Summary of Decommissioning and Contaminated Water Management

September 29, 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

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

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

Fuel Debris Removal

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

Dismantlement of the building cover started in July 2015 and dismantlement of wall panels started in September 2016. The work is being conducted steadily, with anti-scattering measures fully implemented and the density of radioactive materials monitored.

(Dismantlement 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

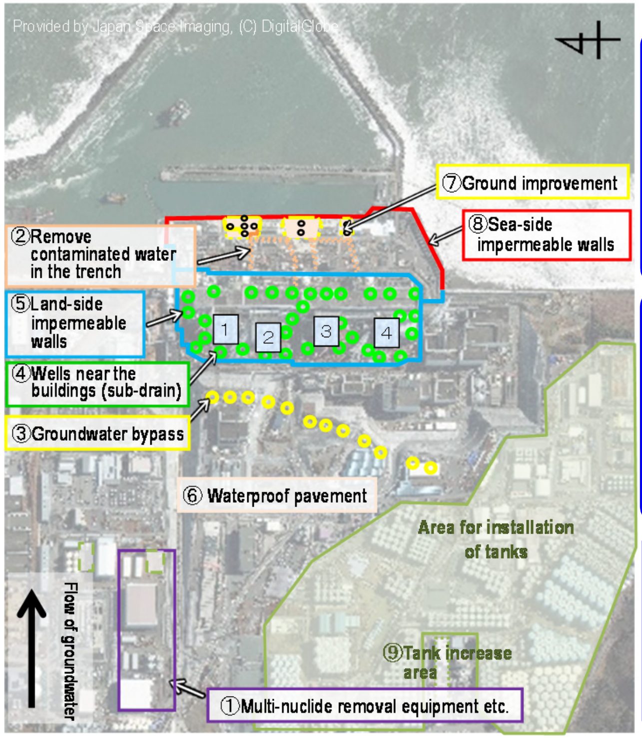
⑥ Waterproof pavement

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.
- 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 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 have been maintained within the range of approx. 25-40°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.

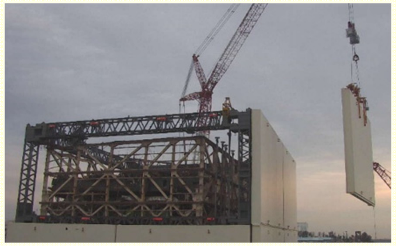
* 2 In August 2016, the radiation exposure dose due to the release of radioactive materials from the Unit 1-4 Reactor Buildings was evaluated as less than 0.00032 mSv/year at the site boundary. The annual radiation dose by natural radiation is approx. 2.1 mSv/year (average in Japan).

Starting dismantlement of the Unit 1 R/B cover wall panels

Regarding the dismantling of the Unit 1 Reactor Building (R/B) cover, preparation for wall panel dismantling has proceeded, including the installation of sprinklers. Dismantling of wall panels (18 in total) started from September 13 and is scheduled for completion in November.

No significant variation attributable to the work was identified at the dust monitors installed on the workplace and near the site boundary. Measures to prevent erroneous alerts have been implemented for the dust monitors near the site boundary.

The work is being conducted with safety first above all.

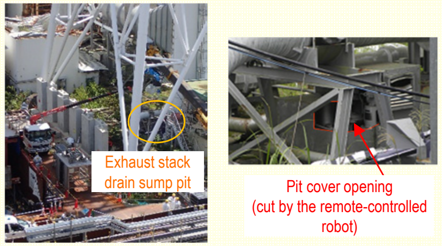


<Dismantlement of wall panels>

Investigation into the Unit 1 and 2 exhaust stack drain sump pit

Regarding the exhaust stack drain sump pit, which was evaluated as "investigation required" in the comprehensive risk review, an investigation was conducted using a remote-controlled robot because of the high dose around the pit.

Accumulated contaminated water inside the pit, which was identified in the investigation, was removed on September 14. A water level gauge will be installed inside the pit for continuous monitoring. If any increase is found, the accumulated water will be removed again.



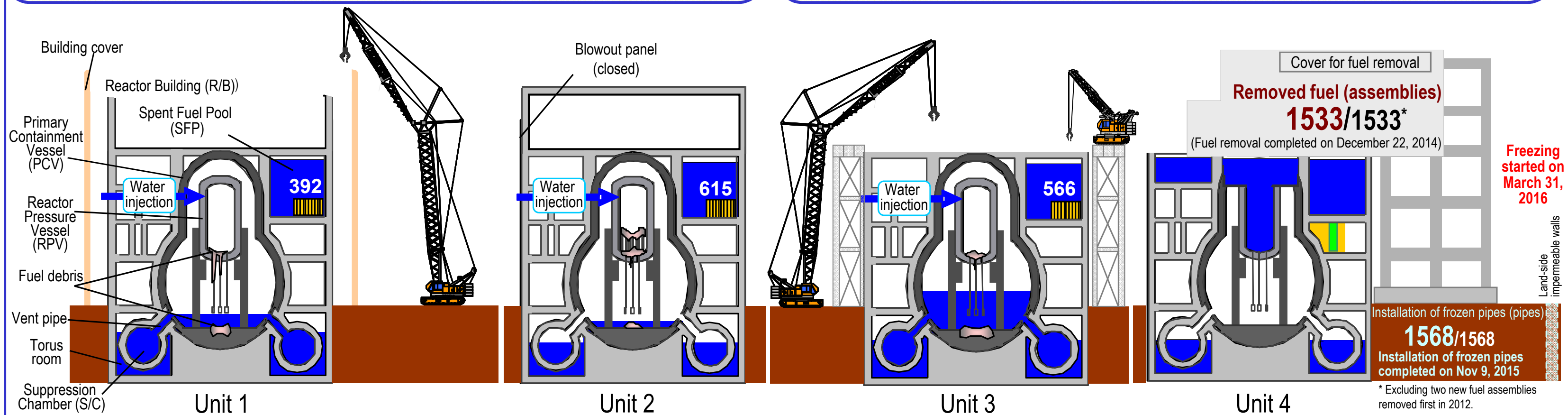
<Investigation into the exhaust stack drain sump pit>

Shortening of the circulation loop

To reduce the risk of contaminated-water leakage, the circulation loop will be 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.

As the prescribed performance of the RO device was confirmed, operation will start in early October.

This measure will shorten the outdoor transfer pipe of the circulation loop from approx. 3 to 0.8 km and reduce the risk of leakage.



Operation start of the new Main Administration Building and utilization of the Temporary Administration Building

As the operation of the new Main Administration Building, which is currently under construction, will start from October, the Temporary Administration Building will be operated as a partner company building from February 2017.

This will create an environment where TEPCO and partner companies work closely alongside each other to help the whole power station become involved in the decommissioning as one unit.

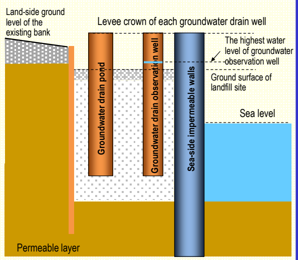
Influence of typhoons

In response to a total of approx. 620 mm rainfall from August 16 to September 24 brought by several typhoons and autumn rain fronts, approx. 50,000m^3 of groundwater was pumped up at subdrains, groundwater drains and well points.

Though the groundwater level near the sea-side raised to the ground level from September 20 to 23, no groundwater spout was identified.

The density of radioactive materials in drainage channels and within the port has increased temporarily due to the impact of rainfall. However, the increase has been within the same range as in past rainfall cases and the density at the port entrance was substantially below the legal discharge limit.

Rainwater inside the fence of the contaminated-water storage tank area was appropriately managed without leakage.



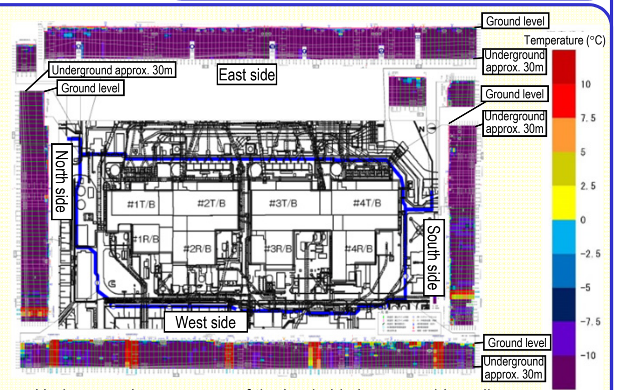
<Groundwater lever near the bank>

Status of the land-side impermeable walls

Freezing of the land-side impermeable walls has progressed. As for the sea side, the supplementary method will be completed in early October and the temperature will decline to 0°C or lower for the full scope of the plan. As for the mountain side, 95% of the scope has been frozen and the temperature declined to 0°C or lower for approx.92%.

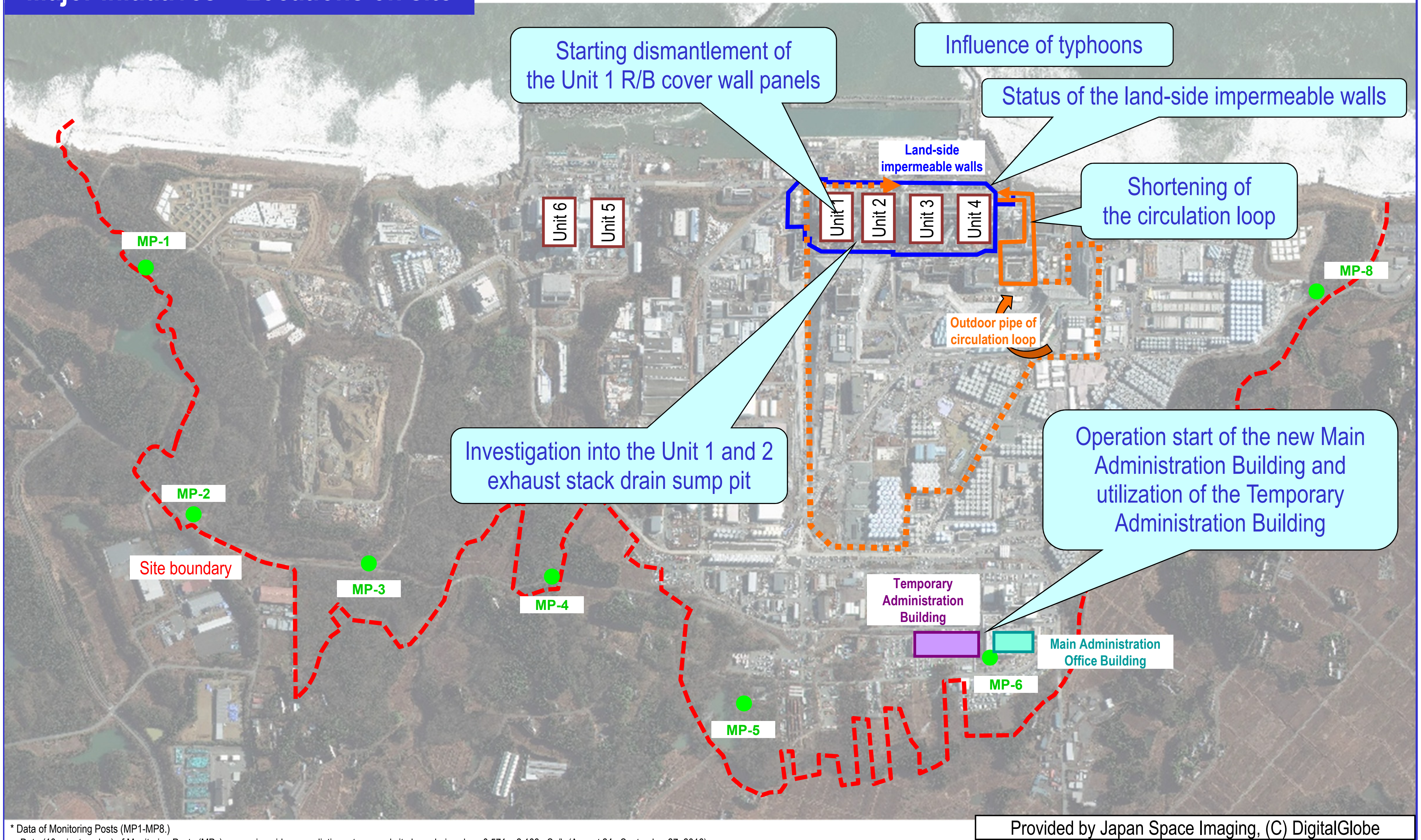
The groundwater level on the upstream side exceeds the level on the down stream side on both sea and mountain sides. The difference has been expanding, and then remained.

