Summary of Decommissioning and Contaminated Water Management

November 24, 2016

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

Main works and steps for decommissioning

Fuel removal from Unit 4 SFP had been completed and 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 (Units 1&2, Unit 3) → Installing a Fuel-Handling Machine → Fuel removal → Storage and handling (Unit 4)

Unit 1: Fuel removal to start in FY2020
Unit 2: Fuel removal to start in FY2020
Unit 3: Fuel removal to start in FY2017
Unit 4: Fuel removal completed in 2014

Fuel Debris Removal: Capturing the status inside PCV/ examination of fuel debris removal method, etc. (Note 2) (Unit 1-3) → Fuel debris removal → Storage and handling

(Note 2) The fuel debris removal method for each unit will be decided two years after revising the Mid- and Long-term road map (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 1 SFP, works to dismantle the building cover are underway.

Dismantling of the building cover started in July 2015 and dismantling of wall panel was completed in November 2016. The work is being conducted steadily, with anti-scattering measures fully implemented and the density of radioactive materials monitored.

(Dismantling of Unit 1 building cover wall panels)

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 in 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

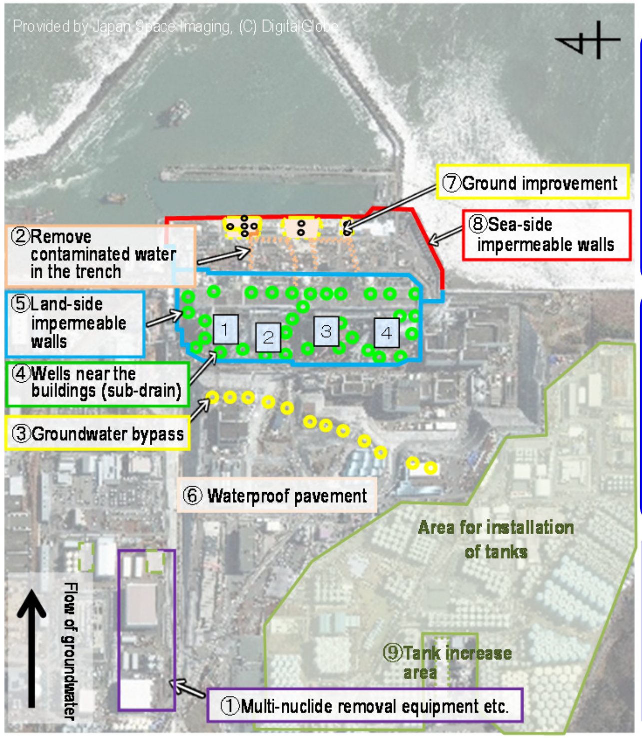
⑥ Waterproof pavement

3. Prevent leakage of contaminated water

⑦ Soil improvement by sodium silicate

⑧ Sea-side impermeable walls

⑨ 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.

(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.
- On the sea side, the underground temperature declined below 0°C throughout the scope requiring freezing except 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 the contaminated groundwater from flowing into the sea.
- The installation of steel pipe sheet piles was completed in September 2015 and they were connected in October 2015. These works completed the closure of the sea-side impermeable walls.

(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 the Primary Containment Vessel (PCV) of Units 1-3 were maintained within the range of approx. 20-35°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 October 2016, the radiation exposure dose due to the release of radioactive materials from the Unit 1-4 Reactor Buildings was evaluated as less than 0.00033 mSv/year at the site boundary. The annual radiation dose by natural radiation is approx. 2.1 mSv/year (average in Japan).

Completion of dismantling of the Unit 1 R/B cover wall panels

To help remove rubble on the Unit 1 Reactor Building (R/B) top floor, dismantling of building cover wall panels started from September 13 and all 18 panels had been dismantled by November 10.

No significant variation attributable to the work was identified at the dust monitors installed in the workplace and near the site boundary.

Currently the status of rubble under the fallen roof is being investigated from the side of the building. Following the investigation, pillars and beams of the building cover will be modified and windbreak sheets installed from March 2017.

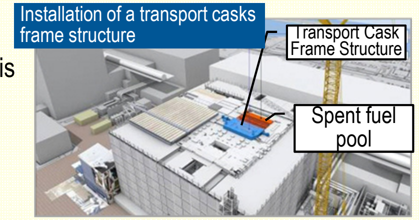
<Dismantling of wall panels>

Installation of a transport casks frame structure to the Unit 3 spent fuel pool

Toward fuel removal from the Unit 3, shields are being installed as measures to reduce the dose on the Reactor Building top floor. The installation was completed for large shields and those between the gantries, and is underway for supplementary shields.

In conjunction with this ongoing work, installation of a transport casks frame structure* started from November 24. As this installation requires human works, temporary shields will be installed to minimize the radiation exposure of workers with safety first.

* A structure supporting fuel transfer containers during fuel removal from the spent fuel pool.

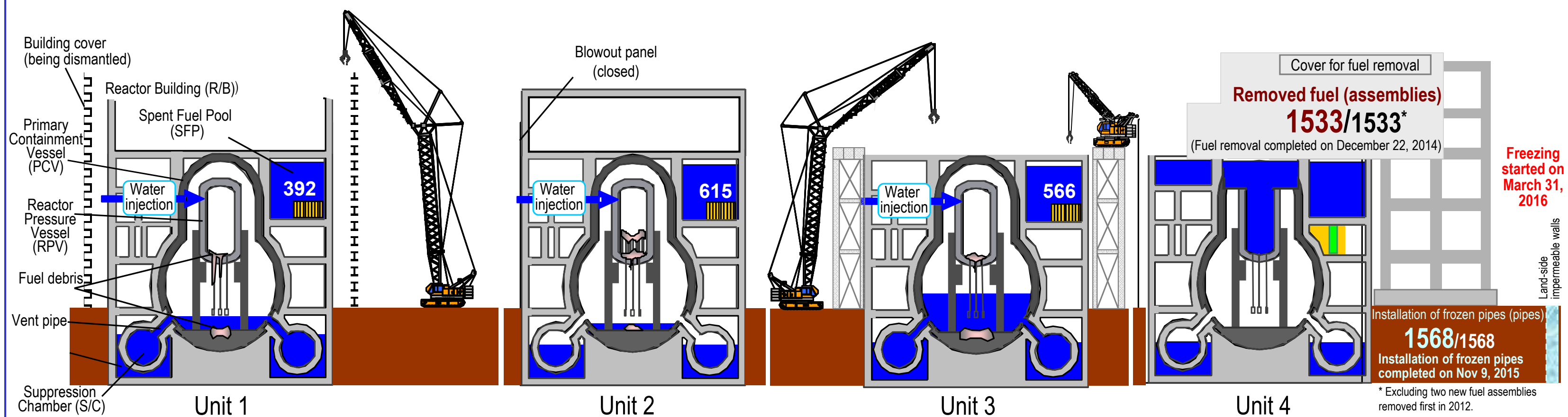


<Image of installation of a pedestal supporting transfer containers>

Status of the land-side impermeable walls

The status of freezing of the land-side impermeable walls was inspected by digging the ground to approx. 1.2 m in depth on the south side. The freezing was confirmed at a point 1.5 m from the frozen line (interval between frozen pipes: 1.0 m).

<Status of freezing>



Response to water drippage from the multi-nuclide removal equipment

Regarding the water drippage from the multi-nuclide removal equipment detected on October 15, the cause investigation identified the drippage as attributable to attached materials staying inside the pipe of the welded part and presumed crevice corrosion was occurred.

The pipe where water drippage was identified will be replaced and operation will resume in early December. In addition, similar parts will also be investigated.

Toward the investigation inside the Unit 2 PCV

Toward the investigation inside the Unit 2 primary containment vessel (PCV) planned in January and February, 2017, a pipe penetration will be made in December from which a robot will be inserted.

The work will proceed with measures implemented to prevent the gas inside the PCV from leaking outside and dust monitors will be installed near the workplace.

Reduction of water injection volume to the Unit 1-3 reactors

Currently, the volume of water injected to cool the Unit 1-3 reactors is more than sufficient. The water injection volume will be reduced sequentially from 4.5 to 3.0m^3/h from December.

When reducing the water injection volume, the temperature at the bottom of the Reactor Pressure Vessel and other parameters will be monitored. In the event of any abnormality in the cooling status, more water will be injected.

In addition, major data will be disclosed in easy-to-understand graphs on our website and information will be promptly delivered.

The capacity of the contaminated water treatment equipment expanded by this measure will help accelerate the purification of contaminated water in the buildings.

Start of contaminated soil removal in the H4 area

As a countermeasure for the leakage in the H4 area tank in August 2013, contaminated soil around the tank was removed. Furthermore, removal of contaminated soil under the tank foundation will start from December with dismantlement of tanks.

Leakage inside the desalination equipment cornice house

On November 1, approx. 3 m^3 of water leaked from the RO membrane cleaning tank of the desalination equipment (RO3) installed on high ground. The leaked water remained within the fences and no leakage outside was identified.

The water overflowed from the top of the tank because of the operational failure of the water-level gauge in the tank. If the water-level gauge works, the water should have stopped when the water level in the tank increased. Measures such as duplication of water-level gauges are being examined.

Major initiatives – Locations on site

Provided by Japan Space Imaging, (C) DigitalGlobe

* Data of Monitoring Posts (MP1-MP8.)

Data (10-minute value) of Monitoring Posts (MPs) measuring airborne radiation rate around site boundaries show 0.563 – 2.232 μSv/h (October 26 – November 21, 2016).

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 February 10 to April 18, 2012.

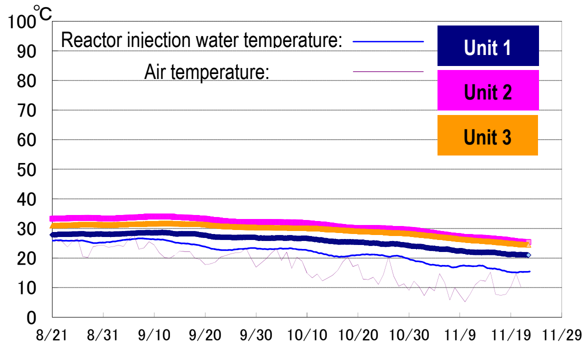
Therefore monitoring results at these points are lower than elsewhere in the power plant site.

The radiation shielding panel around monitoring post No. 6, which is one of the instruments used to measure the radiation dose 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.

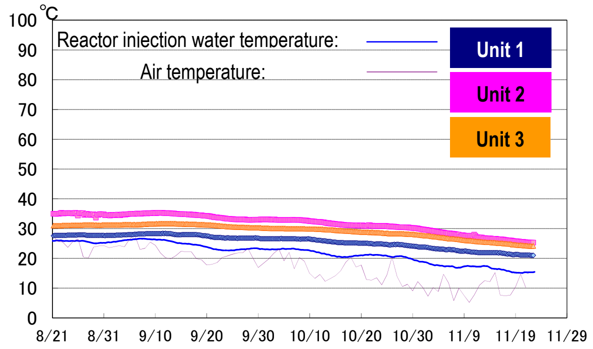
I. Confirmation of the reactor conditions

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 were maintained within the range of approx. 20 to 35°C for the past month, though they vary depending on the unit and location of the thermometer.



