**Main works and steps for decommissioning**

Fuel removal from Unit 4 SFP had been completed. Preparatory works to remove fuel from Unit 1-3 SFP and fuel debris (Note 1) removal are ongoing. (Note 1) Fuel assemblies melted through in the accident.

- **Fuel Removal from SFP**
  - Rubble removal & dose reduction
  - Installing a Fuel-Handling Machine
  - Fuel removal
  - Storage and handling

- **Fuel Debris Removal**
  - Capturing the status inside PCV/examination of 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**

Water to cool fuel having melted in the accident is mixed with groundwater and approx. 300 tons of contaminated water is generated daily. 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 in the trench (Note 3)
   - Land-side impermeable walls
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
   - Soil improvement by sodium silicate
   - Sea-side impermeable walls
   - Increase tanks (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.
- Onsite tests have been conducted since August 2013. Construction work commenced in June 2014.
- Regarding the mountain side, in which freezing will commence first, the installment of frozen pipes was completed in July 2015.

**Sea-side impermeable walls**
- The walls aim to prevent the flow of contaminated groundwater into the sea.
- The installation of steel sheet piles is almost (98%) complete. The closure time is being coordinated.
Progress Status and Future Challenges of the Mid-and-Long-Term Roadmap toward the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station Units 1-4 (Outline)

Progress status

Removal of Unit 3 FHM completed

On August 2, the fuel-handling machine (FHM), the largest piece of rubble which fell in the Unit 3 spent fuel pool, was removed safely.

To facilitate fuel removal, rubble removal from the spent fuel pool and dose reduction on the top floor of the Reactor Building will continue.

Results of inspection inside the Unit 3 spent fuel pool

On August 4, an inspection of the status of rubble in the spent fuel pool using an underwater camera confirmed distortion of fuel handles with four spent fuel assemblies, which were located under the fuel-handling machine being removed on August 2.

During this removal of the fuel-handling machine, there was no significant change in the radiation density of water in the spent fuel pool, no new symptom of damage in fuel assemblies and no effect on the surrounding environment.

Treatment of fuel assemblies with distorted handles will be considered.

Disclosure of all radiation data

TEPCO has sequentially expanded the range of disclosed radiation data being measured at the Fukushima Daiichi Nuclear Power Station since April. Since August 20, the disclosed data has included that of dose rates at workplaces, etc. This has increased the total annual amount of disclosed data to approx. 70,000 records.

Analysis plans will also be disclosed sequentially, to help provide clearer information.

Fatal accident of worker while cleaning a construction vehicle

On August 8 at the soil dump on-site, a partner company's worker, who cleaned a construction vehicle used to construct land-side impermeable walls, was killed by getting his head caught in the tank hatch on the back of the vehicle.

Based on this accident, the rules for the work concerned were reviewed and the adequacy of measures, etc. of other heavy-machine works was confirmed to prevent occurrence of similar accidents.

Questionnaire survey for workers to improve the work environment

To improve the work environment of workers on-site, the 6th annual questionnaire survey will be conducted from August 27. Answers will be collected in September and the results will be summarized by November and utilized to improve the work environment.

Removal of contaminated water and filling completed for Unit 2 and 3 seawater-pipe trenches

Regarding seawater-pipe trenches Note, removal of contaminated water was completed for Unit 2 on June 30 and for Unit 3 on July 30, which will reduce risks significantly.

Filling of the vertical shafts of Unit 3 seawater-pipe trench was completed on August 27.

Preparation status for freezing of land-side impermeable walls

Regarding frozen pipes of land-side impermeable walls, as the installation of pipes and frozen pipes was completed on three sides which will be frozen first, filling of coolant started for added and frozen pipes. When the filling of coolant is finished, preparation for freezing will have been completed on the three mountain sides.

On the sea-side Note, drilling and installation of frozen pipes is underway.

Disclosure plans will also be disclosed sequentially, to help provide clearer information.

