Summary of Decommissioning and Contaminated Water Management

June 29, 2017

Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment

Main decommissioning works and steps

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

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

Fuel Removal from SFP

Units 1 & 2 ▼ Rubble removal & dose reduction → Unit 3 ▼ Installing a Fuel-Handling Machine → Fuel removal → Unit 4 ▼ Storage and handling

Unit 1: Fuel removal to start in FY2020
Unit 2: Fuel removal to start in FY2020
Unit 3: Fuel removal to start in mid-FY2018
Unit 4: Fuel removal completed in 2014

Fuel Debris Removal

Unit 1-3 ▼ Capturing the status inside the PCV/ *examining* the fuel debris removal method, etc. (Note 2) → Fuel debris removal → Storage and handling

(Note 2)
The method employed to remove fuel debris for each unit will be decided two years after revising the Mid- and Long-term roadmap (June 2015). The method for the first unit will be confirmed in the first half of FY2018.

Dismantling Facilities

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

Toward fuel removal from pool

Toward fuel removal from Unit 3 SFP, works to install the cover are underway.

As measures to reduce the dose on the Reactor Building operating floor, the decontamination and installation of shields were completed in June and December 2016 respectively. Installation of a cover for fuel removal started from January 2017.

Installation of a cover for fuel removal at Unit 3 (June 27, 2017)

Three principles behind contaminated water countermeasures:

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

1 Eliminate contamination sources

① Multi-nuclide removal equipment, etc.

② Remove contaminated water from the trench (Note 3)

(Note 3) Underground tunnel containing pipes.

2. Isolate water from contamination

③ Pump up groundwater for bypassing

④ Pump up groundwater near buildings

⑤ Land-side impermeable walls

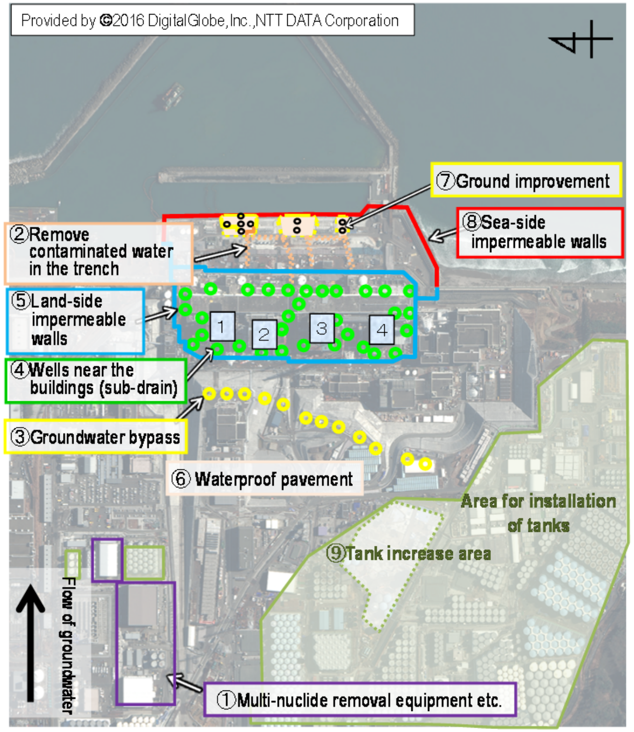
⑥ Waterproof pavement

3. Prevent leakage of contaminated water

⑦ Enhance soil by adding sodium silicate

⑧ Sea-side impermeable walls

⑨ 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.

(High-performance multi-nuclide removal equipment)

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. As for the land-side unfrozen sections, freezing started in two sections from December and four sections from March 3, except for one unfrozen section.
- 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.

(Opening/closure of frozen pipes)

Sea-side impermeable walls

- Impermeable walls are being installed on the sea side of Units 1-4, to prevent 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.

(Sea-side impermeable wall)

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)

Progress status

◆ The temperatures of the Reactor Pressure Vessel (RPV) and Primary Containment Vessel (PCV) of Units 1-3 were maintained within the range of approx. 20-30°C*1 for the past month. There was no significant change in the density of radioactive materials newly released from Reactor Buildings in the air*2. It was evaluated that the comprehensive cold shutdown condition had been maintained

* 1 The values varied somewhat; depending on the unit and location of the thermometer.
* 2 In May 2017, the radiation exposure dose due to the release of radioactive materials from the Unit 1-4 Reactor Buildings was evaluated as less than 0.00026 mSv/year at the site boundary. The annual radiation dose by natural radiation is approx. 2.1 mSv/year (average in Japan).

Transportation of the Unit 3 fuel removal cover dome roof to the site

Toward fuel removal from Unit 3, the FHM girder and work floors were installed and installation of external materials of the FHM girder the traveling rail is underway.

Prior to starting installation of a dome roof around August 2017, a dome roof unit (one of eight) was transported by ship from the Onahama Port to the site on June 27.


<Lifting of the work floor at Unit 3>


<Transportation of a dome roof to the site>

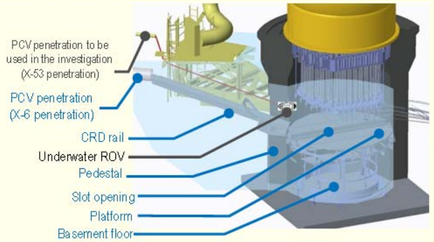
Investigation inside the Unit 3 PCV

Due to the high water level inside Unit 3 PCV, the inside of the pedestal* will be investigated using a remotely operated underwater vehicle (underwater ROV) in late July.

After inspecting the status on the platform on the CRD rail side in the pedestal, the underwater ROV will go down to the basement from the slot opening to inspect the status on the floor.

A dust monitor will be installed near the work place (X-53 penetration).

* The base supporting the RPV



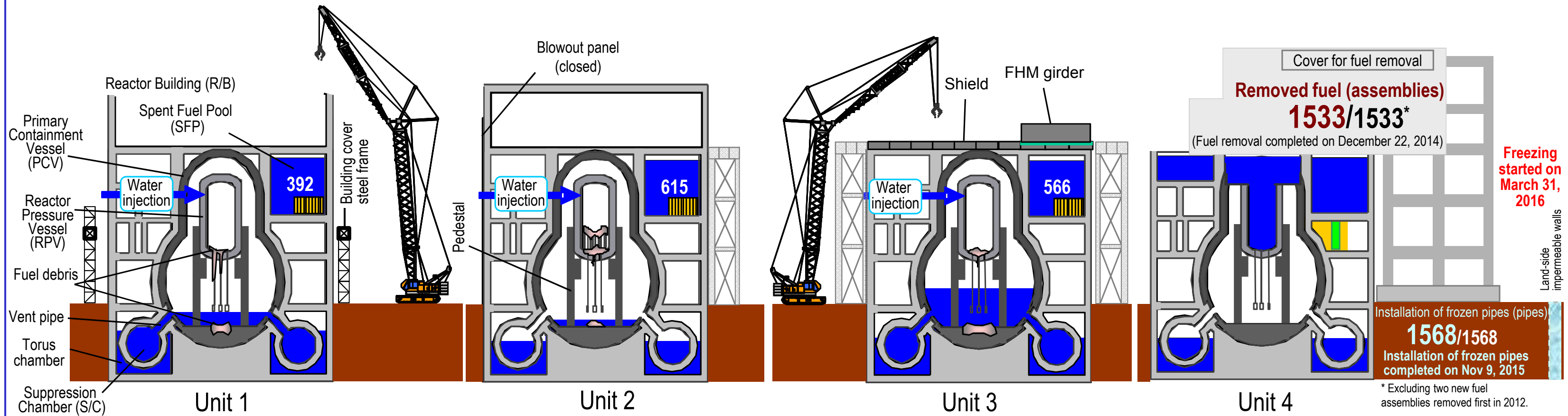
<Schematic view of the investigation>

Status of the land-side impermeable walls

For the land-side impermeable walls (on the mountain side), variation in the groundwater level when the remaining single unfrozen section would be closed was evaluated.

As the latest status of building inflow, pumped-up water volume and groundwater levels showed the effects of measures to improve the subdrain reliability and closure of the land-side impermeable, water levels was expected to be stably manageable after the complete closure.

Based on this result, an application for change in the implementation plan to completely close the land-side impermeable walls was submitted on June 26.



Completion of measures to improve the reliability of the Radioactive Waste Incinerator

Regarding the Radioactive Waste Incinerator, measures to improve reliability were implemented prior to the annual inspection, including changing the bellows materials and preventing gas accumulation in small-diameter pipes and equipment nozzles. Incineration has resumed since June 12.

International Forum on the Decommissioning of the Fukushima Daiichi Nuclear Power Station

The 2nd International Forum on the Decommissioning of the Fukushima Daiichi Nuclear Power Station will be held in Hirono Town on July 2 and Iwaki City on July 3. (Organizer: NDF*)

On Day 1, mainly for the local community, lectures to explain the decommissioning will be provided from the perspective of the local community and panel discussions of interest will be held. On Day 2, mainly for technical experts, the latest information will be discussed beyond the framework of international members and Japanese experts.

* Nuclear Damage Compensation and Decommissioning Facilitation Corporation

Full-scale test of the PCV water shutoff

An operability check test of the filling and shutoff technology in the suppression chamber (S/C)* (June 12-20) and a concrete placement test (June 24) were conducted in the JAEA Naraha Remote Technology Development Center using a full-scale test equipment which simulated part of a PCV. The results showed that the remote-controlled technology could place concrete without any problem.

After confirming the water shutoff performance, etc., further research and development of the water shutoff technology will advance based on the collected data.

* A technology to full high-fluid concrete in the S/C to shutoff water.


<Placement test>

Revision of the Storage Management Plan

The Solid Waste Storage Management Plan formulated in March 2016 was revised on June 29 to update the generation estimate based on the latest storage results, the latest construction plan, etc.

Efforts to further reduce risks will continue by decreasing solid waste as much as possible, storing it inside buildings, and eliminating temporary outdoor storage areas.

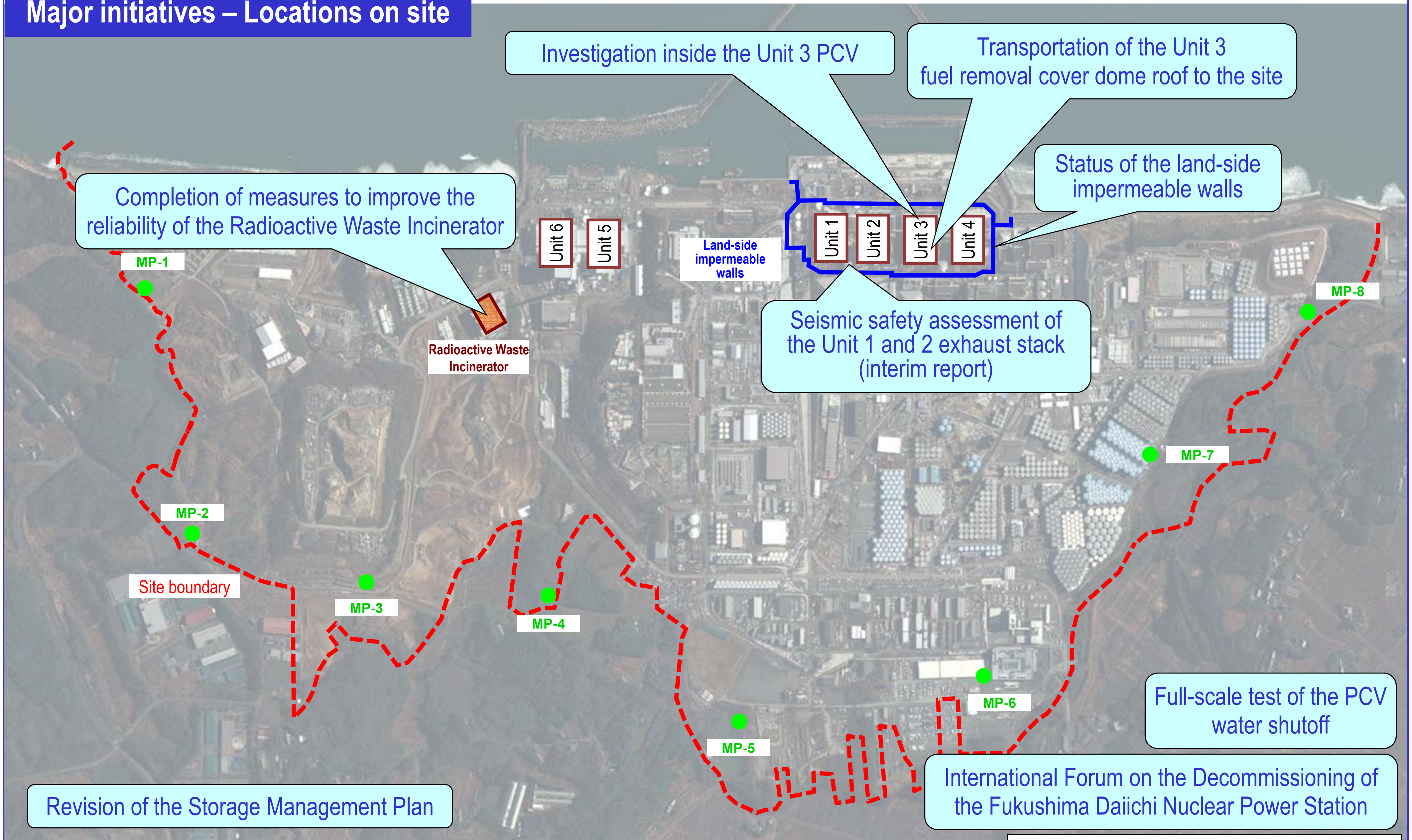
Seismic safety assessment of the Unit 1 and 2 exhaust stack (interim report)

The seismic safety assessment based on the results of the inspection conducted in April confirmed that the stack would not collapse in the design basis ground motion* Ss-1. The seismic safety reassessment of the design basis ground motion Ss-2 and 3 continues.

