# Summary of Decommissioning and Contaminated Water Management

July 28, 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

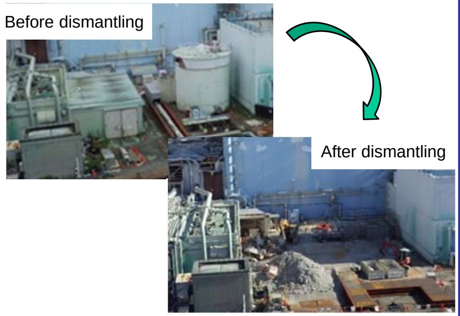
**Fuel Debris Removal**: Capturing the status inside PCV/ examination of fuel debris removal method, etc. (Note 2) (Unit 1-3) → Fuel debris removal → Storage and handling

(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 2 SFP, preparation around the building is underway.
Dismantling of hindrance buildings around the Reactor Building has been underway since September 2015 to clear a work area within which to install large heavy-duty machines, etc.




(Preparation around the Unit 2 Reactor Building)

## 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)

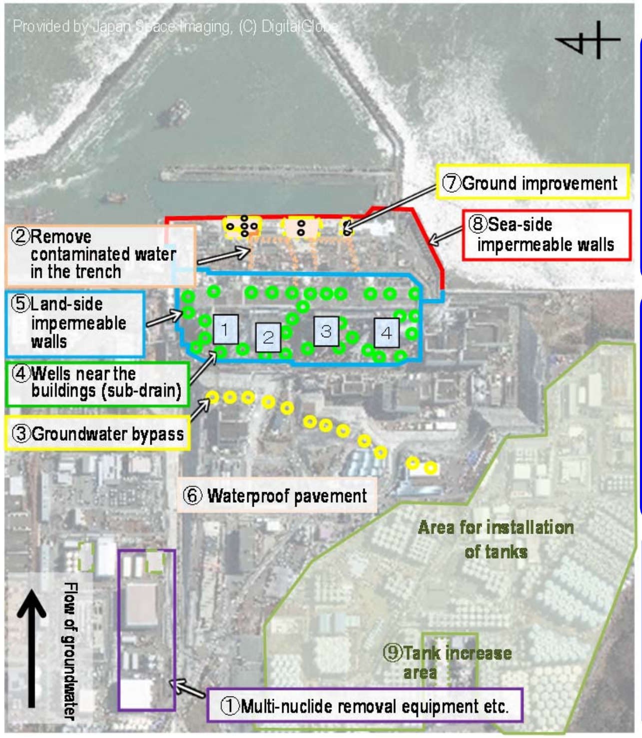
(Note 3) Underground tunnel containing pipes.

**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.
- On-site tests have been conducted since August 2013. Construction work commenced in June 2014.
- Construction on the mountain side was completed in September 2015 and on the sea side, in February 2016.
- Freezing started on the sea side and on part of the mountain side from March 2016 and at 95% of the mountain side from June 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 flow of contaminated groundwater 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 sea-side impermeable walls.

(Sea-side impermeable wall)

# Progress status

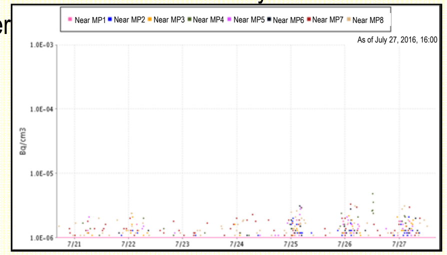
◆ The temperatures of the Reactor Pressure Vessel (RPV) and the Primary Containment Vessel (PCV) of Units 1-3 have been maintained within the range of approx. 20-35°C*1 for the past month. There was no significant change in the density of radioactive materials newly released from Reactor Buildings in 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 June 2016, the radiation exposure dose due to the release of radioactive materials from the Unit 1-4 Reactor Buildings was evaluated as less than 0.00029 mSv/year at the site boundary. The annual radiation dose by natural radiation is approx. 2.1 mSv/year (average in Japan).

## Real-time disclosure of measurement results from dust monitors near the site boundary

To provide timelier and clearer information regarding the environmental impact on the area around the site, real-time data of the measurement results near the site boundary has been disclosed since July 12.

Dismantling of the building cover has been implemented steadily, for example, the completion of sprinkler installation inside the Unit 1 building cover. Works will continue with anti-scattering measures steadily implemented and safety first above all.



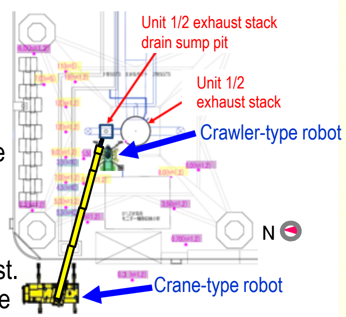

(Alert setting value: 1 × $10^{-5}$ Bq/cm³)
<Measurement results of site-boundary dust monitors>

## Investigation on the Unit 1/2 exhaust stack drain sump pit

Regarding the exhaust stack drain sump pit, where evaluated as "investigation required" in the comprehensive risk reviewing, the water level and quality will be investigated and measures will be taken by using a remote-controlled robots and other equipment because of the high dose around the pit.

On-site preparation started on July 25 to implement an investigation inside the pit from mid- to late-August.

Accumulated water found inside the pit would be released in the building.

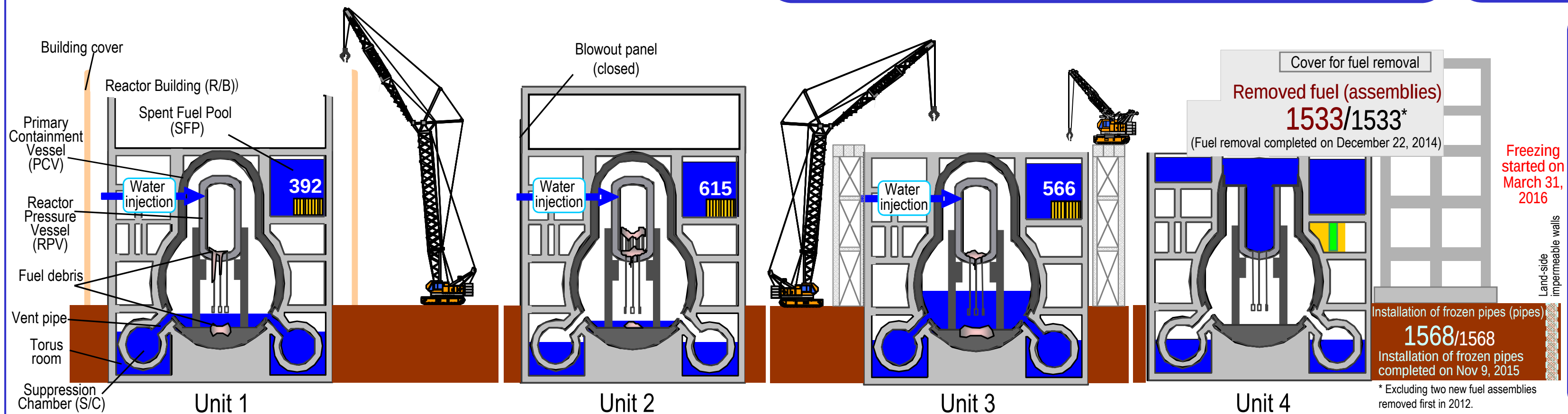



<Layout of remote-controlled robots>

## Leakage from the hose to transfer rainwater from a notch tank

On July 11, during work to collect rainwater from an out-of-service notch tank by a vacuum car, water leaked from the hose disconnected from the vacuum car. The amount of leakage up to approx. 80L and a portion went into the side ditch. Sandbags were installed inside the ditch and leaked water was collected. As no indications of rise by the radiation monitor for the drainage channel downstream of the side ditch, no water was deemed to have leaked into the port.

As measures to prevent disconnection of pressure-resistance hoses, the method of connecting hoses to the vacuum cars was changed to improve and hoses were lashed by chains or other materials.




## Installation of the Unit 3 reverse cleaning pit roof completed

From April to May, a decline in accumulated water levels was identified in the reverse cleaning valve pits installed on the east side of Unit 1-4 buildings. For the Unit 3 reverse cleaning valve pit, where the density was relatively high, accumulated rainwater was transferred and a roof was installed on July 9 to control the rainwater inflow. For Unit 1, a roof was already installed.

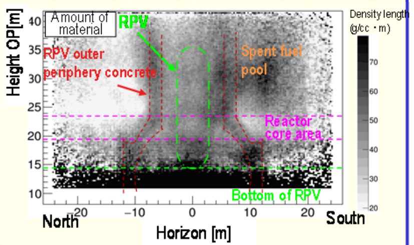
Water levels of all reverse cleaning valve pits are stable with no decline indicated.

## Investigative results of fuel debris inside the Unit 2 reactor using muons

To capture the location of fuel debris inside the Unit 2 reactor, measurement was conducted from March 22 to July 22 via imaging technology using muons (a type of elementary particle).

The investigation confirmed the existence of high-density materials, which was considered as fuel debris, at the bottom of the RPV, and in the lower part and outer periphery of the reactor core. It was assumed that a large part of the fuel debris existed at the bottom of the RPV.

The results of this investigation will be utilized when considering how to remove fuel debris.




<Muon measurement results>

## Status of land-side impermeable walls

Regarding the land-side impermeable walls to control the increase in contaminated water, the scope of freezing on the mountain side expanded to 95%. On the mountain side, the overall temperature is decreasing and signs of an increasing disparity in groundwater levels between the inside and outside of the land-side impermeable walls began to be identified.

On the part of sea side, the temperature is decreasing as work progresses using the supplementary method, which has been implemented since June 6.