<Removal of the fuel-handling machine>

<Construction vehicle of the same type>

<Inspection on rubble inside the pool>
Data of Monitoring Posts (MP1-MP8) measuring airborne radiation rate around site boundaries show 0.907 - 3.670 μSv/h (July 29 – August 25, 2015).

We improved the measurement conditions of monitoring posts 2 to 8 for precise measurement of air dose rate. Construction works such as tree-clearing, surface soil removal and shield wall setting were implemented from Feb. 10 to Apr. 18, 2012. Therefore monitoring results at these points are lower than elsewhere in the power plant site.

The radiation shielding panel around monitoring post No. 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 fallen down due to further cutting down of the forests 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 have been maintained within the range of approx. 20 to 45°C for the past month, though they vary depending on the unit and location of the thermometer.

2. Release of radioactive materials from the Reactor Buildings

As of July 2015, the density of radioactive materials newly released from Reactor Building Units 1-4 in the air and measured at the site boundaries was evaluated at approx. 2.4×10⁻¹² Bq/cm² for Cs-134 and 6.2×10⁻¹² Bq/cm² for Cs-137 respectively. The radiation exposure dose due to the release of radioactive materials was less than 0.00092 mSv/year at the site boundaries.

III. Operation of groundwater bypass

- From April 9, 2014, the operation of 12 groundwater bypass pumping wells commenced sequentially to pump up groundwater. The release commenced 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. As of August 26, 2015, 124,504 m³ of groundwater had been released. The pumped up groundwater has been temporarily stored in tanks and released after TEPCO and a third-party organization (Japanese Chemical Analysis Center) confirmed that its quality met operational targets.
- It was confirmed that the groundwater inflow into the buildings had decreased by approx. 80 m³/day, based on the evaluation data to date, through measures such as groundwater bypass and water stoppage of the High Temperature Incinerator Building (HTI).
- It was confirmed that the groundwater level at the observation holes had decreased by approx. 5-15 cm compared to the level before pumping at the groundwater bypass started.
- For pumping well Nos. 2, 3, 4 and 6, water pumping was suspended for cleaning (No. 2: from August 5; No. 3: from July 28; No. 4: July 8-30; No. 6: from July 21).

Figure 1: Analytical results of inflow into buildings

Construction status of land-side impermeable walls

To facilitate the installation of land-side impermeable walls surrounding Units 1-4 (a subsidy project of the Ministry of Economy, Trade and Industry), drilling to place frozen pipes commenced (from June 2, 2014).

Regarding the mountain side in which freezing will commence first, the installation of frozen pipes was completed on July 28. From April 30, the freezing functioning test was underway at 18 points (58 frozen pipes, approx. 6% on the mountain side). The test confirmed that the facilities were operating correctly and the earth temperature had decreased. As the change in groundwater level at the observation well near the freezing functioning test point Nos. 7, 16, 17 and 18 from the level of multiple observation wells, which had not been affected by freezing, exceeded the standard value for four consecutive days, brine supply to these points was suspended (No. 7: from June 3; No. 16: from August 13; Nos. 17 and 18: from August 14). Filling of brine is underway for added and frozen pipes. Brine supply to freezing functioning test points was suspended due to this filling of brine.

Regarding the sea side, the implementation plan for penetration parts (for frozen pipes: 71 points, for temperature-measurement pipes: 3 points) was approved on July 31. As of August 25, 2015, drilling at 503 points (76%, for frozen pipes: 389 of 533 points, for temperature-measurement pipes: 114 of 132 points) and installation of frozen pipes at 357 of 533 points (67%) had been completed (see Figure 3).
Figure 2: Freezing functioning test place on land-side impermeable walls

Figure 3: Drilling status for frozen-soil impermeable walls and installation of frozen pipes