RPV bottom temperatures (recent quarter)



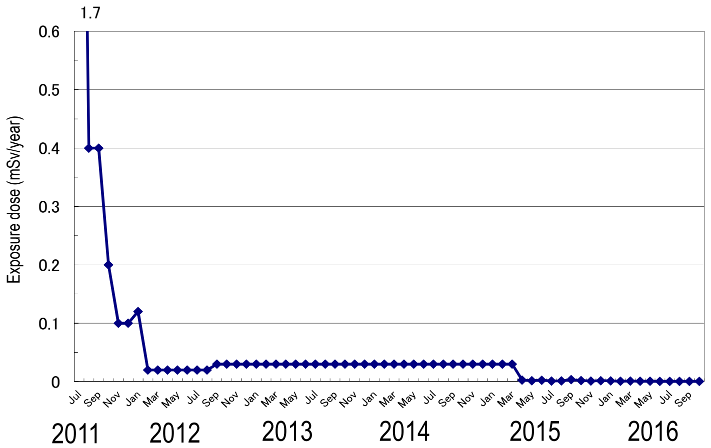
PCV gas phase temperatures (recent quarter)

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

2. Release of radioactive materials from the Reactor Buildings

As of October 2016, 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. 5.3×10^{-12} Bq/cm³ for Cs-134 and 1.2×10^{-11} Bq/cm³ for Cs-137 respectively. The radiation exposure dose due to the release of radioactive materials was less than 0.00033mSv/year at the site boundary.

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 0.563 – 2.232 μSv/h (October 26 – November 21, 2016).
  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

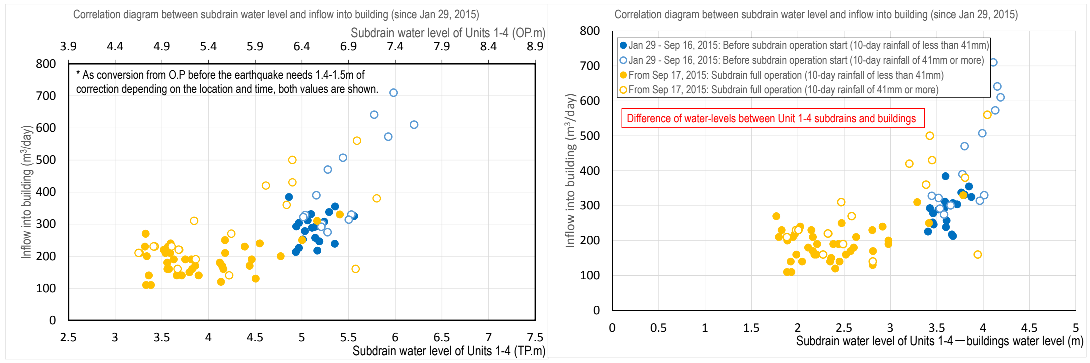
To tackle the increase in accumulated water due to groundwater inflow, fundamental measures to prevent such inflow into the Reactor Buildings will be implemented, while improving the decontamination capability of water treatment and preparing facilities to control the contaminated water

➢ Operation of 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 November 21, 2016, 233,394 m³ of groundwater had been released. The pumped-up groundwater was temporarily stored in tanks and released after TEPCO and a third-party organization had confirmed that its quality met operational targets.
- Pumps are inspected and cleaned as necessary based on their operational status.

➢ Water treatment facility special for Subdrain & Groundwater drains

- To reduce the groundwater flowing into the buildings, work began to pump up groundwater from wells (subdrains) around the buildings on September 3, 2015. The pumped-up groundwater was then purified at dedicated facilities and released from September 14, 2015. Up until November 21, 2016, a total of 228,773 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 November 21, 2016, a total of approx. 107,800 m³ had been pumped up. Approx. 50 m³/day is being transferred from the groundwater drain to the Turbine Buildings (average for the period October 20 – November 16, 2016).
- The effect of ground water inflow control by subdrains is evaluated by both correlations: the "subdrain water levels"; and the "difference between water levels in subdrains and buildings", for the time being.
- However, given insufficient data on the effect of rainfall after the subdrains went into operation, the method used to evaluate the inflow into buildings will be reviewed as necessary, based on data to be accumulated.
- Inflow into buildings declined to approx. 150 - 200 m³/day when the subdrain water level decreased to approx. T.P. 3.5 m or when the difference in water levels with buildings decreased to approx. 2 m after the subdrains went into operation.
- On November 15, a puddle (1m × 1m) was identified inside the fences under the subdrain treatment facility absorption vessel 1B inlet pipe, and the inlet pipe (flexible hose) above the puddle was wet. The potentially abnormal flexible hose was replaced and the operation resumed after a leak check.



As of November 17, 2016

Figure 1: Evaluation of inflow into buildings after the subdrains went into operation

➢ Construction status of the land-side impermeable walls

- As for the land-side impermeable walls (on the sea side), the underground temperature declined below 0℃ throughout the scope by October except for unfrozen parts under the seawater pipe trenches and areas above groundwater level.
- As for the land-side impermeable walls (on the mountain side), parts except for seven unfrozen parts are being frozen.
- Both the groundwater level and head at areas 4 and 10 m above sea level are decreasing due to the continued low rainfall since early October, though the influence of rainfall (approx. 640 mm) from mid-August to late September still remains.
- The water volume pumped at the area 4 m above sea level decreased to the mid-August level of around 200m³/day.

- On the south side of the land-side impermeable walls, freezing was confirmed by digging the ground to a depth of approx. 1.2 m.

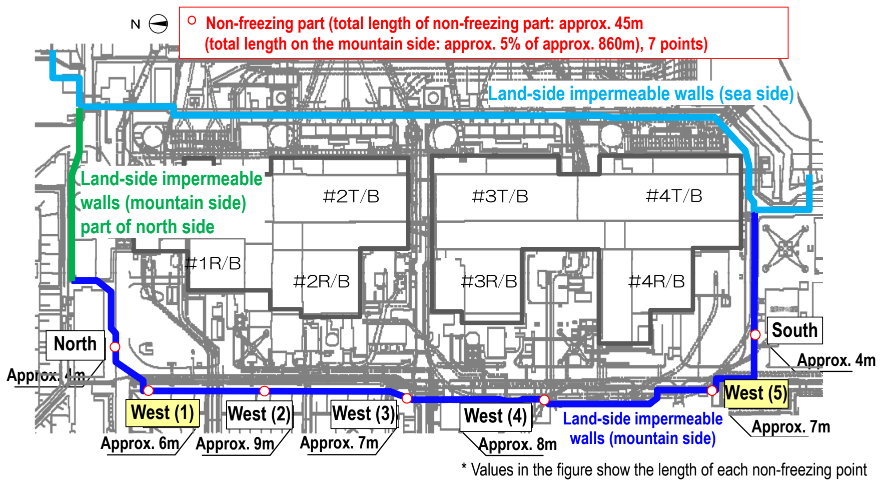


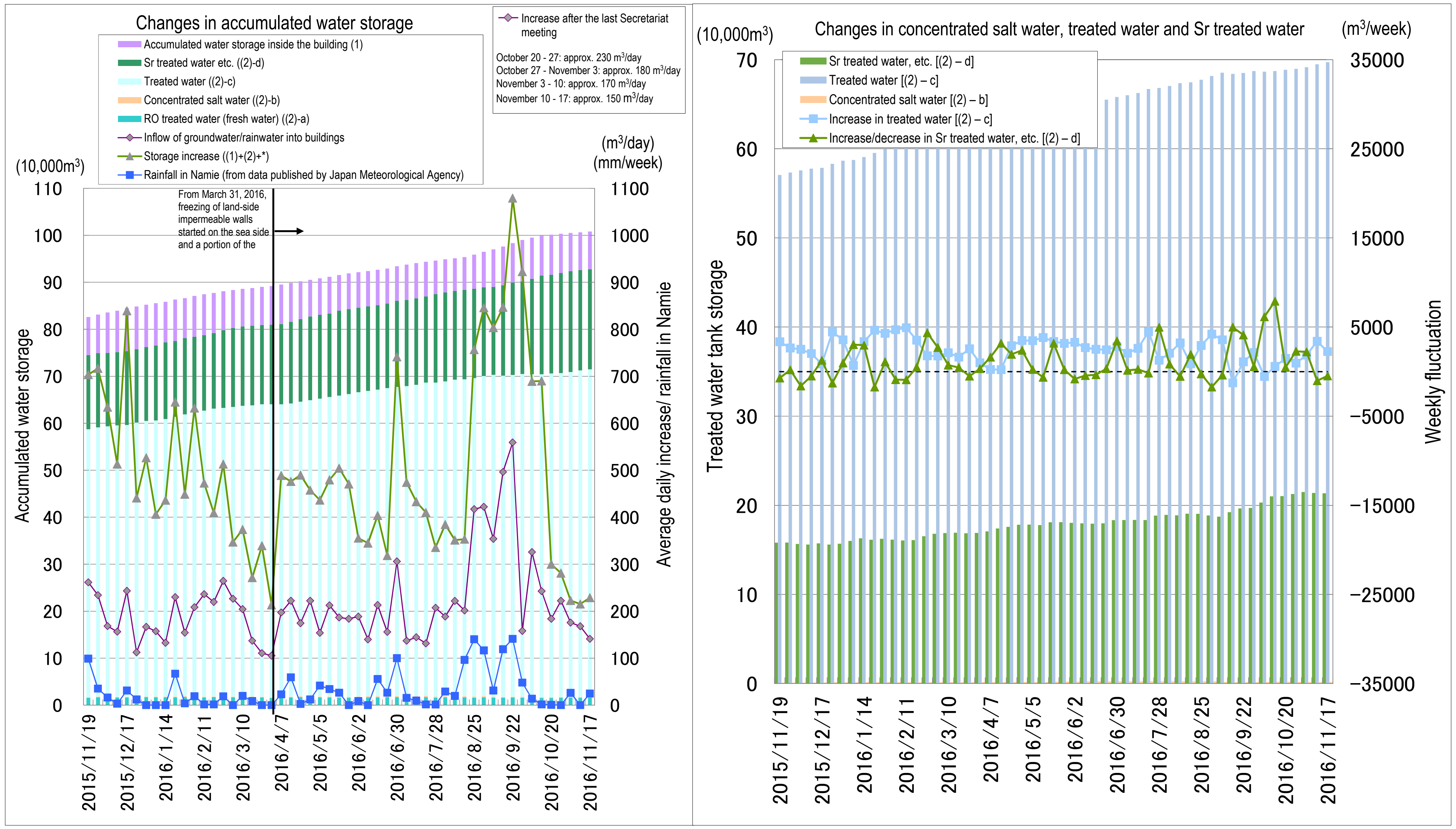
Figure 2: Closure of part of the land-side impermeable walls (on the mountain side)

Operation of multi-nuclide removal equipment

- Regarding the multi-nuclide removal equipment (existing, additional and high-performance), hot tests using radioactive water have been 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; for high-performance equipment, from October 18, 2014).
- As of November 17, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 317,000, 310,000 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 November 17, approx. 279,000 m³ had been treated.
- Regarding the water drippage from the multi-nuclide removal equipment System A detected on October 15, the cause investigation identified that the drippage was considered attributable to sludge and other attached materials remaining on the protruding welding penetration bead part (welded on site), which led to crevice corrosion at the welded metal part. The corrosion developed and subsequently caused the leakage.
- For System A, the relevant pipe will be replaced (installation will be completed in mid-December).
- For the relevant lines of System B and C, the welded parts will be inspected through a radiation transmission test.

