities was completed in February 2016. Freezing started on the sea side and at a part of the mountain side from March 2016 and at 95% of the mountain side from June 2016. Freezing started for two of seven frozen sections on the mountain side from December 2016.

On the sea side, the underground temperature declined below 0°C throughout the scope requiring freezing except for the unfrozen parts under the sea-water pipe trenches and the areas in October 2016.
Progress toward decommissioning: Work to improve the environment within the site

- Reduce the effect of additional release from the entire power station and radiation from radioactive waste (secondary water treatment waste, rubble, etc.) generated after the accident, to limit the effective radiation dose to below 1mSv/year at the site boundaries.
- Prevent contamination expansion in sea, decontamination within the site

Optimization of radioactive protective equipment
Based on the progress of measures to reduce environmental dosage on site, the site is categorized into two zones: highly contaminated area around Unit 1-4 buildings, etc. and other areas to optimize protective equipment according to each category aiming at improving safety and productivity by reducing load during work. From March 8, 2016, limited operation started in consideration of workers’ load.

Installation of dose-rate monitors
To help workers in the Fukushima Daiichi Nuclear Power Station precisely understand the conditions of their workplaces, a total of 86 dose-rate monitors were installed by January 4, 2016. These monitors allow workers to confirm real time on-site dose rates at their workplaces. Workers are also able to check concentrated data through large-scale displays installed in the Main Anti-Earthquake Building and the access control facility.

Installation of sea-side impermeable walls
To prevent the outflow of contaminated water into the sea, sea-side impermeable walls have been installed.
Following the completed installation of steel pipe sheet piles on September 22, 2015, connection of these piles was conducted and connection of sea-side impermeable walls was completed on October 26, 2015. Through these works, closure of sea-side impermeable walls was finished and the contaminated water countermeasures have been greatly advanced.

Status of the large rest house
A large rest house for workers was established and its operation commenced on May 31, 2015. Spaces in the large rest house are also installed for office work and collective worker safety checks as well as taking rest. On March 1, 2016 a convenience store opened in the large rest house. On April 11, operation of the shower room started. Efforts will continue to improve convenience of workers.