Figure 4: Status of accumulated water storage
Operation of multi-nuclide removal equipment
- As of August 20, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 254,000, 184,000 and 83,000 m³ respectively (including approx. 9,500 m³ stored in the J1(D) tank, which contained water with a high density of radioactive materials at the System B outlet of existing multi-nuclide removal equipment).
- For Systems A and C of existing multi-nuclide removal equipment, facility inspections are underway and additional absorption vessels are being installed to improve their performance (from May 24). System B will be operated as necessary to treat wastewater generated in association with inspections, remaining RO-concentrated salt water, etc. An inspection for System B will be conducted after Systems A and C have been inspected.
- To reduce the risks of strontium-treated water, treatment by additional and high-performance multi-nuclide removal equipment is underway (additional: from May 27, high-performance: from April 15). As of August 20, approx. 80,000 m³ had been treated.

Toward reducing the risk of contaminated water stored in tanks
- Treatment measures comprising the removal of strontium by cesium absorption apparatus (KURION) (from January 6) and secondary cesium absorption apparatus (SARRY) (from December 26, 2014) are underway. As of August 20, approx. 91,000 m³ had been treated.

Measures in Tank Areas
- Rainwater, under the release standard and having accumulated inside the fences in the contaminated water tank area, was sprinkled on site after eliminating radioactive materials using rainwater-treatment equipment since May 21, 2014 (as of August 24, 2015 a total of 31,470 m³).

Leakage from desalination equipment (RO3-3)
- On July 17, the desalination equipment (RO3-3) was suspended due to a leakage detected at the high-pressure pump outlet joint of this equipment. Leakage of approx. 2.5 m³ of water remained within the fences, but was collected and decontaminated the same day. As an observation on the broken-out section of the joint screw identified characteristics of fatigue failure beginning with the screw concave, the failure was assumed to be attributable to loosened bolts of the pedestal for the high-pressure pump, which caused the pump to vibrate more than usual, thus repeatedly exerting additional stress on the joint. The investigation into the cause and confirmation of the soundness of the skid concerned were completed and the soundness of other skids (RO3-1, 2, 4, RO2-4, 5) was also confirmed by August 6.
- On August 12, the desalination equipment (RO3-3) was suspended due to misty leakage from a welded part of the high-pressure pump discharge pipe of this equipment. It was confirmed that the floor surface under this pipe was wet over an area of approx. 1m×1m. Given that the leakage remained within the fences, there was no effect on the outside. A detailed investigation will be conducted on this pipe of RO3-3, which will be replaced. Patrols of other skids (RO3-1, 2, 4) have been enhanced and measures to prevent leakage are also underway for similar points (welded parts).

Removal of contaminated water from seawater-pipe trenches
- Regarding the Unit 2 seawater-pipe trench, filling of the tunnel sections was completed on December 18, 2014. Accumulated water within trench was transferred by June 30, 2015, and vertical shafts were filled by July 10.
- Regarding the Unit 3 seawater-pipe trench, filling of the tunnel sections was completed on April 8. Accumulated water within the trench was transferred by July 30 and vertical shafts were filled by August 27.

Regarding the Unit 4 seawater-pipe trench, filling was completed for the tunnel sections on March 21 and opening apertures II and III on April 28. Filling of the parts running over drainage channels will be conducted after coordinating with other construction nearby. Opening aperture I will be filled when the contaminated water level of the building is reduced.