The water inflow-outflow balance will be checked to evaluate the effect of the land-side impermeable walls (on part of the sea side).



< Underground temperature of the land-side impermeable walls>

Major initiatives – Locations on site

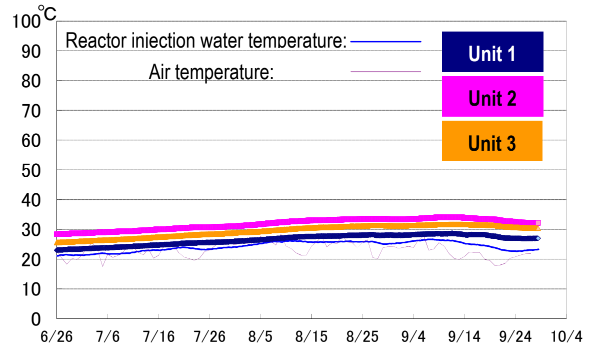


* Data of Monitoring Posts (MP1-MP8.)
Data (10-minute value) of Monitoring Posts (MPs) measuring airborne radiation rate around site boundaries show 0.571 – 2,183 μSv/h (August 24 –September 27, 2016).
We improved the measurement conditions of monitoring posts 2 to 8 for precise measurement of air dose 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

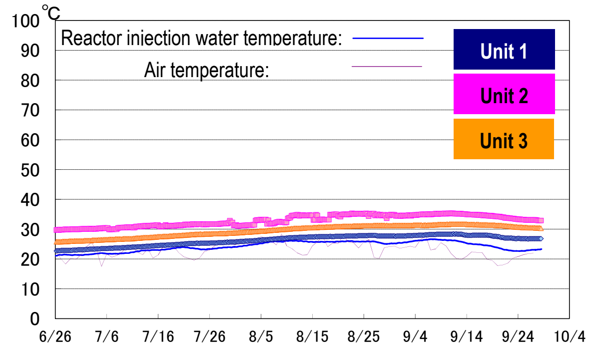
I. Confirmation of the reactor conditions

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 have been maintained within the range of approx. 25 to 40°C for the past month, though they vary depending on the unit and location of the thermometer.



RPV bottom temperatures (recent quarter)



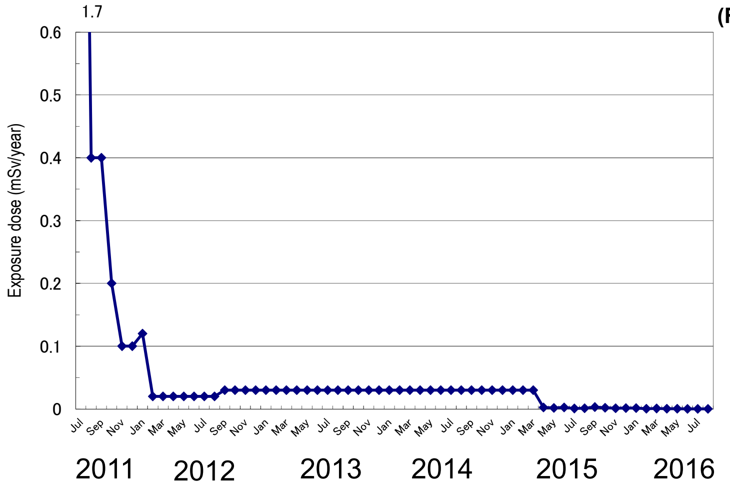
PCV gas phase temperatures (recent quarter)

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

2. Release of radioactive materials from the Reactor Buildings

As of August 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. 5.5×10^{-12} Bq/cm³ for Cs-134 and 1.1×10^{-11} Bq/cm³ for Cs-137 respectively. The radiation exposure dose due to the release of radioactive materials was less than 0.00032 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 0.571 – 2.183 μSv/h (August 24 – September 27, 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

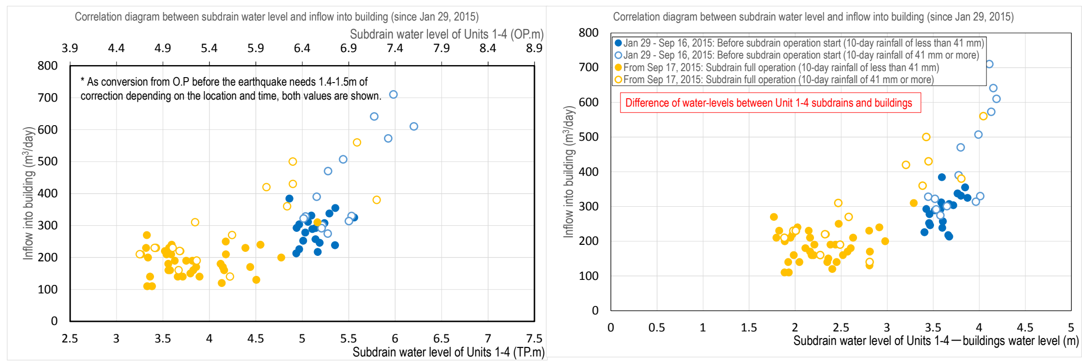
To tackle the increase in accumulated water due to groundwater inflow, fundamental measures to prevent such inflow into the Reactor Buildings will be implemented, while improving the decontamination capability of water treatment and preparing facilities to control the contaminated water

➢ 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 September 27, 2016, 218,912 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 September 27, 2016, a total of 196,099 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 September 27, 2016, a total of approx. 93,500 m³ had been pumped up. Approx. 240 m³/day is being transferred from the groundwater drain to the Turbine Buildings (average for the period August 18 - September 21, 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 the water levels with buildings decreased to approx. 2 m after the subdrains went into operation.



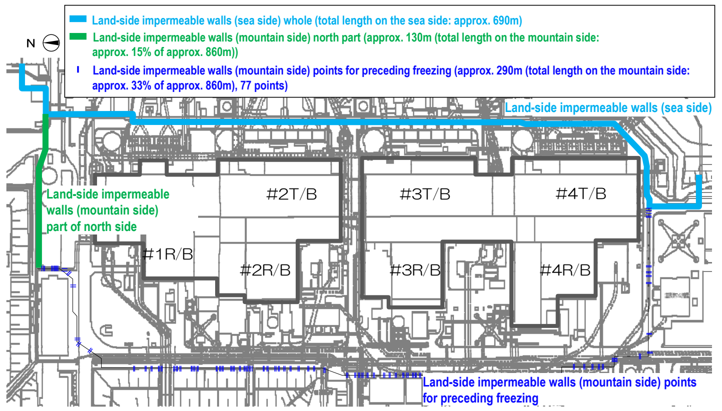
As of September 22, 2016

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

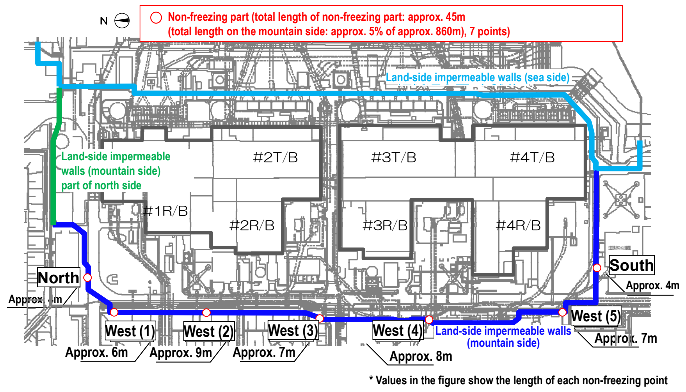
➢ Construction status of the land-side impermeable walls

- As of September 26, the underground temperature declined to 0°C or lower for 99% of the scope on the sea side and 92% of the scope on the mountain side respectively. As for the sea side, the supplementary method will be completed in early October and the temperature will decline to 0°C or lower for the full scope of the supplementary method.
- The groundwater level on the upstream side of the land-side impermeable walls exceeds the level on the down stream side. The difference has been expanding, and then remained.
- Though varying depending on rainfall, the groundwater inflow into the area 4m above sea level has been declining since July, from approx. 250-400m³/day during the period from January to March when there was little rainfall before the freezing started, to 200m³/day in early August. The inflow increased due to rainfall in late August and early September.