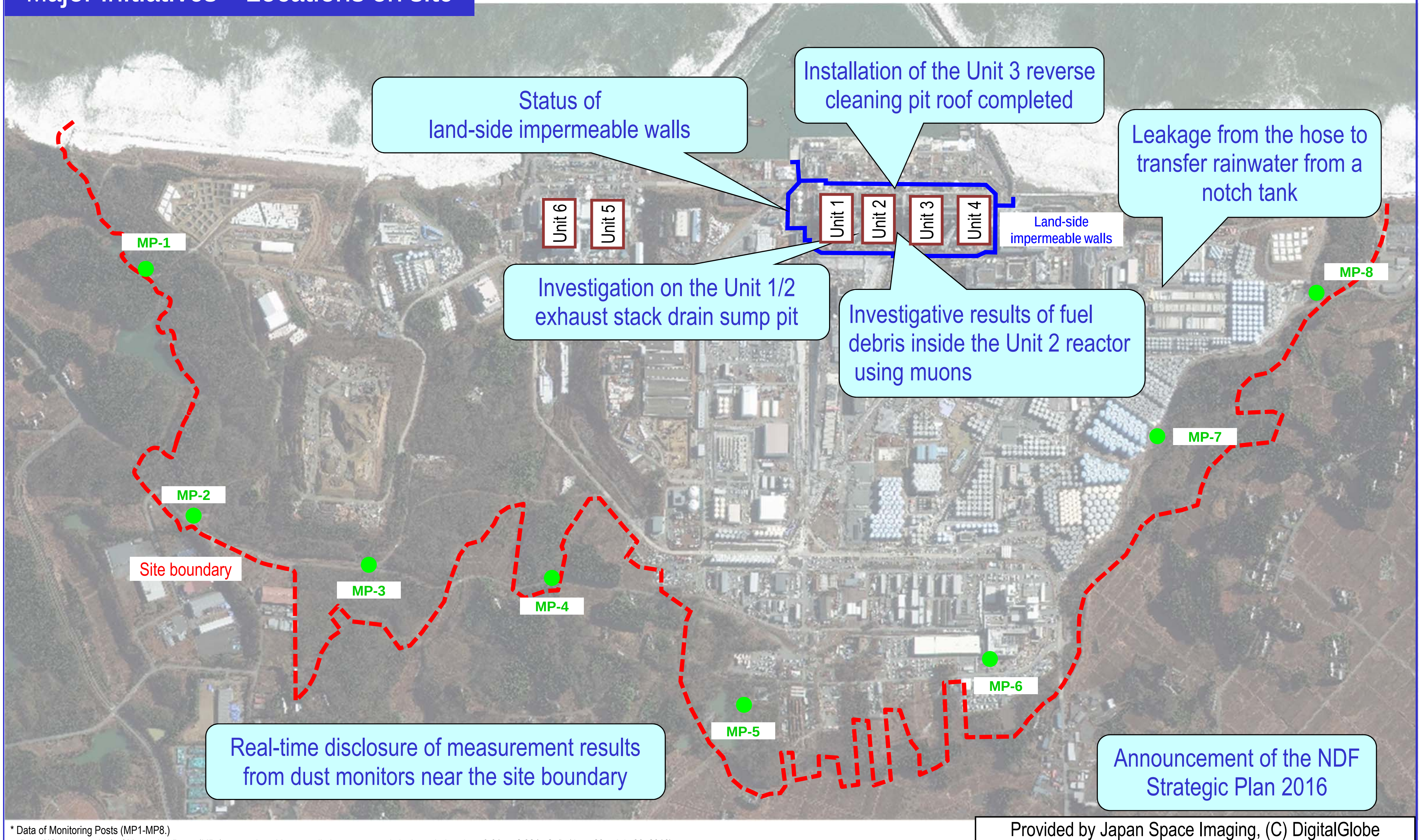
The status continues to be confirmed from the following perspectives: freezing status; the difference in groundwater levels between the inside and outside of the land-side impermeable walls; groundwater inflow into the area of 4m above sea level (on the sea side of the land-side impermeable walls), etc.

## Announcement of the NDF Strategic Plan 2016

On July 13, the Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) announced the "Technical Strategic Plan 2016 for Decommissioning of Fukushima Daiichi Nuclear Power Station of TEPCO Holdings," a report of considerations regarding mid- and long-term decommissioning strategies, to serve as technical evidence needed for the smooth and steady implementation of the Mid- and Long-term Roadmap.

Decommissioning will progress according to the Mid- and Long-Term Roadmap and the Technical Strategic Plan.

# Major initiatives – Locations on site




* Data of Monitoring Posts (MP1-MP8.)

Data (10-minute value) of Monitoring Posts (MPs) measuring airborne radiation rate around site boundaries show 0.617 – 2,324 μSv/h (June 29 – July 26, 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 Feb .10 to Apr. 18, 2012.

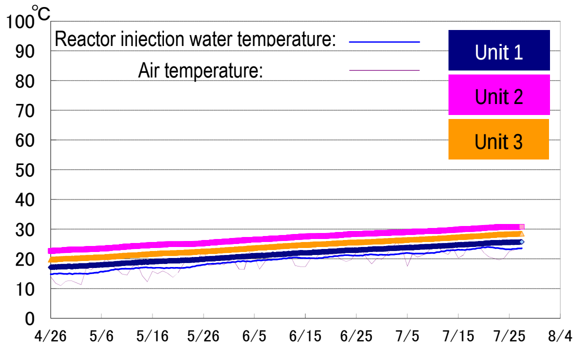
Therefore monitoring results at these points are lower than elsewhere in the power plant site.

The radiation shielding panel around monitoring post No. 6, which is one of the instruments used to measure the radiation dose of the power station site boundary, were taken off from July 10-11, 2013, since the surrounding radiation dose has largely fallen down due to further cutting down of the forests, etc.

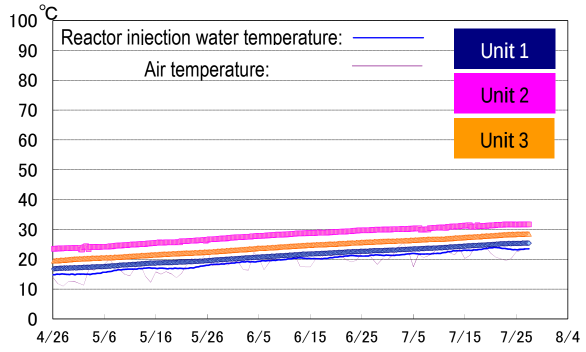
## I. Confirmation of the reactor conditions

### 1. Temperatures inside the reactors

Through continuous reactor cooling by water injection, the temperatures of the Reactor Pressure Vessel (RPV) bottom and the Primary Containment Vessel (PCV) gas phase have been maintained within the range of approx. 20 to 35°C for the past month, though they vary depending on the unit and location of the thermometer.




RPV bottom temperatures (recent quarter)



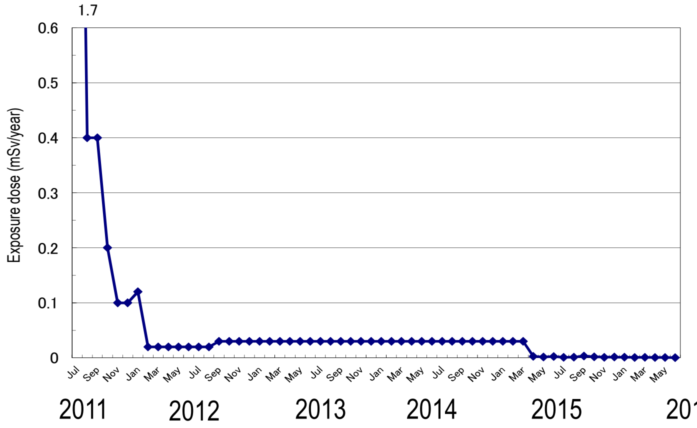

PCV gas phase temperatures (recent quarter)

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

### 2. Release of radioactive materials from the Reactor Buildings

As of June 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. $4.1\times10^{-12}$ Bq/cm³ for Cs-134 and $9.6\times10^{-12}$ Bq/cm³ for Cs-137 respectively. The radiation exposure dose due to the release of radioactive materials was less than 0.00029 mSv/year at the 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 0.617 –2.324 μSv/h (June 29 – July 26, 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

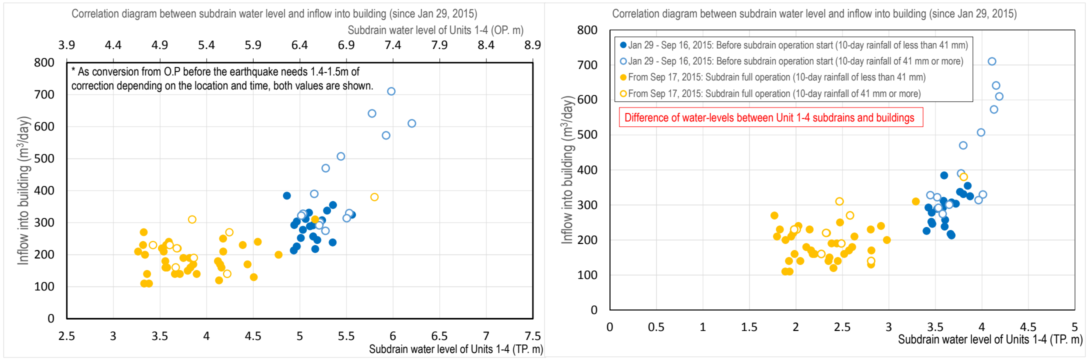
*To tackle the increase in accumulated water due to groundwater inflow, fundamental measures to prevent such inflow into the Reactor Buildings will be implemented, while improving the decontamination capability of water treatment and preparing facilities to control the contaminated water*

#### ➢ 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 July 26, 2016, 203,715 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 drain

- 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 July 26, 2016, a total of 157,330 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 closure of the sea-side impermeable walls, pumping started on November 5, 2015. Up until July 26, 2016, a total of approx. 69,600 m³ had been pumped up. Approx. 150 m³/day is being transferred from the groundwater drain to the Turbine Buildings (average for the period June 23 – July 20, 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 effect of the inflow into buildings will be reviewed as necessary by accumulating data.
- 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 the water levels with buildings decreased to approx. 2 m after the subdrains went into operation.




As of July 21, 2016

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

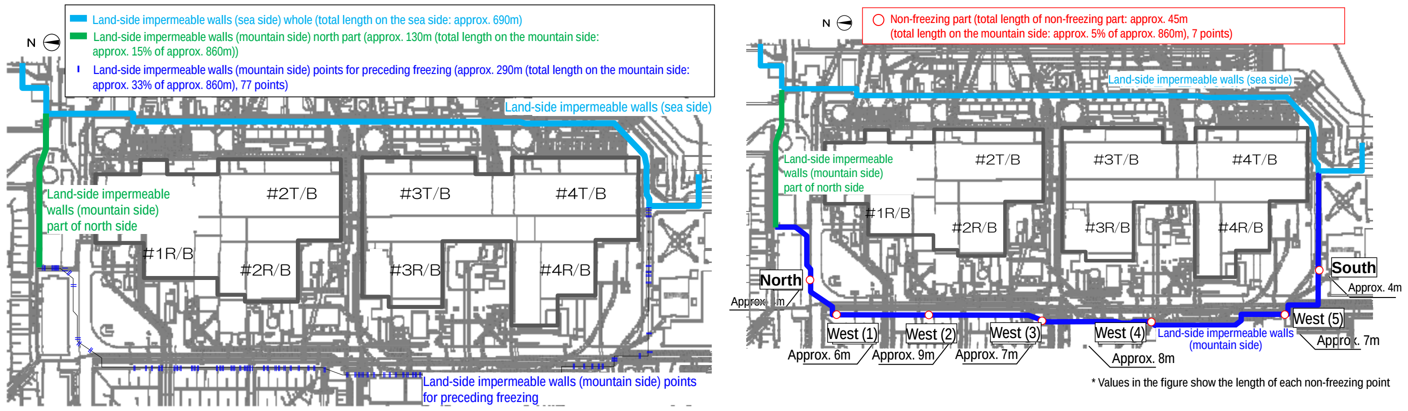
#### ➢ Construction status of the land-side impermeable walls

- Regarding the installation of land-side impermeable walls surrounding Units 1-4 (a subsidy project of the Ministry of Economy, Trade and Industry), preparation for freezing was completed on February 9, 2016.
- As for the land-side impermeable walls (on the sea side), the overall temperature is decreasing to 0°C or lower over time. In the parts where no sufficient decrease was yet identified, the temperature is declining as the supplementary method progresses (implemented from June 6). The difference in groundwater levels between the inside and outside of the land-side impermeable walls (on the sea side) has expanded and been maintained, while the inflow of groundwater started declining after the closure of the land-side impermeable walls (on the sea side). The groundwater inflow into the area of 4m above sea level will continue to be monitored.
- As for the land-side impermeable walls (on the mountain side), the overall temperature has been declining since freezing started. Sings of an increasing disparity in groundwater levels between the inside and outside of the land-side impermeable walls began to be identified.
- During Phase 1, the status is being confirmed from the following perspectives: the difference in groundwater levels between the inside and outside and the decrease in groundwater inflow into the area of 4m above sea level of the land-side impermeable walls (on the sea side); difference in groundwater levels between the inside and outside of the land-side impermeable walls (on the mountain side); and the freezing status of the whole land-side impermeable walls.

