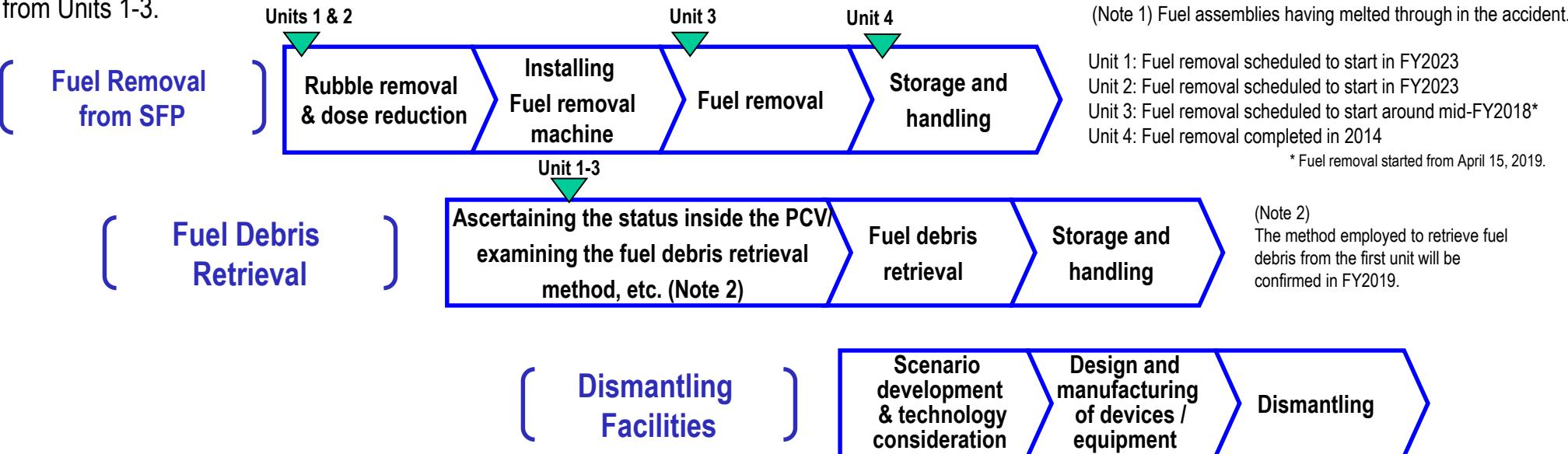


## Main decommissioning work and steps

Fuel removal from the Unit 4 SFP was completed on December 22, 2014 and removal from the Unit 3 SFP has been underway since April 15, 2019. Dust density in the surrounding environment is being monitored and work is being implemented with safety first. Work continues sequentially toward the start of fuel removal from Units 1 and 2 and debris (Note 1) retrieval from Units 1-3.



### Fuel removal from the spent fuel pool

Fuel removal from the Unit 3 SFP started from April 15, 2019. Work continues toward completion of fuel removal within FY2020.

<Reference> Progress to date

As measures to reduce the dose on the Reactor Building operating floor, decontamination and installation of shields were completed in June and December 2016, respectively. Installation of a fuel removal cover started in January 2017 and installation of all dome roofs was completed in February 2018.

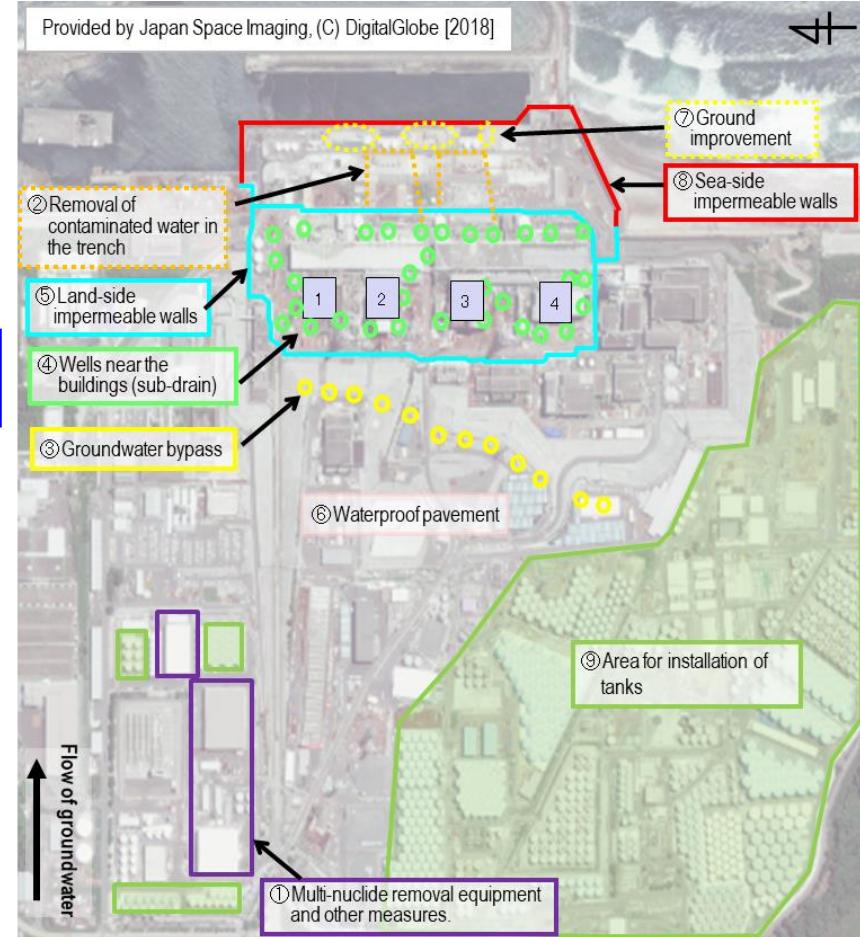
Status of fuel removal (April 15, 2019)