2. Fuel removal from the spent fuel pools
Work to help remove spent fuel from the pool is progressing steadily while ensuring seismic capacity and safety. The removal of spent fuel from the Unit 4 pool commenced on November 18, 2013 and was completed on December 22, 2014
- Main work to help remove spent fuel at Unit 1
  - On July 28, the removal of roof panels of the building cover started. As of August 26, two of six roof panels had been removed. During these works, no significant change was identified in the dust densities at dust monitors and monitoring posts, etc.
  - The dismantling of the building cover is being conducted with anti-scattering measures implemented and safety prioritized above all.
- Main work to help remove spent fuel at Unit 2
  - To help remove spent fuel from the pool of Unit 2 Reactor Building, a yard is being constructed around the Reactor Building to ensure a work area for installing large heavy-duty machines, etc.
  - Preparatory works are currently underway, including closure of ducts, etc. and transfer of existing facilities. Once these works are complete, full-scale dismantling of interfering buildings will commence from around the end of August 2015.
- Main work to help remove spent fuel at Unit 3
  - On August 2, the fuel-handling machine, the largest piece of rubble to have fallen in the spent fuel pool, was removed. On August 4, an inspection on the status of rubble in the spent fuel pool and pool gate identified distortion of fuel handles with four out of eight spent fuel assemblies newly found. As no significant change was identified in the radiation density in pool water, it was confirmed that the distortion of fuel assemblies was not attributable to the removal of the fuel-handling machine. Detailed inspections will be conducted during the process to consider fuel removal. Regarding the pool gate, it was confirmed that gate brackets were hooked on gate hooks.

3. Fuel debris removal
In addition to decontamination and shield installation to improve PCV accessibility, technology was developed and data gathered as required to prepare to remove fuel debris (such as investigating and repairing PCV leak locations)
- Preparation to investigate inside the Unit 2 PCV
  - In preparation for investigating the status of the platform inside the Unit 2 PCV pedestal (A2 investigation), removal of shielding blocks installed in front of the PCV penetration (X-6 penetration), from which the investigation device will be introduced, commenced on June 11 through remote operation. Though 128 of 135 blocks had been removed by July 8, the remaining 7 blocks, which were firmly fixed to the ground, could not be removed.
  - After considering how to remove these fixed blocks, an outlook of the process was confirmed for a method using a new end effector (jig) and development of this tool started.
  - To facilitate early removal of these blocks, preparation for removal using small heavy machines (including removal of fixed blocks by vibration, etc. and chemical removal of fixed blocks) started. The feasibility of this method will be evaluated by a mock-up test, whereupon block removal will start based on the test results.
  - To facilitate decontamination after block removal and preparation for the A2 investigation, an investigation around X-6 penetration will start from early September.
  - Opening a hole of X-6 penetration and the A2 investigation process will be changed based on the status of the above consideration.
6. Reduction in radiation dose and mitigation of contamination

- Status of groundwater and seawater on the east side of Turbine Building Units 1 to 4
  - Regarding the radioactive materials in groundwater near the bank on the north side of the Unit 1 intake, the tritium density has been increasing in groundwater Observation Hole No. 0-4 since September 2014 and currently stands at around 30,000 Bq/L. Pumping of 1 m³/day of water from Observation Hole No. 0-3-2 continues.
  - Regarding the groundwater near the bank between the Unit 1 and 2 intakes, the tritium density at groundwater Observation Hole Nos. 1 and 1-17 has remained constant at around 100,000 Bq/L since March 2015. The density of gross β radioactive materials at groundwater Observation Hole No. 1 has been increasing while the density at groundwater Observation Hole No. 1-17 has been decreasing since February 2015, both of which currently stand at around 3,000 Bq/L since August. Water pumping from the well point (10 m³/day) and the pumping well No. 1-16 (P) (1 m³/day) installed near Observation Hole Nos. 1-16 continues.
  - Regarding radioactive materials in the groundwater near the bank between the Unit 2 and 3 intakes, the densities of tritium and gross β radioactive materials have been further decreasing from March and currently stand at around 1,000 Bq/L for tritium and around 600 Bq/L for gross β radioactive materials. To treat the surface of the ground improvement area and repair the well point, the volume of water pumped from the well point increased to 50 m³/day (from October 31, 2014). The surface treatment commenced on January 8 and was concluded on February 18. The repair of the well point was completed and test operation is underway.
  - Regarding the radioactive materials in groundwater near the bank between the Unit 3 and 4 intakes, a low density was maintained at all observation holes. Following the surface treatment in the ground improvement area (March 19-31), pumping of groundwater commenced (20 m³/day from April 1, 10 m³/day from April 24). Both densities of tritium and gross β radioactive materials have been increasing at groundwater Observation Hole No. 3 since April. The repair of the well point was completed and test operation is underway.
  - Regarding the radioactive materials in seawater outside the sea side impermeable walls and within the open channels of Units 1-4, a low density equivalent to that at the point north of the east breakwater was maintained as up to July.
  - The density of radioactive materials in seawater within the port has remained low at the same level as up to July.
  - Regarding the radioactive materials in seawater outside the port, the densities of cesium 137 and tritium have remained within the same range previously recorded. Though the density of gross β radioactive materials remained below the detection limit (15 – 18 Bq/L), it has been at a level equivalent to the detection limit since late March 2015. Though the density of gross β radioactive materials was 24 Bq/L on the northeast side of the port entrance on June 15, the densities of strontium 90 at the port entrance, on the north side of Unit 5 and 6 outlets and near the south outlet have remained low. No change was identified in the density of gross β radioactive materials on the north side of Unit 5 and 6 outlets and near the south outlet.
  - On August 17, through images of a camera installed at K drainage channel (where a camera and lighting equipment were installed on August 6), it was confirmed a portion of rainwater was discharged beyond the fences to the sea during 21:24- 21:28 due to the effect of rainfall. Subsequently, all rain water within K drainage channel was transferred to C drainage channel and there was no discharge into the sea. Among eight pumps for transfer to C drainage channel, four were operated as of 21:24 and six as of 21:28. Extra cleaning has been underway for K drainage channel since the end of July.