✓ Stage 1: (Phase 1: freezing started on March 31) “Whole sea side,” “part of the north side” and “preceding frozen parts of the mountain side (parts with difficulty in freezing due to significant intervals between frozen pipes, etc.)” will be frozen simultaneously.
(Phase 2: freezing started on June 6) The remaining parts on the mountain side will be frozen except the “unfrozen parts” of Stage 1 when the effect of the sea-side impermeable walls begins to emerge.

✓ Stage 2: Between Stages 1 and 3.

✓ Stage 3: Complete closure.




Stage 1 (Phase 1) Stage 1 (Phase 2)

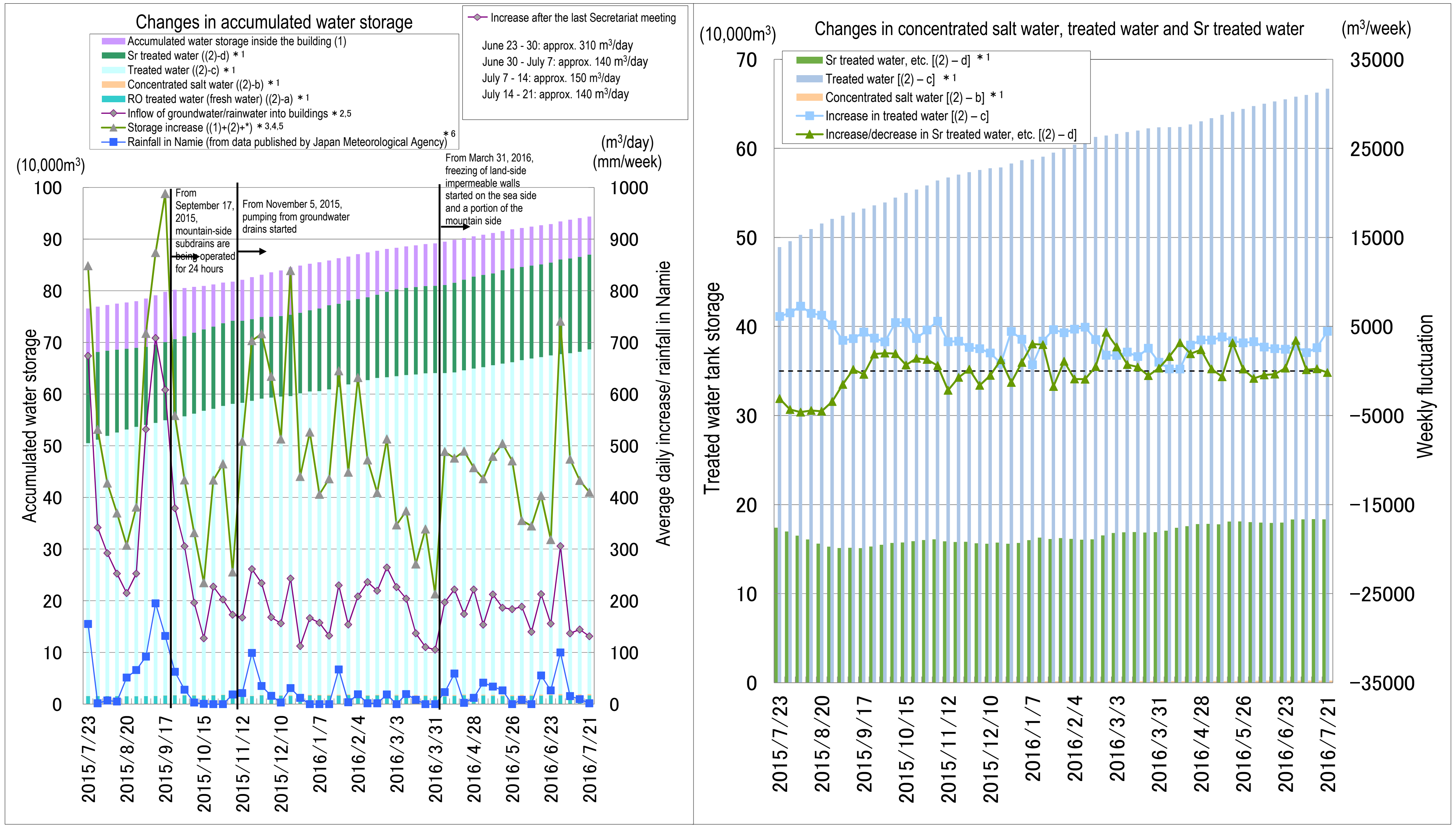
Figure 2: Scope of freezing of land-side impermeable walls

## ➢ 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 July 21, the volumes treated by the existing, additional and high-performance multi-nuclide removal equipment were approx. 291,000, 280,000 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 by 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 July 21, approx. 225,000 m³ had been treated.

## ➢ Toward reducing the risk of contaminated water stored in tanks

- Treatment measures comprising the removal of strontium by the cesium absorption apparatus (KURION) (from January 6, 2015) and the secondary cesium absorption apparatus (SARRY) (from December 26, 2014) have been underway. Up until July 21, approx. 263,000 m³ had been treated.




As of July 21, 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: Values calculated including the calibration effect of the building water-level gauge
(March 10-17, 2016: Main Process Building,
March 17-24, 2016: High-Temperature Incinerator Building (HTI))

*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 July 25, 2016, a total of 59,290 m³)

➢ Measures related to water level decline in the reverse cleaning valve pits

- As a decline in accumulated water levels was identified from April to May in the reverse cleaning valve pits installed on the east side of Unit 1-4 Turbine Buildings, monitoring has been enhanced.
- For the Unit 3 reverse cleaning valve pit, where the density in accumulated rainwater was the second highest following the Unit 1 pit (for which a roof had been installed), a portion of accumulated rainwater was transferred (June 22-27, a total of approx. 300m³ ) and a roof was installed (by July 9) to prevent further inflow of rainwater.
- As the status is stable at present, with no change identified in the reverse cleaning valve pits of Units 1-4, monitoring continues with the water level measured on a monthly basis.

➢ Leakage from the notch tank transfer hose on the west side of the G1 tank area

- On July 11, while transferring rainwater from a notch tank on the west side of the G1 tank area, approx. 80L of water leaked from a disconnected hose. Though a portion went into a branch drainage channel, the leaked water was collected after taking measures to prevent expansion by installing sandbags inside the side ditch.
- As measures to prevent disconnection of pressure-resistance hoses, the method of connecting hoses to the vacuum cars was changed to improve and hoses were lashed by chains or other materials.

## 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 remove the roof panels of the building cover and by October 5, 2015, all six roof panels had been removed. The spray test of the sprinklers was completed on June 30. Following works to suck up small rubble from May 30 to early August, anti-scattering agents will be sprayed from the side. The building cover is being dismantled, with anti-scattering measures steadily implemented and safety prioritized above all.
- On June 20, a leakage of hydraulic oil was identified from the oil cooler of the 750-ton crawler crane. The oil cooler was replaced by July 2.

➢ 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, dismantling of hindrance buildings around the Reactor Building has been underway since September 7, 2015 to clear a work area within which large heavy-duty machines and other instruments will be installed.

➢ Main work to help remove spent fuel at Unit 3

- On the operating floor of the reactor building, shields were installed in the B zone during the period July 13 to 25. Work started in C zone on July 11 and D zone on July 27. Shields will also be installed in the remaining areas.

## 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 accessibility to the PCV*

➢ Investigative results of fuel debris inside the Unit 2 reactor using muons

- To capture the location of fuel debris inside the Unit 2 reactor, measurement via the muon transmission method, the effect of which was confirmed based on measurement results of Unit 1, was conducted from March 22 to July 22 using a small device developed by the subsidy for decommissioning and the contaminated water-treatment project "Development of Technology to Detect Fuel Debris inside the Reactor."
- The investigation confirmed the existence of high-density materials, which were considered fuel debris, at the bottom of the RPV and in the lower part and outer periphery of the reactor core. It was assumed that most of the fuel debris existed at the bottom of the RPV.

## 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 June 2016, the total storage volume of concrete and metal rubble was approx. 190,000 m³ (+800 m³ compared to at the end of May, with an area-occupation rate of 68%). The total storage volume of trimmed trees was approx. 87,400 m³ (+2,500 m³ compared to at the end of May, with an area-occupation rate of 82%). The total storage volume of used protective clothing was approx. 65,500 m³ (-1,000 m³ compared to at the end of May, with an area-occupation rate of 92%). The increase in rubble was mainly attributable to construction to install tanks. The increase in trimmed trees was mainly attributable to construction related to site preparation work. The decrease in used protective clothing was mainly attributable to incineration of the clothing.

➢ Management status of secondary waste from water treatment

- As of July 21, 2016, the total storage volume of waste sludge was 597 m³ (area-occupation rate: 85%) and that of concentrated waste fluid was 9,278 m³ (area-occupation rate: 87%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment, etc. was 3,232 (area-occupation rate: 52%).

## 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*

➢ Nitrogen injection from the Unit 1 jet pump instrumentation line

- As for Unit 1, nitrogen has been injected from the reactor head spray line to RPV. Targeting enhanced reliability, works to install a new nitrogen injection line are currently underway through the jet pump instrumentation line.
- On May 30, the implementation plan was authorized. The lines are currently being installed and will undergo a pre-operation test when construction is completed.

## 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 the radioactive materials in the groundwater near the bank on the north side of the Unit 1 intake, the tritium density at groundwater Observation Hole No. 0-3-2 has been increasing since January 2016 and currently stands at around 30,000 Bq/L.
- Regarding the groundwater near the bank between the Unit 1 and 2 intakes, though the tritium density at groundwater Observation Hole No. 1-9 has been increasing to approx. 800 Bq/L since December 2015, it currently stands at around 200 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 after having declined to 2,000 Bq/L since March 2016 and currently stands at around 20,000 Bq/L. Though the density of gross β radioactive materials at the same groundwater Observation Hole had remained constant at around 7,000 Bq/L, it has been increasing since March 2016 and currently stands at around 300,000 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).