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 November 17, approx. 321,000 m³ had been treated.



As of November 17, 2016

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

*2: Since September 10, 2015, the data collection method has been changed
(Evaluation based on increased in storage: in buildings and tanks → Evaluation based on increase/decrease in storage in buildings)
"Inflow of groundwater/rainwater into buildings" = "Increase/decrease of water held in buildings" + "Transfer from buildings to tanks" - "Transfer into buildings (water injection into reactors and transfer from well points, etc.)"

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

*4: On February 4, 2016, corrected by reviewing the water amount of remaining concentrated salt water

*5: "Increase/decrease of water held in buildings" used to evaluate "Inflow of groundwater/rainwater into buildings" and "Storage increase" is calculated based on the data from the water-level gauge. During the following evaluation periods, when the gauge was calibrated, these two values were evaluated lower than anticipated.
(March 10-17, 2016: Main Process Building; March 17-24, 2016: High-Temperature Incinerator Building (HTI); September 22-29, 2016: Unit 3 Turbine Building)

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

Figure 3: Status of accumulated water storage

➢ 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 November 21, 2016, a total of 70,574 m³).

➢ Start of contaminated soil removal in the H4 area

- Contaminated soil under the tank foundation in the H4 area, where leakage from a tank in August 2013 was detected, will be removed from December with dismantlement of tank.
- Contaminated soil around the H4 area was already removed by 2014.

➢ Progress of accumulated water treatment in the Unit 1 T/B

- As part of efforts to reduce the risks of accumulated water in buildings leaking, accumulated water in the Unit 1 Turbine Building (T/B) will be treated to reduce the water level to the surface of the bottom floor within FY2016.
- To reduce the dose in the area where the transfer equipment will be installed, work is underway from October 5 to remove and dilute water in the Unit 1 condenser, in which high-density contaminated water immediately after the disaster has been accumulated, and flush the high-dose pipes (heater drain pipes) around the installation area. As the shields were installed and the air dose rate in the area was reduced, the installation of the transfer equipment will start at the area as planned from the end of November. In conjunction with this work, removal of obstacles is also underway, part of which was completed in the area where the transfer pump will be installed.

➢ Leakage from the desalination equipment

- On November 1, approx. 3m³ of cleaning water (after RO treatment) leaked from the RO membrane cleaning tank of the desalination equipment (RO3) installed in the area 35 m above sea level. The leaked water remained within the fences and no external leakage was identified.
- The leakage was considered attributable to the operational failure of the water-level gauge in the RO membrane cleaning tank, which prevented the motor valve on the line supplying RO treated water to the cleaning tank from closing. Continued supply to the cleaning tank led to the RO treated water overflowing from the top of the tank. Though stopping the RO equipment has no influence on water injection into the reactor or accumulated water treatment of the building, the RO equipment can be operated even if the RO membrane cleaning equipment is isolated. Permanent measures (duplication of water-level gauges, etc.) are being examined.

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, 2015, work started to dismantle the roof panels of the building cover and by October 5, 2015, all six roof panels had been dismantled. The dismantling of wall panels started from September 13, 2016 and all 18 panels had been dismantled by November 10. No significant variation attributable to the work was identified at the monitoring posts and dust monitors. The building cover is being dismantled, with anti-scattering measures steadily implemented and safety first.
- As well as dismantling the building cover wall panels, the status of rubble under the fallen roof is being investigated to collect data, which will then be used when considering rubble removal methods (from September 13).
- Annual inspection of cranes used in the work to dismantle the Unit 1 building cover is underway (from November 22).
- Pillars and beams of the building cover will be modified and windbreak sheets installed on the beams from March 2017. The pillars and beams (covered by windbreak sheets) will be restored in the 1st half of FY2017.

➢ Main work to help remove spent fuel at Unit 2

- To help remove the spent fuel from the pool of the Unit 2 Reactor Building, roadbeds have been constructed on the west and south sides (excluding the transformer area) of the Reactor Building to clear a work area, within which large heavy-duty machines and other instruments will be installed. The construction was completed by November 21.
- Another construction started from September 28 on the west side of the Reactor Building to install a gantry accessing the operating floor. Up until November 21, 32% of the installation had been completed. (The work will be completed in late April 2017)

➢ Main work to help remove spent fuel at Unit 3

- On the operating floor of the Reactor Building, the installation of shields has been underway (A zone: April 12-22, July 29 – September 7; B zone: July 13-25; C zone: July 11 – August 4; D zone: July 27 – August 11; F zone: from October 28 – November 4; G zone: September 9-20; shields between the supplementary and gantry: from August 24). The installation of a transport cask frame structure also started (from November 24). A cover for fuel removal will be installed from January 2017.

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.

➢ Status toward an investigation inside the Unit 2 PCV

- An investigation inside the Unit 2 PCV will be conducted in January and February 2017 to identify the status of fuel debris and surrounding structures inside the PCV.
- Prior to the investigation, a hole will be made in December in the closure flange (lid) of the pipe penetration (X-6 penetration), from which the investigation device will be inserted.
- The hole will be made with nitrogen pressurized to prevent the gas inside the PCV from leaking. Moreover, the work will be monitored by dust monitors installed near the work area.

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 October 2016, the total storage volume of concrete and metal rubble was approx. 191,500 m³ (-3,900 m³ compared to at the end of September, with an area-occupation rate of 69%). The total storage volume of trimmed trees was approx. 89,800 m³ (±0 m³ compared to at the end of September, with an area-occupation rate of 84%). The total storage volume of used protective clothing was approx. 69,600 m³ (+1,300 m³ compared to at the end of September, with an area-occupation rate of 98%). The decrease in rubble was mainly attributable to area arrangement. The increase in used protective clothing was mainly attributable to acceptance of used clothing.

➢ Management status of secondary waste from water treatment

- As of November 17, 2016, the total storage volume of waste sludge was 597 m³ (area-occupation rate: 85%) and that of concentrated waste fluid was 9,256 m³ (area-occupation rate: 87%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment, etc. was 3,389 (area-occupation rate: 54%).

➢ Status of Radioactive Waste Incinerator

- Operation of the Radioactive Waste Incinerator was suspended because pin holes were identified at the bellows (System B) between the secondary incinerator and the exhaust gas cooler of the facility during operation on August 9 and cracks were identified at the bellows (Systems A and B) between the waste gas coolers and bag filters on August 10 (since the pressure inside the facility and its building was kept negative, no radioactive materials was deemed to have impacted the outside of the building).
- After investigating the cause and implementing countermeasures, operation of Systems A and B resumed on

November 10 and 23 respectively.

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

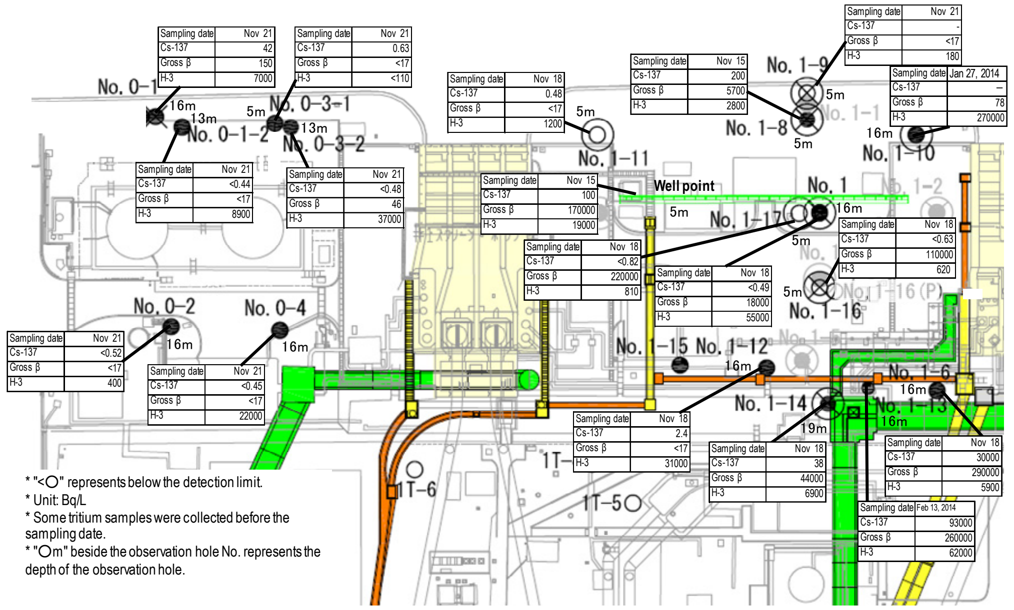
- Progress of work to install the common facility for the Unit 1-3 spent fuel pool circulating cooling facility secondary system
  - Regarding the Unit 1 spent fuel pool circulating cooling facility, not all air could be completely eliminated from the primary system pump bearing cooling water pipe when water was filled to test the operation of the new facility from August 23 to 25, 2016. As accumulated air could not be removed and passing water through the cooling water pipe could not be confirmed, work resumed to cool the spent fuel pool by the existing facility. Following installation of valves for air removal as required as well as reviewing the routing of the water-cooling pipes, cooling of the spent fuel pool will be switched to the new facility (from December 5).
  - The Unit 2 and 3 spent fuel pool circulating cooling facility secondary systems were switched to new systems, which started cooling the spent fuel pool (Unit 2: from November 8; Unit 3: from October 25).
- Nitrogen injection from the Unit 1 jet pump instrumentation line
  - As for Unit 1, nitrogen has currently been injected from the reactor head spray line to the RPV. To enhance reliability, work is underway to install a new nitrogen injection line through the jet pump instrumentation line.
  - On May 30, the implementation plan was authorized. On completion of work to install the line in September, it underwent a pre-operation test in October, which involved injecting nitrogen from the lines additionally installed in this work through the jet pump instrumentation line to the RPV.
  - After verifying the air blow of the line, a regular-use line will be selected to start operation. Following the necessary preparation, tests will be conducted to determine any increase in nitrogen injection volume, etc.
- Reduction of water injection volume to the Unit 1-3 reactors
  - Currently, the volume of water injected to cool the reactors is more than sufficient. It is planned that surplus capacity of the contaminated water treatment facility (cesium absorption apparatus) will be utilized to accelerate treatment of accumulated water in the buildings. Reducing the water injection volume to the reactors is considered as a means to secure surplus capacity.
  - The water injection volume to Unit 1-3 reactors will be reduced steadily by $0.5m^3/h$ from 4.5 to $3.0m^3/h$ from December.
  - When reducing the water injection volume, monitoring parameters will be confirmed, including the temperatures of the RPV bottom and inside the PCV, the water injection volume to the reactor, and PCV gas management facility dust monitors. In addition, major data will be disclosed in easy-to-understand graphs on our website and information will be promptly delivered when any abnormality is identified in the cooling condition.