- Alarm issued from a dust monitor near the site boundary
  - On August 7, a “high-level alarm” (alarm set value: 1.0 × 10^5 Bq/cm³) which indicated an increase in the dust radiation density, was issued from a dust monitor installed beside the monitoring post No. 7 near the site boundary. Later within the day, it was confirmed that the “high-level alarm” of this monitor had been recovered and the value had reverted to the level before the alarm was issued. There was no significant change in the values of other on-site dust monitors and monitoring posts. On August 7, dismantling of Unit 1 reactor building cover and rubble removal was suspended.
  - Later, the filter used in this monitor when the “high-level alarm” was issued was collected and analyzed. The result showed that though natural nuclide (lead 212) had been detected, other nuclides were under the detection limit. Based on this result, it was judged that the “high-level alarm” was issued due to the effect of the natural nuclide...
Investigation into accumulated water in Unit 1-3 drainage channels

- Regarding the contamination status on the rooftops of the Turbine Buildings, which is considered a contamination generated near this monitor and not on-site works.

Figure 5: Groundwater density on the Turbine Building east side

7. Review 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 April to June 2015 was approx. 14,300 (TEPCO and partner company workers), which exceeded the monthly average number of actual workers (approx. 11,200). Accordingly, sufficient people are registered to work on site.
  
  - It was confirmed with prime contractors that the estimated manpower necessary for the work in September (approx. 6,700 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. 3,000 to 7,500 since FY2014 (See Figure 8). * Some works for which contractual procedures have yet to be completed are excluded from the September estimate.
  
  - The number of workers from Fukushima Prefecture has remained the same but the number of workers from outside the prefecture has declined slightly. Accordingly, the local employment ratio (TEPCO and partner company workers) as of July remained at around 50% with a slight increase.
  
  - The average exposure dose of workers remained at approx. 1 mSv/month during FY2013, FY2014 and FY2015. (Reference: Annual average exposure dose 20 mSv/year ≒ 1.7 mSv/month)
• For most workers, the exposure dose was sufficiently within the limit and allowed them to continue engaging in radiation work.

8. Other

➢ Fatal accident of worker while cleaning a construction vehicle
  • On August 8, a fatal accident occurred at the soil dump on-site in which a partner company worker, who had cleaned a construction vehicle used to construct land-side impermeable walls, got his head caught in the tank hatch on the back of the vehicle. The worker was confirmed dead the same day by a doctor.
  • Based on this accident, the rules for the work concerned were reviewed and the adequacy for measures, etc. of other heavy-machine works to prevent similar accidents occurring was confirmed.