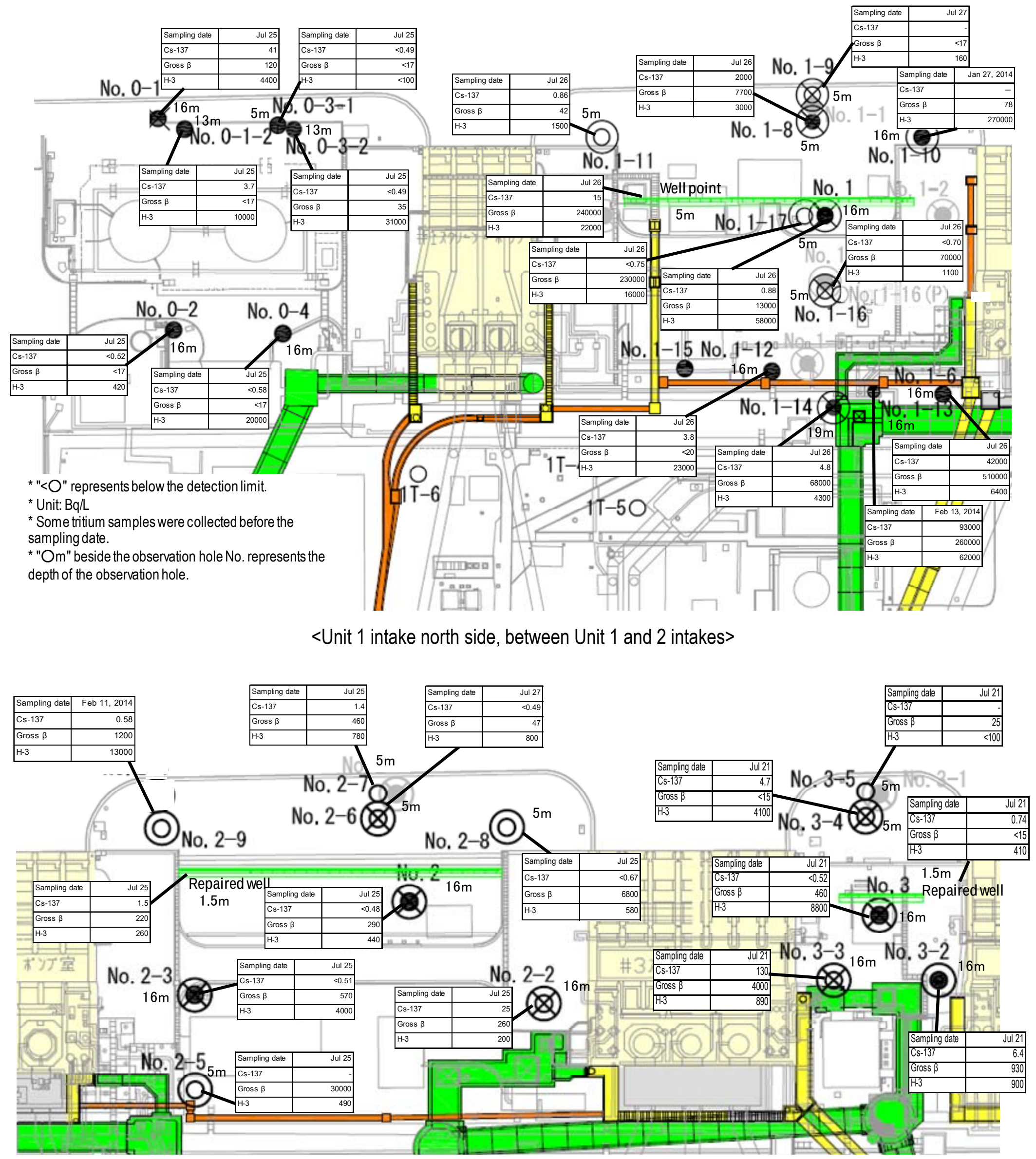
- Regarding radioactive materials in the groundwater near the bank between the Unit 2 and 3 intakes, though the density of gross β radioactive materials at groundwater Observation Hole No. 2-5 had remained constant at around 10,000 Bq/L, it had increased to 500,000 Bq/L since November 2015 and currently stands at around 30,000 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, the density has remained within the same range recently recorded. 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. The detection limit of cesium 137 in seawater within the port has been reviewed since June 1.
- Regarding the radioactive materials in seawater outside the port, the densities of radioactive materials remained within the same range previously recorded.

➢ Alert from a continuous dust monitor on the site boundary

- On July 3, a "high alert" indicating an increased density of dust radiation was issued from the dust monitor near the monitoring post (MP) No. 8.
- The cause was considered to be natural nuclides for the following reasons: no abnormality was detected in other dust monitors and plant parameters; the wind was blowing from outside the site; there was no on-site work around the monitor that could be attributable to dust increase; only natural nuclides (bismuth 214 and Thallium 208) were found in the nuclide analysis on the filter used at the time the alert was issued; and the density increase tendency resembled the alert insurance caused by natural nuclides in August 2015.
- Real-time disclosure of values collected from continuous monitors near MPs started on July 12 (the data has been updated every ten minutes).

➢ Response to the Unit 1/2 exhaust stack drain sump pit

- Regarding the Unit 1/2 exhaust stack drain sump pit, where evaluated as "investigation required" in the comprehensive risk review, the water level and quality will be investigated and measures will be taken by using a remote-controlled robot and other equipment because of the high dose around the pit.
- On-site preparation started on July 25 to implement an investigation inside the pit from mid- to late- August.
- Accumulated water found inside the pit would be released in the building.



<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

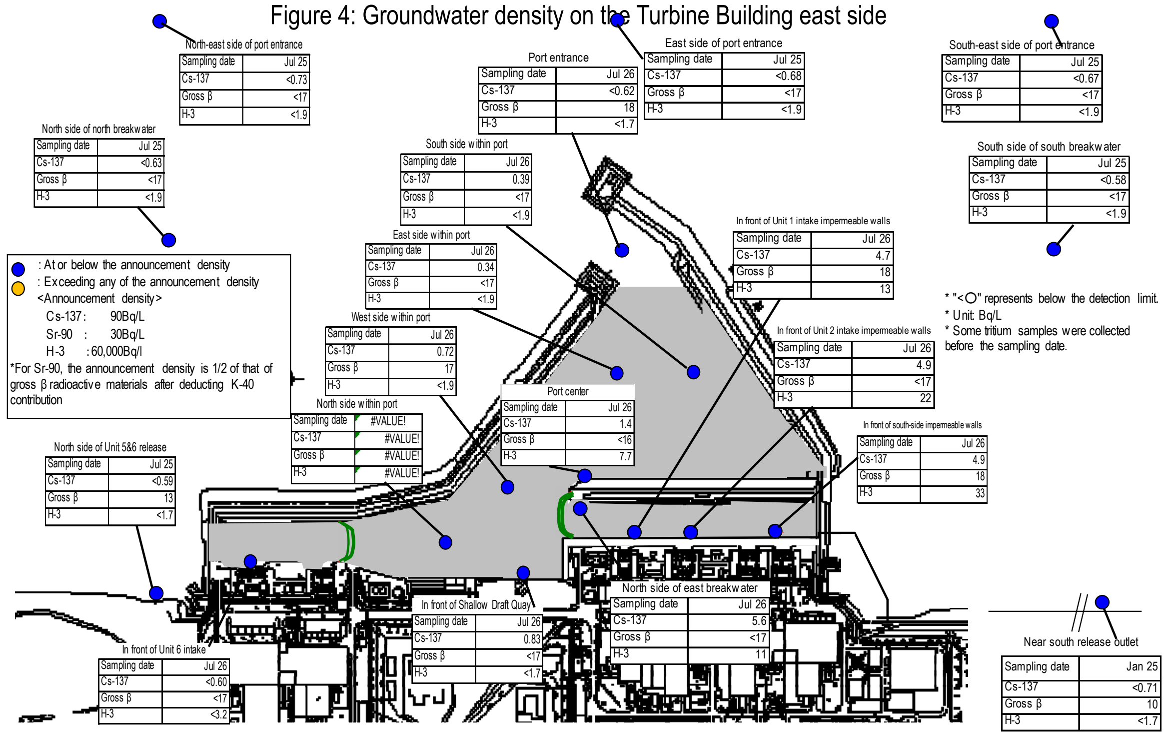


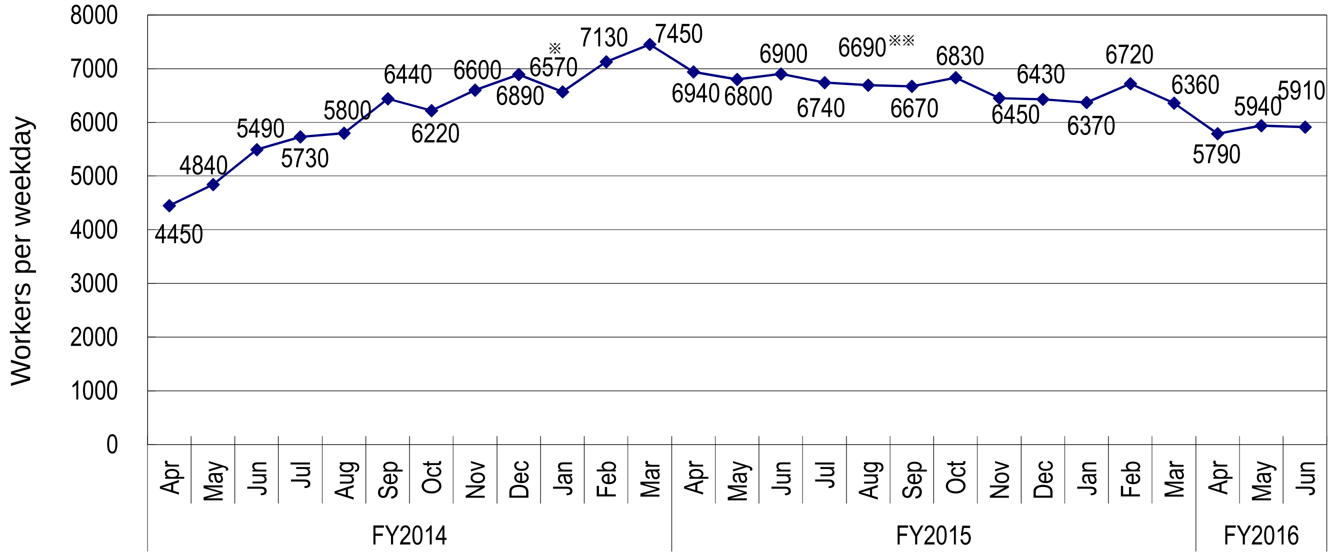
Figure 5: Seawater density around the port

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

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

### ➢ Staff management

- The monthly average total of people registered for at least one day per month to work on site during the past quarter from March to May 2016 was approx. 13,000 (TEPCO and partner company workers), which exceeded the monthly average number of actual workers (approx. 9,900). 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 August 2016 (approx. 5,910 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 August 2016.
- The total number of workers has decreased from both within and outside Fukushima Prefecture. The local employment ratio (TEPCO and partner company workers) remains at around 50% as of June 2016.
- 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 FY2013

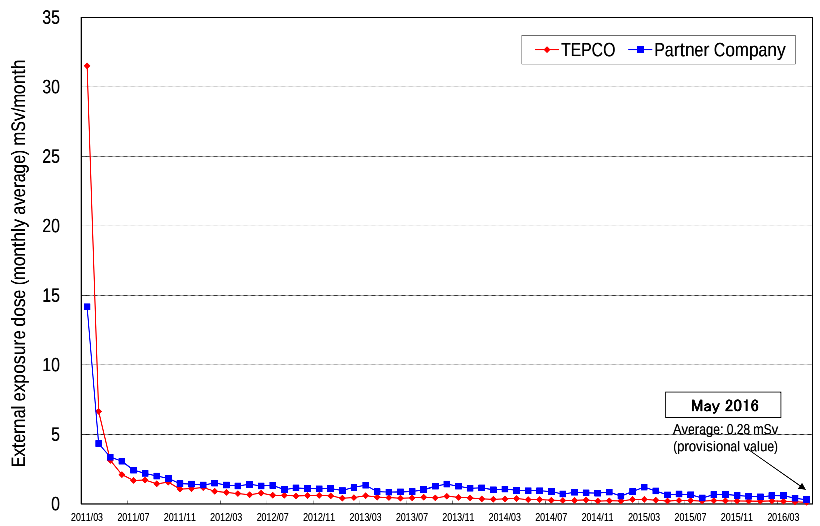



Figure 7: Changes in monthly individual worker exposure dose
(monthly average exposure dose since March 2011)

### ➢ Status of heat stroke cases

- In FY2016, three workers had suffered heat stroke due to work and no worker had suffered light stroke (with no medical treatment required) up until July 26. Continued measures will be taken to prevent heat stroke. (In FY2015, ten workers had heat stroke due to work and two workers had light heat stroke up until the end of July.)