- ✓ 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.)” are frozen simultaneously.
  (Phase 2: freezing started on June 6) The remaining parts on the mountain side are 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)

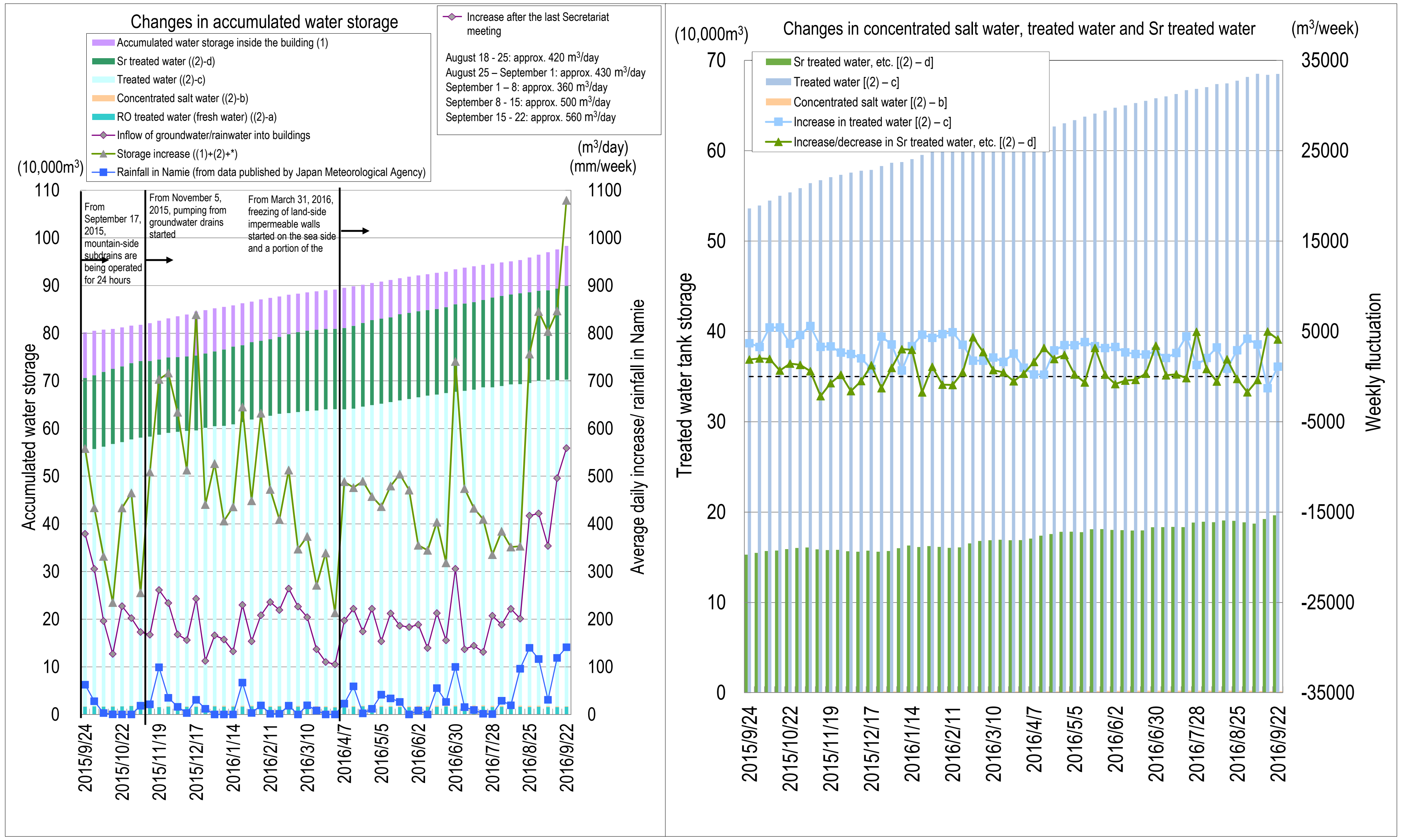
Figure 2: Scope of freezing of land-side impermeable walls

➢ 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 September 22, the volumes treated by the existing, additional and high-performance multi-nuclide removal equipment were approx. 306,000, 296,000 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 September 22, approx. 254,000 m³ had been treated.

➢ Toward reducing the risk of contaminated water stored in tanks

- Treatment measures comprising the removal of strontium by cesium absorption apparatus (KURION) (from January 6, 2015) and the secondary cesium absorption apparatus (SARRY) (from December 26, 2014) have been underway. As of September 22, approx. 292,000 m³ had been treated.



As of September 22, 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 September 26, 2016, a total of 64,490 m³).
- ➢ Progress of accumulated water treatment in the Unit 1 T/B
  - As a part of efforts to reduce leakage risks of accumulated water in buildings, 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.
  - Based on on-site investigative results and other information, consideration has been made to date of methods to install and build the transfer equipment needed to reduce the accumulated water level to the T/B bottom floor surface. At present, works are underway to remove obstacles before installing the transfer equipment, which will start from around November 2016.

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. Anti-scattering agents were sprayed from the side during the period between August 4 and September 3, 2016 and the dismantling of wall panels started from September 13, 2016. 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.
  - Alongside the dismantling of 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).
- ➢ 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, work to dismantle 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. Six of seven buildings were dismantled. Roadbeds have been constructed on the west and south sides of the Reactor Building, including the area where the buildings were dismantled.
  - Construction will start from September 28 on the west side of the Reactor Building to install a gantry accessing the operating floor. As preparation for the gantry installation, work to unite steel frames on the ground has been underway to construct a yard.
- ➢ 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; G zone: September 9-20; shields between the supplementary and gantry: from August 24).

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

- ➢ Management status of rubble and trimmed trees
  - As of the end of August 2016, the total storage volume of concrete and metal rubble was approx. 192,800 m³ (+1,600 m³ compared to at the end of July, with an area-occupation rate of 69%). The total storage volume of trimmed trees was approx. 89,700 m³ (±0 m³ compared to at the end of July, with an area-occupation rate of 84%). The total storage volume of used protective clothing was approx. 67,100 m³ (+1,000 m³ compared to at the end of July, with an area-occupation rate of 94%). The increase in rubble was mainly attributable to construction to install tanks. The increase in used protective clothing was mainly attributable to acceptance of used clothing.
- ➢ Management status of secondary waste from water treatment
  - As of September 22, 2016, the total storage volume of waste sludge was 597 m³ (area-occupation rate: 85%) and that of concentrated waste fluid was 9,289 m³ (area-occupation rate: 87%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment, etc. was 3,320 (area-occupation rate: 53%).
- ➢ Suspension of Radioactive Waste Incinerator
  - On August 10, traces of water drippage were detected in the lower joint part between the secondary incinerator and the exhaust gas cooler of the Radioactive Waste Incinerator System B during operation. An investigation identified pin holes at the bellows and the operation was suspended. As investigations into other bellows identified cracks at the joint bellows between the waste gas coolers and bag filters of Systems A and B, the operation of System A was also suspended (see Figure 4).
  - Since the pressure inside the facility and its building was kept negative, radioactive materials had no impact on the outside of the building.
  - Regarding the bellows where pin holes were detected, though no concentrated water was identified, traces of accumulated water were identified. Several pitting corrosions were also detected in addition to the pin holes, and existence of chloride ions was confirmed. Investigations continue to identify the detailed mechanism.
  - Regarding the bellows where cracks were detected, texture observations confirmed cracks which were considered attributable to stress corrosion. Investigations continue to identify the detailed mechanism.
  - The investigation, conducted as a horizontal deployment, found cracks at six of the 35 metal bellows used in the incinerator. The inside was checked and causes are being investigated.

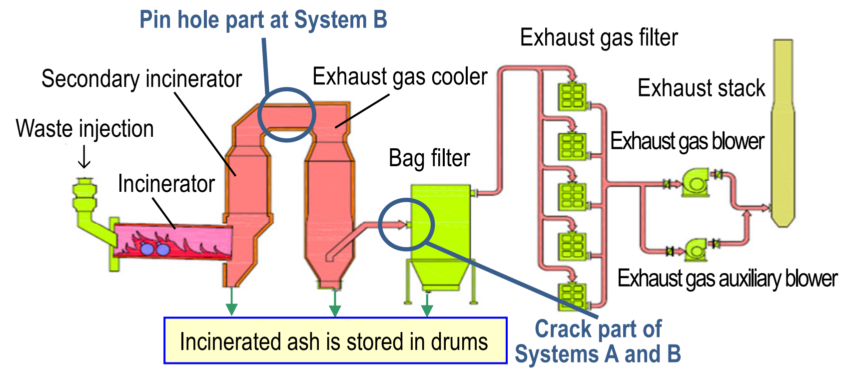


Figure 4: Overview of Radioactive Waste Incinerator

- ➢ Progress of the 9th solid waste storage facility
  - To store rubble on a temporary basis or rubble generated on site, in a permanent facility sequentially, a solid waste storage facility (9th) with a capacity of approx. 110,000 200L-drums is being constructed.
  - The facility was scheduled for completion in February 2017. However, as experimental drilling in the on-site investigation found buried objects not taken into account in the initial plan, the construction period was extended by approx. 11 months to January 2018.
- ➢ Installation and expansion of waste-related facilities
  - To store rubble generated after the accident more appropriately, a storage management plan was formulated in March 2016 to install and expand waste-related equipment and facilities. Amounts of rubble and other waste exceeding the storage capacity of existing facilities, which are now temporarily stored outdoors, will be transferred and stored inside the buildings to further reduce risks.
  - On August 24, 2016, an application for prior approval was submitted to initiate the facility installation process based on the storage management plan.

- Analytical result of waste samples

  (sludge in Unit 1 T/B, rubble in Unit 1 R/B, slurry of the multi-nuclide removal equipment)
  - To confirm the waste characteristics, nuclides were sampled and analyzed for rubble on the Unit 1 Reactor Building (R/B) 5th floor, sludge on the Unit 1 T/B underground, and slurry in the multi-nuclide removal equipment. Sampling and analysis continue to accumulate analytical data.

4. 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 secondary system, air could not be completely eliminated from the primary system pump bearing cooling water pipe when water was filled for test operation of the new facility from August 23 to 25, 2016. As air accumulation 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. Valves for air removal will be installed where necessary as well as initially inspecting and testing Units 2 and 3, which have no similar pipes requiring measures.
- Progress of construction to minimize the circulation loop
  - To reduce the risk of leakage from the outdoor transfer pipe by shortening the loop, a reverse osmosis (RO) device will be installed in the Unit 4 Turbine Building within the circulation loop, comprising the transfer of contaminated water, water treatment and injection into the reactors, which will shorten the circulation loop (outdoor transfer pipe) from approx. 3 to 0.8 km (approx. 2.1 km including the accumulated-water transfer line).
  - During the function verification test, a pump was suspended due to low pressure at the pump inlet before reaching the rated flow rate. The diameter was expanded over an approx. 300m stretch of the pipe (80→100A).
  - As the prescribed performance was confirmed, operation will start in early October. Following the operation training for approx. two weeks when operation started (daytime operation only), normal (24-hour) operation will start.
- Variation in indication of the Unit 3 PCV thermometer
  - The indicated values of the Unit 3 PCV thermometer have varied since June 10. Based on the investigation, including potential electric noise, the cause was considered to be the applied electric pressure of the PCV water level gauge installed together with the thermometer, which intruded as noise through the reduced insulation parts. The reduced insulation was considered attributable to the disconnected flexible hose of the terminal block box, which exposed a portion of the signal cable and subsequently reduced the insulation due to humidity.
  - As an emergency measure, power to the PCV water level gauge was cut off and it was confirmed that the PCV thermometer had recovered from the variation in indicated values.
  - As countermeasures, the flexible cables will be repaired and silica gel will be installed inside the terminal block box to restore the signal cable insulation by eliminating moisture.
- 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 the RPV. To enhance reliability, works to install a new line for nitrogen injection through the jet pump instrumentation line are currently underway.
  - On May 30, the implementation plan was authorized. As work to install the line was completed in September, it will undergo a pre-operation test from October, wherein nitrogen will be injected from the additionally installed lines through the jet pump instrumentation rack to the RPV.
  - Based on the results of the pre-operation test, a line will be selected for regular use and air blow will be verified.