## Three principles behind contaminated water countermeasures

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

- 1 Remove contamination sources**
  - ① Purification using Multi-nuclide removal equipment and other measures
  - ② Removal of contaminated water from the trench (Note 3)

(Note 3) Underground tunnel containing pipes.
- 2. Redirect groundwater from contamination sources**
  - ③ Pump up groundwater for bypass
  - ④ Pump up groundwater near buildings
  - ⑤ Land-side impermeable walls (frozen-soil walls)
  - ⑥ Waterproof pavement
- 3. Prevent leakage of contaminated water**
  - ⑦ Enhance soil by adding sodium silicate
  - ⑧ Sea-side impermeable walls
  - ⑨ Increase the number of (welded-joint) tanks



### Multi-nuclide removal equipment (ALPS), etc.

- This equipment removes radionuclides from the contaminated water in tanks and reduces risks.
- Treatment of contaminated water (RO concentrated salt water) was completed in May 2015 with multi-nuclide removal equipment, additional multi-nuclide removal equipment installed by TEPCO (operation commenced in September 2014) and a Japanese Government subsidy project (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)

### Reducing the generation of contaminated water through multi-layered measures

- Multi-layered measures are implemented to suppress the inflow of rainwater and groundwater into buildings.
- Multi-layered contaminated water management measures, including land-side impermeable walls and subdrains, have stabilized the groundwater at a low level. The increase in the amount of contaminated water generated during rainfall is being suppressed by repairing damaged portions of building roofs, facing onsite, etc.
- Through these measures, the generation of contaminated water was reduced from approx. 470 m<sup>3</sup>/day (in FY2014) to approx. 170 m<sup>3</sup>/day (in FY2018).
- The groundwater level around Unit 1-4 Reactor Buildings will remain limited by steadily operating land-side impermeable walls. In addition, measures to prevent the inflow of rainwater, including repairing damaged parts of building roofs and facing, continue to reduce the generation of contaminated water still further.

Inside the land-side impermeable wall    Outside the land-side impermeable wall

### Replacing flanged tanks with welded-joint tanks

- Replacement of flanged tanks with more reliable welded-joint tanks is underway.
- Strontium-treated water stored in flanged tanks was purified and transferred to welded-joint tanks. The transfer was completed in November 2018. Transfer of ALPS-treated water was completed in March 2019.

(Installed welded-joint tanks)

# Progress status

◆ The temperatures of the Reactor Pressure Vessel (RPV) and Primary Containment Vessel (PCV) of Units 1-3 have been maintained within the range of approx. 25-35°C<sup>\*1</sup> over the past month. There was no significant change in the density of radioactive materials newly released from Reactor Buildings into the air<sup>\*2</sup>. It was concluded 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 2019, the radiation exposure dose due to the release of radioactive materials from the Unit 1-4 Reactor Buildings was evaluated at less than 0.00027 mSv/year at the site boundary. The annual radiation dose from natural radiation is approx. 2.1 mSv/year (average in Japan).

## Examination about installation of an additional dust monitor to construct an access at Unit 1

For a resume the access route construction for the internal investigation of the Primary Containment Vessel (PCV), examination is underway based on the data acquired so far to optimize the cutting time and monitor the dust density near the PCV more intensively.

Specifically, we are considering adding a dust monitor using piping installed near the PCV head.

After investigating the closure of piping from the beginning of October, a dust monitor will be installed, and the access route construction work will be resumed from the beginning of November at the earliest.

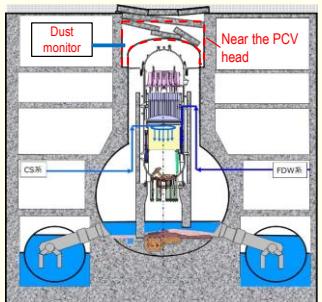


Image of additional installation of dust density monitor

## Outlook toward resumption of fuel removal at Unit 3

The periodical inspection of the fuel-handling facility, which started on July 24, was completed on September 2.

Some defective rotations of the tensile truss and the mast were detected during the following adjustment work toward resumption of the fuel removal. After adjusting the tensile truss and other related work, rubble removal inside the SFP got underway from September 10.

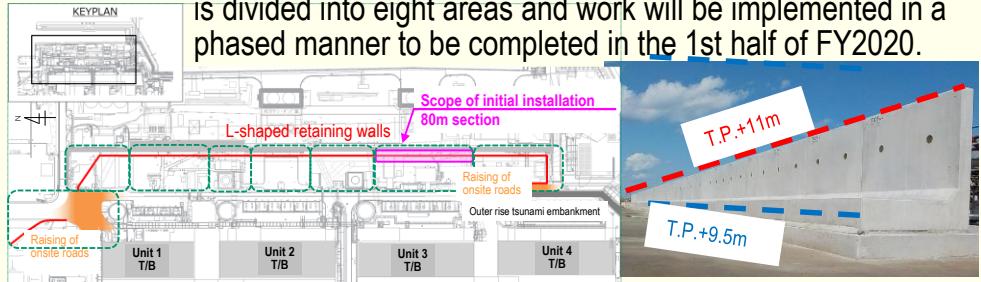
For the mast, it was confirmed that its defective rotation was attributable to the motor for rotation. So, we are preparing to replace the motor. Due to these defects, fuel removal will resume in October or later.