### ➢ Classification of controlled zones and status of optimized operation of radiation protective equipment

- Since the operation start on March 8, approx. 2,000 workers per day working in G zone have worn dedicated wear for on-site works. As evidenced by the declining usage rate of full-face masks and the shift from a combination of coverall and full-face masks to a combination of disposable dust masks (DS2) and dedicated wear for on-site works, over-wearing has been improved.
- Following the operation start, dedicated summer wear for on-site works were also introduced, lighting and air-conditioning started service at the protective equipment switching facility and an additional protective equipment switching facility was installed.

## 8. Other

### ➢ Trip of on-site distribution lines

- On June 28, the standby transformation M/C[6B] line (on-site distribution line No. 2) blacked out. Based on the investigative results, the cause was supposed to be the circuit breaker having shorted due to dust and humidity in the high-pressure incoming panel of the company building, which connected to the on-site distribution line No. 2 downstream of the standby transformation M/C[6B].
- The trip of the standby transformation M/C[6B] was considered attributable to the shorting in the high-pressure incoming panel, which caused overcurrent in the on-site distribution line No. 2 and the subsequent trip of the standby transformation M/C[6B] line.
- The high-pressure incoming panel which was subject to shorting was disconnected from the distribution line. The entire power supply to other facilities and buildings was recovered by June 30.
- Visual inspections are being conducted for similar power supply facilities to assess the likelihood of such events.
- From now onward, the necessary reliability improvement measures will be taken for on-site distribution lines, power supply facilities and plant facilities to prevent similar events.

### ➢ Announcement of the NDF Strategic Plan 2016

- On July 13, the Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) announced the "Technical Strategic Plan 2016 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings," a report of considerations regarding mid- and long-term decommissioning strategies, to serve as technical evidence for the smooth and steady implementation of the Mid- and Long-term Roadmap. On July 20, NDF also announced a partial modification to the description.

# 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 20-28)"; 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) → | 0.34 | Below 1/20 |
| Gross β: | 74 | (2013/ 8/19) → | ND(17) | Below 1/4 |
| Tritium: | 67 | (2013/ 8/19) → | ND(1.7) | Below 1/30 |

| | | | | |
|---|---|---|---|---|
| Cesium-134: | 4.4 | (2013/12/24) → | ND(0.35) | Below 1/10 |
| Cesium-137: | 10 | (2013/12/24) → | 0.72 | Below 1/10 |
| Gross β: | 60 | (2013/ 7/ 4) → | 17 | Below 1/3 |
| Tritium: | 59 | (2013/ 8/19) → | 1.9 | Below 1/30 |

| | | | | |
|---|---|---|---|---|
| Cesium-134: | 5.0 | (2013/12/2) → | ND(0.34) | Below 1/10 |
| Cesium-137: | 8.4 | (2013/12/2) → | ND(0.35) | Below 1/20 |
| Gross β: | 69 | (2013/8/19) → | ND(17) | Below 1/4 |
| Tritium: | 52 | (2013/8/19) → | 2.0 | Below 1/20 |

| | | | | |
|---|---|---|---|---|
| Cesium-134: | 2.8 | (2013/12/2) → | ND(0.52) | Below 1/5 |
| Cesium-137: | 5.8 | (2013/12/2) → | ND(0.6) | Below 1/9 |
| Gross β: | 46 | (2013/8/19) → | ND(17) | Below 1/2 |
| Tritium: | 24 | (2013/8/19) → | ND(3.2) | Below 1/7 |

| | |
|---|---|
| Cesium-134: | ND(0.45) |
| Cesium-137: | 1.4 |
| Gross β: | ND(16) |
| Tritium: | 2.8 * |

| | | | | |
|---|---|---|---|---|
| Cesium-134: | 3.3 | (2013/12/24) → | ND(0.44) | Below 1/7 |
| Cesium-137: | 7.3 | (2013/10/11) → | ND(0.62) | Below 1/10 |
| Gross β: | 69 | (2013/ 8/19) → | 18 | Below 1/3 |
| Tritium: | 68 | (2013/ 8/19) → | ND(1.9) | Below 1/30 |

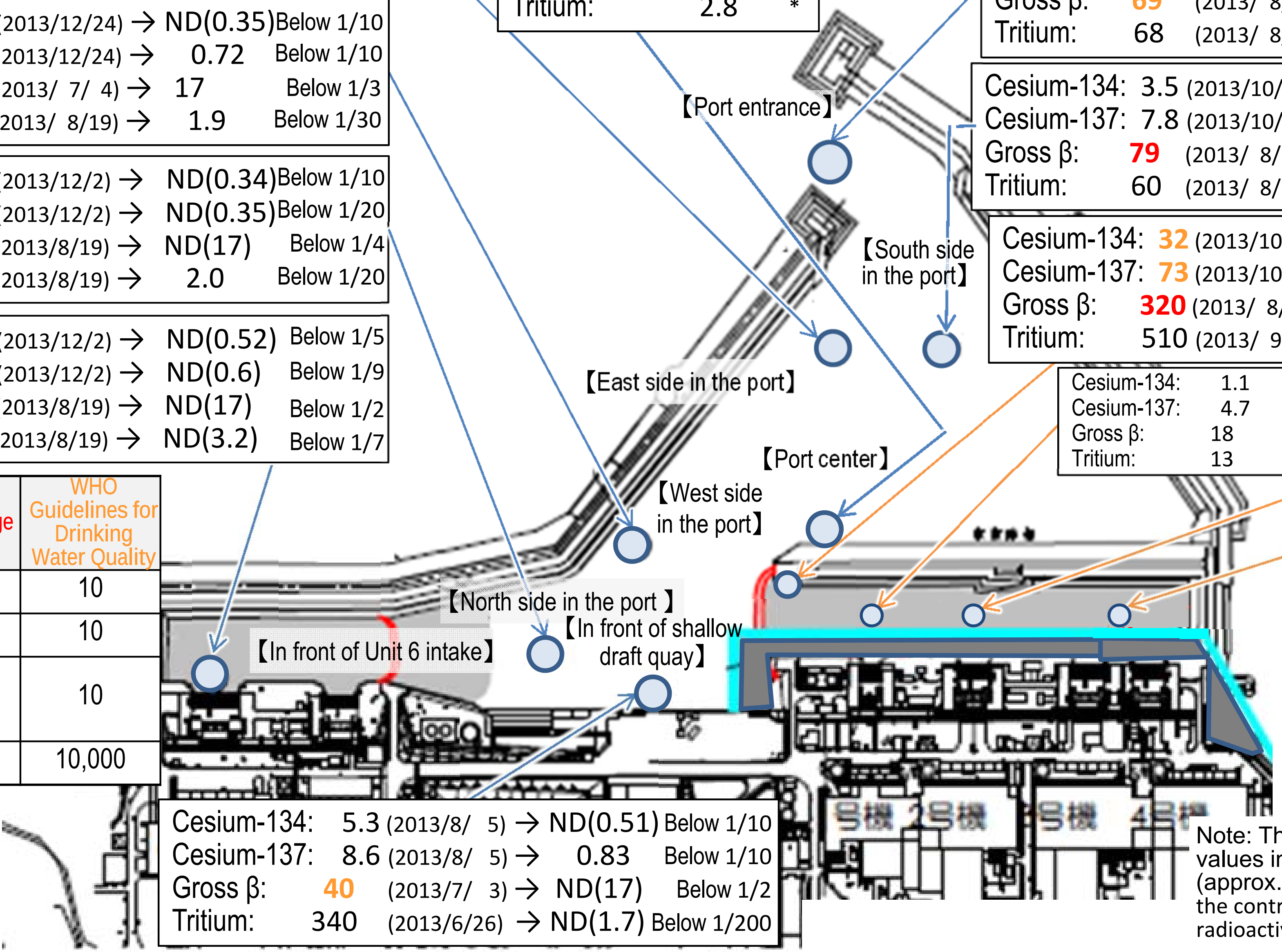
| | | | | |
|---|---|---|---|---|
| Cesium-134: | 3.5 | (2013/10/17) → | ND(0.27) | Below 1/10 |
| Cesium-137: | 7.8 | (2013/10/17) → | 0.39 | Below 1/20 |
| Gross β: | 79 | (2013/ 8/19) → | 18 | Below 1/4 |
| Tritium: | 60 | (2013/ 8/19) → | ND(1.7) | Below 1/30 |

| | | | | |
|---|---|---|---|---|
| Cesium-134: | 32 | (2013/10/11) → | 0.61 | Below 1/50 |
| Cesium-137: | 73 | (2013/10/11) → | 5.6 | Below 1/10 |
| Gross β: | 320 | (2013/ 8/12) → | ND(17) | Below 1/10 |
| Tritium: | 510 | (2013/ 9/ 2) → | 11 | Below 1/40 |

| | |
|---|---|
| Cesium-134: | 1.1 |
| Cesium-137: | 4.7 |
| Gross β: | 18 |
| Tritium: | 13 * |

| | |
|---|---|
| Cesium-134: | 0.69 |
| Cesium-137: | 4.9 |
| Gross β: | ND(17) |
| Tritium: | 22 * |

| | |
|---|---|
| Cesium-134: | 1.0 |
| Cesium-137: | 4.9 |
| Gross β: | 18 |
| Tritium: | 33 * |




| Cesium-134: | 5.3 | (2013/8/ 5) → | ND(0.51) | Below 1/10 |
|---|---|---|---|---|
| Cesium-137: | 8.6 | (2013/8/ 5) → | 0.83 | Below 1/10 |
| Gross β: | 40 | (2013/7/ 3) → | ND(17) | Below 1/2 |
| Tritium: | 340 | (2013/6/26) → | ND(1.7) | 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 July 27