6. Reduction in radiation dose and mitigation of contamination

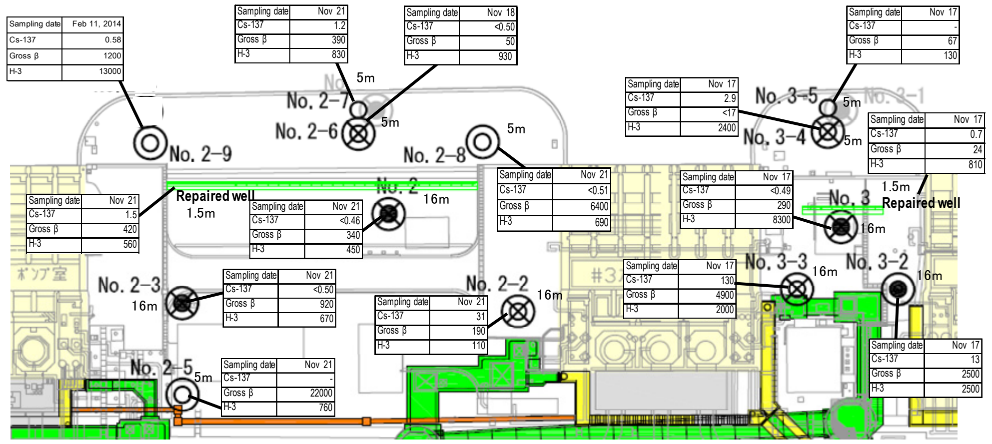
Effective dose-reduction at site boundaries and purification of port water to mitigate the impact of radiation on the external environment

- Status of groundwater and seawater on the east side of Turbine Building Units 1 to 4
  - Regarding radioactive materials in the groundwater near the bank on the north side of the Unit 1 intake, though the tritium density at groundwater Observation Hole No. 0-1 has remained constant at around 5,000Bq/L, it has been gradually increasing since October 2016 and currently stands at around 7,000 Bq/L. The tritium density at groundwater Observation Hole No. 0-3-2 has been gradually increasing since January 2016 and currently stands at around 40,000 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 has remained constant at around 700,000Bq/L, it has been decreasing since July 2016 and currently stands at around 300,000 Bq/L. Though the density of gross β radioactive materials at groundwater Observation Hole No. 1-16 had remained constant at around 90,000 Bq/L, after declining to 6,000 Bq/L, it has been increasing since August 2016 and currently stands at around 100,000 Bq/L. Though the tritium density at groundwater Observation Hole No. 1-17 had remained constant at around 50,000 Bq/L, it has been increasing and declining since March 2016 and currently stands at around 1,000 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 density of gross β radioactive materials at groundwater Observation Hole No. 2-5 had remained constant at around 10,000 Bq/L, it had increased to 500,000 Bq/L since November 2015 and currently stands at around 20,000 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. 3-2 had remained constant at around 800 Bq/L and been increasing since September 2016, it has currently been decreasing. As for the density of gross β radioactive materials at the same groundwater Observation Hole, though having remained constant at around 1,000 Bq/L and been increasing since September 2016, it has currently been decreasing. At groundwater Observation Hole No. 3-3, though the tritium density had remained constant at around 800 Bq/L, it has been increasing since September 2016 and currently stands at around 2,000 Bq/L. At groundwater Observation Hole No. 3-4, though the tritium density had remained constant at around 4,000 Bq/L, it has been decreasing since September 2016 and currently stands at around 2,000 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 outside the sea-side impermeable walls and within the open channels of Units 1 - 4, as well as those inside the port, the density was declining due to the effect of the completed installation and the connection of steel pipe sheet piles for the sea-side impermeable walls.
  - As seawater samples are taken from surface water, seawater is also monitored around the bottom according to changes in port conditions to confirm the distribution of depth direction influence from the inside to the outside of the port as required. Based on the monitoring result to date, in which the density of cesium 137 near the bottom was the same or lower than at the surface, it was evaluated that the influence on the outside of the port could be identified through monitoring of the surface. Besides, with the K drainage channel switched in March this year and the new drainage channel going into operation in June, a route was arranged for inflow from areas of contaminated soil or on-site areas where contaminated water was handled to the port. The reinvestigation conducted on completion of this arrangement confirmed no change in the density in the port.
- Alert from a continuous dust monitor on the site boundary
  - On November 7, a “high alert” indicating an increased density of dust radiation was issued from the dust monitor near the monitoring post (MP) No. 3.
  - The cause was considered to be natural nuclides for the following reasons: there was no on-site work around the monitor that could be attributable to dust increase; a visual inspection observed no condensation at the detection part of the dust monitor; the impact of noise was unlikely because the measurement value rose and declined slowly; no artificial nuclide was identified; and the density increase tendency resembled the alert caused by natural nuclides which was issued at the dust monitor near MP8 in July 2016.
- Response to the Unit 1 and 2 exhaust stack drain sump pit
  - Investigations are being conducted and countermeasures taken for the Unit 1 and 2 exhaust stack drain sump pit as part of the comprehensive risk review. On October 3, the installation of a water-level gauge was completed and measurement of the water-level trends started.
  - To date, increase in the pit water level was identified during heavy rains.

- Increased water in the pit due to rains is promptly transferred via the drainage facility installed in the above countermeasures.
- In addition, improvement will be made, including enhancement of the drainage facility and closure of the upper part of the exhaust stack.



<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

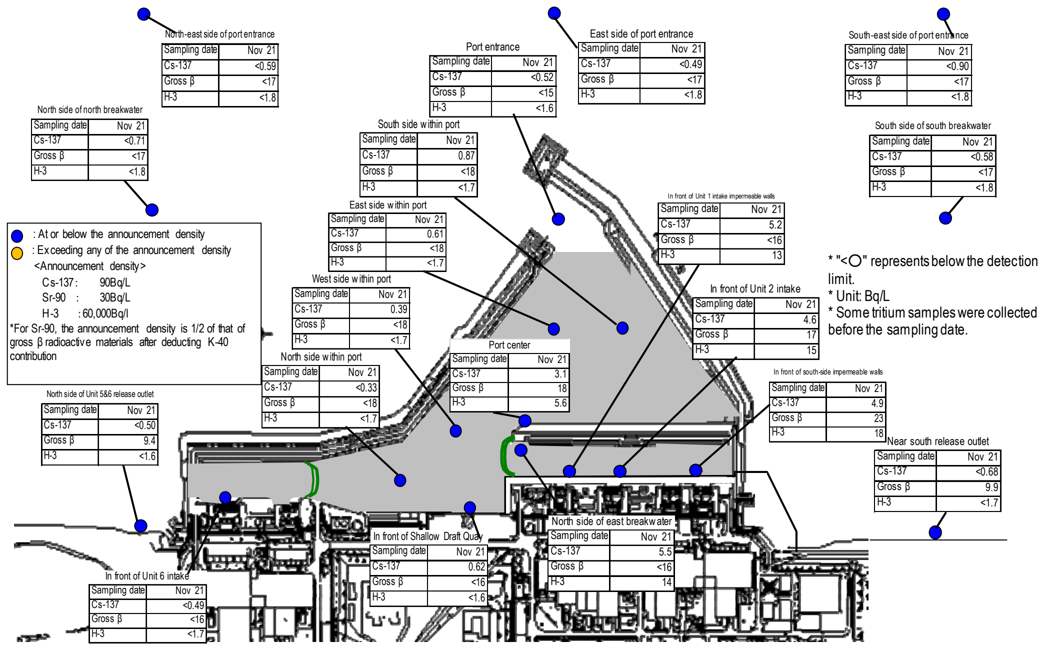


Figure 5: Seawater density around the port

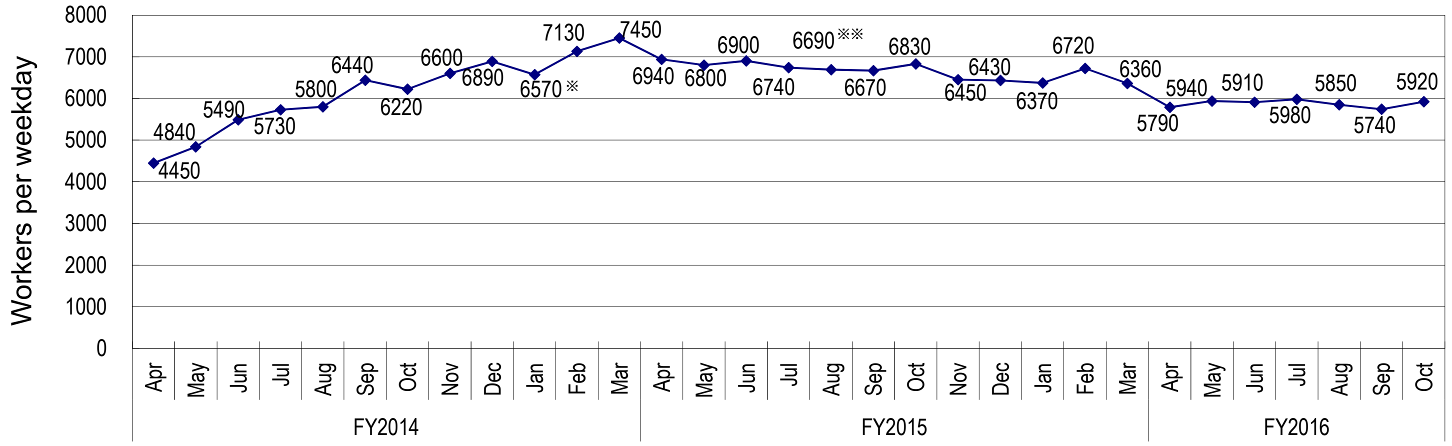
7. Outlook of the number of staff required and efforts to improve the labor environment and conditions

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 July to September 2016 was approx. 12,600 (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 December 2016 (approx. 5,610 per day: TEPCO and partner company workers)* would be secured at present. The average numbers of workers per day for each month (actual values) were maintained, with approx. 4,500 to 7,500 since FY2014 (see Figure 6).