Tensile truss: Hoist for the manipulator  
Mast: Fuel grappler

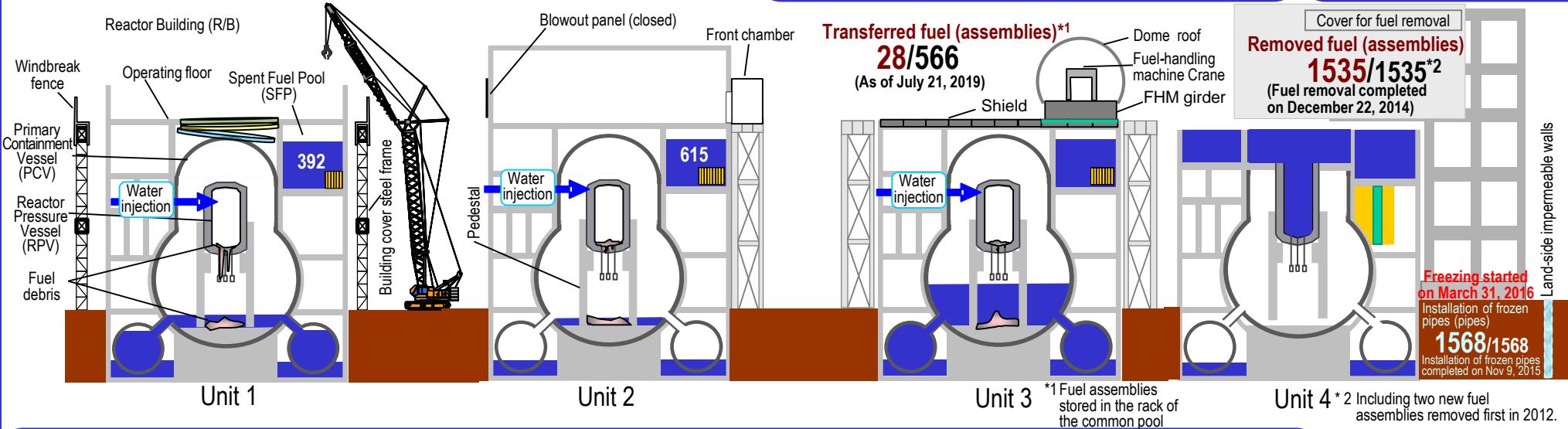
## Installation start of a tide embankment for the Chishima trench tsunami

In preparation for the potentially urgent hazard of the Chishima trench tsunami, a tide embankment is being installed.

Following preparatory work, including removal and transfer of the existing facilities and site preparation and raising, installation of L-shaped retaining walls started from September 23. The tide embankment (approx. 600m long) is divided into eight areas and work will be implemented in a phased manner to be completed in the 1st half of FY2020.



Scope and status of tide embankment installation



## Publication of the Technical Strategic Plan 2019

The Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) made and published the "Technical Strategic Plan 2019 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc." on September 9; aiming to provide a firm technical basis for the government's "Mid- and long-term Roadmap" and facilitate the smooth and steady implementation of decommissioning. This plan provides strategic proposals concerning the methods used to retrieve fuel debris from the first unit.

## Completion of work to dismantle the 2nd block of the Unit 1/2 exhaust stack

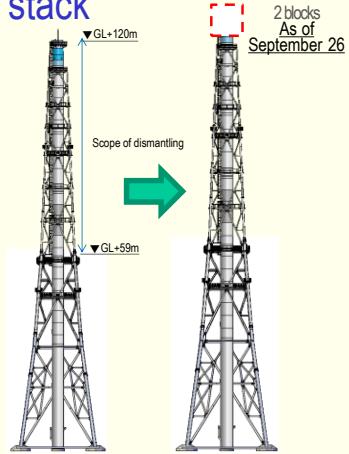
Regarding dismantling of the Unit 1/2 exhaust stack, cutting work of the top block started on August 7 and the dismantling of the top block was completed on September 1.

After the review of the proceeding step, dismantling work of the 2nd block started on September 12 and was completed on September 26, although there were some malfunction in the communication facility during the preparation and a suspension due to the typhoon.

Based on the insights obtained in dismantling of the 2nd block, we proceed with the goal of completing the dismantle of the 3rd and the 4th blocks in late October.



Hanging down of the top block



Before dismantling After dismantling

## Water shutoff of the inflow part to the Onsite Bunker Building

The inflow route, which was identified by the core removal near the funnel, was closed on August 30.