Though periodical inspections will continue, the stack will be dismantled early from the perspective of further reducing risks.

* Conditions used in the seismic safety assessment for nuclear power plants

Major initiatives – Locations on site



* Data of Monitoring Posts (MP1-MP8.)

Data (10-minute values) of Monitoring Posts (MPs) measuring the airborne radiation rate around site boundaries show 0.510 – 2.005 μSv/h (May 24 – June 27, 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.

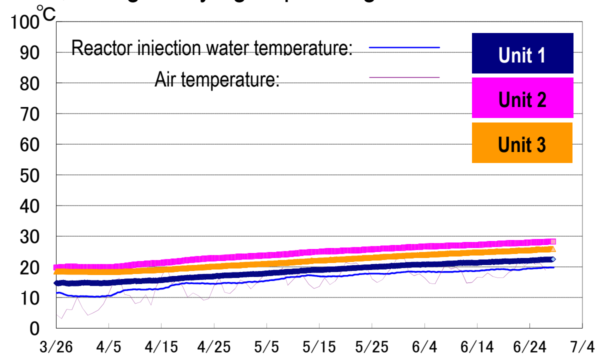
Therefore monitoring results at these points are lower than elsewhere in the power plant site.

The radiation shielding panel around monitoring post No. 6, which is one of the instruments used to measure the radiation dose at the power station site boundary, were taken off from July 10-11, 2013, since further deforestation, etc. has caused the surrounding radiation dose to decline significantly.

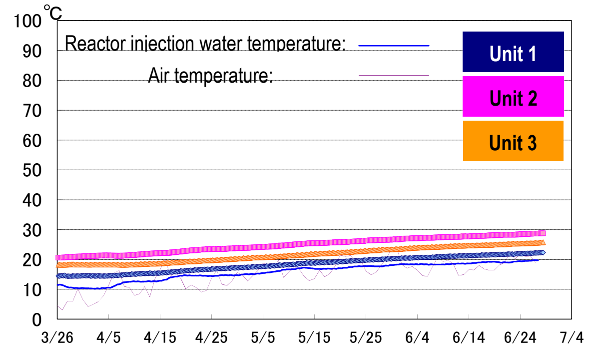
I. Confirmation of the reactor conditions

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. 20 to 30°C for the past month, though varying depending on the unit and location of the thermometer.



RPV bottom temperatures (recent quarter)



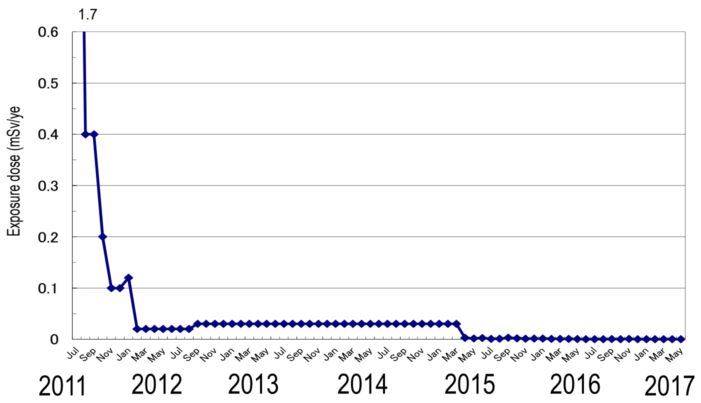
PCV gas phase temperatures (recent quarter)

* The trend graphs show part of the temperature data measured at multiple points.

2. Release of radioactive materials from the Reactor Buildings

As of May 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. 2.3×10^{-12} Bq/cm^3 for Cs-134 and 8.3×10^{-12} Bq/cm^3 for Cs-137, while the radiation exposure dose due to the release of radioactive materials there was less than 0.00026 mSv/year.

Annual radiation dose at site boundaries by radioactive materials (cesium) released from Reactor Building Units 1-4



(Reference)

- * The density limit of radioactive materials in the air outside the surrounding monitoring area:
  [Cs-134]: 2 x 10^{-5} Bq/cm³
  [Cs-137]: 3 x 10^{-5} Bq/cm³
- * Dust density around the site boundaries of Fukushima Daiichi Nuclear Power Station (actual measured values):
  [Cs-134]: ND (Detection limit: approx. 1 x 10^{-7} Bq/cm³)
  [Cs-137]: ND (Detection limit: approx. 2 x 10^{-7} Bq/cm³)
- * Data of Monitoring Posts (MP1-MP8).
  Data of Monitoring Posts (MPs) measuring the airborne radiation rate around the site boundary showed 0.510 – 2.005 μSv/h (May 24 – June 27, 2017).
  To measure the variation in the airborne radiation rate of MP2-MP8 more accurately, environmental improvement (tree trimming, removal of surface soil and shielding around the MPs) was completed.

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.

3. Other indices

There was no significant change in indices, including the pressure in the PCV and the PCV radioactivity density (Xe-135) for monitoring criticality, nor was any abnormality in the cold shutdown condition or criticality sign detected.

Based on the above, it was confirmed that the comprehensive cold shutdown condition had been maintained and the reactors remained in a stabilized condition.

II. Progress status by each plan

1. Contaminated water countermeasures

To tackle the increase in accumulated water due to groundwater inflow, fundamental measures to prevent such inflow into the Reactor Buildings will be implemented, while improving the decontamination capability of water treatment and preparing facilities to control the contaminated water

➢ Operation of the groundwater bypass

- From April 9, 2014, the operation of 12 groundwater bypass pumping wells commenced sequentially to pump up groundwater. The release 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 June 27, 2017, 290,122 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 required based on their operational status.

➢ Water treatment facility special for Subdrain & Groundwater drains

- To reduce the level of 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 June 27, 2017, a total of 353,936 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 June 27, 2017, a total of approx. 134,900 m³ had been pumped up. A quantity of less than 10 m³/day is being transferred from the groundwater drain to the Turbine Buildings (average for the period May 18 – June 21, 2017).
- On June 1, leakage was identified from the subdrain and groundwater drains water treatment facility (System B) absorption vessel inlet pipe flange. No leakage outside the fences was identified. The leakage amount was approx. 2.7 m³. The leakage was considered attributable to a gasket pushed by inner pressure due to the weight and operation pressure of a hose. The flange gasket of the leakage part was replaced, flanges of similar facilities were inspected and any gaps identified were closed by tightening the flange gaskets. After confirming no abnormality, the treatment operation resumed. As a permanent measure, the setting value of flange gasket tightening was reviewed.
- As a measure to enhance subdrains and groundwater drains, the capability of the treatment facility for subdrains and groundwater drains is being improved. Installation of additional water collection tanks and temporary water storage tanks was completed and installation of fences, pipes and ancillary facilities is underway.
- To maintain the groundwater pumped up from subdrains at a constant volume, work to install additional subdrain pits and recover existing subdrain pits is underway. They will go into operation sequentially from a pit for which work is completed.
- “Inflow of groundwater/rainwater into buildings” correlates highly with the average water level of subdrains around Unit 1-4 buildings.
- Since January 2017 in particular, the average subdrain water level has declined as measures for subdrains, closure of unfrozen sections of the land-side impermeable walls (on the mountain side) and other constructions have progressed as well as the low-rainfall climate. The “inflow of groundwater/rainwater into buildings” has also declined correspondingly.

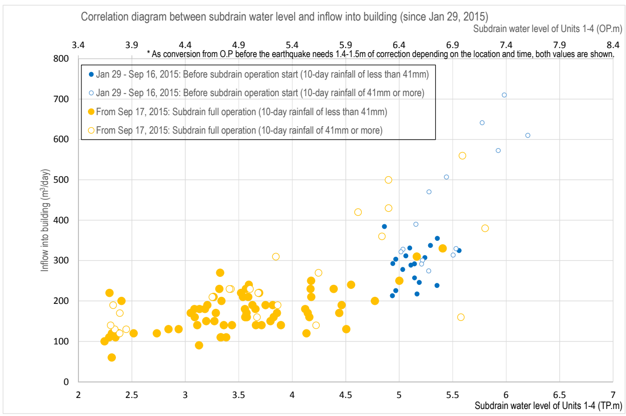


Figure 1: Correlation between inflow such as groundwater and rainwater into buildings and the water level of Unit 1-4 subdrains

➢ Construction status of the land-side impermeable walls

- For the land-side impermeable walls (on the mountain side), variation in the groundwater level when the remaining single unfrozen section would be closed was evaluated. As the latest building inflow status, the pumped-up water volume and groundwater levels showed the effects of measures to improve the subdrain reliability, while closure of the land-side impermeable water levels was expected to be stably manageable after complete closure. Based on this result, an application to change the implementation plan to completely close the land-side impermeable walls was submitted on June 26.

- Monitoring of the groundwater level and underground temperature will continue.

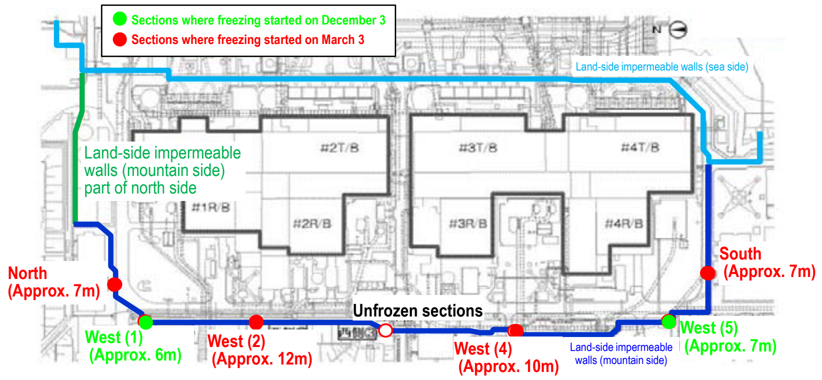
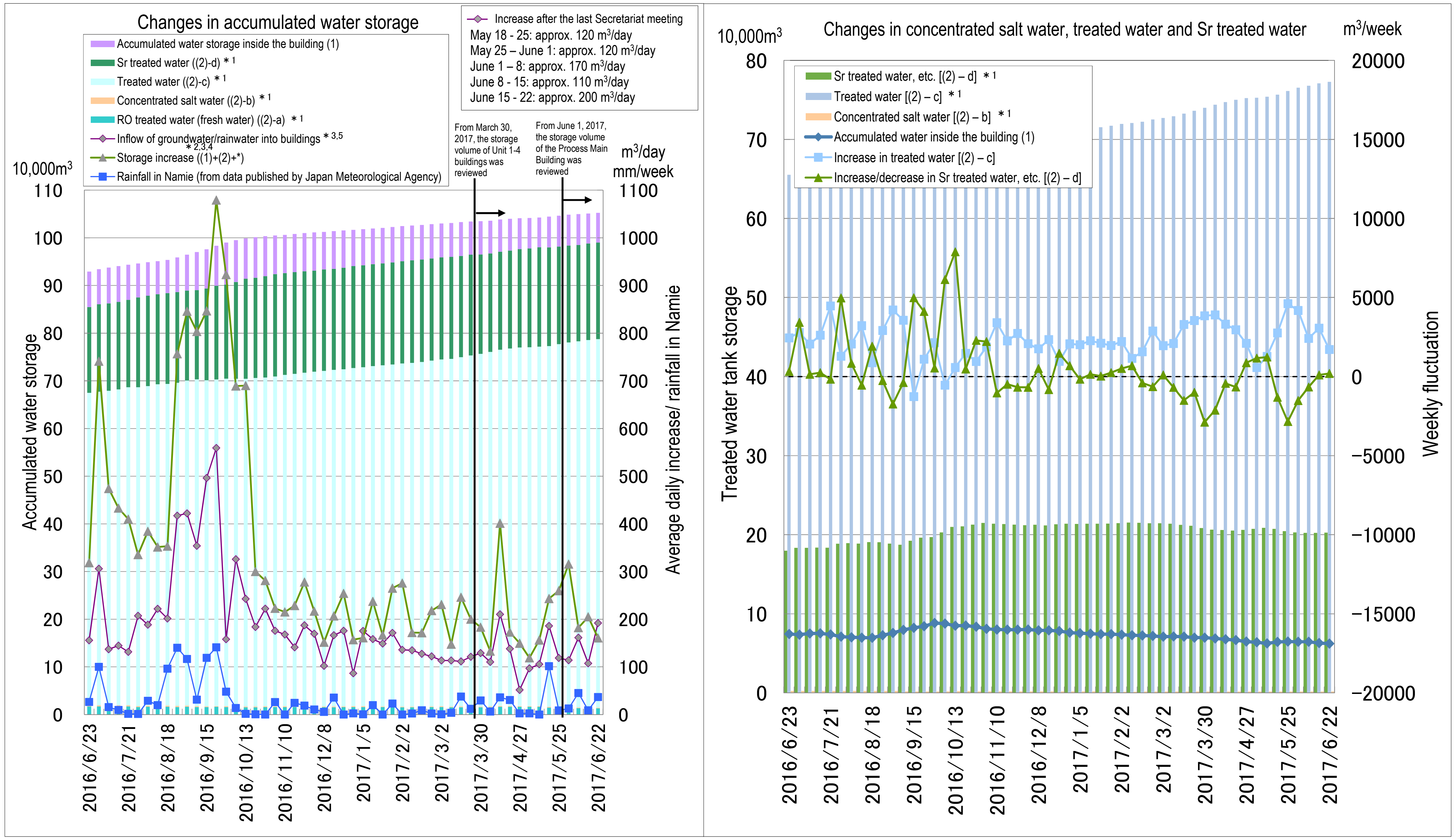