  * Some works for which contractual procedures have yet to be completed were excluded from the estimate for December 2016.
- The number of workers from within Fukushima Prefecture has decreased. The local employment ratio (TEPCO and partner company workers) as of October has remained at around 55%.
- The monthly 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.



※ Calculated based on the number of workers as of January 20 (due to safety inspection from January 21)

※※ 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 FY2014

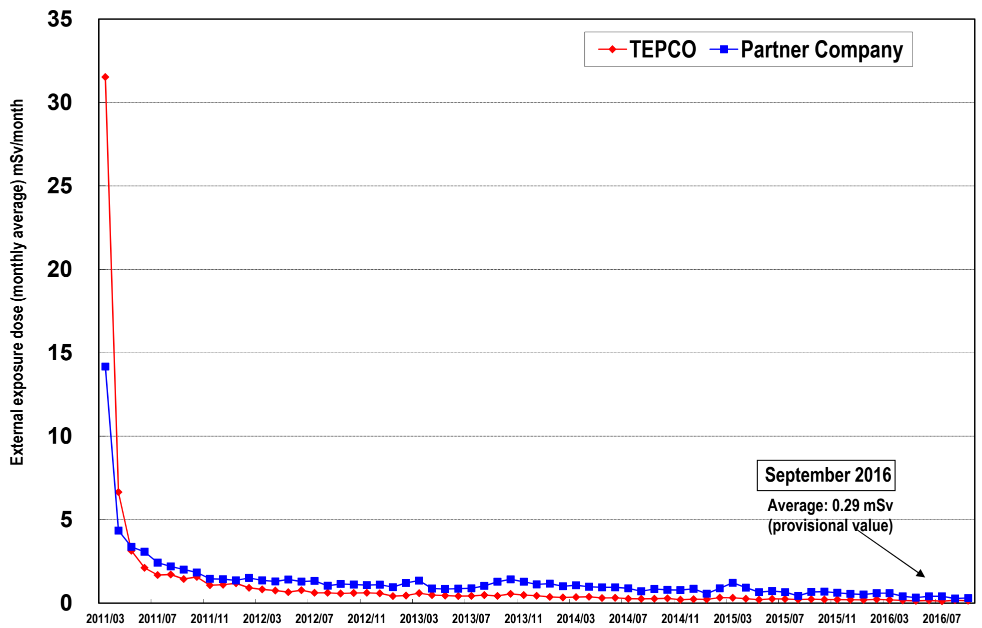


Figure 7: Changes in monthly individual worker exposure dose
(monthly average exposure dose since March 2011)

- Measures to prevent infection and expansion of influenza and norovirus
  - Since November, measures for influenza and norovirus have been implemented, including free influenza vaccinations (subsidized by TEPCO) in the Fukushima Daiichi Nuclear Power Station (from October 26 to December 2) and medical clinics around the site (from November 1 to January 31, 2017) for partner company workers. As of November 11, a total of 3,101 workers had been vaccinated. In addition, a comprehensive range of other measures is also being implemented, including daily actions to prevent infection and expansion (measuring body temperature, health checks and monitoring infection status) and response after detecting possible infections (control of swift entry/exit and mandatory wearing of masks in working spaces).
- Status of influenza and norovirus cases
  - Until the 44th week of 2016 (October 31 - November 6, 2016), there were two cases of influenza infections and no norovirus infections. The totals for the same period for the previous season showed no cases of influenza or norovirus infections.

8. Other

- Response to the damage to parts of Units 5 and 6 power line anchor structures
  - On August 22, damage was detected to a steel portion of the anchor structure, installed on the switchyard roof, during work to re-route the leading-in cable of the Futaba line of the Unit 5 and 6 switch yard.
  - As emergency measures, the damaged parts were repaired to satisfy the electrical equipment technical standards*1. The repair was completed on November 15.
  - To further enhance reliability, parts were reinforced by adding bents (scheduled for completion on November 25).
  - Permanent measures, including the new installation of alternative anchor structures, will also be considered.
  - The Facility Management Plan*2 of the anchor structures was not formulated and the anchor structures had been excluded from the inspection scope since the Fukushima Daiichi Nuclear Power Station Unit 5 went into operation in 1978. The 2nd safety inspection in FY2016 decided that the anchor structures were classified as “Monitoring” in the Implementation Plan Non-Fulfillment Category because this failure constituted a non-fulfillment of the Implementation Plans for the Fukushima Daiichi Nuclear Power Station designated as the Specified Nuclear Power Facilities, III Chapter 2 Article 107. (The decision was publicized on November 2)
  - A Facility Management Plan for the anchor structures was formulated (on October 7) and periodical inspections will be conducted. Furthermore, an investigation will be performed to confirm whether any similar equipment and instruments not included in the Facility Management Plan exists at the boundary of facility control, to include them in the Facility Management Plan and inspect them as necessary (scheduled for completion at the end of December).

*1 Evaluation criteria of the electrical equipment technical standards: Wind load bearing of 40m/s

*2 Facility Management Plan: A facility inspection plan based on the Implementation Plans for the Fukushima Daiichi Nuclear Power Station designated as the Specified Nuclear Power Facility, III Security of Specified Nuclear Facility, Chapter 2 (Security Measures concerning Unit 5 and 6 Reactors)

- Response to the earthquake occurred on November 22
  - At around 5:59 on November 22, an earthquake centering in the waters off Fukushima Prefecture occurred. The intensity was 5 lower (announced by the Japan Meteorological Agency). The maximum earthquake acceleration observed on site was horizontal 54.2 gal and vertical 45.5 gal at the Unit 6 Reactor Building base mat.
  - At 6:38, a tide increase of approx. 1m was identified at the tide gauge in the central monitoring room of the Main Anti-Earthquake Building.
  - At 6:05, TEPCO and partner company workers on site were ordered to evacuate to higher ground via an announcement across the power station. (The number of works at the time of the earthquake occurrence: 7, the evacuation order to higher ground was canceled at 17:54)
  - To ensure safety, the following facilities were suspended: the transfer facility of accumulated water in the buildings, the water treatment facility special for Subdrain & Groundwater drains, and the secondary cesium absorption apparatus (SARRY). Operation of these facilities resumed after the on-site patrol following the earthquake confirmed no abnormality.
  - Besides, no significant variation attributable to the earthquake or fluctuation in the tide level was identified in the Unit 1-6 plant parameters and the values of monitoring posts.

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 November 14-21)"; unit (Bq/L); ND represents a value below the detection limit

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

Sea side impermeable wall

Silt fence

Cesium-134:	3.3 (2013/10/17) → ND(0.31)	Below 1/10
Cesium-137:	9.0 (2013/10/17) → 0.61	Below 1/10
Gross β:	74 (2013/ 8/19) → ND(18)	Below 1/4
Tritium:	67 (2013/ 8/19) → ND(1.7)	Below 1/30

Cesium-134:	4.4 (2013/12/24) → ND(0.32)	Below 1/10
Cesium-137:	10 (2013/12/24) → 0.39	Below 1/20
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(0.36)	Below 1/10
Cesium-137:	8.4 (2013/12/2) → ND(0.33)	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(0.68)	Below 1/4
Cesium-137:	5.8 (2013/12/2) → ND(0.49)	Below 1/10
Gross β:	46 (2013/8/19) → ND(16)	Below 1/2
Tritium:	24 (2013/8/19) → ND(1.7)	Below 1/10

Cesium-134:	0.74
Cesium-137:	3.1
Gross β:	18
Tritium:	5.6 *

Cesium-134:	3.3 (2013/12/24) → ND(0.58)	Below 1/5
Cesium-137:	7.3 (2013/10/11) → ND(0.52)	Below 1/10
Gross β:	69 (2013/ 8/19) → ND(15)	Below 1/4
Tritium:	68 (2013/ 8/19) → ND(1.6)	Below 1/40

Cesium-134:	3.5 (2013/10/17) → ND(0.28)	Below 1/10
Cesium-137:	7.8 (2013/10/17) → 0.87	Below 1/8
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) → 0.61	Below 1/50
Cesium-137:	73 (2013/10/11) → 5.5	Below 1/10
Gross β:	320 (2013/ 8/12) → ND(16)	Below 1/20
Tritium:	510 (2013/ 9/ 2) → 14	Below 1/30

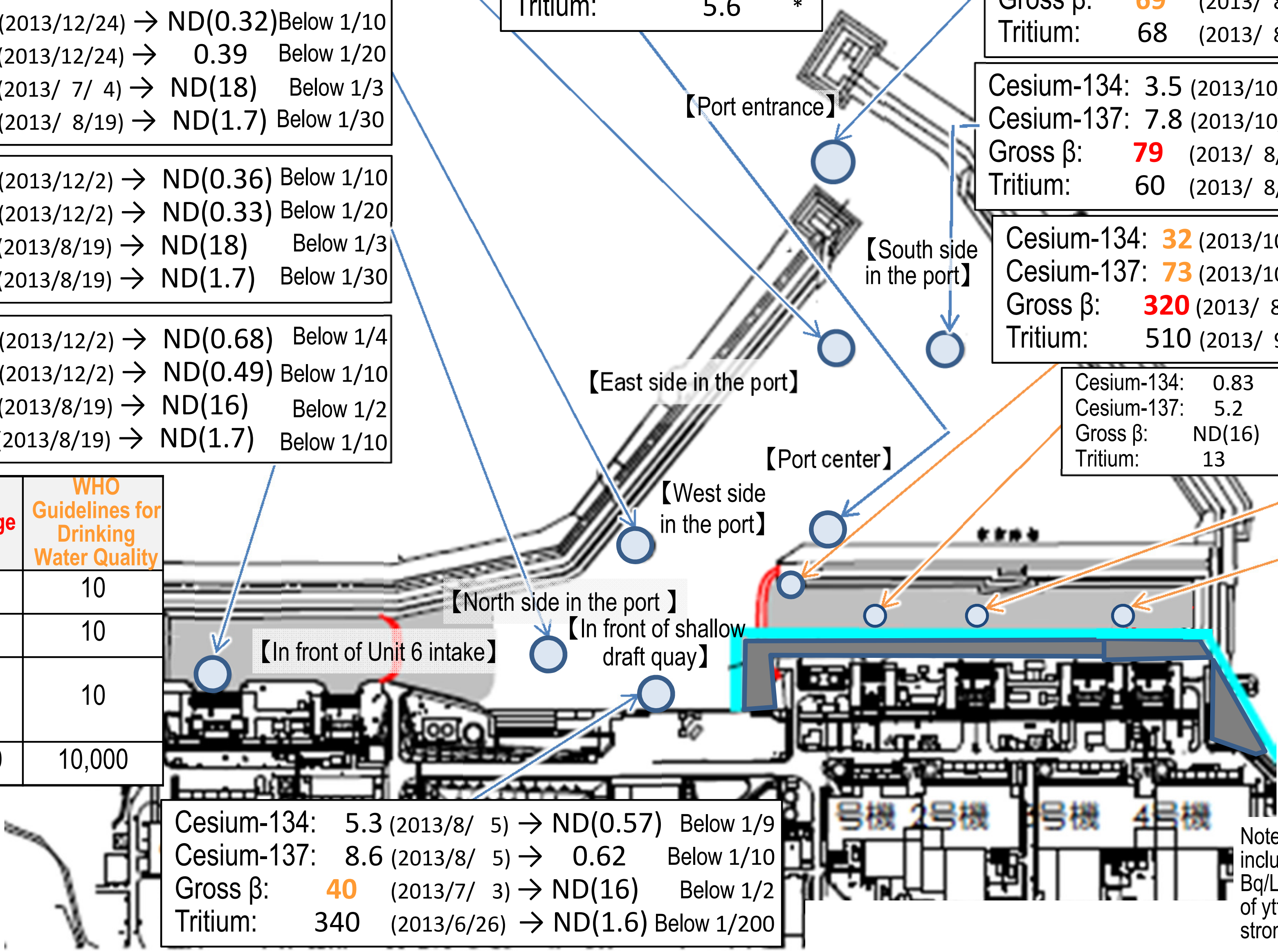
Cesium-134:	0.83
Cesium-137:	5.2
Gross β:	ND(16)
Tritium:	13 *