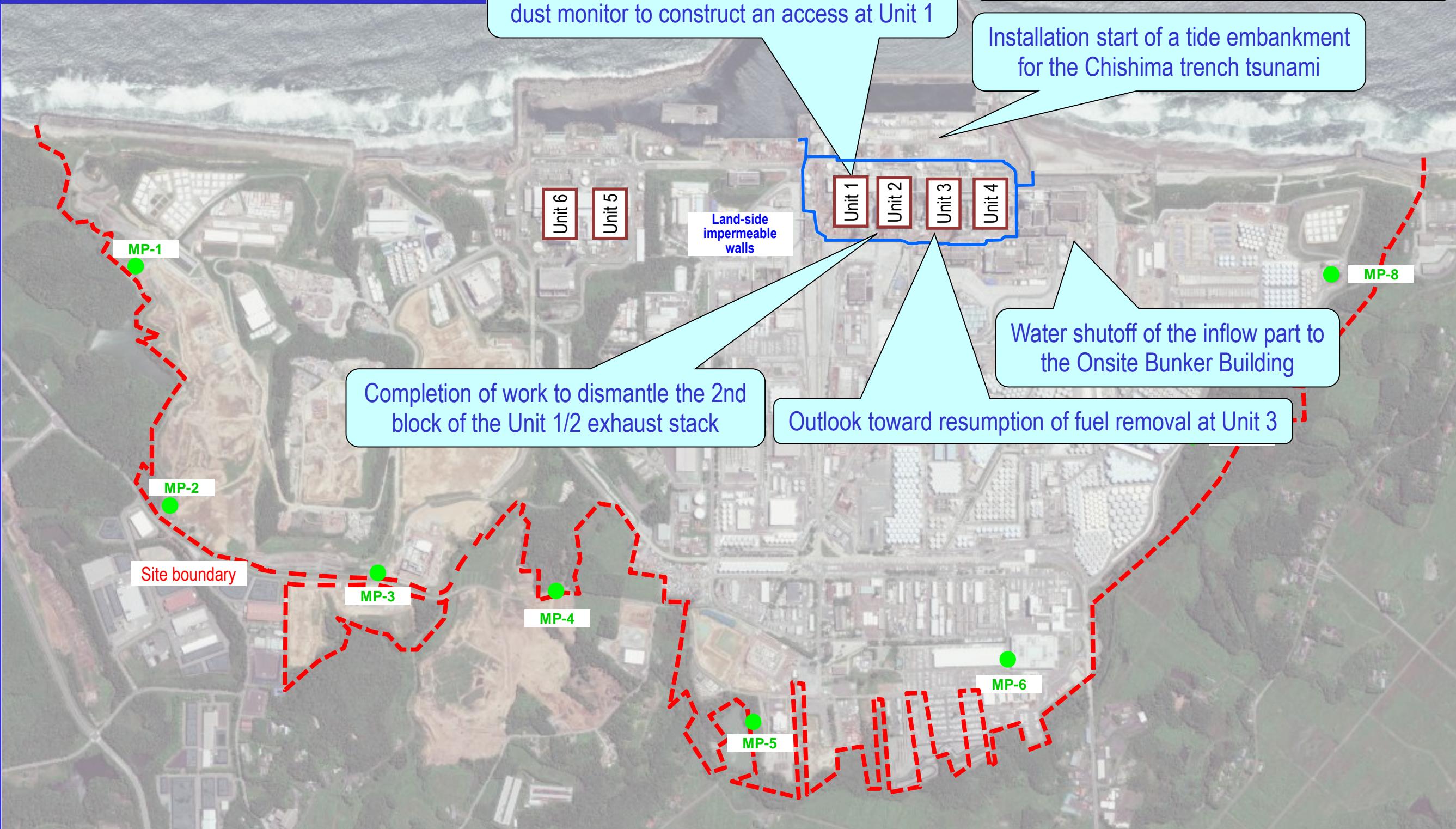
After the closure, inflow from the closed part stopped and the inflow rate to the Onsite Bunker Building declined from approx. 40 m<sup>3</sup>/day to almost none (approx. 0.2 m<sup>3</sup>/day).

Ongoing monitoring of the water level continues.



Status of water shutoff measures

# Major initiatives – Locations on site



Examination about installation of an additional dust monitor to construct an access at Unit 1

Publication of the Technical Strategic Plan 2019

Installation start of a tide embankment for the Chishima trench tsunami

Unit 6  
Unit 5

Land-side impermeable walls

Unit 1  
Unit 2  
Unit 3  
Unit 4

MP-8

MP-1

Water shutoff of the inflow part to the Onsite Bunker Building

Completion of work to dismantle the 2nd block of the Unit 1/2 exhaust stack

Outlook toward resumption of fuel removal at Unit 3

MP-2

Site boundary

MP-3

MP-4

MP-6

MP-5

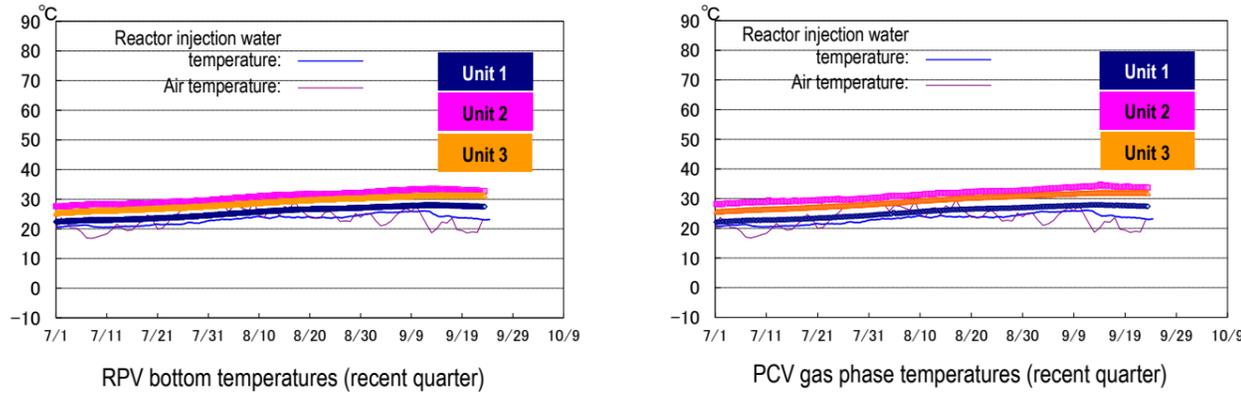
\* Data of Monitoring Posts (MP1-MP8.)  
 Data (10-minute values) of Monitoring Posts (MPs) measuring the airborne radiation rate around site boundaries showed 0.323 – 1.340  $\mu\text{Sv/h}$  (August 28 – September 24, 2019).  
 We improved the measurement conditions of monitoring posts 2 to 8 to measure the air-dose rate precisely. Construction work, 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 panels around monitoring post No. 6, which is one of the instruments used to measure the radiation dose at the power station site boundary, were taken off from July 10-11, 2013, since further deforestation, etc. had caused the surrounding radiation dose to decline significantly.

Provided by Japan Space Imaging, photo taken on June 14, 2018  
 Product(C) [2018] DigitalGlobe, Inc.