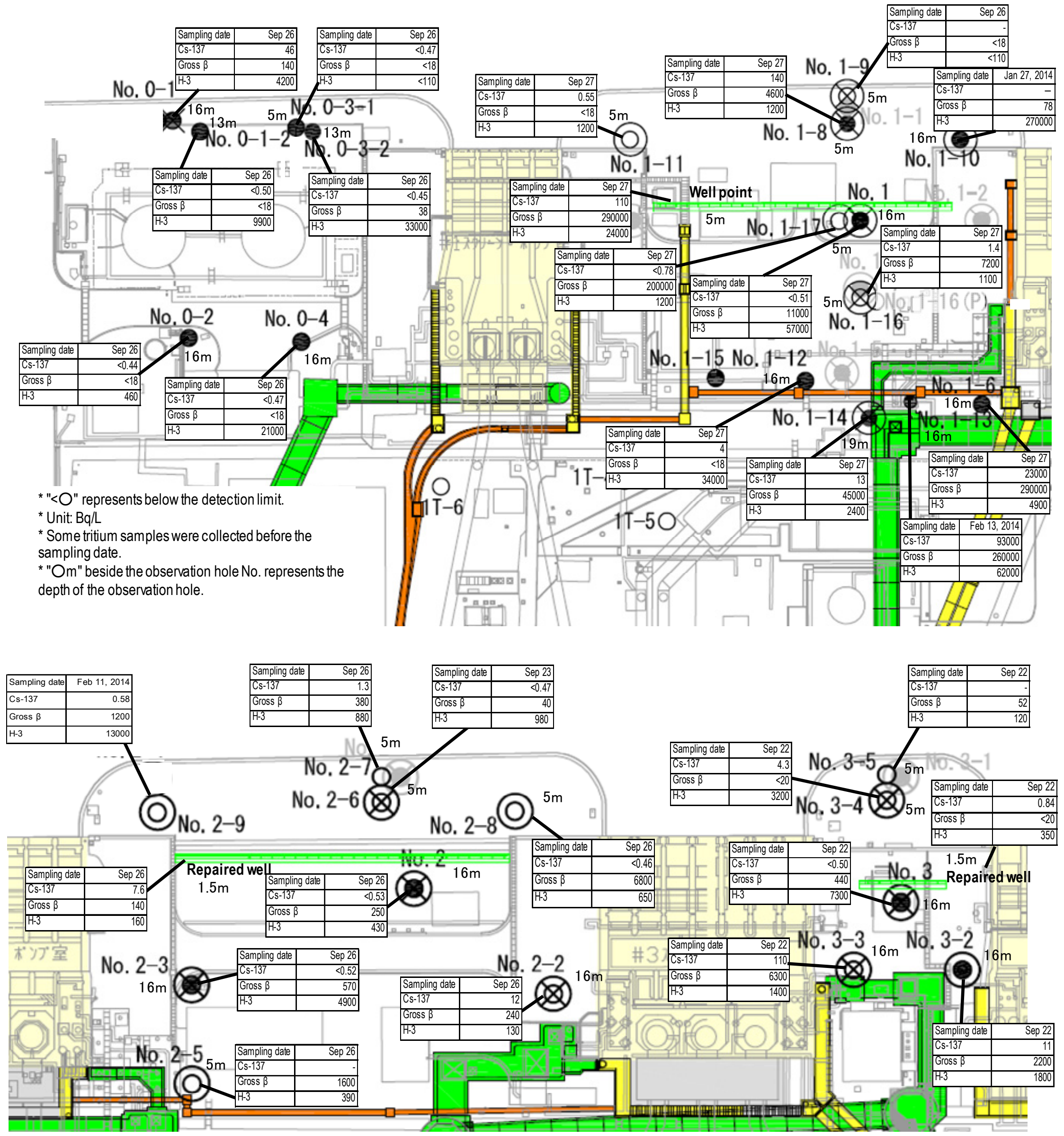
5. Reduction in radiation dose and mitigation of contamination

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, the tritium density at groundwater Observation Hole No. 0-3-2 has been gradually 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 declined to the level before the increase and currently stands at approx. 100 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, it has been declining since August 2016 and currently stands at approx. 7,000 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 after having declined to 2,000 Bq/L since March 2016. 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 200,000 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 10,000 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.
  - Regarding the radioactive materials in seawater outside the port, the densities of radioactive materials remained within the same range previously recorded.
- Response to the Unit 1 and 2 exhaust stack drain sump pit
  - Regarding the exhaust stack drain sump pit, which was evaluated as “investigation required” in the comprehensive risk review, the water level and quality were investigated and countermeasures will be taken using a remote-controlled robot and other equipment because of the high dose around the pit.
  - On-site preparation has been conducted since July 25 and work to open a portion of the pit cover started from August 26. A portion of the inspection aperture inside the pit was also opened and the inspection on September 9 identified the water level inside at approx. 60 cm. On September 12, accumulated water was sampled for analysis. (Gross β: approx. 6.0×10^7 Bq/L; Cs134: approx. 8.3×10^6 Bq/L; Cs137: approx. 5.2×10^7 Bq/L)
  - Accumulated water inside the pit, which may become a contamination source for surrounding facilities and other buildings, has been transferred to an area underground of the Unit 2 waste treatment building since September 14. Monitoring of the water level will continue.

➢ Actions after Typhoon No. 7

- In response to a total of approx. 620 mm rainfall from August 16 to September 24 brought by typhoons and rain fronts, approx. 49,000m³ of groundwater was pumped up at subdrains, groundwater drains and well points from August 15 to September 25.
- Though the groundwater level near the sea-side bank reached ground level from September 20 to 23, no groundwater spout was identified. The density of Cs137 in drainage channels has increased due to the impact of the rainfall. However, this increase has been within the same range as past cases and with similar rainfall. Due to the density increase in drainage channels, the density of radioactive materials has also increased in seawater in the port. However, the density at the port entrance was substantially below the legal discharge limit.



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

Figure 5: Groundwater density on the Turbine Building east side

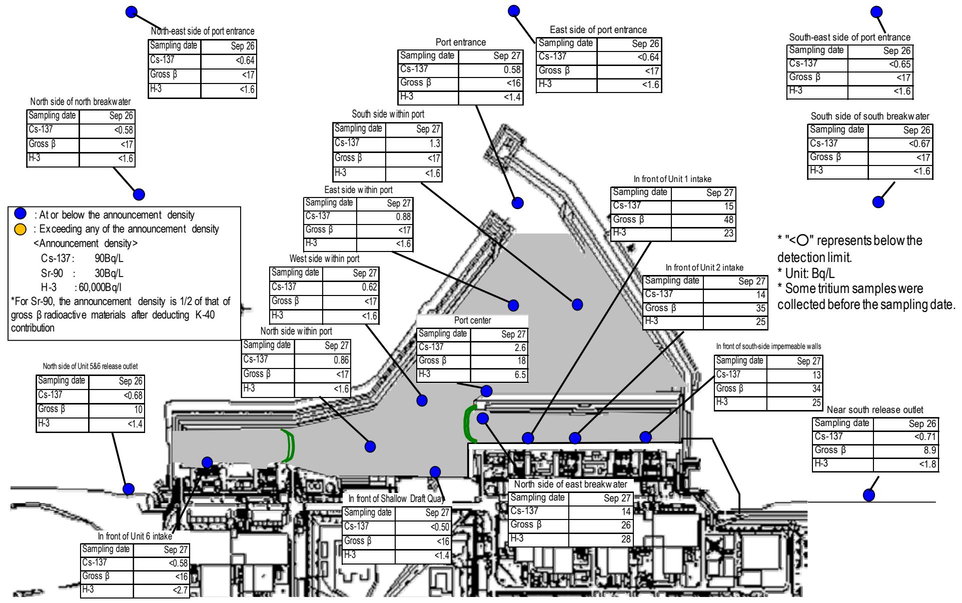


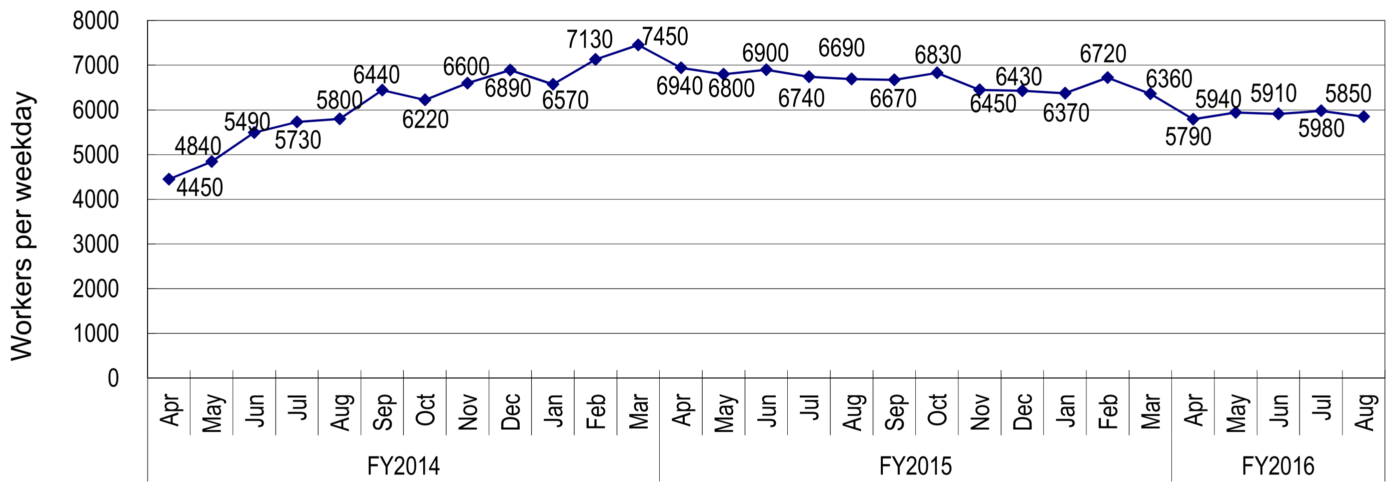
Figure 6: Seawater density around the port

6. 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 May to July 2016 was approx. 12,700 (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 October 2016 (approx. 5,530 per day: TEPCO and partner company workers)* would be secured at present. The average numbers of workers per day for each month (actual values) were maintained, with approx. 4,500 to 7,500 since FY2014 (see Figure 7). Some works for which contractual procedures have yet to be completed were excluded from the estimate for October 2016.
- The total number of workers has decreased, from both within and outside Fukushima Prefecture. The local employment ratio (TEPCO and partner company workers) as of August 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 7: Changes in the average number of workers per weekday for each month since FY2014