Figure 2: Closure of part of the land-side impermeable walls (on the mountain side)

➢ Operation of multi-nuclide removal equipment

- 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, 2014 and for high-performance equipment, from October 18, 2014).
- As of June 22, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 353,000, 350,000 and 103,000 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).
- 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 June 22, approx. 348,000 m³ had been treated.



As of June 22, 2017

*1: Water amount for which the water-level gauge indicates 0% or more

*2: On January 19, 2017, the water volume was reviewed by reevaluating the remaining volume of concentrated salt water and the data was corrected.

*3: "Increase/decrease of water held in buildings" used to evaluate the "Inflow of groundwater/rainwater into buildings" and "Storage increase" is calculated based on data from the water-level gauge. During the following evaluation periods, when the gauge was calibrated, these two values were evaluated as lower than anticipated.
(September 22-29, 2016: Unit 3 Turbine Building)

*4: Including the effect of variation in water volume stored in tanks with the change in temperature.

*5: The increase is considered attributable to the uncertain cross-section area (evaluated value) for the water level needed to calculate the water volume stored in the Centralized Radiation Waste Treatment Facility.
Since the calculation of June 1, 2017, the cross-section area (evaluated value) has been reviewed.

*6: Including the rainwater volume, which could not be treated in the rainwater treatment facilities, transferred to Sr-treated water tanks (May 25 – June 1, 2017: 700m³/week).

Figure 3: Status of accumulated water storage

- On June 12, water leakage and a puddle from the sample sink inside the additional multi-nuclide equipment were detected. The leaked water remained within the fences and no leakage outside the building was identified. Following closure of the sampling main valve, no further dripping from the same was confirmed. The leakage amount was approx. 36 L and the leakage from the sampling sink was considered attributable to a failure by an operator to close the sampling main valve during the Ca ion concentration measurement on June 11 and continued drippage due to sampling valve seat pass.

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, 2015) and the secondary cesium-absorption apparatus (SARRY) (from December 26, 2014) have been underway. Up until June 22, approx. 375,000 m³ had been treated.

Measures in Tank Areas

- Rainwater, under the release standard and having accumulated within 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 June 26, 2017, a total of 85,194 m³).

Removal of stored water in Unit 1-3 condensers

- High-dose contaminated water has been stored in Unit 1-3 condensers. To advance accumulated water treatment in buildings, the density of accumulated water in these condensers must be lowered from an early stage to reduce the quantity of radioactive materials in accumulated water in buildings.
- For Unit 1, water accumulated above the hot well roof in the condenser was removed and diluted in November 2016. Preparatory work to remove water having accumulated below the hot well roof is also currently underway.
- For Unit 2, water accumulated above the hot well roof in the condenser was removed during the period April 3-13, 2017 and transferred. An investigation into the structures, etc. inside the condenser is underway using a remote-control camera, etc. to examine how best to remove water having accumulated below the hot well roof.
- For Unit 3, water accumulated above the hot well roof in the condenser was removed during the period June 1-6 2017 and transferred. An investigation into the structures, etc. inside the condenser is underway using a remote-control camera, etc. to examine how best to remove water having accumulated below the hot well roof.

Leakage from the G6 area A9 tank flange inside the fences

- On June 4, water drippage at a rate of about five drops/second was identified from the second flange of G6 area A9 tank. The leaked water remained within the inner fences and no leakage outside the system was identified.
- On June 5, following the countermeasure to transfer water in the tank to the C8 tank in the same area, an inspection confirmed that the leakage had stopped. The causes will be investigated while replacing the tank.

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

- Removal of pillars and beams of the building cover started from March 31, 2017 and was completed on May 11. Modification of the pillars and beams (including windbreak sheets) will follow.
- Toward formulating a work plan for rubble removal, an additional investigation into the rubble status and dose rate measurement on the well plug are underway from May 22 to July to identify the status around the well plug.
- 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.

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, preparatory work to make an opening in the external wall on the west wide of the building was completed for access to the operating floor.
- From June 19, preparatory work to remove the roof protection layer, etc. is underway.

Main work to help remove spent fuel at Unit 3

- Installation of the FHM girder* and work floor started on March 1 and was completed on June 10. External materials of the FHM girder are being installed and the installation of the traveling rail started on June 12. On June 27, a fuel removal cover dome roof unit (one of eight) was transported to the site. The subsequent installation of a dome roof will start in around August 2017.

* Horizontal members composing the gate structure. A rail will be mounted on the girder where the fuel-handling machine (FHM) and a crane will travel.

- To make space in the common pool prior to removing the fuel debris from Unit 3, part of the spent fuel stored in the common pool will be transported to and stored in the temporary cask storage facility. On June 10, two containers (casks) to store the spent fuel were delivered to the Fukushima Daiichi Nuclear Power Station.

3. Removal of fuel debris

Promoting the development of technology and collection of data required to prepare fuel debris removal, such as investigations and repair of PCV's leakage parts as well as decontamination and shielding to improve PCV accessibility.

Investigation inside the Unit 3 PCV

- The inside of the PCV will be investigated in around summer 2017 to inspect the pedestal basement floor where fuel debris potentially exists and collect feedback on designing and developing equipment for the next investigation inside the pedestal.
- The investigation will use a remotely operated underwater vehicle (hereinafter referred to as the "underwater ROV"). After inspecting the status on the platform on the CRD rail side in the pedestal, the underwater ROV will go down to the basement from the slot opening to inspect the status on the floor.
- A dust monitor will be installed near the work place (X-53 penetration).

Full-scale test of PCV water shutoff

- An operability check test of the filling and shutoff technology in the suppression chamber (S/C)* (June 12-20) and a concrete placement test (June 24) were conducted in the JAEA Naraha Remote Technology Development Center using full-scale test equipment which simulated part of a PCV. The results showed that the remote-controlled technology could place concrete without any problem. * A technology to fill high-fluid concrete in the S/C and shut off the water.
- After confirming the water shutoff performance, etc., the water shutoff technology will be further researched and developed based on the collected data.

4. Plans to store, process and dispose of solid waste and decommission of reactor facilities

Promoting efforts to reduce and store waste generated appropriately and R&D to facilitate adequate and safe storage, processing and disposal of radioactive waste

Management status of rubble and trimmed trees

- As of the end of May 2017, the total storage volume of concrete and metal rubble was approx. 208,900 m³ (+1,000 m³ compared to at the end of April, with an area-occupation rate of 64%). The total storage volume of trimmed trees was approx. 107,400 m³ (+8,300 m³, with an area-occupation rate of 63%). The total storage volume of used protective clothing was approx. 67,900 m³ (+400 m³, with an area-occupation rate of 95%). The increase in rubble was mainly attributable to the acceptance of materials to be incinerated. The increase in trimmed trees was mainly attributable to the formal operation launch of the temporary storage area for site preparation-related work. The increase in used protective clothing was mainly attributable to the acceptance of used clothing, etc.

- Management status of secondary waste from water treatment
  - As of June 22, 2017, the total storage volume of waste sludge was 597 m³ (area-occupation rate: 85%) and that of concentrated waste fluid was 9,367 m³ (area-occupation rate: 88%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment, etc. was 3,664 (area-occupation rate: 58%).
- Status of the Radioactive Waste Incinerator
  - Regarding the Radioactive Waste Incinerator, measures to improve reliability were implemented prior to the annual inspection, including changing the materials used for the bellows, and preventing gas accumulation in small-diameter pipes and equipment nozzles. Incineration has resumed since June 12.
- Revision of the Solid Waste Storage Management Plan
  - The Solid Waste Storage Management Plan formulated in March 2016 was revised on June 29 to update the generation estimate based on the latest storage results, the latest construction plan, etc.
  - Efforts to further reduce risks will continue by decreasing solid waste as much as possible, storing it inside buildings, and eliminating temporary outdoor storage areas.

5. Reactor cooling

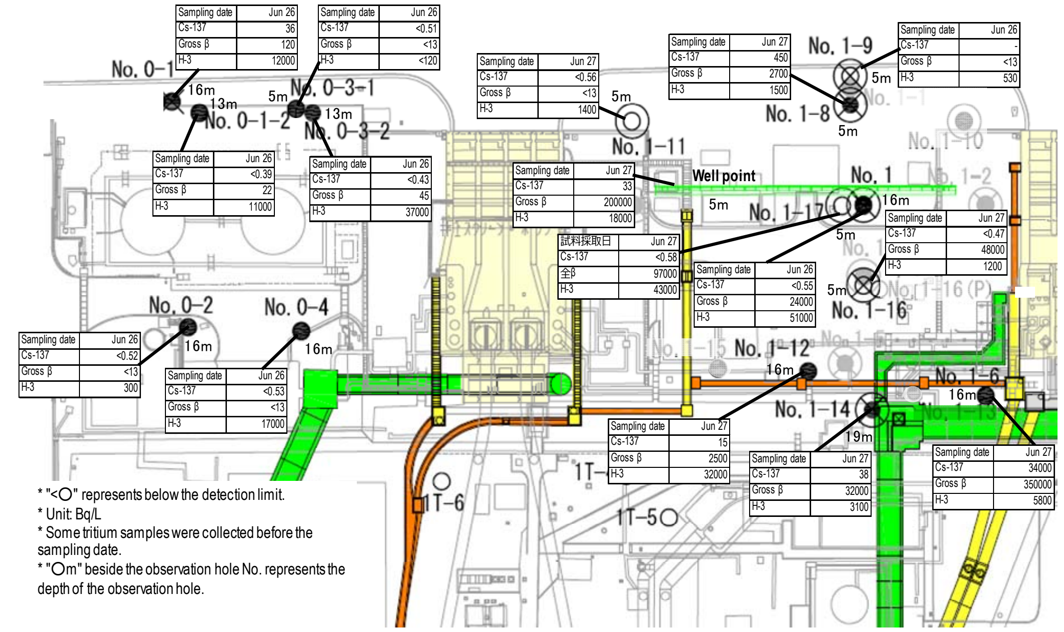
The cold shutdown condition will be maintained by cooling the reactor by water injection and measures to complement the status monitoring will continue

- Water injection solely by the FDW system during PE pipe installation work for the Unit 1-3 reactor water injection line
  - In the Unit 1-3 reactor water injection equipment, SUS flexible tubes of the core spray system (CS system) line will be replaced with PE pipes to improve reliability. During the replacement, water will be injected into the reactor solely via the feed water (FDW) system. Based on past water injection performance, it was evaluated that the reactor could be cooled by the full-volume injection from the FDW system.
- Nitrogen injection from the Unit 1 jet pump instrumentation rack line
  - For Unit 1, into which nitrogen was injected from the reactor pressure vessel (RPV) head spray line to the RPV at present, a new jet pump instrumentation rack line was installed for nitrogen injection.
  - To verify the effect inside the RPV during solo nitrogen injection of the jet pump instrumentation rack line, replacement of the head spray line with the jet pump instrumentation rack line is underway from June 6 for nitrogen injection to the RPV (as of June 28, the work was in step 4 of six steps and the replacement will be completed by July 18).
  - Based on the verification results, the operation of the nitrogen injection line will be examined.