➢ Disclosure of all radiation data
  • Based on the policy to disclose all radiation data, the range of disclosed radiation data being measured at the Fukushima Daiichi Nuclear Power Station was expanded since April and approx. 50,000 records of radiation data were disclosed annually.
  • On August 20, disclosure of dose rate data at workplaces, etc. started and a total of approx. 70,000 data records are disclosed annually. Disclosure of the analysis plan and lists of the results started sequentially, which will lead to clearer information being provided.

➢ Implementers of the decommissioning and contaminated water treatment project (METI FY2014 supplementary budget) were decided
  • Public offerings were made regarding the following projects (offering period: June 23 – July 21, 2015): “advancement of processes and systems to remove fuel debris and structures inside reactors” and “development of base technology to remove fuel debris and structures inside reactors.”
  • Following screening by the review board, comprising external experts, five implementers for the above two projects were decided on August 26.

➢ Status of heat stroke cases
  • As of August 25 in FY2015, there were a total of 15 heat stroke cases, 12 of which attributable to work and three alleged cases. Thorough preventive measures for heat stroke continue to be taken. (As of the end of August FY2014, there were a total of 30 heat stroke cases, 13 of which attributable to work and seventeen alleged cases.)

➢ Questionnaire survey for workers to improve the work environment
  • To improve the work environment of workers on-site, a questionnaire survey will be conducted from August 27. Answers will be collected by September and the results will be summarized by November and utilized to improve the work environment.

➢ Resumption of meal service at the large rest house
  • At the large rest house with a capacity of approx. 1,200 workers, the meal service had been temporarily suspended, after deciding that the building would require renovation to further improve it from a hygiene perspective. The service resumed on August 3.
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 August 17-25)”; unit (Bq/L); ND represents a value below the detection limit


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<td>5.8</td>
<td>5.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Gross β</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Tritium</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Summary of TEPCO data as of August 27

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 commenced in or after March 2014
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 (0.68)</td>
<td>ND (2013) → ND (0.73)</td>
<td>ND (2013) → ND (17)</td>
<td>ND (2013) → ND (1.8)</td>
</tr>
<tr>
<td>East side of port entrance (offshore 1km)</td>
<td>ND (2013) → ND (0.58)</td>
<td>1.6 (2013/10/18) → ND (0.68) Below 1/2</td>
<td>ND (2013) → ND (17)</td>
<td>6.4 (2013/10/18) → 1.9 Below 1/3</td>
</tr>
<tr>
<td>North side of north breakwater (offshore 0.5km)</td>
<td>ND (2013) → ND (0.66)</td>
<td>ND (2013) → ND (0.63)</td>
<td>ND (2013) → ND (17)</td>
<td>4.7 (2013/8/18) → ND (1.8) Below 1/2</td>
</tr>
<tr>
<td>North side of Units 5 and 6 discharge channel</td>
<td>1.8 (2013/6/21) → ND (0.75) Below 1/2</td>
<td>4.5 (2013/3/17) → ND (0.72) Below 1/6</td>
<td>12 (2013/12/23) → 11</td>
<td>8.6 (2013/6/26) → 1.7 Below 1/5</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.

**Progress toward decommissioning: Fuel removal from the spent fuel pool (SFP)**

**Immediate target**

Commence fuel removal from the Unit 1-3 Spent Fuel Pools

---

### Unit 1

Regarding fuel removal from Unit 1 spent fuel pool, there is a plan to install a dedicated cover for fuel removal over the operating floor\(^{*1}\).

Before starting this plan, the building cover will be dismantled to remove rubble from the top of the operating floor, with anti-scattering measures steadily implemented.

On July 28, removal of the roof panels started. All these panels will be removed by the middle of this fiscal year. Dismantling of the building cover will proceed with radioactive materials thoroughly monitored.