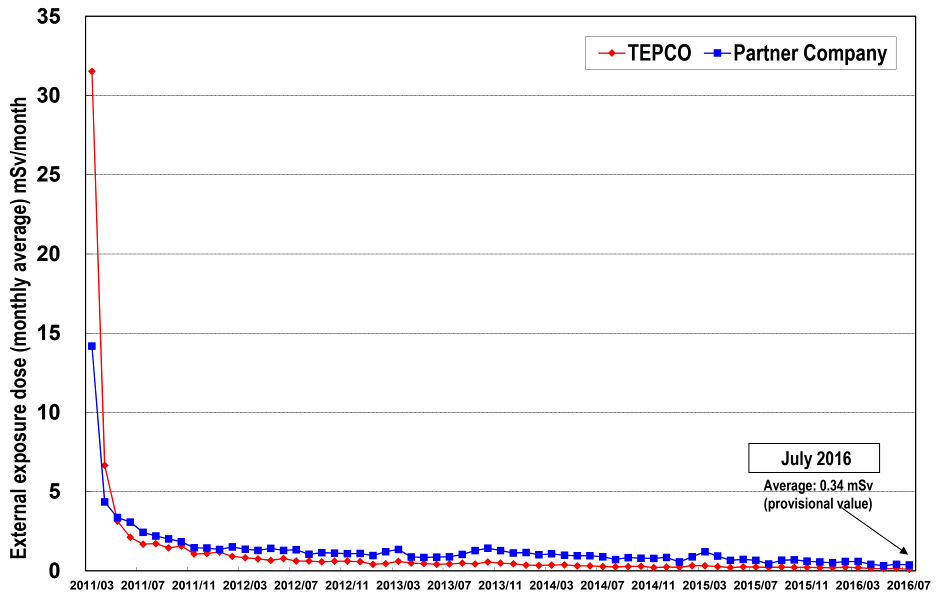


Figure 8: Changes in monthly individual worker exposure dose
(monthly average exposure dose since March 2011)

➢ Status of heat stroke cases

・ In FY2016, three workers had suffered heat stroke due to work and three workers had suffered light stroke (with no medical treatment required) up until September 27. Continued measures will be taken to prevent heat stroke. (In FY2015, 12 workers had heat stroke due to work and three workers had light heat stroke up until the end of September.)

➢ Health management of workers at the Fukushima Daiichi Nuclear Power Station

・ As health management measures in line with the guidelines of the Ministry of Health, Labour and Welfare (issued in August 2015), a scheme was established where primary contractors confirmed reexamination at medial institutions and the subsequent status of workers who are diagnosed as "detailed examination and treatment required" in the health checkup and TEPCO confirms the implementation status of the primary contractors.

➢ Operation start of the new Main Administration Building and utilization of the Temporary Administration Building as a partner company building

・ To promote the safe implementation of decommissioning measures through cooperation between partner companies, which are currently involved in remote work from the power station, and TEPCO, by helping partner companies take actions in the vicinity of the site and facilitate communications with TEPCO, the neighboring Temporary Administration Building will be operated as a partner company building when the new Main Administration Building, currently under construction, is completed.

・ TEPCO employees will be transferred to the new Main Administration Building in October. Following the subsequent modification of the Temporary Administration Building, partner companies will be transferred sequentially from February 2017.

7. Status of Units 5 and 6

➢ Status of spent fuel storage in Units 5 and 6

・ Regarding Unit 5, fuel removal from the reactor was completed in June 2015. 1,374 spent fuel assemblies and 168 non-irradiated fuel assemblies are stored in the spent fuel pool (storage capacity: 1,590 assemblies)

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

➢ Status of accumulated water in Units 5 and 6

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

➢ 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.

・ From August 29, emergency measures such as welding are being implemented to the damaged parts (scheduled for completion in late October).

・ Permanent measures, including the new installation of alternative anchor structures, will be considered and implemented (the consideration will be completed in late October and construction will start in FY2017).

・ Due to insufficient information sharing when the management of the structures was decided in 1978, the facility management group failed to regard the facility as "requiring management" in the Conservation Plan* and include it in the plan.

・ Structures will be added to the Conservation Plan to provide regular inspection and the necessary actions will be taken for vertical deployment.

・ This matter is being examined in the safety inspection by the Secretariat of the Nuclear Regulation Authority for a failure in the Conservation Plan, which was formulated based on the Implementation Plan related to Specified Nuclear Facilities of the Fukushima Daiichi Nuclear Power Station.

* Conservation Plan: A facility inspection plan based on the Implementation Plan related to Specified Nuclear Facilities of Fukushima Daiichi Nuclear Power Station III Security of Specified Nuclear Power Facilities Chapter 2 (Security Measures related to Unit 5 and 6 Reactors)

8. Other

➢ Investigation into Unit 1 and 2 exhaust stacks

・ In consideration of the method used to dismantle the exhaust stacks, an investigation into the dose rate of the exhaust stacks is being conducted from September 24 to estimate the number of necessary workers, evaluate the exposure dose, and increase the accuracy of conditions to evaluate the feasibility of the work.

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 September 19-27)"; unit (Bq/L); ND represents a value below the detection limit

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

Sea side impermeable wall
Silt fence

Cesium-134:	3.3	(2013/10/17) →	ND(0.31)	Below 1/10
Cesium-137:	9.0	(2013/10/17) →	0.88	Below 1/10
Gross β:	74	(2013/ 8/19) →	ND(17)	Below 1/4
Tritium:	67	(2013/ 8/19) →	ND(1.6)	Below 1/40

Cesium-134:	4.4	(2013/12/24) →	ND(0.34)	Below 1/10
Cesium-137:	10	(2013/12/24) →	0.62	Below 1/10
Gross β:	60	(2013/ 7/ 4) →	ND(17)	Below 1/3
Tritium:	59	(2013/ 8/19) →	ND(1.6)	Below 1/30

Cesium-134:	5.0	(2013/12/2) →	ND(0.28)	Below 1/10
Cesium-137:	8.4	(2013/12/2) →	0.86	Below 1/9
Gross β:	69	(2013/8/19) →	ND(17)	Below 1/4
Tritium:	52	(2013/8/19) →	ND(1.6)	Below 1/30

Cesium-134:	2.8	(2013/12/2) →	ND(0.54)	Below 1/5
Cesium-137:	5.8	(2013/12/2) →	ND(0.58)	Below 1/10
Gross β:	46	(2013/8/19) →	ND(16)	Below 1/2
Tritium:	24	(2013/8/19) →	ND(2.7)	Below 1/8

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

Cesium-134:	ND(9.6)
Cesium-137:	2.6
Gross β:	18
Tritium:	6.5 *

Cesium-134:	3.3	(2013/12/24) →	ND(0.51)	Below 1/6
Cesium-137:	7.3	(2013/10/11) →	0.58	Below 1/10
Gross β:	69	(2013/ 8/19) →	ND(16)	Below 1/4
Tritium:	68	(2013/ 8/19) →	ND(1.4)	Below 1/40

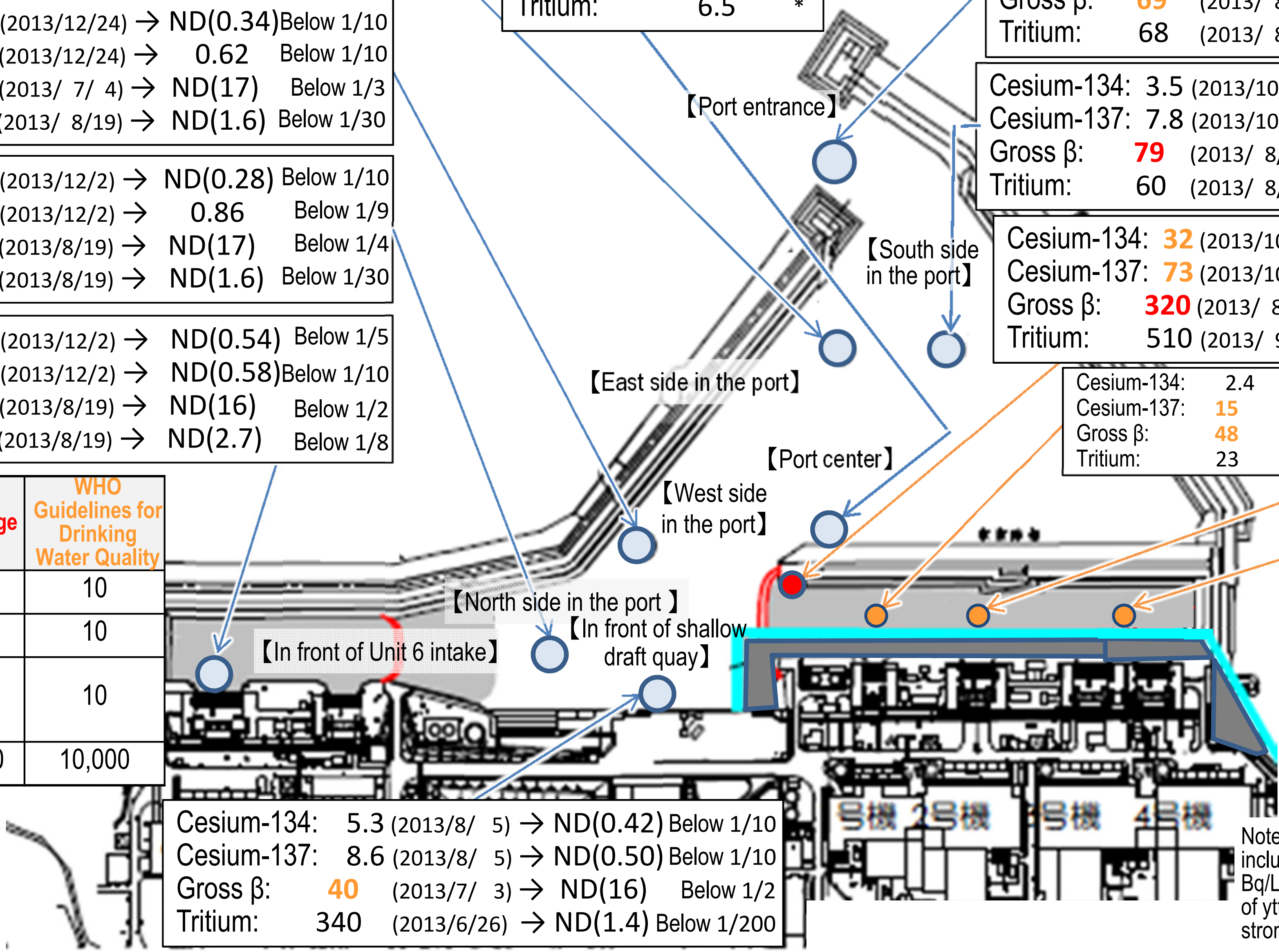
Cesium-134:	3.5	(2013/10/17) →	ND(0.54)	Below 1/6
Cesium-137:	7.8	(2013/10/17) →	1.3	Below 1/6
Gross β:	79	(2013/ 8/19) →	ND(17)	Below 1/4
Tritium:	60	(2013/ 8/19) →	ND(1.6)	Below 1/30

Cesium-134:	32	(2013/10/11) →	2.4	Below 1/10
Cesium-137:	73	(2013/10/11) →	14	Below 1/5
Gross β:	320	(2013/ 8/12) →	26	Below 1/10
Tritium:	510	(2013/ 9/ 2) →	28	Below 1/10

Cesium-134:	2.4
Cesium-137:	15
Gross β:	48
Tritium:	23 *

Cesium-134:	2.2
Cesium-137:	14
Gross β:	35
Tritium:	25 *

Cesium-134:	2.7
Cesium-137:	13
Gross β:	34
Tritium:	25 *



Cesium-134:	5.3	(2013/8/ 5) →	ND(0.42)	Below 1/10
Cesium-137:	8.6	(2013/8/ 5) →	ND(0.50)	Below 1/10
Gross β:	40	(2013/7/ 3) →	ND(16)	Below 1/2
Tritium:	340	(2013/6/26) →	ND(1.4)	Below 1/200

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

Summary of TEPCO data as of September 28

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.