## I. Confirmation of the reactor conditions

### 1. Temperatures inside the reactors

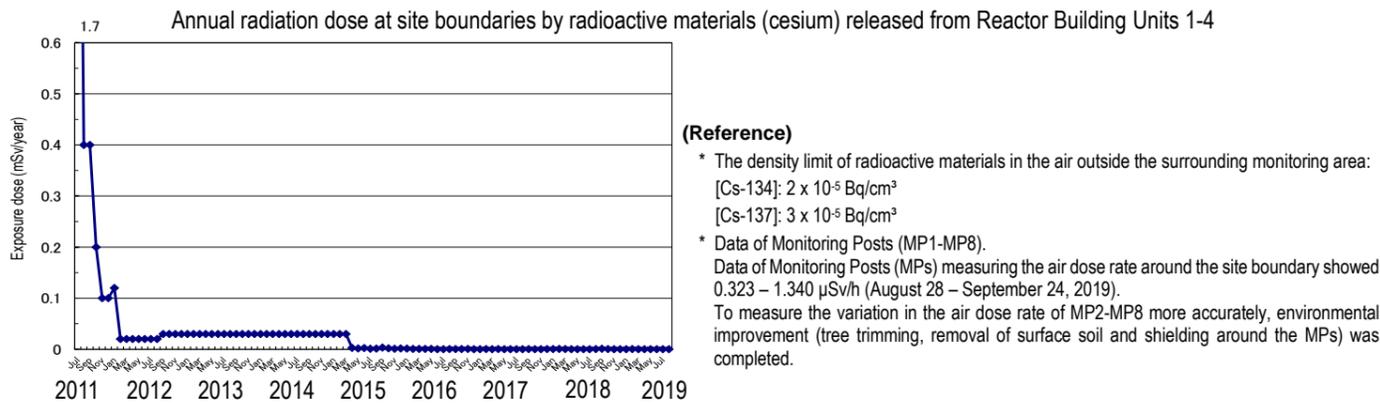
Through continuous reactor cooling by water injection, the temperatures of the Reactor Pressure Vessel (RPV) bottom and the Primary Containment Vessel (PCV) gas phase were maintained within the range of approx. 25 to 35°C for the past month, though they varied depending on the unit and location of the thermometer.



\* 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 2019, the density of radioactive materials newly released from Reactor Building Units 1-4 into the air and measured at the site boundary was evaluated at approx.  $2.9 \times 10^{-12}$  Bq/cm<sup>3</sup> and  $9.6 \times 10^{-12}$  Bq/cm<sup>3</sup> for Cs-134 and Cs-137 respectively, while the radiation exposure dose due to the release of radioactive materials there was less than 0.00027 mSv/year.



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 management

*In accordance with the three principles "remove" contamination sources, "redirect" groundwater from contamination sources and "prevent leakage" of contaminated water, multi-layered contaminated water management measures have been implemented to stably control groundwater*

#### ➤ Status of contaminated water generated

- Multi-layered measures, including pumping up by subdrains and land-side impermeable walls, which were

implemented to control the continued generation of contaminated water, suppress the groundwater inflow into buildings.

- Following the steady implementation of "redirecting" measures (groundwater bypass, subdrains, land-side impermeable walls and other measures), the generation amount reduced from approx. 470 m<sup>3</sup>/day (the FY2014 average) when the measures were first launched to approx. 170 m<sup>3</sup>/day (the FY2018 average).
- Measures will continue to further reduce the volume of contaminated water generated.

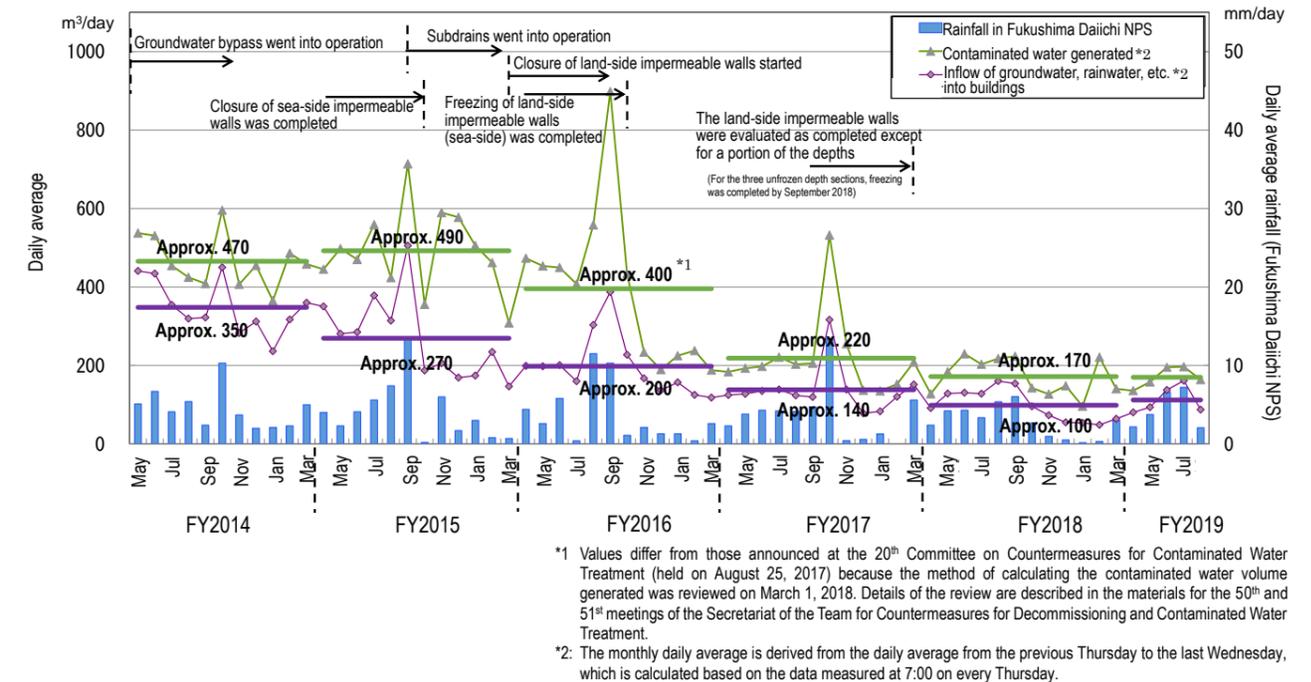


Figure 1: Changes in contaminated water generated and inflow of groundwater, rainwater, into buildings