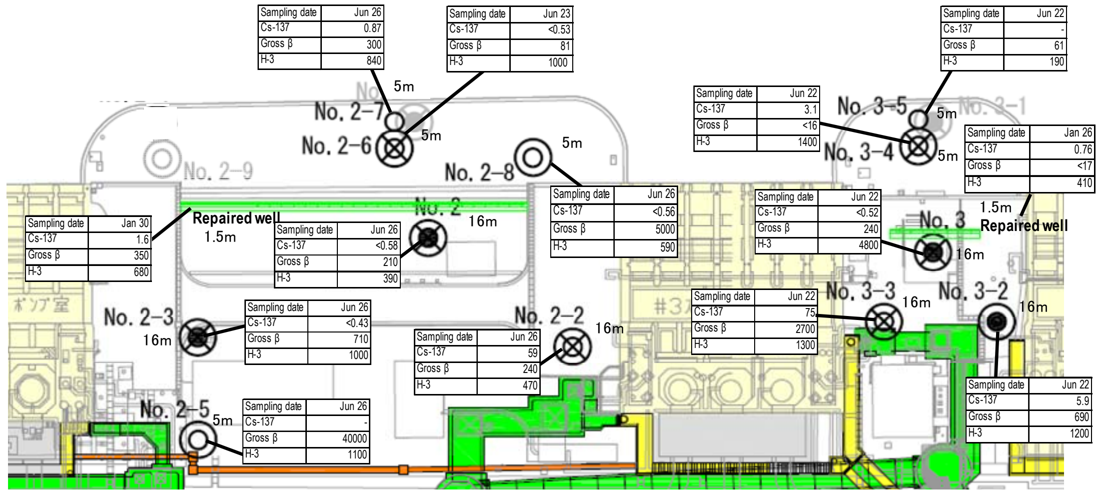
6. Reduction in radiation dose and mitigation of contamination

Effective dose-reduction at site boundaries and purification of port water to mitigate the impact of radiation on the external environment

- Status of groundwater and seawater on the east side of Turbine Building Units 1-4
  - Regarding radioactive materials in the groundwater near the bank on the north side of the Unit 1 intake, despite the tritium density at groundwater in Observation Hole No. 0-1 gradually increasing since October 2016, it currently remains constant at around 12,000 Bq/L.
  - Regarding the groundwater near the bank between the Unit 1 and 2 intakes, though the tritium density at groundwater Observation Hole No. 1-6 had been increasing from around 6,000 to 60,000 Bq/L since November 2016, it currently stands at around 7,000 Bq/L. Though the density of gross β radioactive materials at the same groundwater Observation Hole had been declining since July 2016, it has remained constant since mid-October 2016 at around 400,000 Bq/L. Though the density of gross β radioactive materials at groundwater Observation Hole No. 1-8 had remained constant at around 8,000 Bq/L, it has been declining since April 2017 and currently stands at around 4,000 Bq/L. Though the density of gross β radioactive materials at the groundwater Observation Hole No. 1-12 had remained constant at around 20 Bq/L, it currently stands at around 3,000 Bq/L. Though the tritium density at groundwater Observation Hole No. 1-14 had remained constant at around 10,000 Bq/L, it has been declining since April 2017 and currently stands at around 3,000 Bq/L. Though the tritium density at groundwater Observation Hole No. 1-17 had been declining from 40,000 Bq/L and increasing since March 2016, and then declining since October 2016, it has been increasing since February 2017 and currently stands at around 40,000 Bq/L. Though the density of gross β radioactive materials at the same groundwater Observation Hole increased from 200,000 Bq/L to 600,000 Bq/L in May 2017 and then declining, it currently stands at around 100,000 Bq/L. Since August 15, 2013, pumping of groundwater continued (at the well point between the Unit 1 and 2 intakes: August 15, 2013 – October 13, 2015 and from October 24; at the repaired well: October 14 - 23, 2015).
  - Regarding radioactive materials in the groundwater near the bank between the Unit 2 and 3 intakes, though the tritium density at groundwater Observation Hole No. 2-3 had remained constant at around 4,000 Bq/L, having initially declined since November 2016 before remaining constant, it has been increasing since March 2017 and currently stands at around 1,000 Bq/L. Though the tritium density at groundwater Observation Hole No. 2-5 had remained constant at around 500 Bq/L, it has increased to 2,000 Bq/L since November 2016, then declined and currently stands at around 1,000 Bq/L. Though the density of gross β radioactive materials at the same groundwater Observation Hole had been increasing from 10,000 Bq/L since November 2016, it has remained constant at around 40,000 Bq/L. Since December 18, 2013, pumping of groundwater continued (at the well point between the Unit 2 and 3 intakes: December 18, 2013 - October 13, 2015; at the repaired well: from October 14, 2015).
  - Regarding radioactive materials in the groundwater near the bank between the Unit 3 and 4 intakes, though the tritium density at groundwater Observation Hole No. 3 had remained constant at around 9,000 Bq/L, it has been gradually declining since October 2016 and currently stands at around 5,000 Bq/L. Though the density of gross β radioactive materials at the same groundwater Observation Hole had remained constant at around 500 Bq/L, it has been gradually declining since November 2016 and currently stands at around 300 Bq/L. The tritium density at groundwater Observation Hole No. 3-2 has been gradually declining from 3,000 Bq/L since October 2016 and currently stands at around 1,200 Bq/L. The density of gross β radioactive materials at the same groundwater Observation Hole has been gradually declining from 3,500 Bq/L since October 2016 and currently stands at around 800 Bq/L. The tritium density at groundwater Observation Hole No. 3-3 has been gradually declining from 2,500 Bq/L since early November and currently stands at around 1,200 Bq/L. At groundwater Observation Hole No. 3-4, though the tritium density had been gradually increasing from 2,500 Bq/L since October 2016, it had declined and currently stands at around 1,500 Bq/L. At groundwater Observation Hole No. 3-5, the density of gross β radioactive materials had been declining from 100 Bq/L since October 2016 and repeatedly increasing, it currently stands at around 60 Bq/L. Since April 1, 2015, pumping of groundwater continued (at the well point between the Unit 3 and 4 intakes: April 1 – September 16, 2015; at the repaired well: from September 17, 2015).
  - Regarding the radioactive materials in seawater in the Unit 1-4 intake area, densities have remained low except for the increase in cesium 137 and strontium 90 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. The density of cesium 137 has been increasing since January 25, 2017, when a new silt fence was installed to accommodate the relocation.
  - Regarding the radioactive materials in seawater in the area within the port, densities have remained low except for the increase in cesium 137 and strontium 90 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 of cesium 137 and strontium 90 have been declining and remained low following the completed installation and the connection of steel pipe sheet piles for the sea-side impermeable walls.



<Unit 1 intake north side, between Unit 1 and 2 intakes>



<Between Unit 2 and 3 intakes, between Unit 3 and 4 intakes>

Figure 4: Groundwater density on the Turbine Building east side

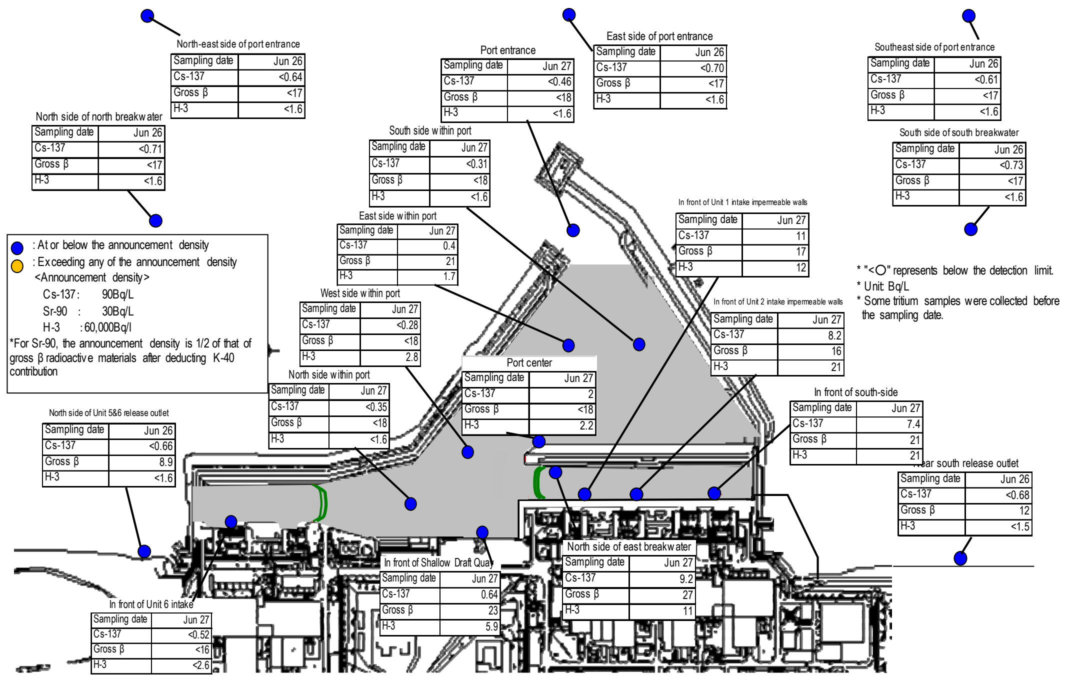


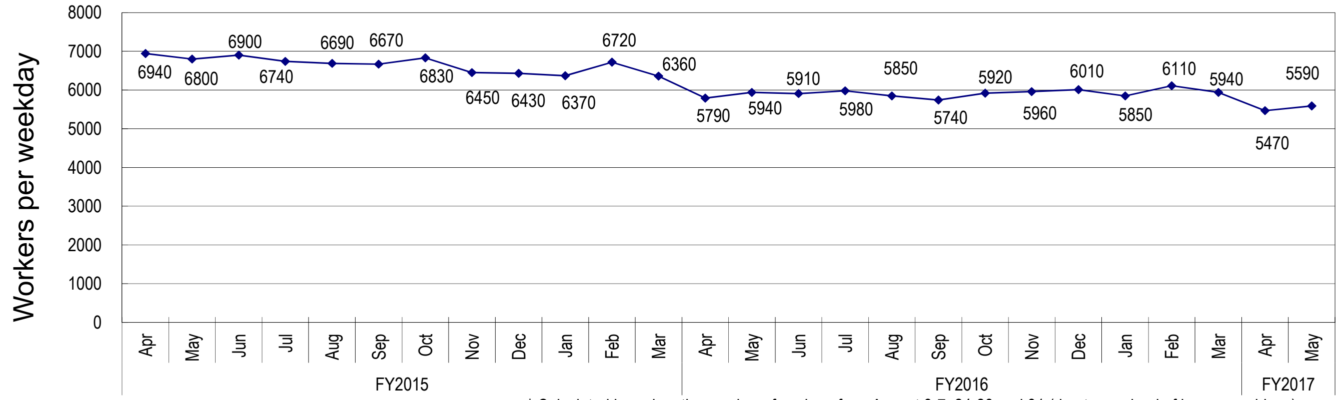
Figure 5: Seawater density around the port

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 February to April 2017 was approx. 12,400 (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 July 2017 (approx. 5,450 per day: TEPCO and partner company workers)* would be secured at present. The average numbers of workers per day per month (actual values) were maintained, with approx. 5,500 to 7,000 since FY2014 (see Figure 6). Some works for which contractual procedures have yet to be completed were excluded from the estimate for July 2017.
- The number of workers from both within and outside Fukushima Prefecture has decreased. The local employment ratio (TEPCO and partner company workers) as of May has remained at around 55%.
- The monthly average exposure dose of workers remained at approx. 0.81 mSv/month during FY2014, approx. 0.59 mSv/month during FY2015 and approx. 0.39 mSv/month* during FY2016. (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.