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 September 19-27)

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

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

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

Cesium-134:	ND (2013)	→	ND (0.73)	
Cesium-137:	ND (2013)	→	ND (0.64)	
Gross β:	ND (2013)	→	ND (17)	
Tritium:	ND (2013)	→	ND (1.6)	

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

Cesium-134:	ND (2013)	→	ND (0.63)	
Cesium-137:	1.6 (2013/10/18)	→	ND (0.64)	Below 1/2
Gross β:	ND (2013)	→	ND (17)	
Tritium:	6.4 (2013/10/18)	→	ND (1.6)	Below 1/4

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

Cesium-134:	ND (2013)	→	ND (0.87)	
Cesium-137:	ND (2013)	→	ND (0.65)	
Gross β:	ND (2013)	→	ND (17)	
Tritium:	ND (2013)	→	ND (1.6)	

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

Cesium-134:	ND (2013)	→	ND (0.76)	
Cesium-137:	ND (2013)	→	ND (0.58)	
Gross β:	ND (2013)	→	ND (17)	
Tritium:	4.7 (2013/ 8/18)	→	ND (1.6)	Below 1/2

【Port entrance】

Cesium-134:	3.3 (2013/12/24)	→	ND (0.51)	Below 1/6
Cesium-137:	7.3 (2013/10/11)	→	0.58	Below 1/10
Gross β:	69 (2013/ 8/19)	→	ND (16)	Below 1/4
Tritium:	68 (2013/ 8/19)	→	ND (1.4)	Below 1/40

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

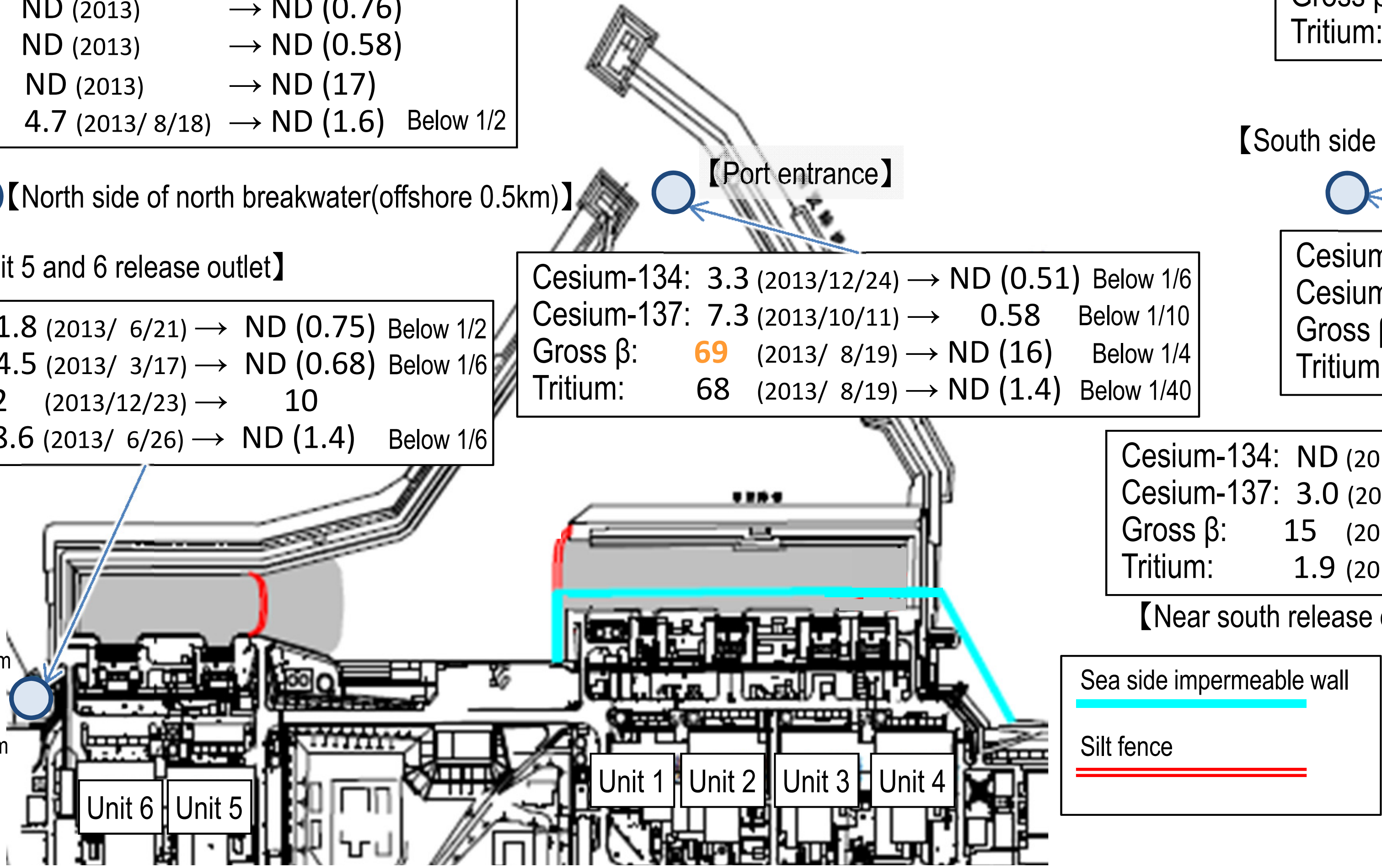
Cesium-134:	ND (2013)	→	ND (0.62)	
Cesium-137:	ND (2013)	→	ND (0.67)	
Gross β:	ND (2013)	→	ND (17)	
Tritium:	ND (2013)	→	ND (1.6)	

【North side of Unit 5 and 6 release outlet】

Cesium-134:	1.8 (2013/ 6/21)	→	ND (0.75)	Below 1/2
Cesium-137:	4.5 (2013/ 3/17)	→	ND (0.68)	Below 1/6
Gross β:	12 (2013/12/23)	→	10	
Tritium:	8.6 (2013/ 6/26)	→	ND (1.4)	Below 1/6

【Near south release outlet】

Cesium-134:	ND (2013)	→	ND (0.49)	
Cesium-137:	3.0 (2013/ 7/15)	→	ND (0.71)	Below 1/4
Gross β:	15 (2013/12/23)	→	8.9	
Tritium:	1.9 (2013/11/25)	→	ND (1.8)	



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.

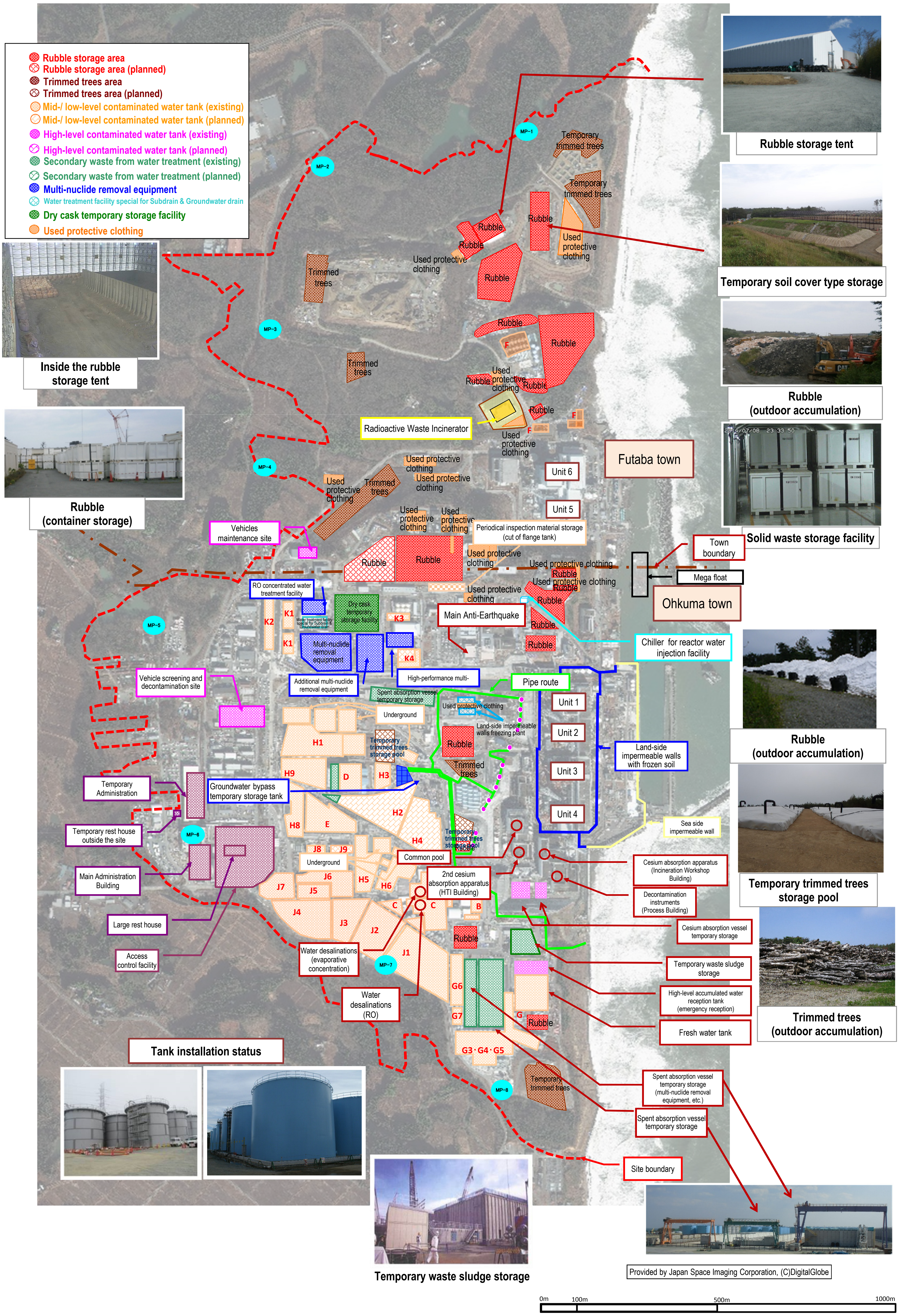
Note: Because safety of the sampling points was unassured due to the influence of Typhoon No. 10, samples were taken from approx. 330 m south of the Unit 1-4 release outlet.