Cesium-134:	0.57
Cesium-137:	4.6
Gross β:	17
Tritium:	15 *

Cesium-134:	ND(0.55)
Cesium-137:	4.9
Gross β:	23
Tritium:	18 *

Cesium-134:	5.3 (2013/8/ 5) → ND(0.57)	Below 1/9
Cesium-137:	8.6 (2013/8/ 5) → 0.62	Below 1/10
Gross β:	40 (2013/7/ 3) → ND(16)	Below 1/2
Tritium:	340 (2013/6/26) → ND(1.6)	Below 1/200

	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



* 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 November 22

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 November 14-21)

	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

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 (0.59)
Gross β: ND (2013) → ND (17)
Tritium: ND (2013) → ND (1.8)

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

Cesium-134: ND (2013) → ND (0.71)
Cesium-137: 1.6 (2013/10/18) → ND (0.49) Below 1/3
Gross β: ND (2013) → ND (17)
Tritium: 6.4 (2013/10/18) → ND (1.8) Below 1/3

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

Cesium-134: ND (2013) → ND (0.81)
Cesium-137: ND (2013) → ND (0.90)
Gross β: ND (2013) → ND (17)
Tritium: ND (2013) → ND (1.8)

【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 (1.8) Below 1/2

【Port entrance】

Cesium-134: 3.3 (2013/12/24) → ND (0.58) Below 1/5
Cesium-137: 7.3 (2013/10/11) → ND (0.52) Below 1/10
Gross β: 69 (2013/ 8/19) → ND (15) Below 1/4
Tritium: 68 (2013/ 8/19) → ND (1.6) Below 1/40

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

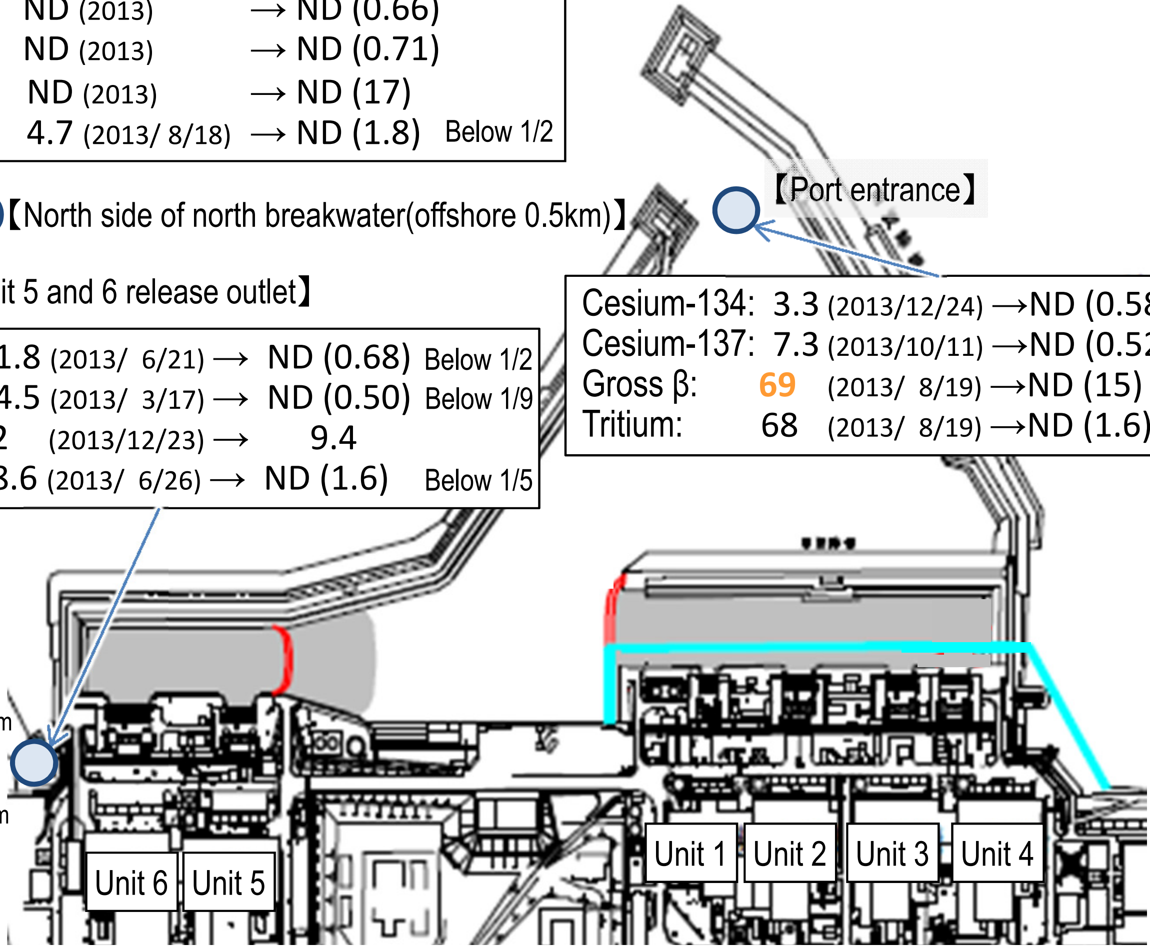
Cesium-134: ND (2013) → ND (0.84)
Cesium-137: ND (2013) → ND (0.58)
Gross β: ND (2013) → ND (17)
Tritium: ND (2013) → ND (1.8)

【North side of Unit 5 and 6 release outlet】

Cesium-134: 1.8 (2013/ 6/21) → ND (0.68) Below 1/2
Cesium-137: 4.5 (2013/ 3/17) → ND (0.50) Below 1/9
Gross β: 12 (2013/12/23) → 9.4
Tritium: 8.6 (2013/ 6/26) → ND (1.6) Below 1/5

【Near south release outlet】

Cesium-134: ND (2013) → ND (0.79)
Cesium-137: 3.0 (2013/ 7/15) → ND (0.68) Below 1/4
Gross β: 15 (2013/12/23) → 9.9
Tritium: 1.9 (2013/11/25) → ND (1.7)



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.

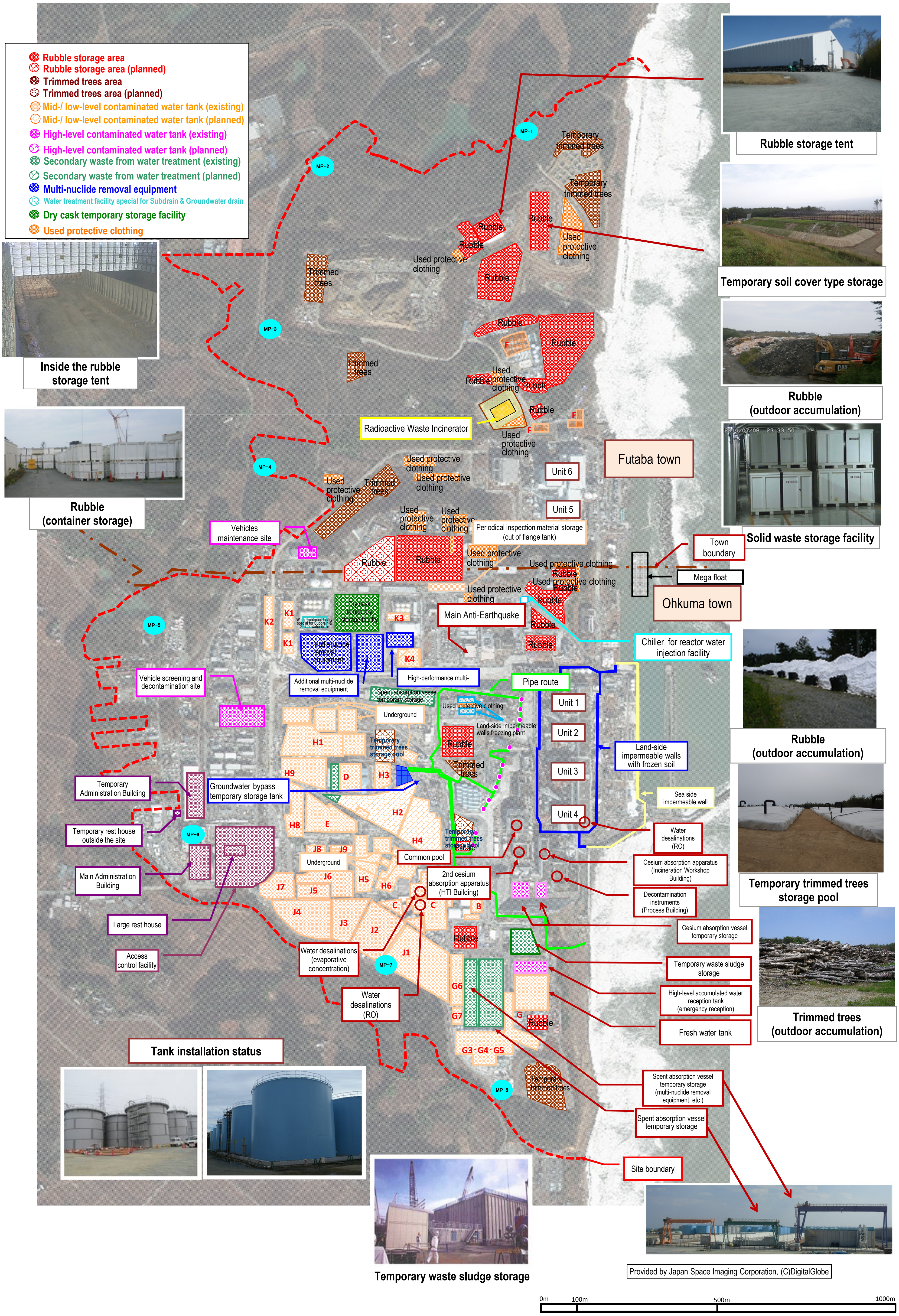
Note: Because safety of the sampling points was unassured due to the influence of Typhoon No. 10, samples were taken from approx. 330 m south of the Unit 1-4 release outlet.