# 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 July 11-26)

| | 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 (0.73)
Cesium-137: ND (2013) → ND (0.78)
Gross β: ND (2013) → ND (18)
Tritium: ND (2013) → ND (1.6)

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

Cesium-134: ND (2013) → ND (0.72)
Cesium-137: 1.6 (2013/10/18) → ND (0.64) Below 1/2
Gross β: ND (2013) → ND (18)
Tritium: 6.4 (2013/10/18) → ND (1.6) Below 1/4

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

Cesium-134: ND (2013) → ND (0.85)
Cesium-137: ND (2013) → ND (0.69)
Gross β: ND (2013) → ND (18)
Tritium: ND (2013) → ND (1.6)

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

Cesium-134: ND (2013) → ND (0.62)
Cesium-137: ND (2013) → ND (0.53)
Gross β: ND (2013) → ND (18)
Tritium: 4.7 (2013/ 8/18) → ND (1.6) Below 1/2

【Port entrance】

Cesium-134: 3.3 (2013/12/24) → ND (0.44) Below 1/7
Cesium-137: 7.3 (2013/10/11) → ND (0.62) Below 1/10
Gross β: 69 (2013/ 8/19) → 18 Below 1/3
Tritium: 68 (2013/ 8/19) → ND (1.9) Below 1/30

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

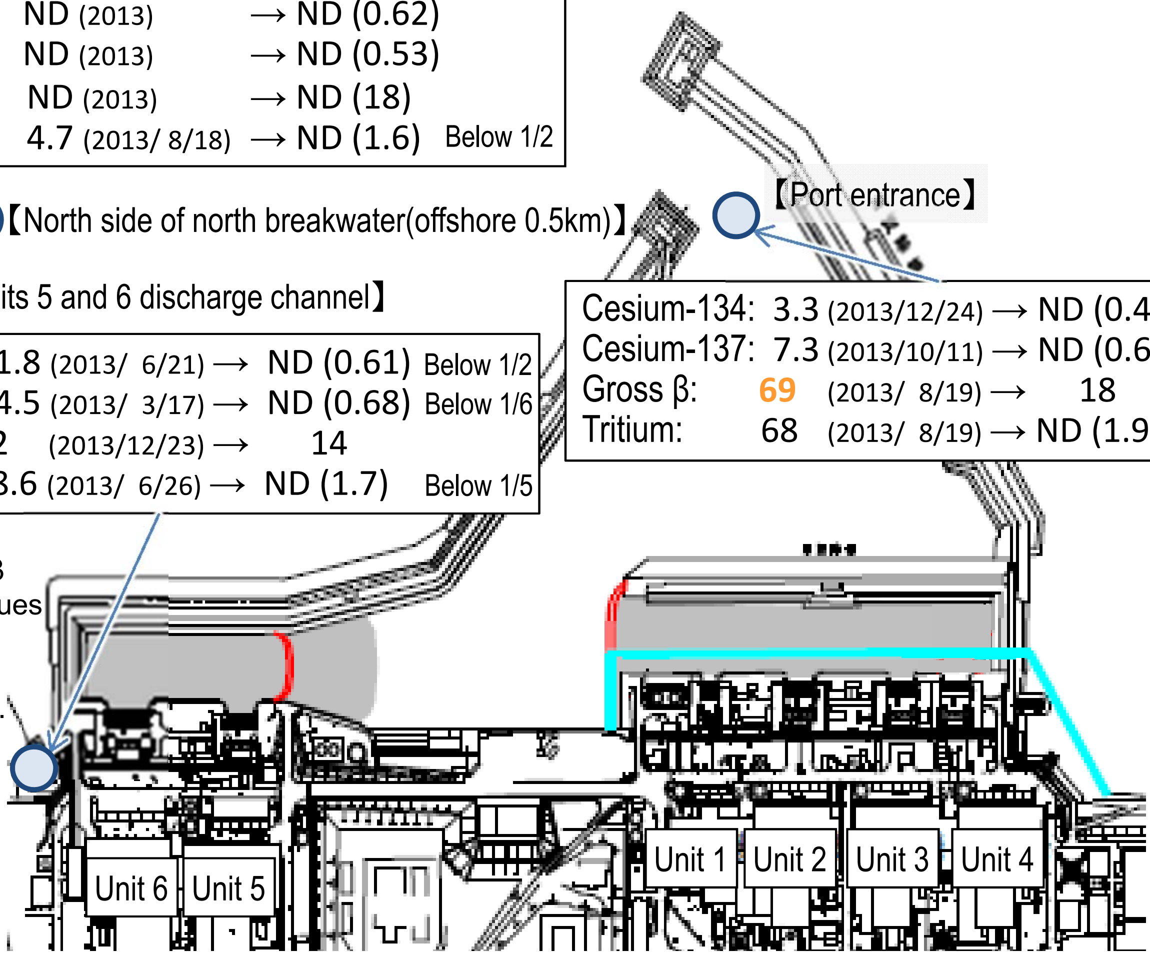
Cesium-134: ND (2013) → ND (0.73)
Cesium-137: ND (2013) → ND (0.76)
Gross β: ND (2013) → ND (18)
Tritium: ND (2013) → ND (1.6)

【North side of Units 5 and 6 discharge channel】

Cesium-134: 1.8 (2013/ 6/21) → ND (0.61) Below 1/2
Cesium-137: 4.5 (2013/ 3/17) → ND (0.68) Below 1/6
Gross β: 12 (2013/12/23) → 14
Tritium: 8.6 (2013/ 6/26) → ND (1.7) Below 1/5

【Around south discharge channel】

Cesium-134: ND (2013) → ND (0.58)
Cesium-137: 3.0 (2013/ 7/15) → ND (0.53) Below 1/5
Gross β: 15 (2013/12/23) → 15
Tritium: 1.9 (2013/11/25) → ND (1.7)



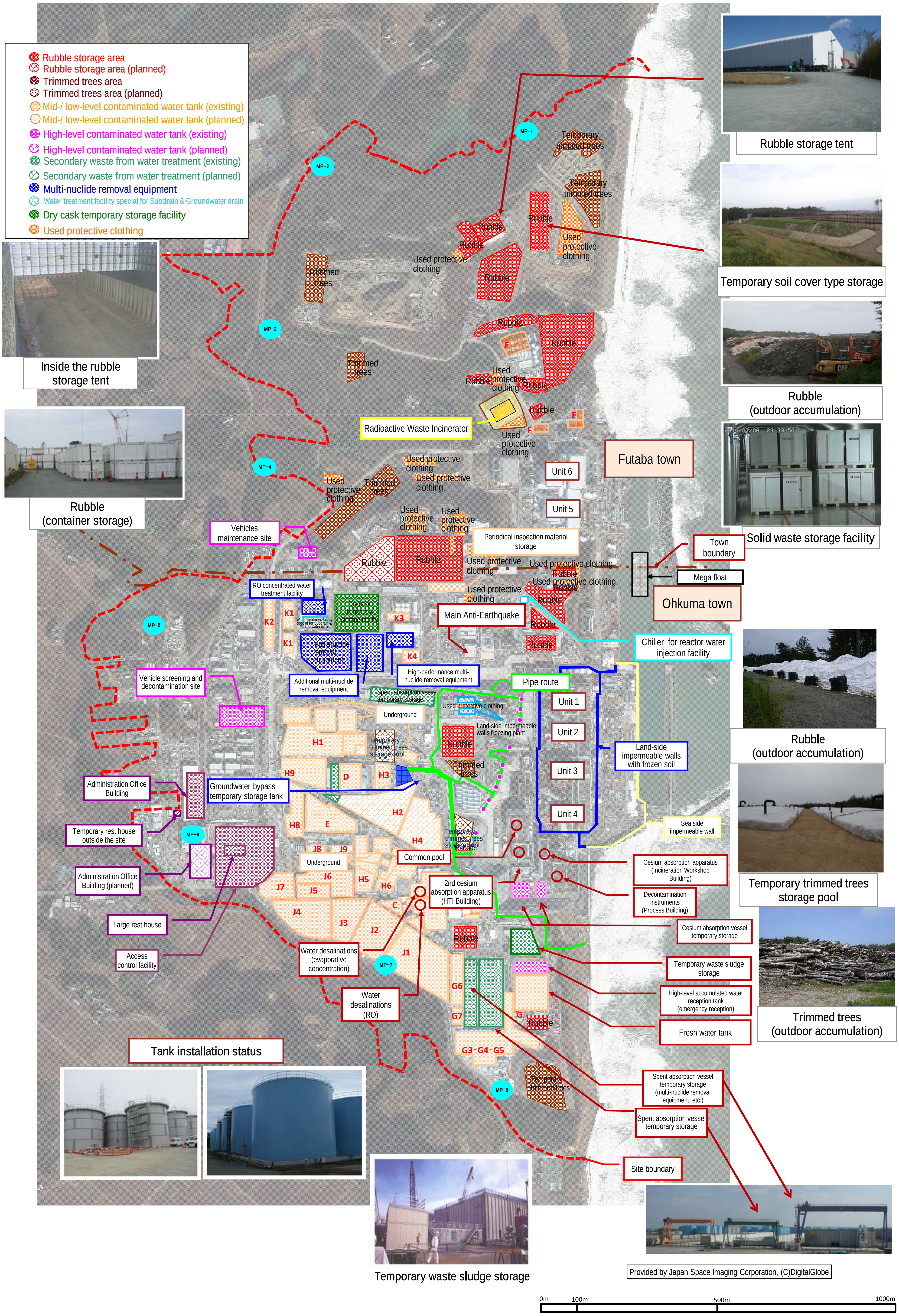

Note: The gross β measurement values include natural potassium 40 (approx. 12 Bq/L). They also include the contribution of yttrium 90, which radioactively balance strontium 90.

Summary of TEPCO data as of July 27

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
July 28, 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 |
|---|---|

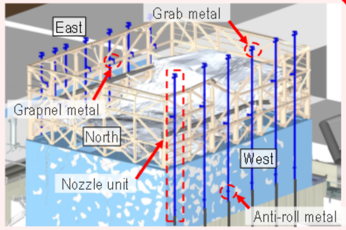
## Unit 1

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 will be dismantled to remove rubble from the top of the operating floor, with anti-scattering measures steadily implemented.

All panels were removed by October 5, 2015. Sprinklers were installed as measures to prevent dust scattering and the sprinkling test of these sprinklers was completed on June 30, 2016.

Dismantling of the building cover will proceed with radioactive materials thoroughly monitored.




<Image of sprinkler system>


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.