Summary of TEPCO data as of September 28

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
September 29, 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

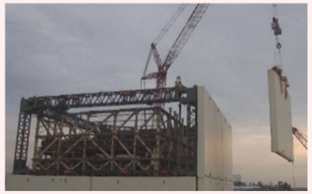
Unit 1

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. Operation of sprinklers started on June 30, 2016 as a measure to prevent dust scattering. Suction of rubble was completed on August 2, 2016. Dismantling of wall panels started on September 13, 2016.

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



<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.

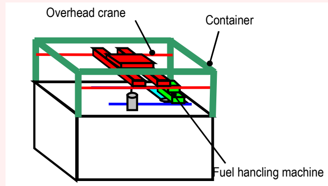


Image of Plan 1

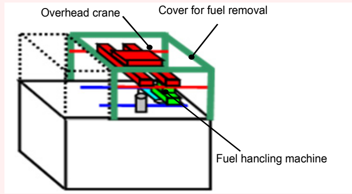


Image of Plan 2

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)

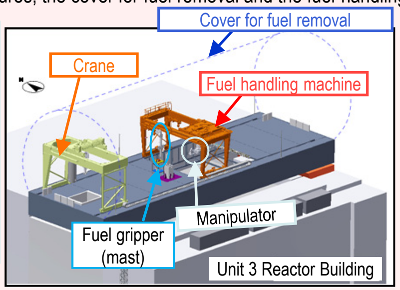


Image of entire fuel handling facility inside the cover

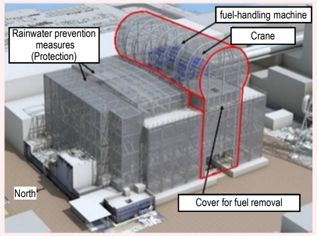


Image of the cover for fuel removal

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)

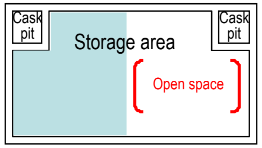
This marks the completion of fuel removal from the Unit 4 Reactor Building.

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.

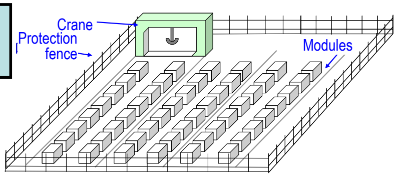
Common pool



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.

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

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

Leak point

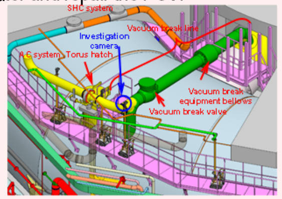
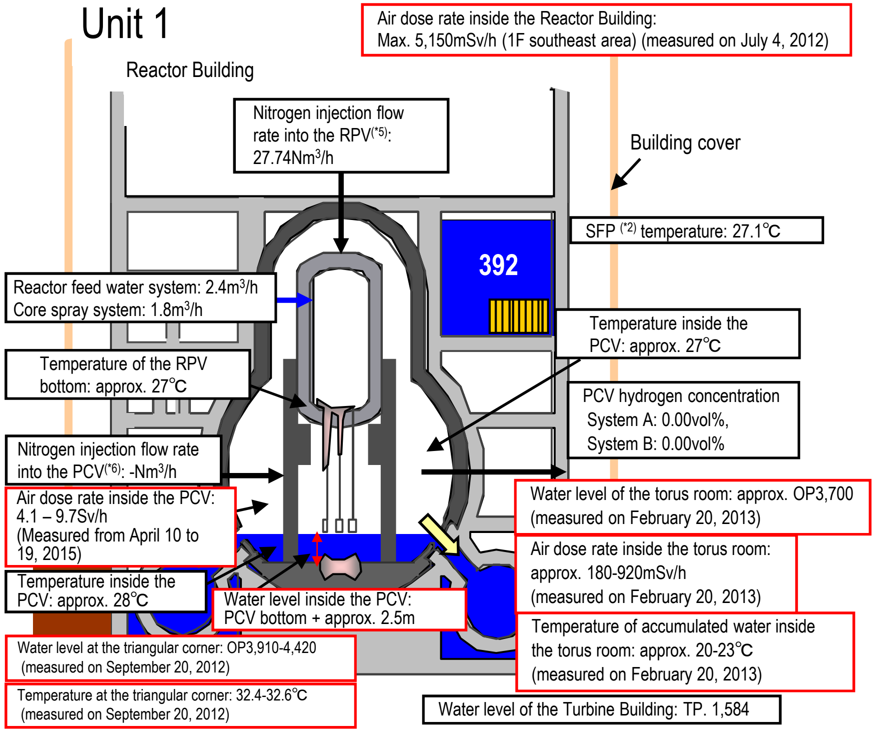


Image of the S/C upper part investigation

Unit 1



* Indices related to the plant are values as of 11:00, September 28, 2016

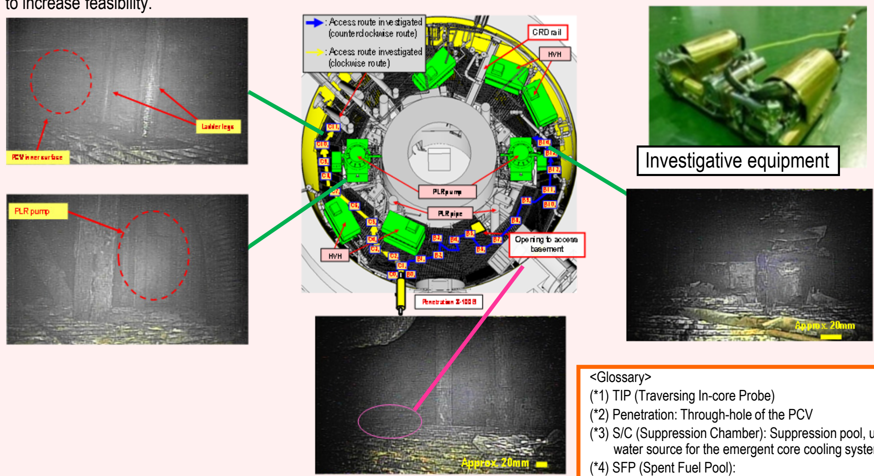
Investigations inside PCV	1st (Oct 2012)	- Acquiring images - Measuring air temperature and dose rate - Measuring water level and temperature - Sampling accumulated water - Installing permanent monitoring instrumentation
	2nd (Apr 2015)	Confirming the status of PCV 1st floor - Acquiring images - Measuring 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)	

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.



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

September 29, 2016
Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment

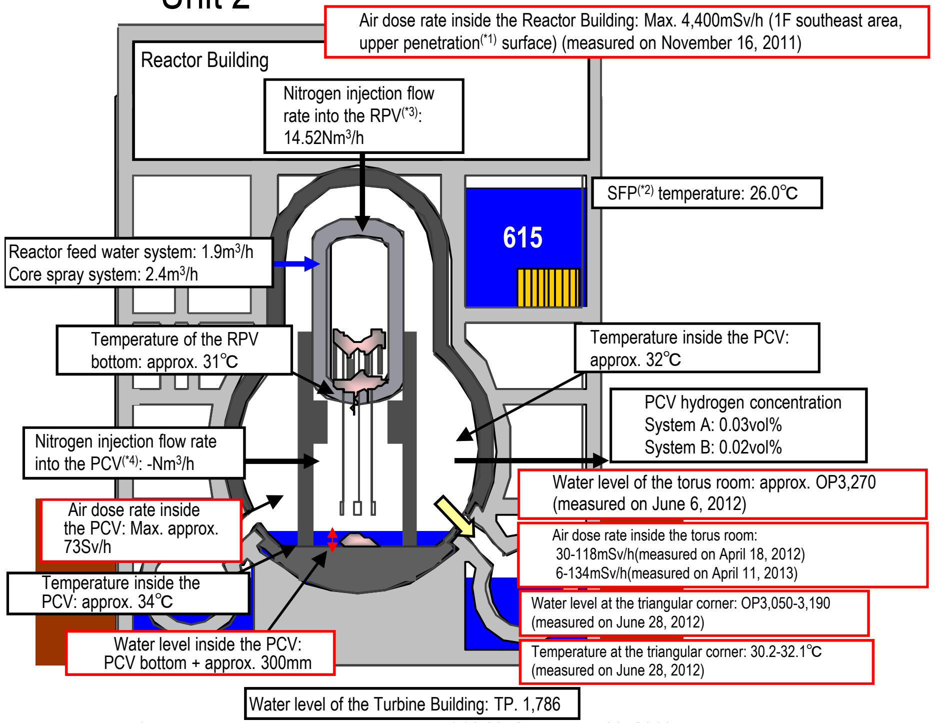
Immediate target	Identify the plant status and commence R&D and decontamination toward fuel debris removal

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

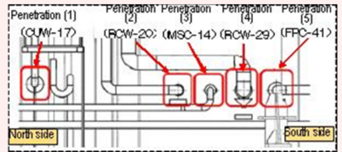


* Indices related to plant are values as of 11:00, September 28, 2016

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

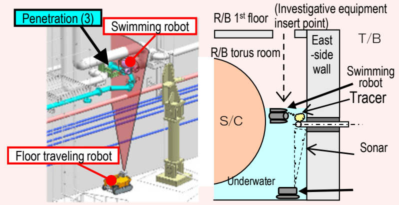


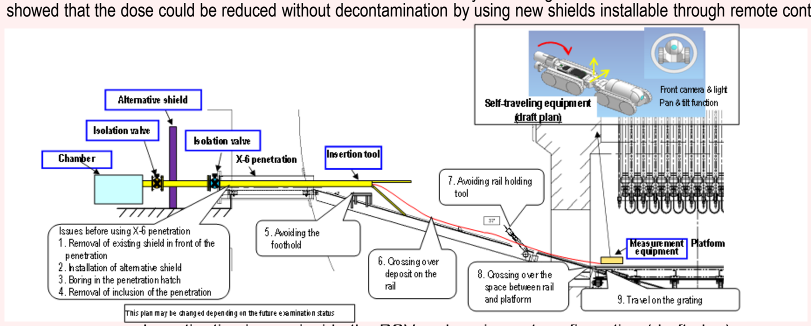
Image of the torus room east-side cross-sectional investigation

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.
- 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. However, the dose was not decreased to the target level through decontamination (removal of eluted materials, decontamination by steam, chemical decontamination, and surface grind).
- An examination on the extent to which the dose could be reduced by combining additional decontamination and shielding showed that the dose could be reduced without decontamination by using new shields installable through remote control.