**Status of removal of roof panels**

#### Flow of building cover dismantling

---

### Unit 2

Regarding fuel removal for Unit 2 spent fuel pool, two plans are being considered:

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.

As both plans require work areas of large heavy machines, etc. to install a structure for fuel removal and a fuel handling machine, preparatory work is currently underway to construct a yard around the Reactor Building.

**Image of Plan 1**

**Image of Plan 2**

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### Unit 3

To facilitate the installation of a cover for fuel removal, measures to reduce dose (decontamination and shielding) and rubble removal from the spent fuel pool are underway.

(Decontamination and shielding: from October 15, 2013, rubble removal from the pool: from December 17, 2013)

On August 2, 2015, the fuel-handling machine, the largest rubble which fell in the Unit 3 spent fuel pool (approx. 20t), was removed.

To facilitate fuel removal, rubble removal from the spent fuel pool and dose reduction on the top floor of the Reactor Building will continue. In tandem with these works, training of fuel removal by remote control is underway.

**Removal of fuel-handling machine on August 2**

**Status of removal of roof panels**

#### Flow of building cover dismantling

---

### Unit 4

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 16, 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. (2 of the non-irradiated fuel assemblies were removed in advance in July 2012 for fuel checks)

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.

\(^{*1}\) A part of the photo is corrected because it includes sensitive information related to physical protection.

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### Common pool

- **Storage area**
  - Open space

An open space will be maintained in the common pool (Transfer to the temporary dry cask storage facility)

**Progress to date**

- The common pool has been restored to a condition allowing it to re-accommodate fuel to be handled (November 2012)
- Loading of spent fuel stored in the common pool to dry casks commenced (June 2013)
- Fuel removed from the Unit 4 spent fuel pool began to be received (November 2013)

**Glossary**

\(^{*1}\) Operating floor: During regular inspection, the roof over the reactor is opened while on the operating floor. Fuel inside the core is replaced and the core internals are inspected.

\(^{*2}\) Cask: Transportation container for samples and equipment, including radioactive materials.
### 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

---

**3D laser scan inside the Unit 1 R/B underground floor**

The upper part of the underground floor (torus room) of Unit 1 R/B was investigated with a laser scan using a remote-controlled robot, and collected 3D data.

3D data, which allows examination based on actual measurements, can be used to examine more detailed accessibility and allocation of equipment.

Combining it with 3D data on the R/B 1st floor allows obstacles on both 1st and underground floors to be checked simultaneously. This allows efficient examination of positions to install repair equipment for PCVs and vacuum break lines.

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

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.

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**Status of equipment development toward investigating 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 is scheduled.

**Investigative outline**

- Inserting equipment from Unit 1 X-100B penetration to investigate in clockwise and counter-clockwise directions.

**[Status of investigation equipment development]**

- Using the crawler-type equipment with a shape-changing structure which allows it to enter the PCV from the narrow access entrance (bore: 100mm) and stably move on the grating, a field demonstration was implemented from April 10 to 20, 2015.
- Through this investigation, information including images inside the PCV 1st floor and airborne radiation was obtained. The investigation also confirmed the absence of obstacles around the access aperture leading to the basement floor, which will be considered in next investigation of the PCV basement floor.

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**Glossary**

- (1) S/C (Suppression Chamber): Suppression pool, used as the water source for the emergent core cooling system.
- (2) SFP (Spent Fuel Pool):
- (3) RPV (Reactor Pressure Vessel)
- (4) PCV (Primary Containment Vessel)
- (5) Penetration: Through-hole of the PCV
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, it was excluded from the monitoring thermometers (February 19, 2014).
- On April 17, 2014, removal of the broken thermometer failed and was suspended. Rust-stripping chemicals were injected and the broken thermometer was removed on January 19, 2015. A new thermometer was reinstalled on March 13, 2015. The thermometer has been used as a part of permanent supervisory instrumentation since April 23.