* Calculated based on the number of workers from August 3-7, 24-28 and 31 (due to overhaul of heavy machines)

Figure 6: Changes in the average number of workers per weekday for each month since FY2015 (actual values)

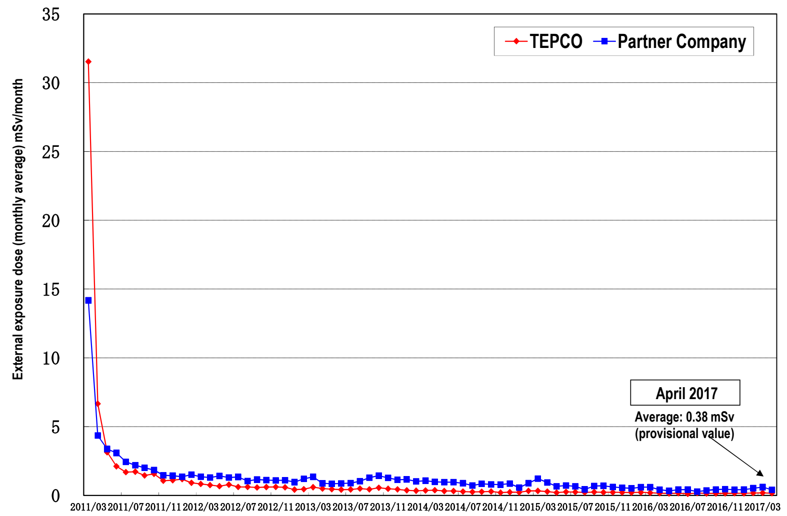


Figure 7: Changes in monthly individual worker exposure dose
(monthly average exposure dose since March 2011)

Status of heat stroke cases

- In FY2017, one worker suffered heat stroke due to work and no worker had suffered light stroke (not requiring medical treatment) up until June 28. Continued measures will be taken to prevent heat stroke. (In FY2016, one worker had heat stroke due to work and no worker had light heat stroke up until the end of June.)

8. Status of Units 5 and 6

Status of spent fuel storage in Units 5 and 6

- Regarding Unit 5, fuel removal from the reactor was completed in June 2015. 1,374 spent fuel assemblies and 168 non-irradiated fuel assemblies are stored in the spent fuel pool (storage capacity: 1,590 assemblies).
- Regarding Unit 6, fuel removal from the reactor was completed in FY2013. 1,456 spent fuel assemblies and 198 non-irradiated fuel assemblies (180 of which were transferred from the Unit 4 spent fuel pool) are stored in the spent fuel pool (storage capacity: 1,654 assemblies) and 230 non-irradiated fuel assemblies are stored in the storage facility of non-irradiated fuel assemblies (storage capacity: 230 assemblies).

Status of accumulated water in Units 5 and 6

- Accumulated water in Units 5 and 6 is transferred from Unit 6 Turbine Building to outdoor tanks and sprinkled after undergoing oil separation and RO treatment and confirming the density of radioactive materials.

Flood from the Unit 5 and 6 accumulated water treatment equipment (desalination equipment) intake chamber

- On June 5, following an alert indicating flow balance variation issued at the Unit 5 and 6 accumulated water treatment (desalination) equipment, the equipment was automatically suspended. After confirming no abnormality at the site, manual water filling in the intake chamber started as preparation for reactivation. Though water filling was suspended when finding a fixed "glass float" in the liquid-level gauge, it failed to prevent flood from the intake chamber manhole. The identified leakage was terminated after closing the inlet valve of the intake chamber. The leakage amount was approx. 240 L. All the leaked water remained within the desalination equipment pre-treatment unit container and no external leakage was identified.
- On June 8, the liquid-level gauge was inspected and cleaned. From June 12, inspection of similar parts is underway.

9. Other

Seismic safety assessment of the Unit 1 and 2 exhaust stack (interim report)

- In April 2017, an extraordinary inspection from the Unit 1 and 2 Turbine Building roofs, which became available by the improved work environment, was conducted for the exhaust stack of Units 1 and 2 in response to external requests.
- The inspection identified an additional breakage at a bent connection around 45m on the east side.
- The reassessment of seismic safety for parts, including the additional breakage, confirmed that the stack would not collapse in the design basis ground motion Ss-1. The seismic safety reassessment of the design basis ground motion Ss-2 and 3 continues.

Results of the applicability test of multi-copters capable of steric dose evaluation

- To develop plans for radiation work effectively and check the dose reduction results, multi-copters capable of steric dose evaluation will be introduced. An applicability test was conducted during the period February to April 2017.
- The test results confirmed that the multi-copters had actual operation ability, despite items to be noted for radiation measurement.
- Multi-copters will be effectively utilized in high-dose locations such as Reactor Buildings and Turbine Buildings basement floors to reduce exposure.

JAEA Fukushima Research Conference (FRC)

- As part of efforts to gather wisdom in the field of decommissioning study from around Japan and worldwide, the Fukushima Research Conference (FRC), an international conference which invites experts in this field, is held.
- In addition to leading researchers of their generations in various study fields invited from Japan and overseas, students and young researchers also attend the FRC. The conference expands the base of the decommissioning study as well as contributing to human resource development.
- This fiscal year, the FRC is organized five times in Tomioka and Naraha Towns. The first meeting was held in Tomioka Town Art & Media Center on June 20, with the theme "Conference for Study on Cementitious Composites in Decommissioning and Waste Management." Approx. 100 domestic and overseas researchers were involved in discussions.

The 2nd International Forum on the Decommissioning of the Fukushima Daiichi Nuclear Power Station

- The 2nd International Forum on the Decommissioning of the Fukushima Daiichi Nuclear Power Station will be held in Hirono Town on July 2 and Iwaki City on July 3. (Organizer: Nuclear Damage Compensation and Decommissioning Facilitation Corporation)
- On Day 1, mainly for the local community, lectures to explain the decommissioning will be provided from the perspective of the local community and panel discussions of interest will be held. On Day 2, mainly for technical experts, the latest information will be discussed beyond the framework of international members and Japanese experts.

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 June 19-27)"; 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/f1/smp/index-j.html

Sea side impermeable wall

Silt fence

Cesium-134: 3.3 (2013/10/17) → ND(0.32) Below 1/10
Cesium-137: 9.0 (2013/10/17) → 0.40 Below 1/20
Gross β: 74 (2013/ 8/19) → 21 Below 1/3
Tritium: 67 (2013/ 8/19) → ND(1.7) Below 1/30

Cesium-134: 4.4 (2013/12/24) → ND(0.23) Below 1/10
Cesium-137: 10 (2013/12/24) → ND(0.28) Below 1/30
Gross β: 60 (2013/ 7/ 4) → ND(18) Below 1/3
Tritium: 59 (2013/ 8/19) → ND(1.7) Below 1/30

Cesium-134: 5.0 (2013/12/2) → ND(0.28) Below 1/10
Cesium-137: 8.4 (2013/12/2) → ND(0.35) Below 1/20
Gross β: 69 (2013/8/19) → ND(18) Below 1/3
Tritium: 52 (2013/8/19) → ND(1.7) Below 1/30

Cesium-134: 2.8 (2013/12/2) → ND(0.47) Below 1/5
Cesium-137: 5.8 (2013/12/2) → ND(0.52) Below 1/10
Gross β: 46 (2013/8/19) → ND(16) Below 1/2
Tritium: 24 (2013/8/19) → ND(2.6) Below 1/9

Cesium-134: ND(0.63)
Cesium-137: 2.0
Gross β: ND(18)
Tritium: 2.9 *

Cesium-134: 3.3 (2013/12/24) → ND(0.52) Below 1/6
Cesium-137: 7.3 (2013/10/11) → ND(0.46) Below 1/10
Gross β: 69 (2013/ 8/19) → ND(18) Below 1/3
Tritium: 68 (2013/ 8/19) → ND(1.8) Below 1/30

Cesium-134: 3.5 (2013/10/17) → ND(0.30) Below 1/10
Cesium-137: 7.8 (2013/10/17) → ND(0.31) Below 1/20
Gross β: 79 (2013/ 8/19) → ND(18) Below 1/4
Tritium: 60 (2013/ 8/19) → ND(1.7) Below 1/30

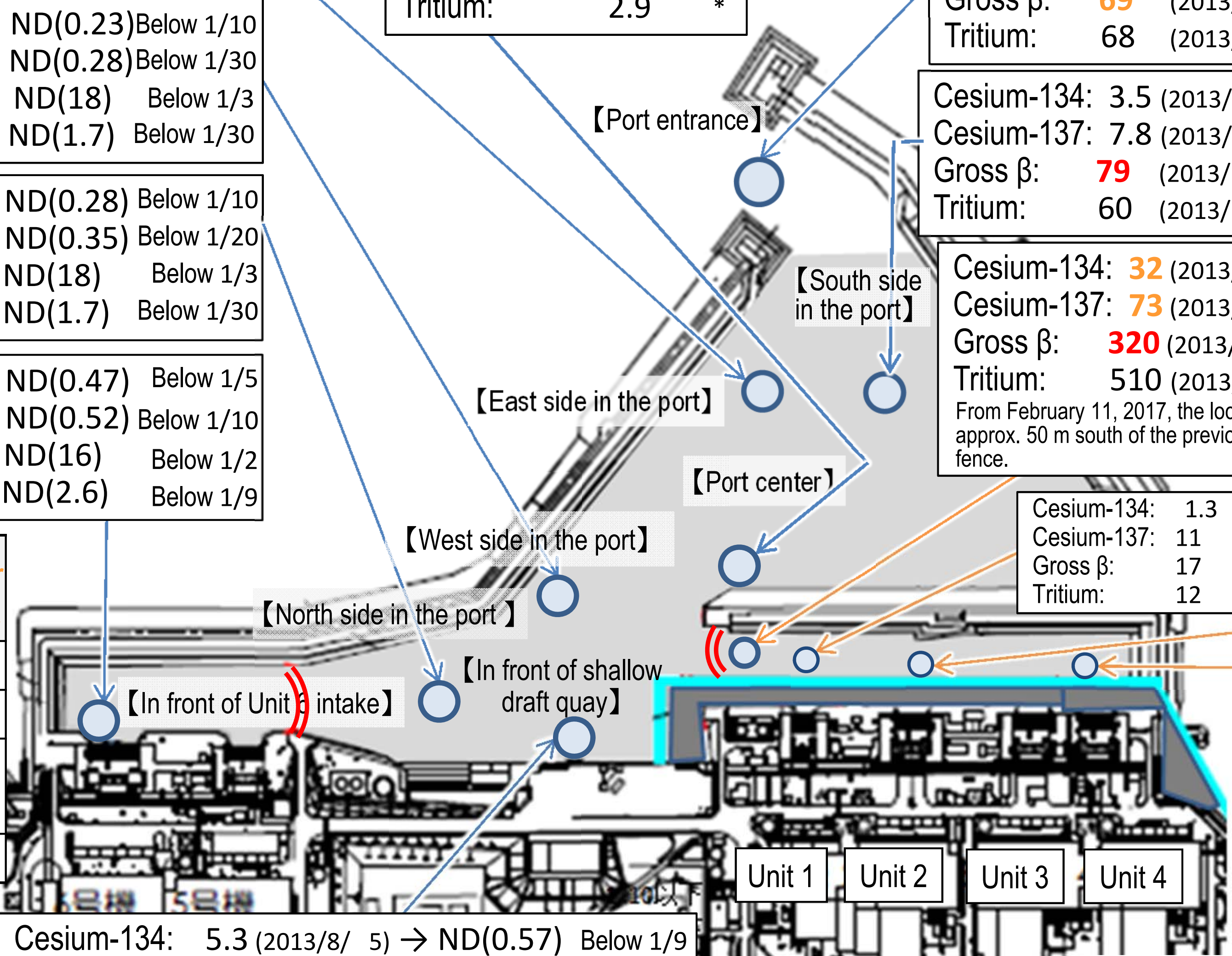
Cesium-134: 32 (2013/10/11) → 1.2 Below 1/20
Cesium-137: 73 (2013/10/11) → 9.2 Below 1/7
Gross β: 320 (2013/ 8/12) → 27 Below 1/10
Tritium: 510 (2013/ 9/ 2) → 11 Below 1/40
From February 11, 2017, the location of the sampling point was shifted approx. 50 m south of the previous point due to the location shift of the silt fence.