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

September 29, 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

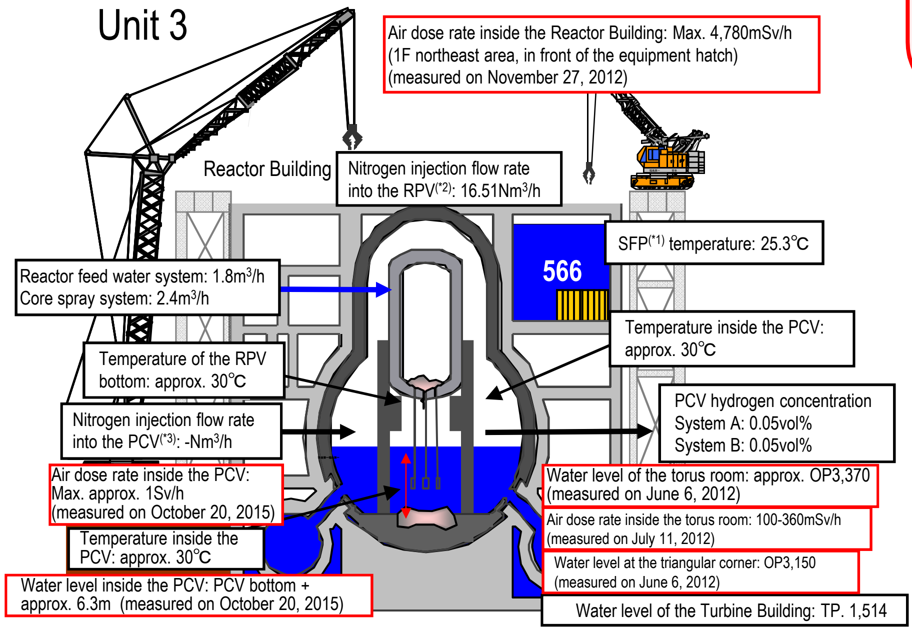
On January 18, 2014, a flow of water from around the door of the Steam Isolation Valve room in the Reactor Building Unit 3 1st floor northeast area to the nearby floor drain funnel (drain outlet) was detected. As the drain outlet connects with the underground part of the Reactor Building, there is no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

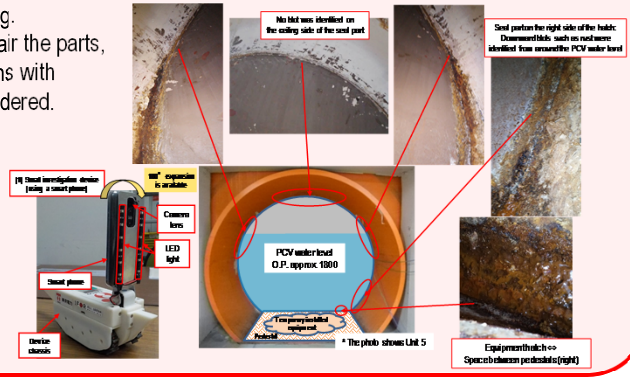


* Indices related to plant are values as of 11:00, September 28, 2016

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.

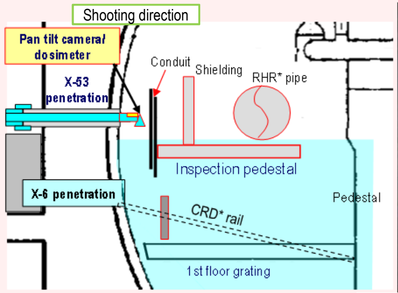


Investigation inside the PCV

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

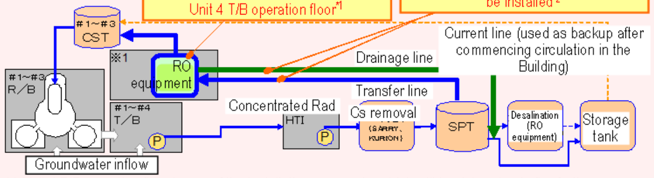
<Glossary>
(*1) SFP (Spent Fuel Pool)
(*2) RPV (Reactor Pressure Vessel)
(*3) PCV (Primary Containment Vessel)
(*4) Penetration: Through-hole of the PCV

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

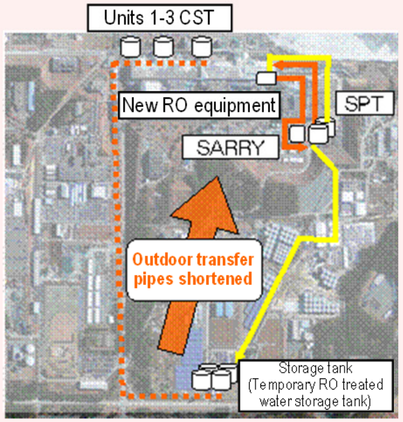
Immediate target	Stably continue reactor cooling and accumulated water treatment, and improve reliability

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 will be 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 will start in early October. Installation of the new RO device inside the building will shorten 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.

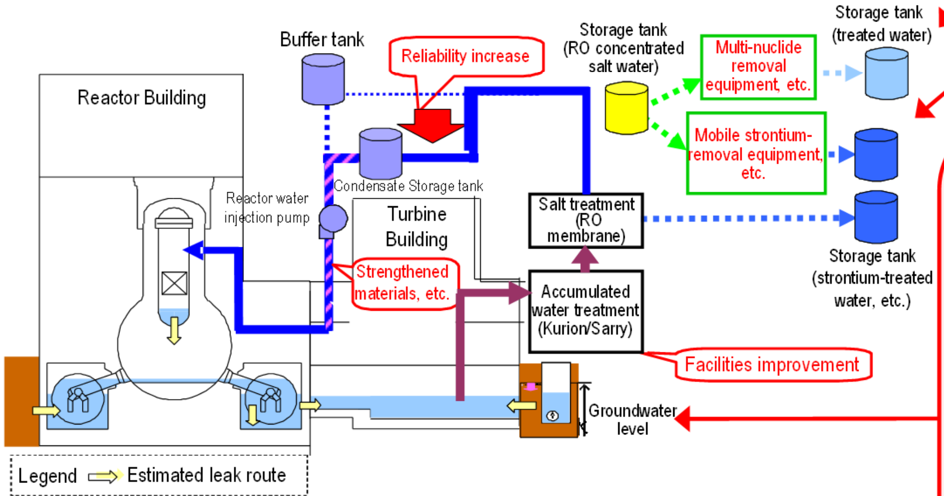
Start of dismantling in H1 east area

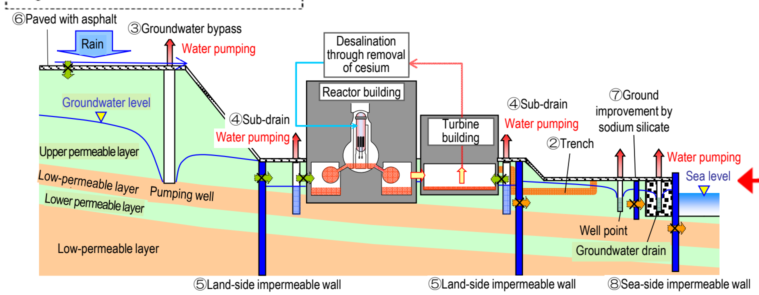
After dismantling in H1 east area

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.

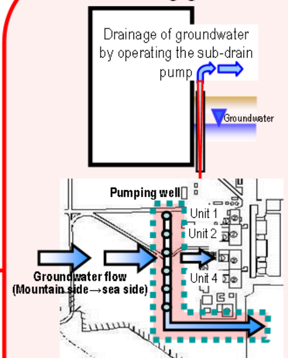
The strontium-treated water from other facilities than the multi-nuclide removal equipment will be re-purified in the multi-nuclide removal equipment to further reduce risks.





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.

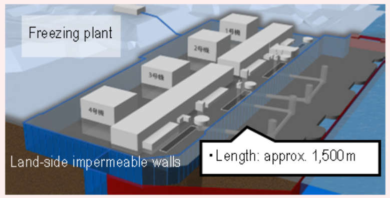
The pumped up groundwater is temporarily stored in tanks and released after TEPCO and a third-party organization have confirmed that its quality meets operational targets.

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 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.

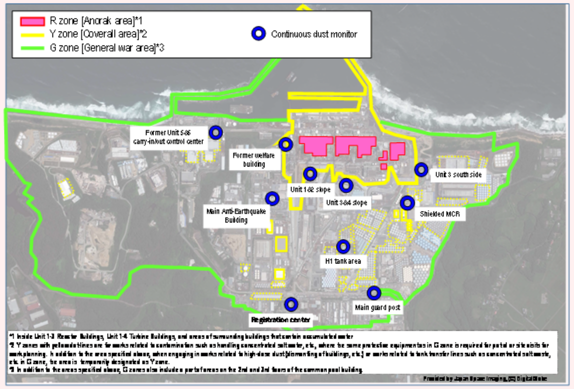
Progress toward decommissioning: Work to improve the environment within the site

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. ・Prevent contamination expansion in sea, decontamination within the site

Optimization of radioactive protective equipment

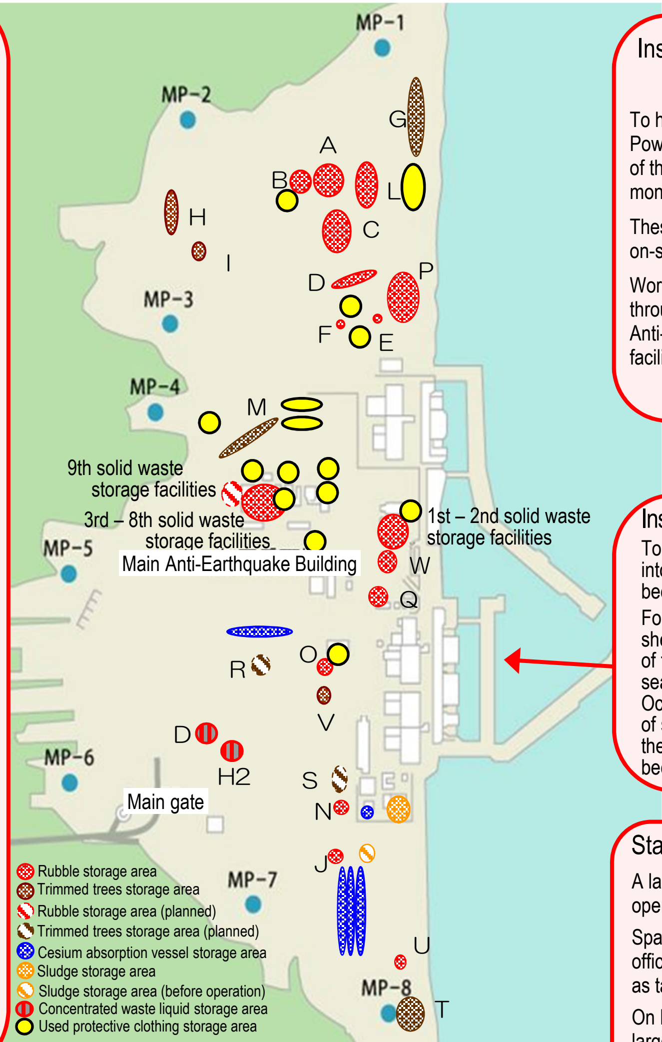
Based on the progress of measures to reduce environmental dosage on site, the site is categorized into two zones: highly contaminated area around Unit 1-4 buildings, etc. and other areas to optimize protective equipment according to each category aiming at improving safety and productivity by reducing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