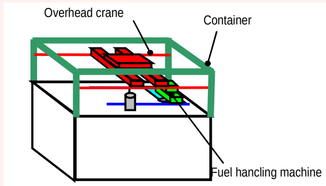



Image of Plan 1

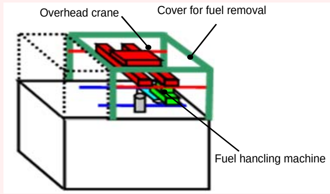



Image of Plan 2

## 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)

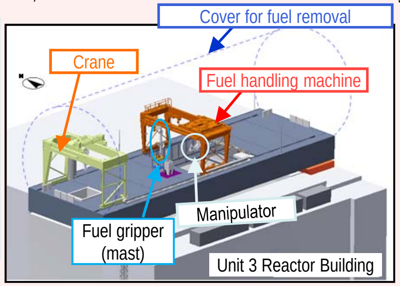



Image of entire fuel handling facility inside the cover

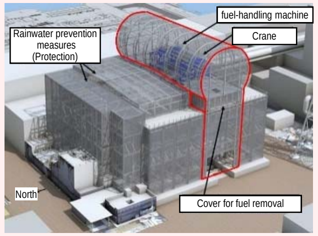



Image of the cover for fuel removal

## 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)

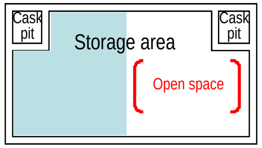
This marks the completion of fuel removal from the Unit 4 Reactor Building.

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

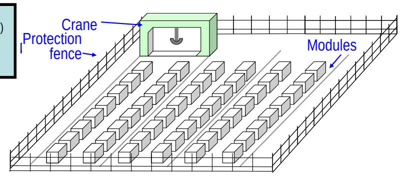



An open space will be maintained in the common pool (Transfer to the temporary dry cask storage facility)

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.

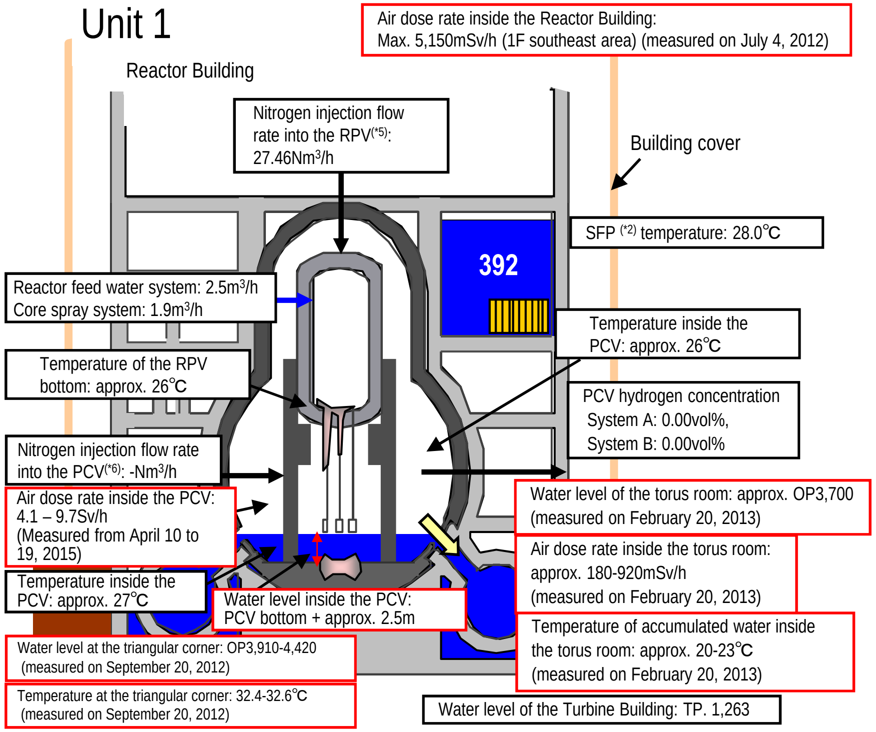
(*2) Cask: Transportation container for samples and equipment, including radioactive materials.

# 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.




* Indices related to the plant are values as of 11:00, July 27, 2016

| | | |
|---|---|---|
| Investigations inside PCV | 1st (Oct 2012) | - Acquiring images - Measuring air temperature and dose rate<br>- Measuring water level and temperature - Sampling accumulated water<br>- Installing permanent monitoring instrumentation |
| | 2nd (Apr 2015) | Confirming the status of PCV 1st floor<br>- Acquiring images - Measuring air temperature and dose rate<br>- Replacing permanent monitoring instrumentation |
| Leakage points from PCV | - PCV vent pipe vacuum break line bellows (identified in May 2014)<br>- 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

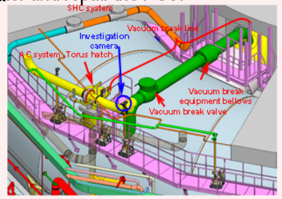


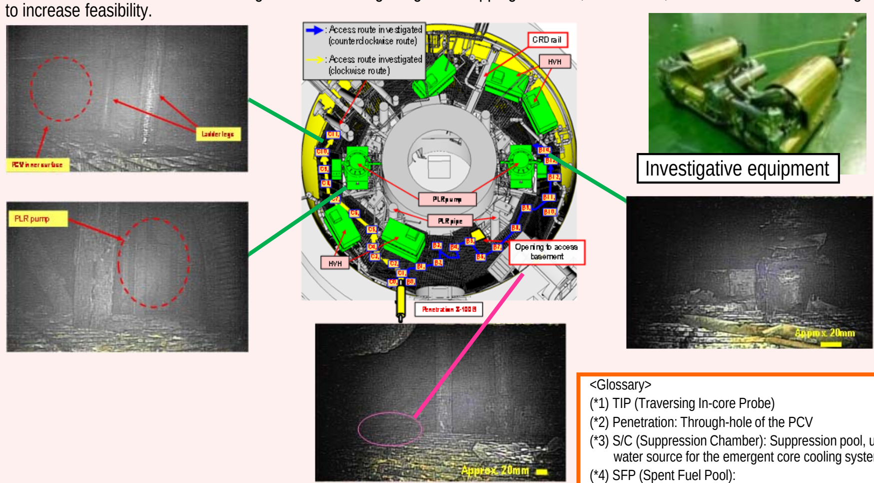

Image of the S/C upper part investigation

## 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: $\phi$ 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.




Investigative equipment

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

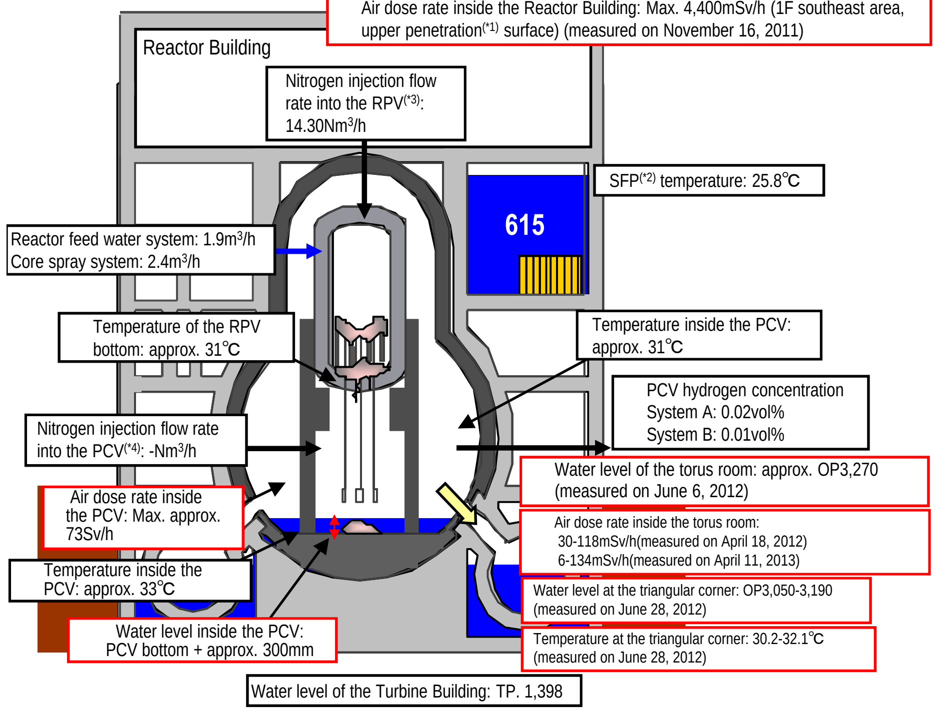
| Immediate target | Identify the plant status and commence R&D and decontamination toward fuel debris removal |
|---|---|

## 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

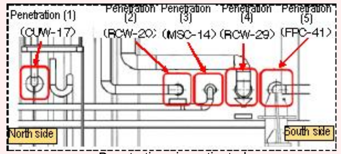



* Indices related to plant are values as of 11:00, July 27, 2016

| | | |
|---|---|---|
| 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<br>- Measuring water level - Installing permanent monitoring instrumentation |
| Leakage points from PC | - No leakage from torus room rooftop<br>- 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

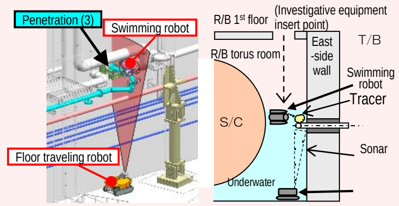


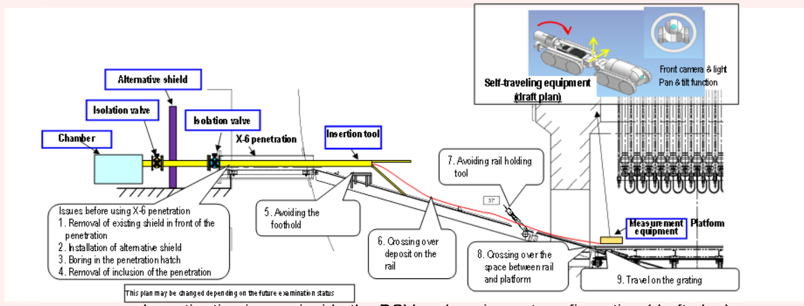

Image of the torus room east-side cross-sectional investigation

## 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.
- To start the investigation into the inside of PCV, dose on the floor surface in front of X-6 penetration needs to be reduced to approx. 100 mSv/h. As the dose was not decreased to the target level through decontamination (removal of eluted materials, decontamination by steam, chemical decontamination, surface grind), dose reduction methods including anti-dust scattering measures will be re-examined. Investigations inside the PCV will be conducted according to the decontamination status.