Cesium-134: 1.3
Cesium-137: 11
Gross β: 17
Tritium: 12 *

Cesium-134: 1.0
Cesium-137: 8.2
Gross β: 16
Tritium: 21 *

Cesium-134: 0.86
Cesium-137: 7.4
Gross β: 21
Tritium: 21 *

	Legal discharge limit	WHO Guidelines for Drinking Water Quality
Cesium-134	60	10
Cesium-137	90	10
Strontium-90 (strongly correlate with Gross β)	30	10
Tritium	60,000	10,000



Cesium-134: 5.3 (2013/8/ 5) → ND(0.57) Below 1/9
Cesium-137: 8.6 (2013/8/ 5) → 0.64 Below 1/10
Gross β: 40 (2013/7/ 3) → 23
Tritium: 340 (2013/6/26) → 6.8 Below 1/50

* Monitoring commenced in or after March 2014.
Monitoring inside the sea-side impermeable walls was finished because of the landfill.

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 June 28, 2017

Status of seawater monitoring around outside of the port
(comparison between the highest values in 2013 and the latest values)

(The latest values sampled during June 19-27)

	Legal discharge limit	WHO Guidelines for Drinking Water Quality
Cesium-134	60	10
Cesium-137	90	10
Strontium-90 (strongly correlate with Gross β)	30	10
Tritium	60,000	10,000

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

【Northeast side of port entrance(offshore 1km)】

Cesium-134:	ND (2013) → ND (0.74)	
Cesium-137:	ND (2013) → ND (0.64)	
Gross β:	ND (2013) → ND (17)	
Tritium:	ND (2013) → ND (1.7)	

【East side of port entrance (offshore 1km)】

Cesium-134:	ND (2013) → ND (0.75)	
Cesium-137:	1.6 (2013/10/18) → ND (0.70)	Below 1/2
Gross β:	ND (2013) → ND (17)	
Tritium:	6.4 (2013/10/18) → ND (1.7)	Below 1/3

【Southeast side of port entrance(offshore 1km)】

Cesium-134:	ND (2013) → ND (0.84)	
Cesium-137:	ND (2013) → ND (0.61)	
Gross β:	ND (2013) → ND (17)	
Tritium:	ND (2013) → ND (1.7)	

【North side of north breakwater(offshore 0.5km)】

Cesium-134:	ND (2013) → ND (0.66)	
Cesium-137:	ND (2013) → ND (0.71)	
Gross β:	ND (2013) → ND (17)	
Tritium:	4.7 (2013/ 8/18) → ND (1.7)	Below 1/2

【Port entrance】

Cesium-134:	3.3 (2013/12/24) → ND (0.52)	Below 1/6
Cesium-137:	7.3 (2013/10/11) → ND (0.46)	Below 1/10
Gross β:	69 (2013/ 8/19) → ND (18)	Below 1/3
Tritium:	68 (2013/ 8/19) → ND (1.8)	Below 1/30

【South side of south breakwater(offshore 0.5km)】

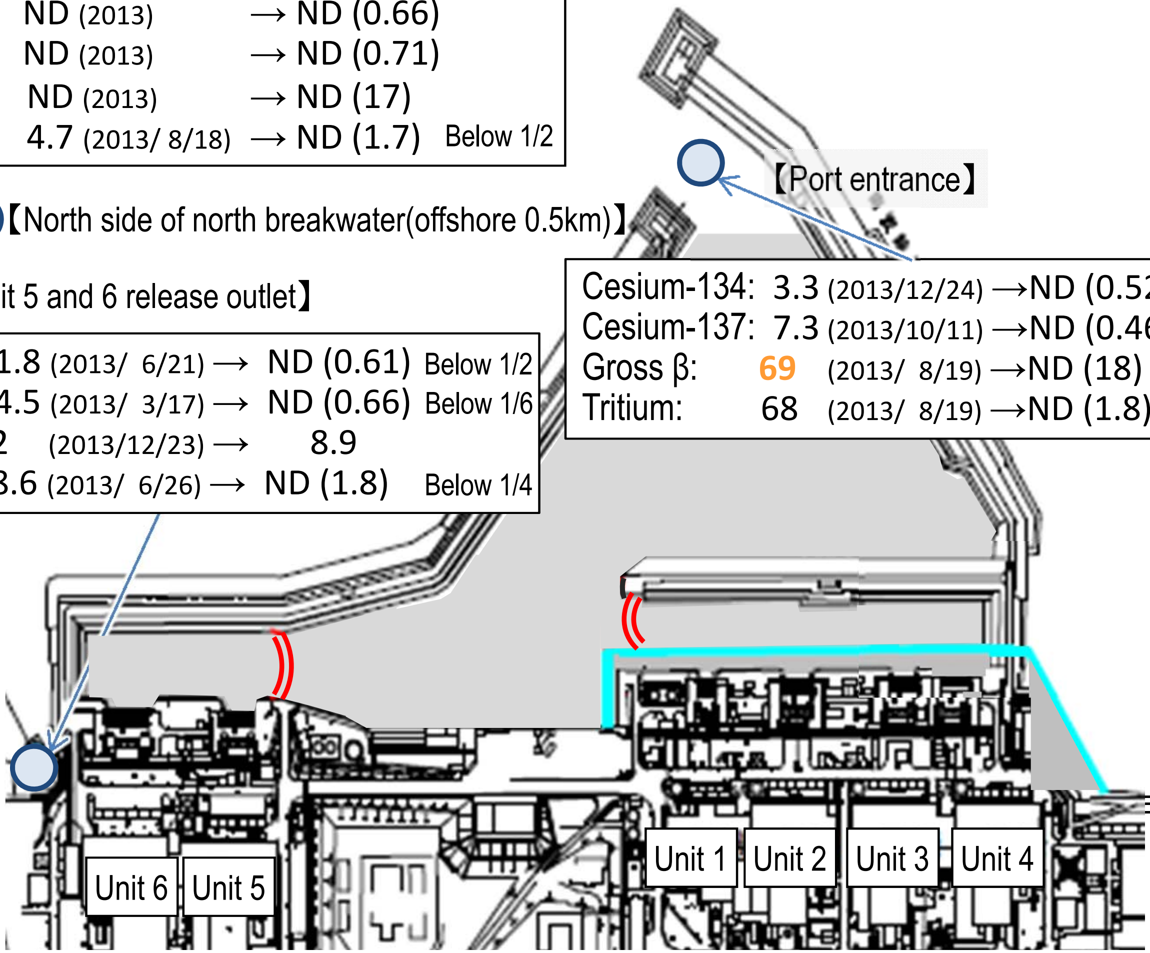
Cesium-134:	ND (2013) → ND (0.68)	
Cesium-137:	ND (2013) → ND (0.73)	
Gross β:	ND (2013) → ND (17)	
Tritium:	ND (2013) → ND (1.7)	

【North side of Unit 5 and 6 release outlet】

Cesium-134:	1.8 (2013/ 6/21) → ND (0.61)	Below 1/2
Cesium-137:	4.5 (2013/ 3/17) → ND (0.66)	Below 1/6
Gross β:	12 (2013/12/23) → 8.9	
Tritium:	8.6 (2013/ 6/26) → ND (1.8)	Below 1/4

【Near south release outlet】

Cesium-134:	ND (2013) → ND (0.66)	
Cesium-137:	3.0 (2013/ 7/15) → ND (0.68)	Below 1/4
Gross β:	15 (2013/12/23) → 12	
Tritium:	1.9 (2013/11/25) → ND (1.5)	



Sea side impermeable wall

Silt fence

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.

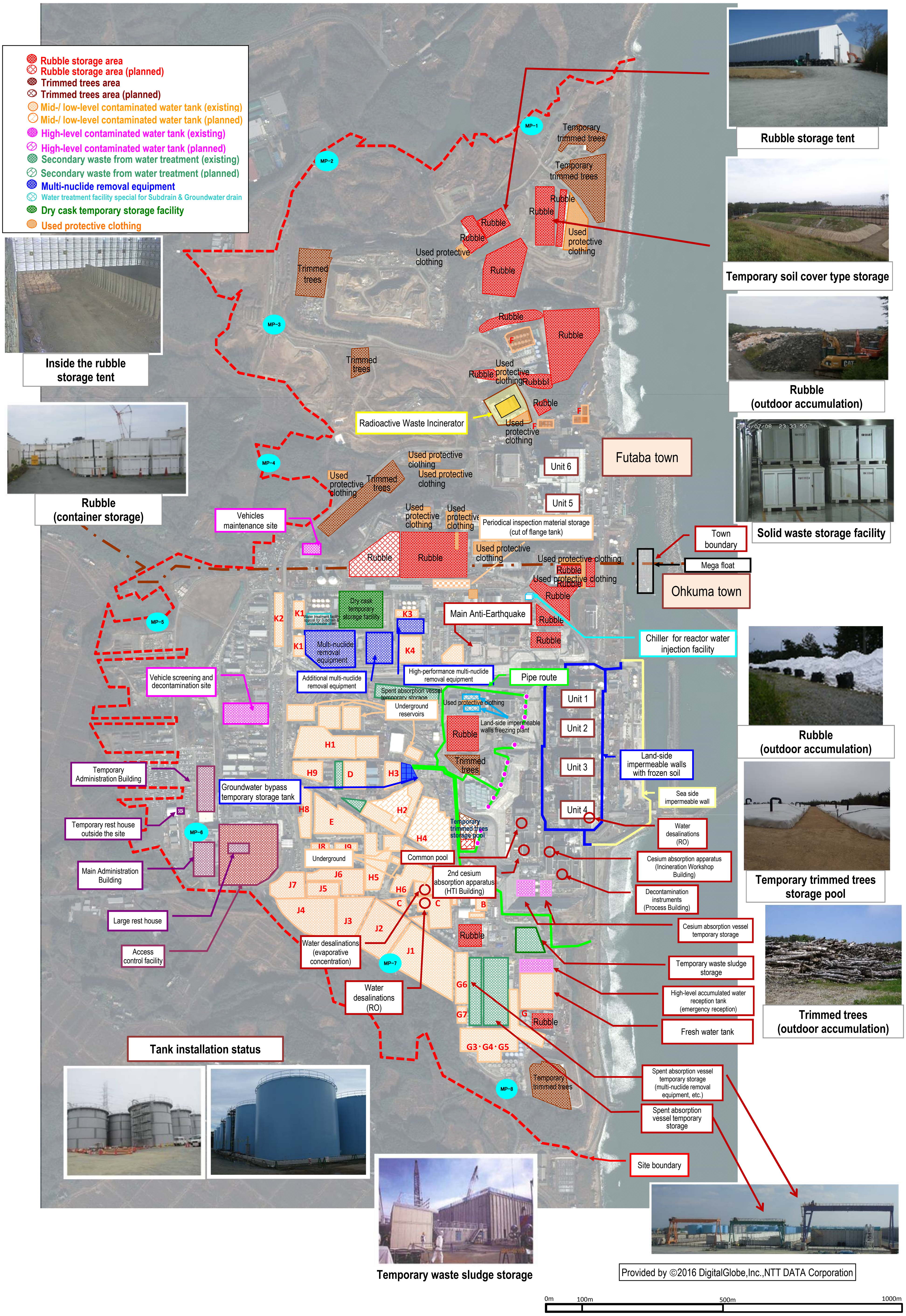
Note: Because safety of the sampling points was unassured due to the influence of Typhoon No. 10 in 2016, samples were taken from approx. 330 m south of the Unit 1-4 release outlet. From January 27, 2017, the location of the sampling point was also shifted approx. 280 m south of the Unit 1-4 release outlet.

Summary of TEPCO data as of June 28, 2017

Source: TEPCO website, Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station, http://www.tepco.co.jp/nu/fukushima-np/f1/smp/index-j.html

Appendix 2
June 29, 2017

TEPCO Holdings Fukushima Daiichi Nuclear Power Station Site



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 top floor of the Reactor Building (operating floor).

All roof panels and wall panels of the building cover were dismantled by November 10, 2016.

Removal of pillars and beams of the building was completed on May 11. Modification of the pillars and beams (including windbreak sheets) will follow.

Prior to formulating a work plan for rubble removal, additional investigation into rubble status on the operating floor is underway.

Thorough monitoring of radioactive materials will continue.

<Dismantling of wall panels>

Flow of building cover dismantling

Unit 2

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.

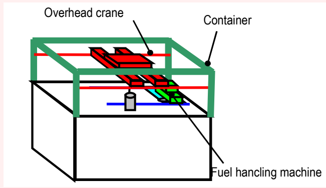


Image of Plan 1

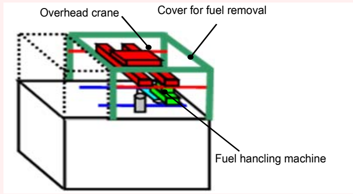


Image of Plan 2

Unit 3

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.