#### ➤ Operation of the groundwater bypass

- From April 9, 2014, the operation of 12 groundwater bypass pumping wells commenced sequentially to pump up groundwater. The release then 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 24, 2019, 498,459 m<sup>3</sup> of groundwater had been released. The pumped-up groundwater was temporarily stored in tanks and released after TEPCO and a third-party organization had confirmed that its quality met operational targets.
- Pumps are inspected and cleaned as required based on their operational status.

#### ➤ Operation of the Water Treatment Facility special for Subdrain & Groundwater drains

- To reduce the level of groundwater flowing into the buildings, work began to pump up groundwater from wells (subdrains) around the buildings on September 3, 2015. The pumped-up groundwater was then purified at dedicated facilities and released from September 14, 2015, in the presence of officials from the Intergovernmental Liaison Office for the Decommissioning and Contaminated Water Issue of the Cabinet Office. Up until September 24, 2019, a total of 761,422 m<sup>3</sup> had been drained after TEPCO and a third-party organization had confirmed that its quality met operational targets.
- Due to the rising level of the groundwater drain pond after the sea-side impermeable walls had been closed, pumping started on November 5, 2015. Up until September 24, 2019, a total of approx. 212,317 m<sup>3</sup> had been pumped up and a volume of under 10 m<sup>3</sup>/day is being transferred from the groundwater drain to the Turbine Buildings (average for the period August 22 – September 18, 2019).
- As one of the multi-layered contaminated-water management measures, in addition to waterproof pavement (facing: as of the end of August 2019, approx. 94% of the planned area had been completed) to prevent rainwater infiltrating the ground, facilities to enhance the subdrain treatment system were installed and went into operation from April 2018, increasing the treatment capacity from 900 to 1,500 m<sup>3</sup>/day and improving reliability. Operational efficiency was also improved to treat up to 2,000 m<sup>3</sup>/day for almost one week during the peak period.
- To maintain the level of groundwater pumped up from the subdrains, work to install additional subdrain pits and recover

those already in place is underway. The additional pits are scheduled to begin operation sequentially from a pit for which work was completed (12 of 14 pits went into operation). For recovered pits, work for all three pits scheduled was completed, all of which went into operation from December 26, 2018. Work to recover another pit will start within FY2019 (No. 49 pit).

- To eliminate the need to suspend water pumping while cleaning the subdrain transfer pipe, the pipe will be duplicated. Installation of the pipe and ancillary facilities was completed.
- Since the subdrains went into operation, the inflow into buildings tended to decline to under 150 m<sup>3</sup>/day when the subdrain water level declined below T.P. 3.0 m but increased during rainfall.

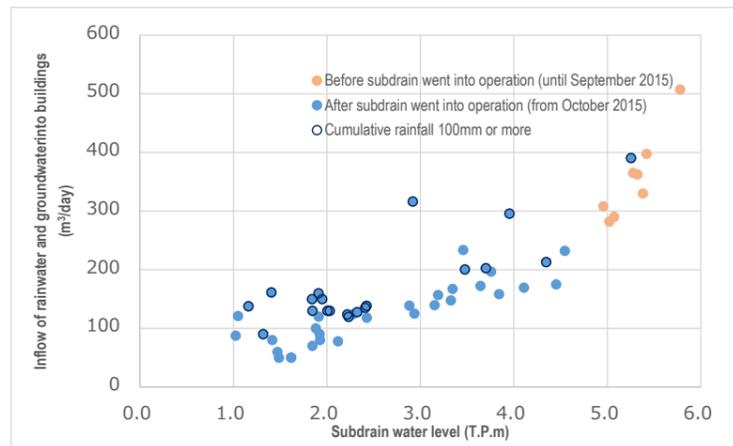


Figure 2: Correlation between inflow such as groundwater and rainwater into buildings and the water level of Unit 1-4 subdrains

#### ➤ Construction status of the land-side impermeable walls and status of groundwater levels around the buildings

- An operation to maintain the land-side impermeable walls and prevent the frozen soil from thickening further continued from May 2017 on the north and south sides and started from November 2017 on the east side, where sufficiently thick frozen soil was identified. The scope of the maintenance operation was expanded in March 2018.
- In March 2018, construction of the land-side impermeable walls was completed, except for a portion of the depth, based on a monitoring result showing that the underground temperature had declined below 0°C in almost all areas, while on the mountain side, the difference between the inside and outside increased to approx. 4-5 m. The 21st Committee on Countermeasures for Contaminated-Water Treatment, held on March 7, 2018, evaluated that together with the function of subdrains and other measures, a water-level management system to stably control groundwater and isolate the buildings from it had been established and allowed the amount of contaminated water generated to be reduced significantly.
- A supplementary method was implemented for the unfrozen depth and it was confirmed that the temperature of this portion had declined below 0°C by September 2018. From February 2019, a maintenance operation started throughout all sections.
- The groundwater level in the area inside the land-side impermeable walls has been declining every year. On the mountain side, the difference between the inside and outside increased to approx. 4-5 m. The water level in the bank area has remained low (T.P. 1.6-1.7 m) compared to the ground surface (T.P. 2.5 m).