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

| 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

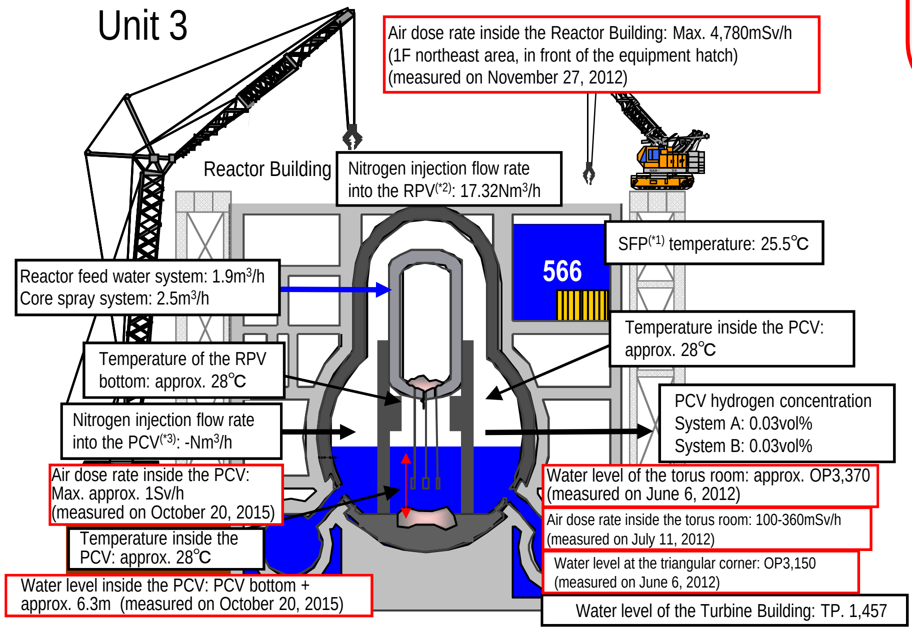
On January 18, 2014, a flow of water from around the door of the Steam Isolation Valve room in the Reactor Building Unit 3 1st floor northeast area to the nearby floor drain funnel (drain outlet) was detected. As the drain outlet connects with the underground part of the Reactor Building, there is no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

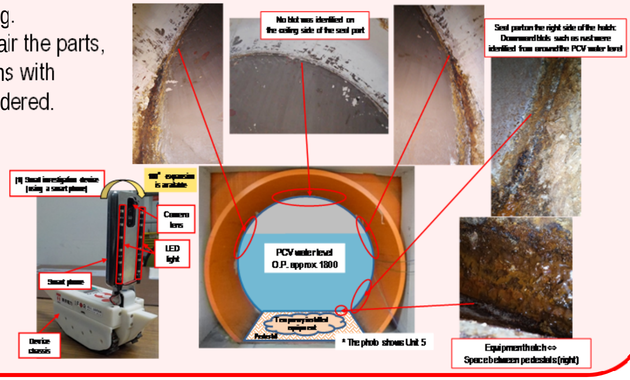



* Indices related to plant are values as of 11:00, July 27, 2016

| | | |
|---|---|---|
| Investigations inside PCV | 1st (Oct – Dec 2015) | - Acquiring images - Measuring air temperature and dose rate<br>- Measuring water level and temperature - Sampling accumulated water<br>- 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.

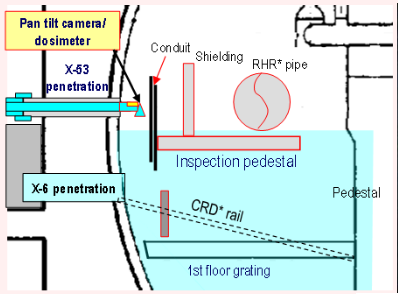



## Investigation inside the PCV

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

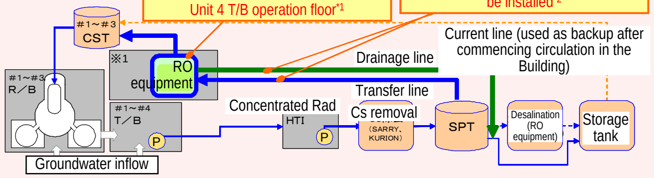
# Progress toward decommissioning: Work related to circulation cooling and accumulated water treatment line

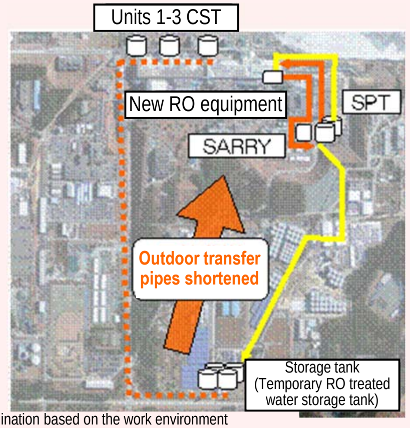
| Immediate target | Stably continue reactor cooling and accumulated water treatment, and improve reliability |
| --- | --- |

## 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, in addition to the shortened outdoor line, the reliability of the reactor water injection system was enhanced, e.g. by increasing the amount of water-source storage and enhancing durability.
- By newly installing RO equipment inside the Reactor Building, the reactor water injection loop (circulation loop) will be shortened from approx. 3km to approx. 0.8km*.

* The entire length of contaminated water transfer pipes is approx. 2.1km, including the transfer line of surplus water to the upper heights (approx. 1.3km).




*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

## 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.

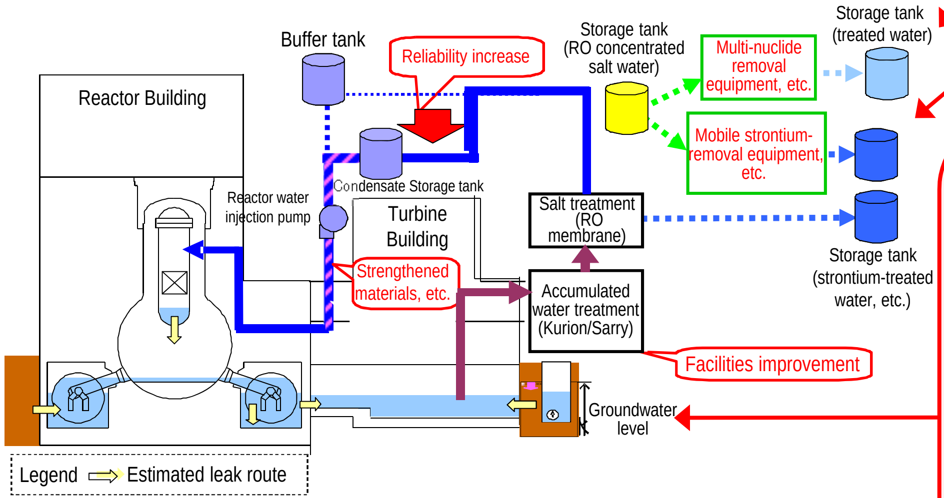

Start of dismantling in H1 east area

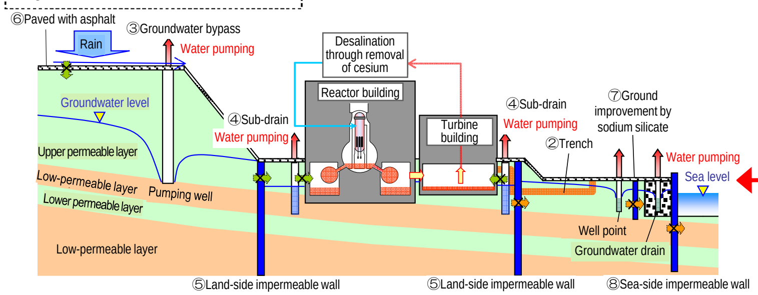

After dismantling in H1 east area

## 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.

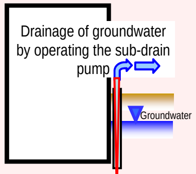
The strontium-treated water from other facilities than the multi-nuclide removal equipment will be re-purified in the multi-nuclide removal equipment to further reduce risks.




Land-side impermeable wall

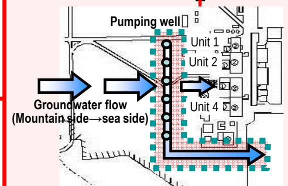
## Preventing groundwater from flowing into the Reactor Buildings




**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.

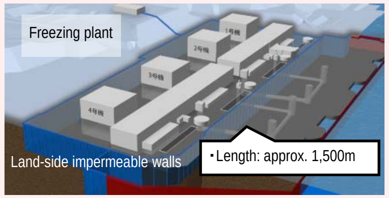
The pumped up groundwater is temporarily stored in tanks and released after TEPCO and a third-party organization have confirmed that its quality meets operational targets.

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 R/B**




To prevent the inflow of groundwater into the Reactor 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.

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

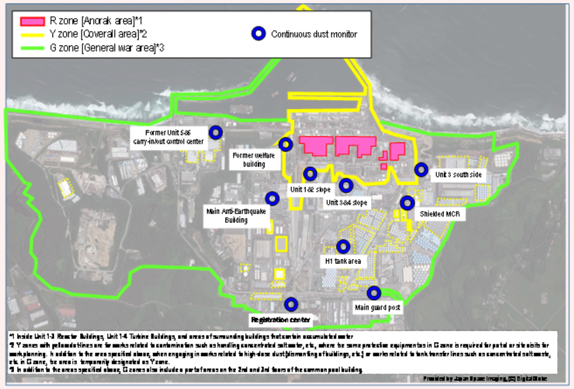
# Progress toward decommissioning: Work to improve the environment within the site

| 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.<br>・Prevent contamination expansion in sea, decontamination within the site |
|---|---|

## Optimization of radioactive protective equipment

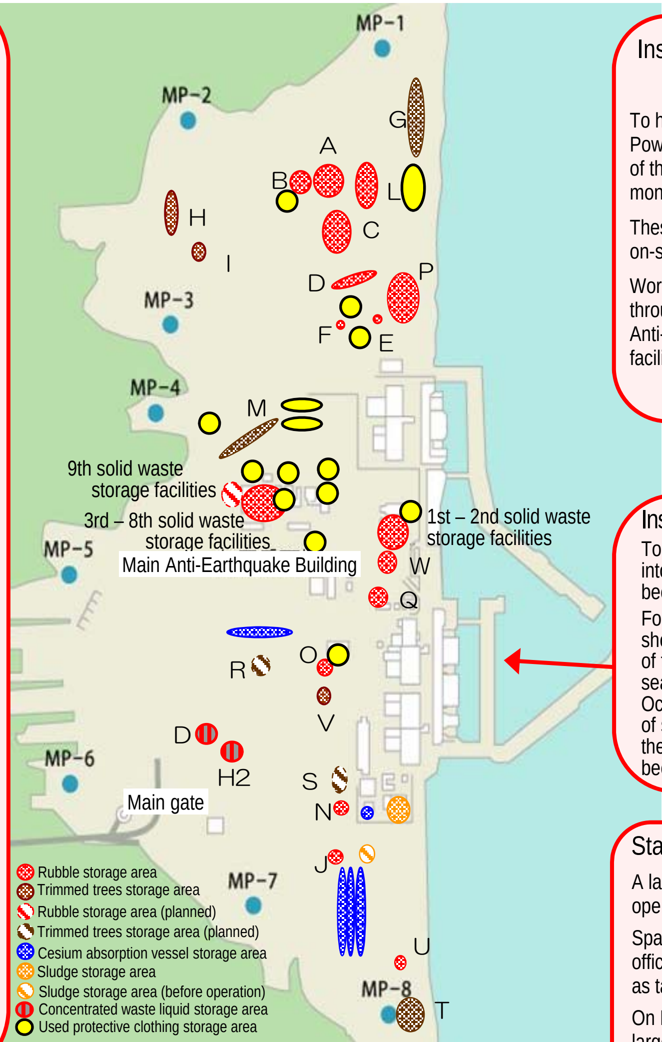
Based on the progress of measures to reduce environmental dosage on site, the site is categorized into two zones: highly contaminated area around Unit 1-4 buildings, etc. and other areas to optimize protective equipment according to each category aiming at improving safety and productivity by reducing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