Fuel gripper (mast)

Manipulator

Fuel-handling facility (in the factory)

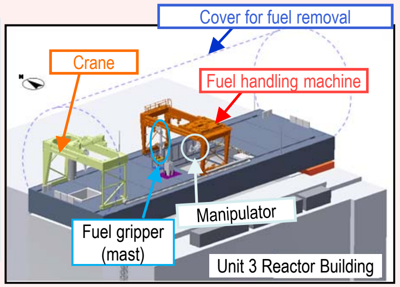


Image of entire fuel handling facility inside the cover

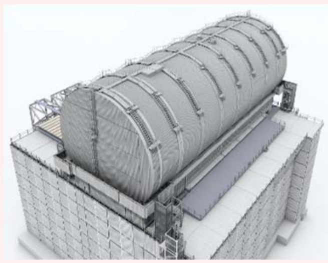


Image of the cover for fuel removal

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

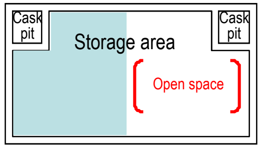
This marks the completion of fuel removal from the Unit 4 Reactor Building.

Based on this experience, fuel assemblies will be removed from Unit 1-3 pools.

Fuel removal status

* A part of the photo is corrected because it includes sensitive information related to physical protection.

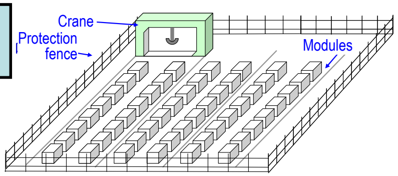
Common pool



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)

Temporary dry cask (*) storage facility



Spent fuel is accepted from the common pool

Operation commenced on April 12, 2013; from the cask-storage building, transfer of 9 existing dry casks completed (May 21, 2013); fuel stored in the common pool sequentially transferred.

<Glossary>
(*) 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

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(*1). (Due to high dose around the entrance in 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(*2) (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.

Leak point

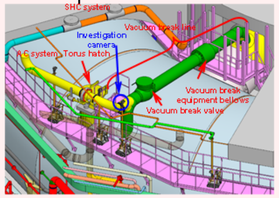
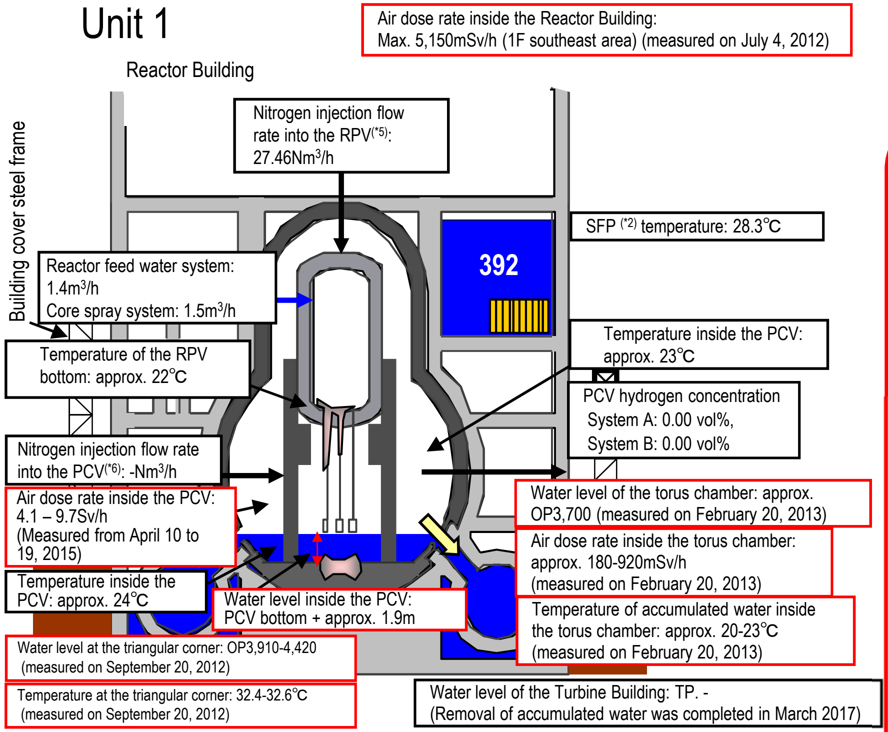


Image of the S/C upper part investigation

Unit 1



* Indices related to the plant are values as of 11:00, June 28, 2017

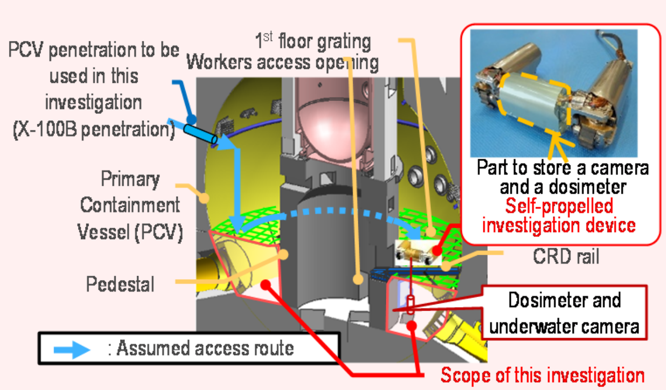
Investigations inside PCV	1st (Oct 2012)	- Acquiring images - Measuring air temperature and dose rate - Measuring water level and temperature - Sampling accumulated water - Installing permanent monitoring instrumentation
	2nd (Apr 2015)	Confirming the status of PCV 1st floor - Acquiring images - Measuring air temperature and dose rate - Replacing permanent monitoring instrumentation
	3rd (Mar 2017)	Confirming the status of PCV 1st basement floor - Acquiring images - Measuring and dose rate - Sampling deposit - Replacing permanent monitoring instrumentation
Leakage points from PCV	- PCV vent pipe vacuum break line bellows (identified in May 2014) - Sand cushion drain line (identified in November 2013)	

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, a 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.
- In March 2017, the investigation using a self-propelled investigation device, conducted to inspect the spreading of debris to the basement floor outside the pedestal, took images of the PCV bottom status for the first time. The status inside the PCV will continue to be examined based on the collected image and dose data.



<Image of investigation inside the PCV>

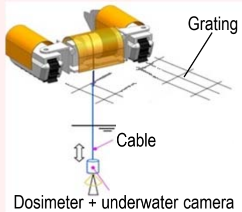


Image of hanging of dosimeter and camera

Image near the bottom

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

Period	Evaluation results
Feb - May 2015	Confirmed that there was no large fuel in the reactor core.

<Glossary>
(*1) TIP (Traversing In-core Probe)
(*2) Penetration: Through-hole of the PCV
(*3) S/C (Suppression Chamber): Suppression pool, used as the water source for the emergent core cooling system.
(*4) SFP (Spent Fuel Pool):
(*5) RPV (Reactor Pressure Vessel)
(*6) PCV (Primary Containment Vessel)

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

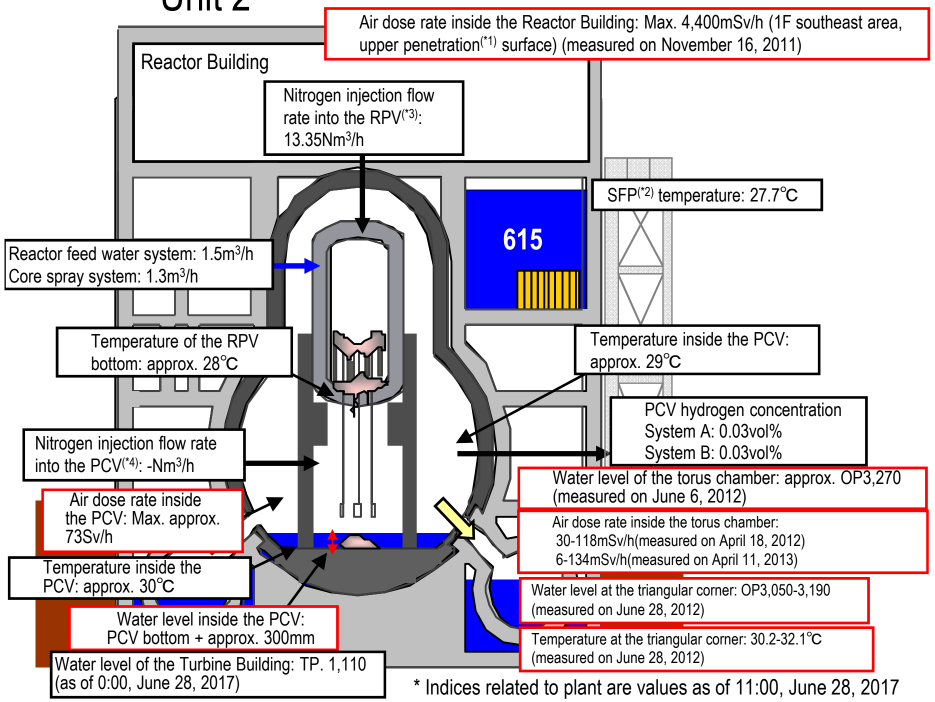
(1) Replacement of the RPV thermometer

- 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.

Unit 2

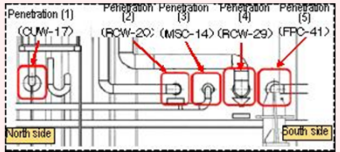


* Indices related to plant are values as of 11:00, June 28, 2017

Investigations inside PCV	1st (Jan 2012)	- Acquiring images - Measuring air temperature
	2nd (Mar 2012)	- Confirming water surface - Measuring water temperature - Measuring dose rate
	3rd (Feb 2013 – Jun 2014)	- Acquiring images - Sampling accumulated water - Measuring water level - Installing permanent monitoring instrumentation
	4th (Jan – Feb 2017)	- Acquiring images - Measuring dose rate - Measuring air temperature
Leakage points from PC		- No leakage from torus chamber rooftop - No leakage from all inside/outside surfaces of S/C

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 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 (*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)



Penetrations investigated

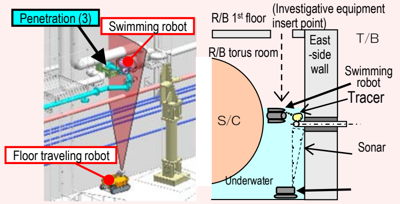


Image of the torus chamber east-side cross-sectional investigation

Status of investigation inside the PCV

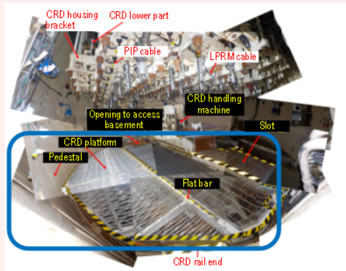
Prior to fuel debris removal, an investigation inside the PCV will be conducted to inspect the status there including the location of fuel debris.

[Investigative outline]

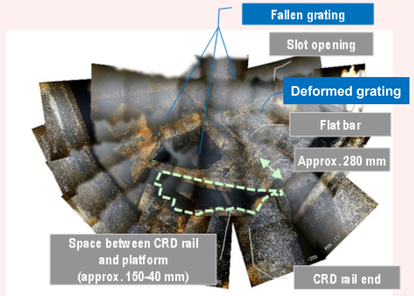
- A robot, injected from Unit 2 X-6 penetration(*1), will access the inside of the pedestal using the CRD rail.

[Progress status]

- 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, deposit on the access route of the self-propelled investigative 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.



(Reference) Inside the Unit 5 pedestal



Scope of investigation inside the PCV

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

Period	Evaluation results
Mar – Jul 2016	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.