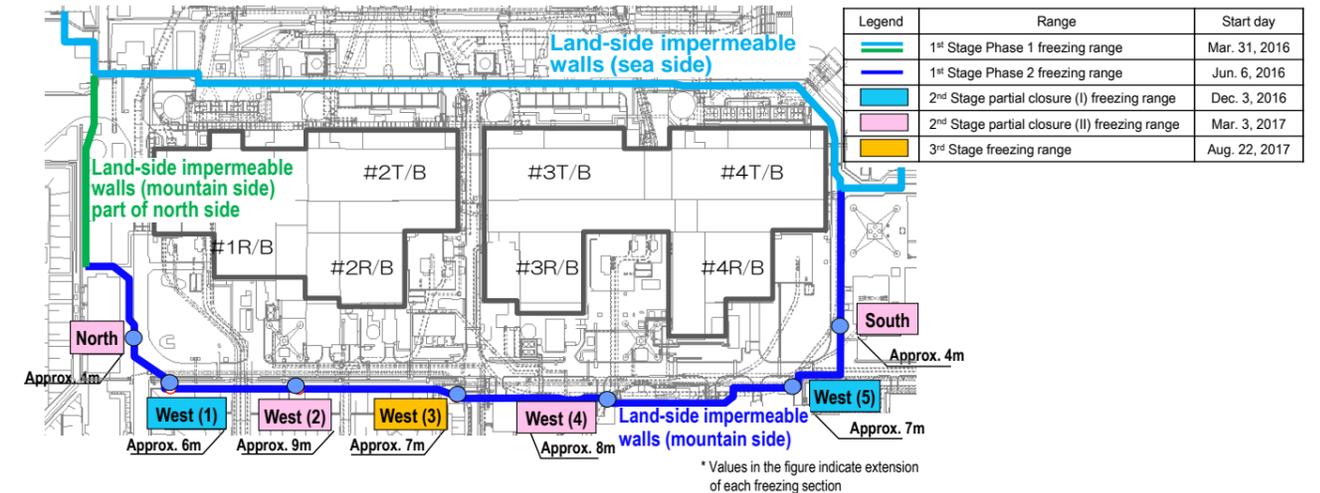
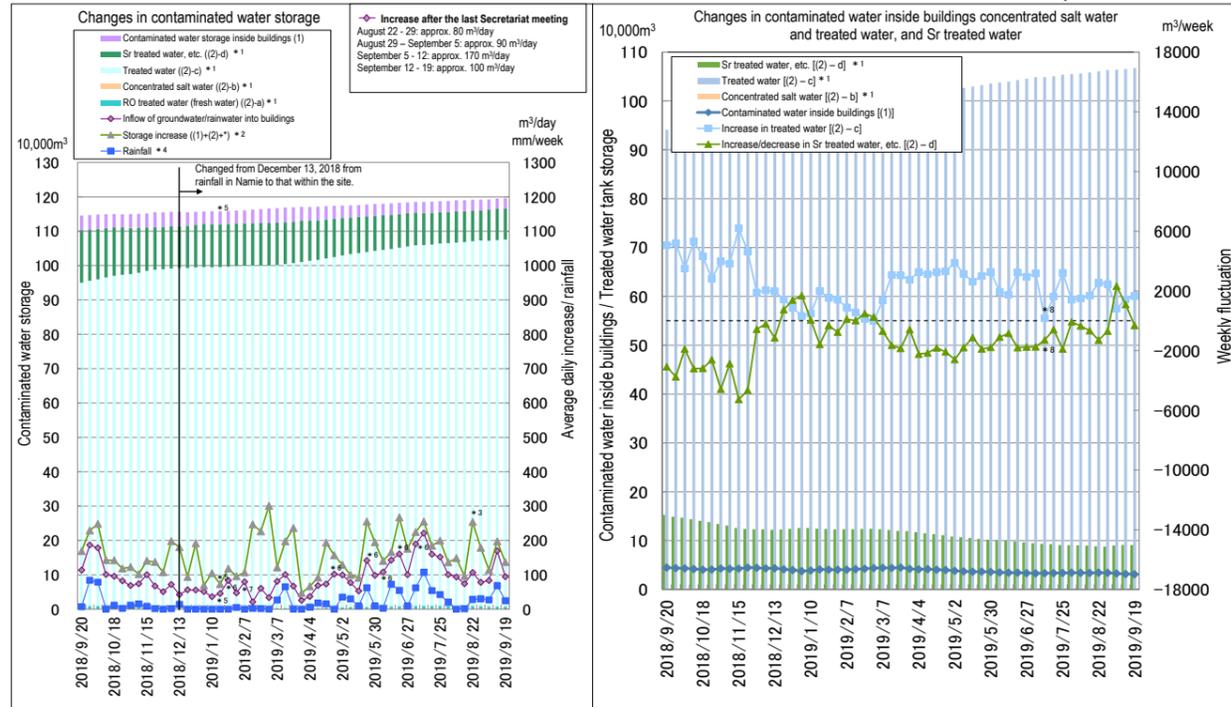


Figure 3: Closure parts of the land-side impermeable walls (on the mountain side)