Summary of TEPCO data as of November 22

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
November 24, 2016

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 operating floor(*1).

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

All roof panels and wall panels of the building cover were dismantled by November 10, 2016. Following the investigation into the status of rubble on the operating floor, pillars and beams of the building cover will be modified and windbreak sheets installed. Thorough monitoring of radioactive materials will continue.

<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.

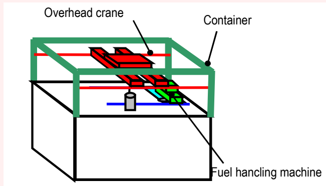


Image of Plan 1

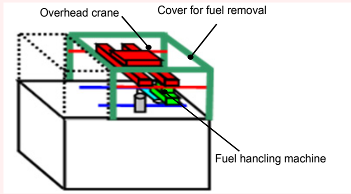


Image of Plan 2

Unit 3

To facilitate the installation of a cover for fuel removal, removal of large rubble from the spent fuel pool was completed in November 2015. Measures to reduce dose (decontamination and shielding) are underway. (from October 15, 2013)

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).

After implementing the dose-reduction measures, the cover for fuel removal and the fuel-handling machine will be installed.

Fuel gripper (mast)

Manipulator

Fuel-handling facility (in the factory)

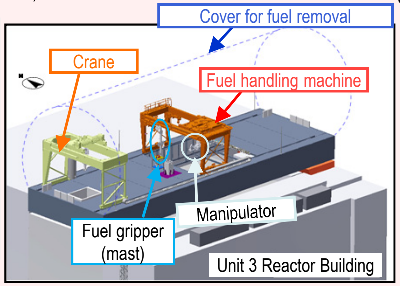


Image of entire fuel handling facility inside the cover

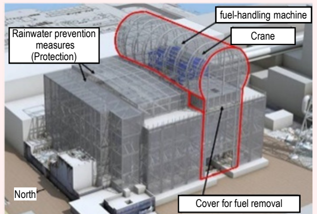


Image of the cover for fuel removal

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)

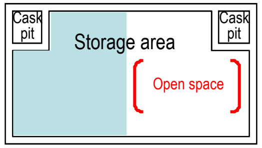
This marks the completion of fuel removal from the Unit 4 Reactor Building.

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

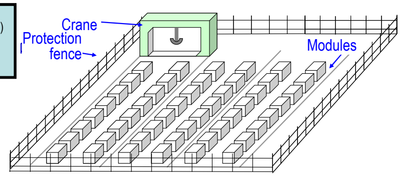


An open space will be maintained in the common pool (Transfer to the temporary dry cask storage facility)

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 (*3) 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>

(*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

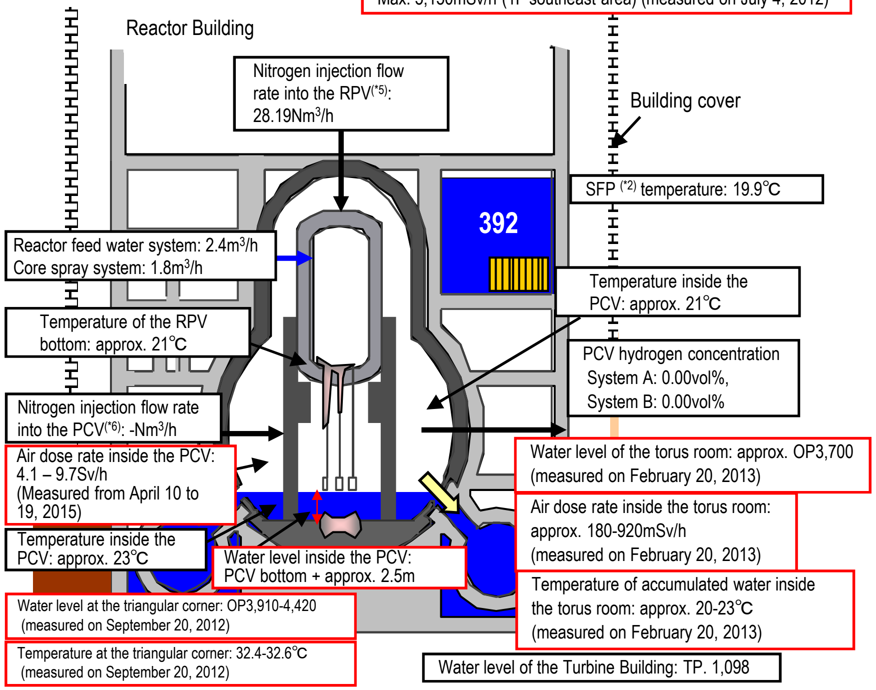
Immediate target	Identify the plant status and commence R&D and decontamination toward fuel debris removal

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.

Unit 1

Air dose rate inside the Reactor Building:
Max. 5,150mSv/h (1F southeast area) (measured on July 4, 2012)



* Indices related to the plant are values as of 11:00, November 22, 2016

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
Leakage points from PCV	- PCV vent pipe vacuum break line bellows (identified in May 2014) - Sand cushion drain line (identified in November 2013)	

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

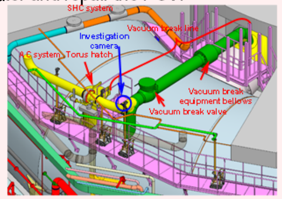


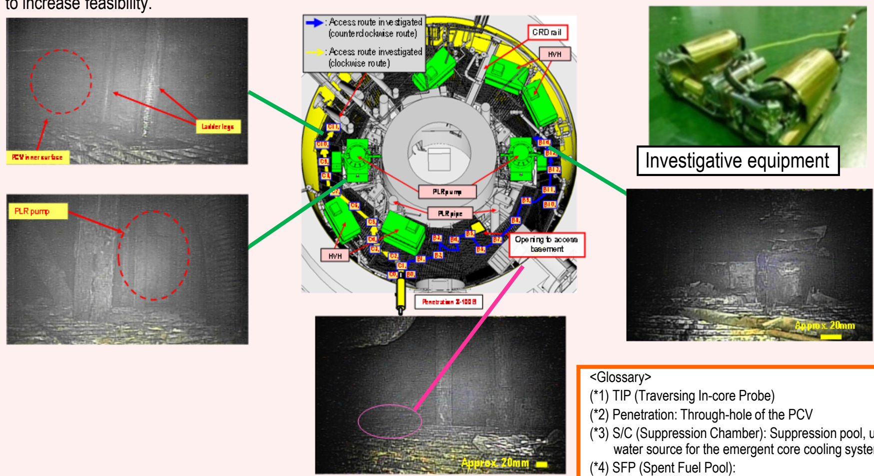
Image of the S/C upper part investigation

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(*5) 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: ϕ 100mm) and stably move on the grating, a field demonstration was implemented from April 10 to 20, 2015. Through this investigation, information including images and airborne radiation inside the PCV 1st floor was obtained.
- Based on the investigative results in April 2015 and additional information obtained later, an investigation on the PCV basement floor will be conducted in a method of traveling on the 1st floor grating and dropping cameras, dosimeters, etc. from above the investigative target to increase feasibility.



Investigation inside PCV

<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)

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.

Progress toward decommissioning: Works to identify the plant status and toward fuel debris removal

November 24, 2016
Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment

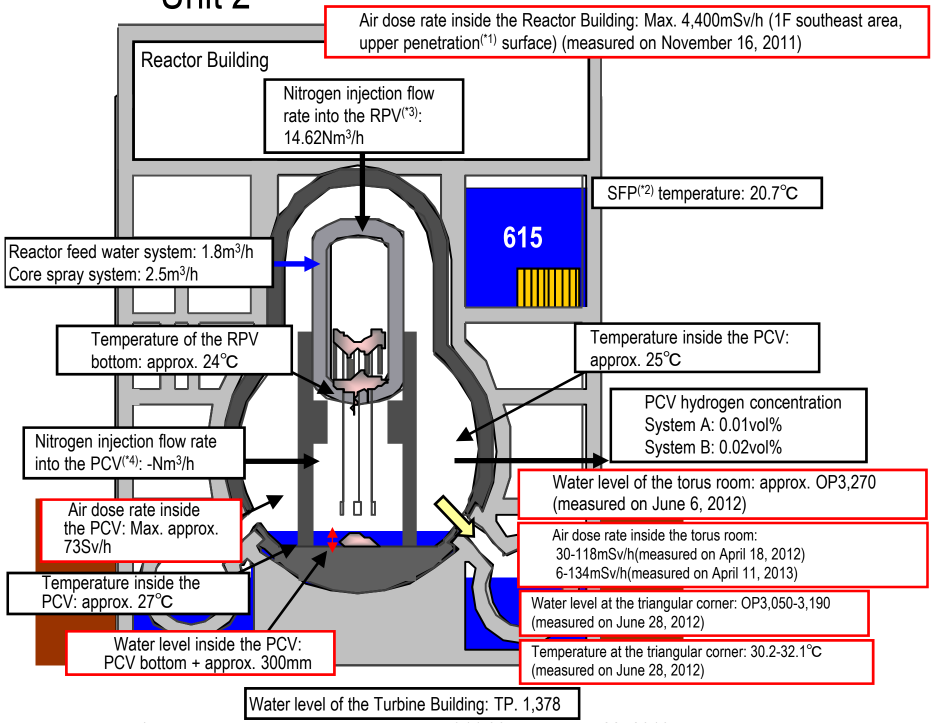
Immediate target	Identify the plant status and commence R&D and decontamination toward fuel debris removal

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

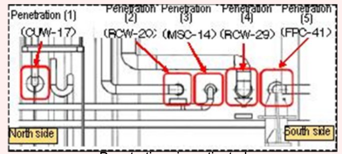


* Indices related to plant are values as of 11:00, November 22, 2016

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
Leakage points from PC	- No leakage from torus room rooftop - No leakage from all inside/outside surfaces of S/C	

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 (*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

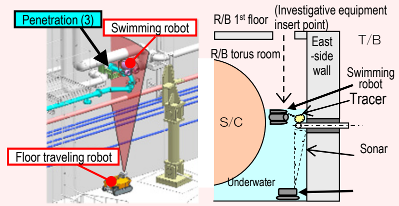


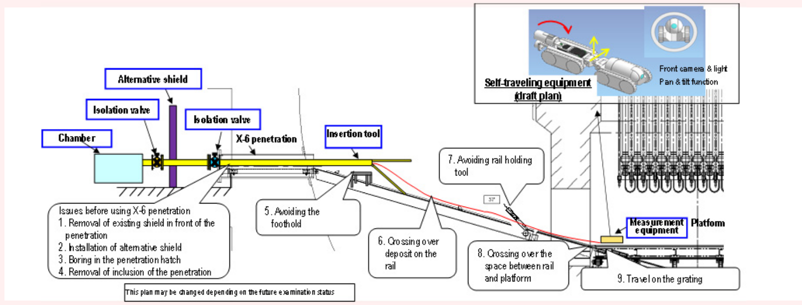
Image of the torus room east-side cross-sectional investigation

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.
- As a portion of shielding blocks installed in front of X-6 penetration could not be moved, a removal method using small heavy machines was planned. The work for removing these blocks resumed on September 28, 2015 and removal of interfering blocks for future investigations was also completed on October 1, 2015.
- As manufacturing of shields needed for dose reduction around X-6 penetration was completed, work to make a pipe penetration will start in December 2016 from which a robot will be inserted.