<Glossary> (*1) Penetration: Through-hole of the PCV (*2) SFP (Spent Fuel Pool) (*3) RPV (Reactor Pressure Vessel) (*4) PCV (Primary Containment Vessel) (*5) Tracer: Material used to trace the fluid flow. Clay particles

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* room

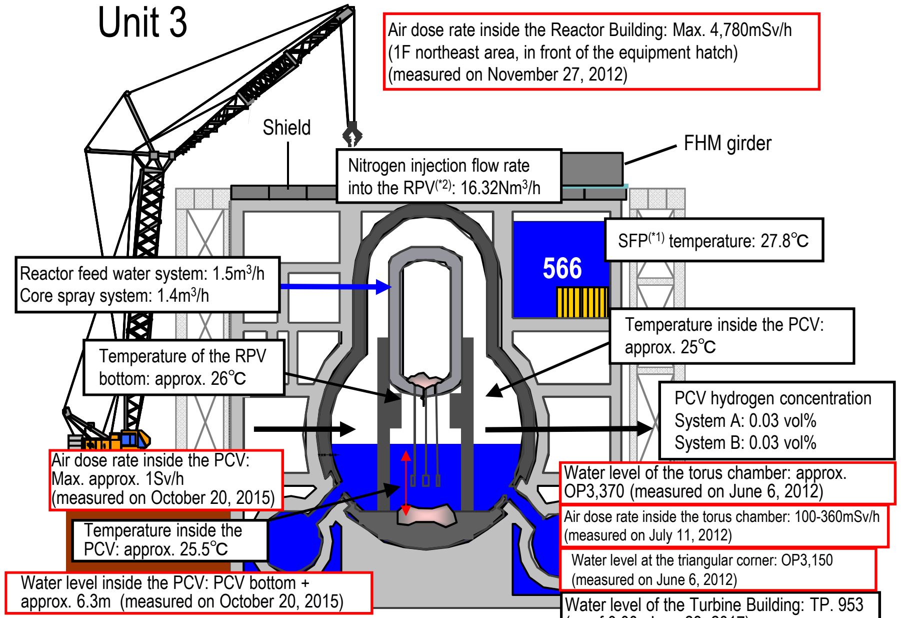
On January 18, 2014, a flow of water from around the door of the Steam Isolation Valve room in the Reactor Building Unit 3 1st floor northeast area to the nearby floor drain funnel (drain outlet) was detected. As the drain outlet connects with the underground part of the Reactor Building, there is no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

* Main Steam Isolation Valve: A valve to shut off the steam generated from the Reactor in an emergency

Unit 3

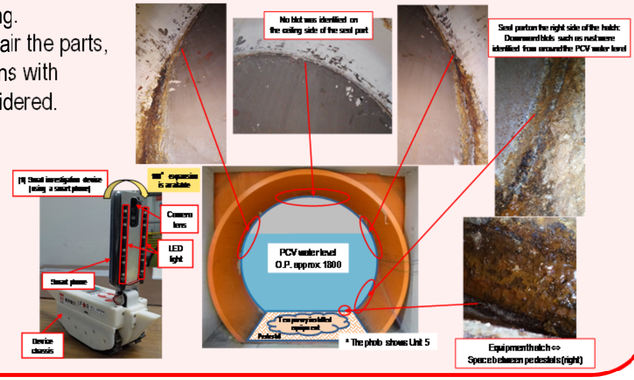


* Indices related to plant are values as of 11:00, June 28, 2017

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

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.

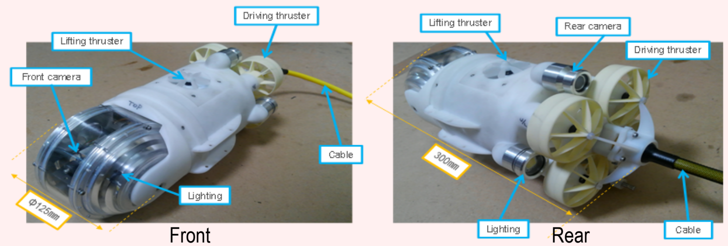


Investigation inside the PCV

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.
- The inside of the pedestal will be investigated using remotely operated underwater vehicle in around summer 2017 to collect information for future debris removal.



Remotely operated underwater vehicle

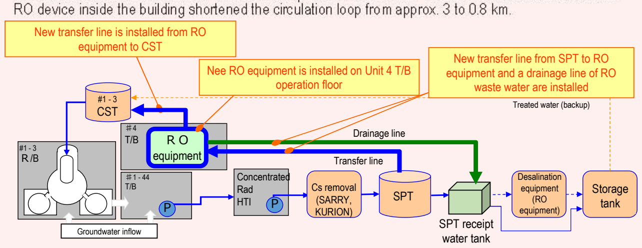
<Glossary>
(*1) SFP (Spent Fuel Pool)
(*2) RPV (Reactor Pressure Vessel)
(*3) PCV (Primary Containment Vessel)
(*4) Penetration: Through-hole of the PCV

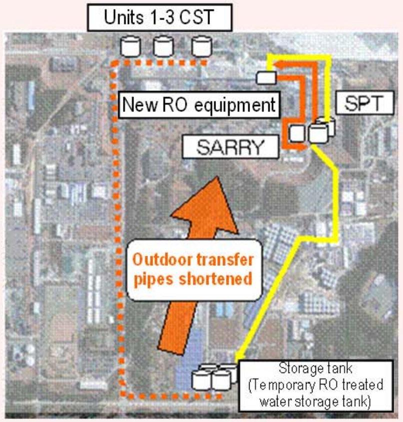
Progress toward decommissioning: Work related to circulation cooling and accumulated water treatment line

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.





* 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).

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 was completed in H1 east area (12 tanks) in October 2015, in H2 area (28 tanks) in March 2016 and in H4 area (56 tanks) in May 2017. Dismantling of flange tanks in H3, H5 and B areas is underway.

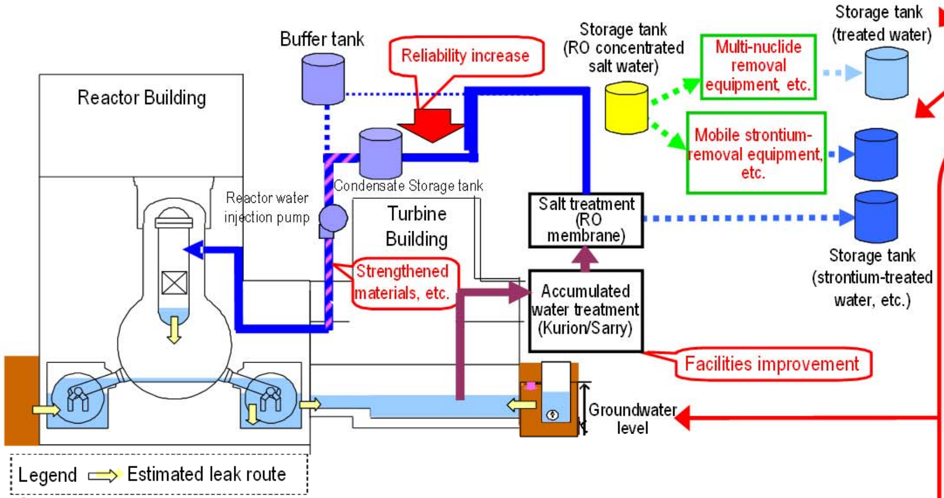

Start of dismantling in H1 east area

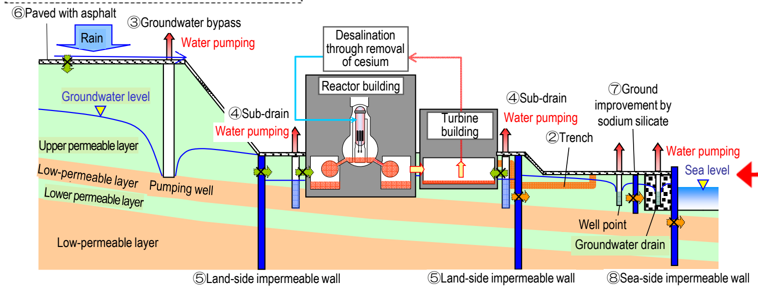

After dismantling in H1 east area

Completion of purification of contaminated water (RO concentrated salt water)

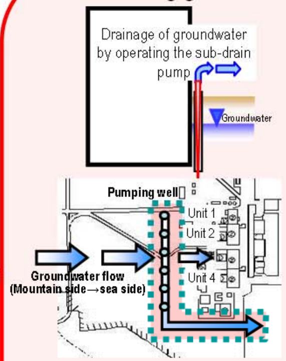
Contaminated water (RO concentrated salt water) is being treated using seven types of equipment including the multi-nuclide removal equipment (ALPS). Treatment of the RO concentrated salt water was completed on May 27, 2015, with the exception of the remaining water at the tank bottom. The remaining 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 wells (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 met 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.

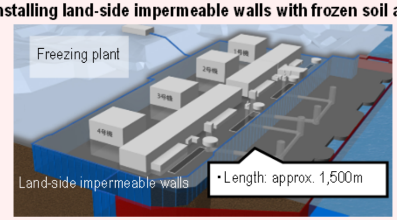
The pumped up groundwater is temporarily stored in tanks and released after TEPCO and a third-party organization have confirmed that its quality meets operational targets.

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.

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. On the sea side, the underground temperature declined 0℃ or less throughout the scope requiring freezing except for the unfrozen parts under the sea-water pipe trenches and the areas above groundwater level in October 2016.

Freezing started for two of seven unfrozen sections on the mountain side from December 2016, and four of the remaining five unfrozen sections from March 2017.

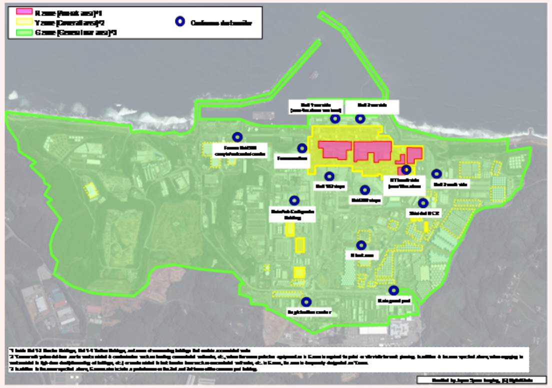
Progress toward decommissioning: Work to improve the environment within the site

Immediate targets	・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

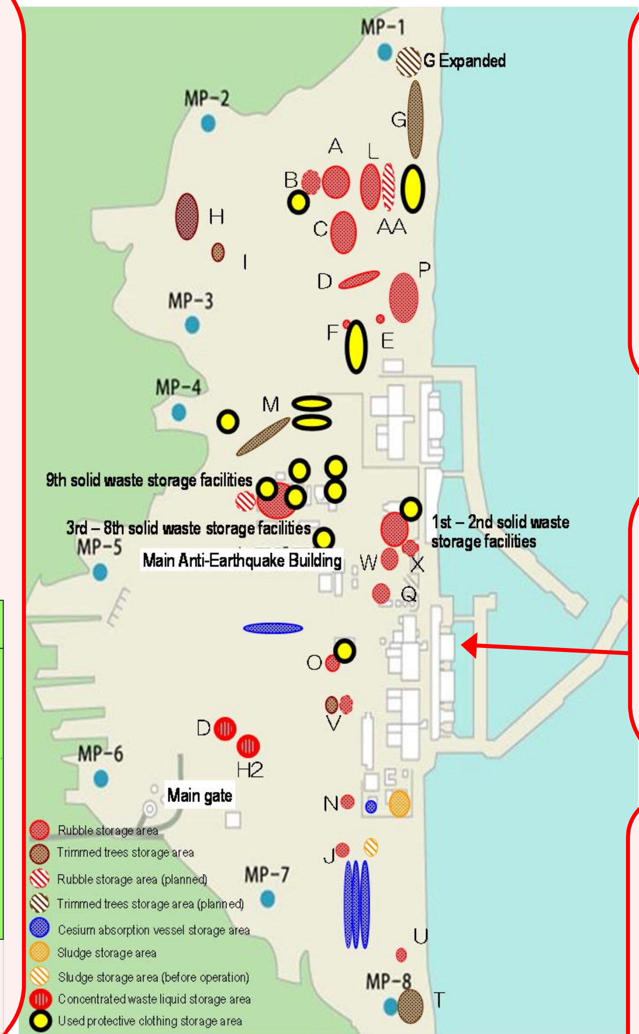
Based on the progress of measures to reduce environmental dosage on site, the site is categorized into two zones: highly contaminated area around Unit 1-4 buildings, etc. and other areas to optimize protective equipment according to each category aiming at improving safety and productivity by reducing load during work.

From March 8, 2016, limited operation started in consideration of workers' load. From March 30, 2017 the G Zone is expanded.



R zone (Anorak area)	Y zone (Coverall area)	G zone (General wear)	
Full-face mask 	Full-face or half-face masks *1 *2 	Disposable disposable mask 	
Anorak on coverall Or double coveralls 	Coverall 	General*3 	Dedicated on-site wear 

*1 For works in buildings including water-treatment facilities [multi-nuclide removal equipment, etc.] (excluding site visits), wear a full-face mask.
*2 For works in tank areas containing concentrated salt water or Sr-treated water (excluding works not handling concentrated salt water, etc., patrol, on-site investigation for work planning, and site visits) and works related to tank transfer lines, wear a full-face mask.
*3 Specified light works (patrol, monitoring, delivery of goods brought from outside, etc.)



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 Dose-rate monitor

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.

Installation of steel pipe sheet piles for sea-side impermeable wall

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.