(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 13, 2013).
- The instrumentation was removed on May 27, 2014 and new instruments were reinstalled on June 5 and 6, 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 room walls
- The torus room 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 pipe 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 (1) 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 equipment development toward investigating 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, investigations inside the PCV are scheduled.

Investigative outline
- Inserting the equipment from Unit 2 X-6 penetration (1) and accessing inside the pedestal using the CRD rail to conduct investigation.

[Status of investigative equipment development]
- Based on issues confirmed by the CRD rail status investigation conducted in August 2013, the investigation method and equipment design are currently being examined.
- Solution is being examined to the issue that a portion of shielding blocks installed in front of X-6 penetration could not be moved. After the preparation is completed, removal of the remaining blocks will resume.

* Indices related to plant are values as of 11:00, August 26, 2015
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

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

On January 18, 2014, a flow of water from around the door of the 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 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.

**Status of equipment development toward investigating 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 is scheduled. As the water level inside the PCV is high and the penetration scheduled for use in Units 1 and 2 may be under the water, another method needs to be examined.

**Steps for investigation and equipment development**

1. Investigation from X-53 penetration
   - 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.
   - An investigation of the inside of the PCV is scheduled for around the 1st half of FY2015. Given the high radioactivity around X-53 penetration, the introduction of remote-controlled equipment will be examined based on the decontamination status and shielding.

2. Investigation plan following the investigation of X-53 penetration
   - Based on the measurement values of hydraulic head pressure inside the PCV, X-6 penetration may decline. It is estimated that access to X-6 penetration is difficult.
   - For access from another penetration, approaches such as “further downsizing the equipment” or “moving in water to access the pedestal” are necessary and will be examined.

* Indices related to plant are values as of 11:00, August 26, 2015

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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
Work to improve the reliability of the circulation water injection system and pipes to transfer accumulated water.

- Operation of the reactor water injection system using Unit 3 CST as a water source commenced (from July 5, 2013). Compared to the previous systems, in addition to the shortened outdoor line, the reliability of the reactor water injection system was enhanced, e.g. by increasing the amount of water-source storage and enhancing durability.
- By newly installing RO equipment inside the Reactor Building, the reactor water injection loop (circulation loop) will be shortened from approx. 3km to approx. 0.8km.
- The entire length of contaminated water transfer pipes is approx. 2.1km, including the transfer line of surplus water to the upper heights (approx. 1.3km).

The reactor water injection system was enhanced, e.g. by increasing the amount of water-source storage and enhancing durability.

Compensation 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, 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

Aiming to reduce the level of groundwater by pumping sub-drain water, tests were conducted to verify the stable operation of water treatment facilities, including sub-drain. The results showed that through purification by the system, the density of radioactive materials declined to below the operational target and no other γ nuclides were detected.

Reducing groundwater inflow by pumping sub-drain water

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 tests were confirmed. Currently, a total of 120mm of rainfall was recorded by typhoon Nos. 18 and 19, no outflow of contaminated rainwater from inside the fences was detected.

Typhoon measures improved for Tank Area

- Enhanced rainwater measures were implemented, including increasing the height of fences to prevent rainwater inflow. Though a total of 300mm of rainfall was recorded by typhoon Nos. 18 and 19, no outflow of contaminated rainwater from inside the fences was detected.
- A detailed line configuration was determined after further examination.
Operation start of the large rest house

A large rest house for workers was established and its operation commenced on May 31. Spaces in the large rest house are also installed for office work and collective worker safety checks as well as taking rest. Meal service at the dining space, which had been temporarily suspended due to the construction to ensure further improvement from a hygiene perspective, resumed on August 3.

Expansion of full-face mask unnecessary area

The number of dust monitors has increased to ten with additional monitors installed in Units 3 and 4 slopes and tank areas, the full-face mask unnecessary area will be expanded to approx. 90% of the site from May 29.

However, wearing full- or half-face mask is required for works exposed to highly concentrated dust; and full-face masks, for works involving a risk of ingesting concentrated salt water, etc.