Investigative issues inside the PCV and equipment configuration (draft plan)

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

November 24, 2016
Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment

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

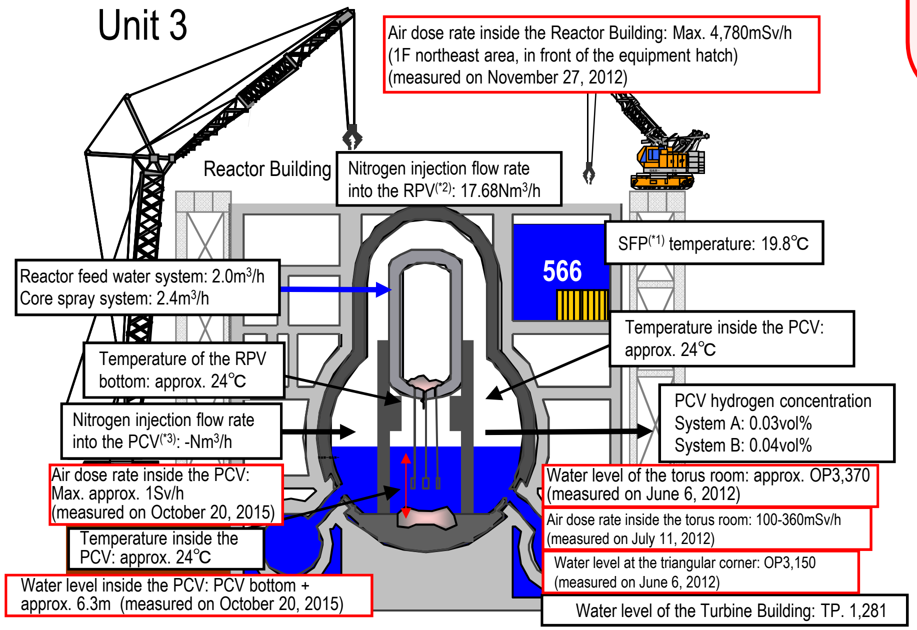
On January 18, 2014, a flow of water from around the door of the Steam Isolation Valve room in the Reactor Building Unit 3 1st floor northeast area to the nearby floor drain funnel (drain outlet) was detected. As the drain outlet connects with the underground part of the Reactor Building, there is no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

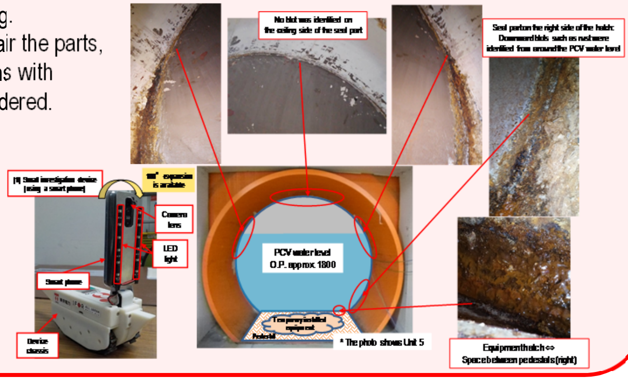


* Indices related to plant are values as of 11:00, November 22, 2016

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.

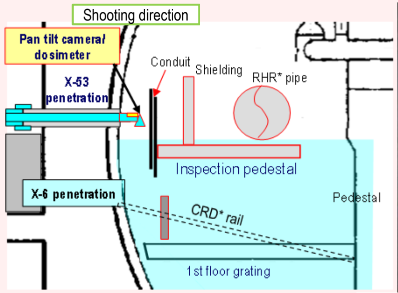


Investigation inside the PCV

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.
- In the next step, the obtained information will be analyzed to be utilized in the consideration about the policy for future fuel debris removal.




Inspection pedestal and water surface

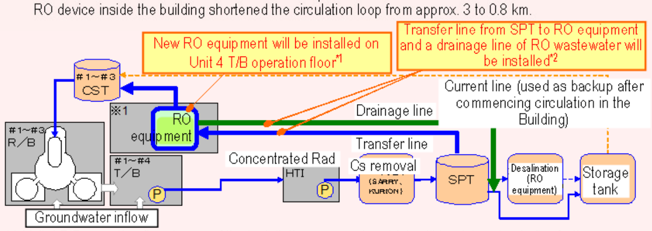
<Glossary>
(*1) SFP (Spent Fuel Pool)
(*2) RPV (Reactor Pressure Vessel)
(*3) PCV (Primary Containment Vessel)
(*4) Penetration: Through-hole of the PCV

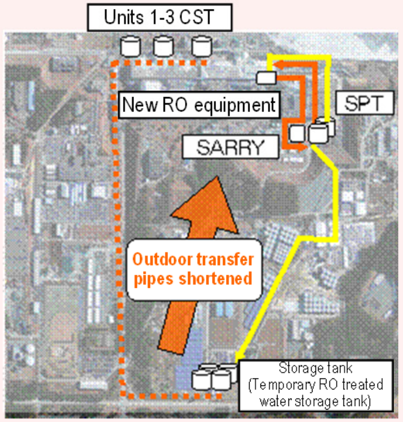
Progress toward decommissioning: Work related to circulation cooling and accumulated water treatment line

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 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.





*1 Unit 4 T/B operation floor is one of the installation proposals, which will be determined after further examination based on the work environment

*2 A detailed line configuration will be determined after further examination

* 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 (12 tanks) in H1 east area was completed in October 2015. Dismantling of all flange tanks (28 tanks) in H2 area was completed in March 2016. Dismantling of H4 flange tanks is underway.

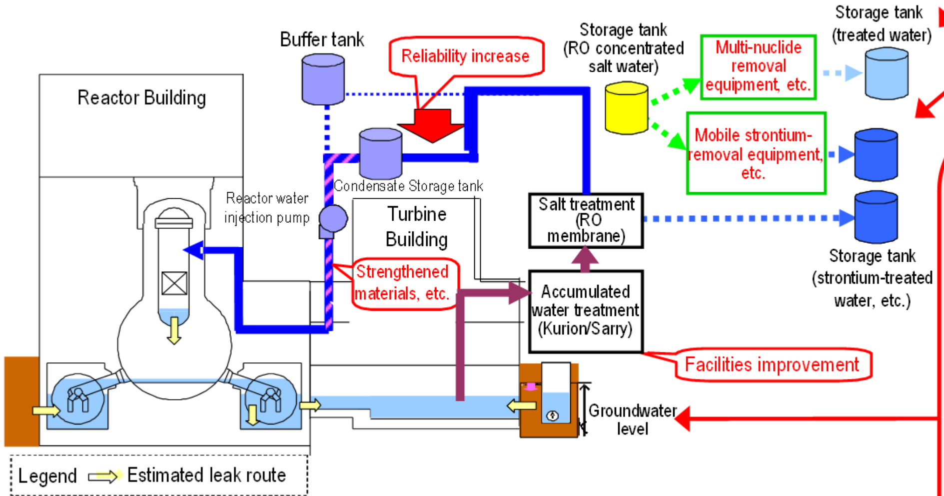
Start of dismantling in H1 east area

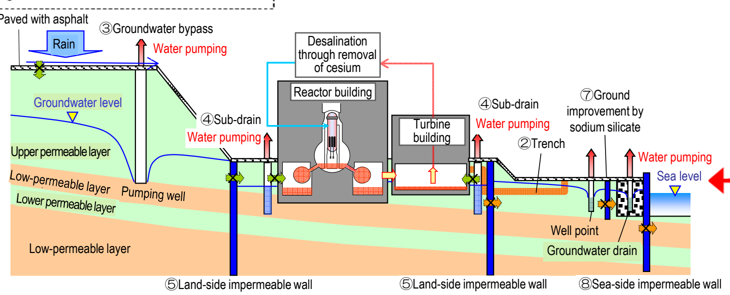
After dismantling in H1 east area

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.

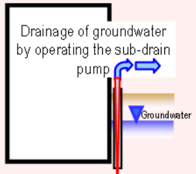
The strontium-treated water from other facilities than the multi-nuclide removal equipment will be re-purified in the multi-nuclide removal equipment to further reduce risks.





Land-side impermeable wall

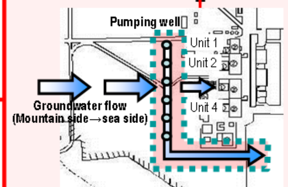
Preventing groundwater from flowing into the Reactor Buildings



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.

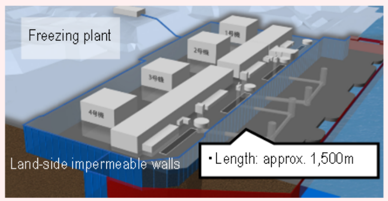
The pumped up groundwater is temporarily stored in tanks and released after TEPCO and a third-party organization have confirmed that its quality meets operational targets.

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 around Units 1-4 to prevent the inflow of groundwater into the building



To prevent the inflow of groundwater into the buildings, installation of impermeable walls on the land side is planned.

Installation of frozen pipes commenced on June 2, 2014. Construction for freezing facilities was completed in February 2016.

Freezing started on the sea side and at a part of the mountain side from March 2016 and at 95% of the mountain side from June 2016.

On the sea side, the underground temperature declined below 0°C throughout the scope requiring freezing except for the unfrozen parts under the sea-water pipe trenches and the areas In October 2016.

<Glossary>
(*1) CST (Condensate Storage Tank)
Tank for temporarily storing water used in the plant.

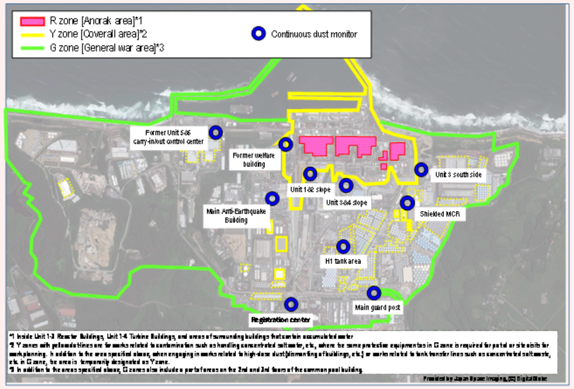
Progress toward decommissioning: Work to improve the environment within the site

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.



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.