#### ➤ Operation of multi-nuclide removal equipment

- Regarding the multi-nuclide removal equipment (existing and high-performance), hot tests using radioactive water were underway (for existing equipment, System A: from March 30, 2013, System B: from June 13, 2013, System C: from September 27, 2013; and for high-performance equipment, from October 18, 2014). The additional multi-nuclide removal equipment went into full-scale operation from October 16, 2017.
  - As of September 19, 2019, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 412,000, 586,000 and 103,000 m<sup>3</sup>, respectively (including approx. 9,500 m<sup>3</sup> stored in the J1(D) tank, which contained water with highly concentrated radioactive materials at the System B outlet of the 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 19, 2019, approx. 626,000 m<sup>3</sup> had been treated.
- #### ➤ Toward reducing the risk of contaminated water stored in tanks
- Treatment measures comprising the removal of strontium by cesium-adsorption apparatus (KURION) (from January 6, 2015), the secondary cesium-adsorption apparatus (SARRY) (from December 26, 2014) and the third cesium-adsorption apparatus (SARRY II) (from July 12, 2019) have been underway. Up until September 19, 2019, approx. 541,000 m<sup>3</sup> had been treated.
- #### ➤ Measures in the Tank Area
- Rainwater, under the release standard and having accumulated within the fenced-in area of the contaminated-water tank area, was sprinkled on site after eliminating radioactive materials using rainwater-treatment equipment since May 21, 2014 (as of September 23, 2019, a total of 137,586 m<sup>3</sup>).



\*1: Water amount for which the water-level gauge indicates 0% or more  
 \*2: To detect storage increases more accurately, the calculation method was reviewed as follows from February 9, 2017: (The revised method was applied from March 1, 2018) [(Inflow of groundwater/rainwater into buildings) + (other transfer) + (chemical injection into ALPS)]  
 \*3: The storage amount increased due to transfer to buildings in association with the decommissioning work. (The transferred amount comprised ①Transfer from On-site Bunker Building to Process Main Building: approx. 110 m³/day, ②ALPS waste chemical: 13 m³/day, ③Transfer from wells and groundwater drains: approx. 13 m³/day, others)  
 \*4: Changed from December 13, 2018 from rainfall in Namie to that within the site.  
 \*5: Since January 17, 2019, Unit 3 C/B contaminated water has been managed in addition to contaminated water storage in buildings. For the inflow of groundwater, rainwater, and others to buildings and increase in storage have been reflected since January 24, 2019.  
 \*6: Considered attributable to the increased inflow of groundwater, rainwater, and others to buildings due to the decline in the level of contaminated water in buildings. (January 17, April 22, May 16 and 30, June 13 and 27, 2019)  
 \*7: Water-level gauges were replaced (February 7 – March 7, 2019)  
 \*8: Calculation methods for water volume and the capacity of tanks, which had varied in each tank area, were unified in all areas. By this unification, the calculated increase in treated water and variation in Sr-treated water, and others changed. However, the actual treated volumes were approx. 2200 m³/week for treated water and approx. 1100 m³/week for Sr-treated water, and others (July 11, 2019).

Figure 4: Status of contaminated water storage

➤ Measures to shutoff groundwater inflow to the Onsite Bunker Building

- From mid-November 2018, the groundwater inflow to the Onsite Bunker Building increased.
- On August 30, 2019, the vinyl hose, which was identified as the inflow route by the core removal near the funnel, was closed.
- After the closure, inflow from the closed part stopped and the inflow rate to the Onsite Bunker Building declined from approx. 40 m³/day to almost none (approx. 0.2 m³/day). Ongoing monitoring of the water level continues.

➤ Investigative results on the basement floor of the Process Main Building

- In December 2018, work to investigate the radiation dose up to the floor surface of the Process Main Building and the High-Temperature Incinerator Building detected a high air dose rate on the lowest floor (Process Main Building: max. 2,600 mSv/h, High-Temperature Incinerator Building: max. 830 mSv/h).
- From September 5, 2019, the cause of the high air dose rate was investigated using an underwater drone at the Process Main Building.
- The investigation detected a dose rate peaking at 3,000 mSv/h near the Zeolite sandbags, which were placed on the lowest floor. Since the dose rate increased as the drone approached the sandbags, the high dose rate was considered mainly attributable to these Zeolite sandbags.
- Based on the investigative results, the optimal approach to handling the Zeolite sandbags will be examined.

2. Fuel removal from the spent fuel pools

*Work to help remove spent fuel from the pool is progressing steadily while ensuring seismic capacity and safety. The removal of spent fuel from the Unit 4 pool commenced on November 18, 2013 and was completed by December 22, 2014*

➤ Main work to help spent fuel removal at Unit 1

- From January 22, 2018, toward fuel removal from the spent fuel pool (SFP), work began to remove rubble on the north side of the operating floor. Once removed, the rubble is stored in solid waste storage facilities or elsewhere depending on the dose level.
- To create an access route for preparatory work to protect the SFP, work to remove four sections of X-braces (one each on the west and south sides and two on the east side, respectively) started from September 19, 2018 and all planned four sections had been removed by December 20.
- From March 18, 2019, the removal of small rubble in the east-side area around the SFP started using pliers and suction equipment, while from July 9, small rubble removal on the south side of the SFP started.
- The well plug, which was considered as misaligned from its normal position due to the influence of the hydrogen explosion at the time of the accident, was investigated for the period July 17 – August 26, 2019, by taking photos using a camera, measuring the air dose rate and collecting 3D images.
- The investigation checked the positional relation of the upper and intermediate plugs, detected an inclination of the plug and confirmed that the air dose rate peaked at the plug center. Based on the imagery and data related to the contamination condition obtained, optimal handling for the plug will be examined.
- Before removing the fallen roof on the south side, the SFP will be covered. As preparatory work, the transparency of the pool water was investigated on August 2, 2019. The investigation confirmed that a view of approx. 7m would be available by creating an environment such as installing lighting. On September 20, the inside of the SFP was also investigated to check any obstacle. The investigation confirmed that there was no obstacle which may hinder the installation of a covering bag within the visible range but could not check the entire SFP surface. The SFP will be re-investigated on September 27 (planned).
- From September 17, 2019, cutting and removal of roof steel frames on the north side started.

➤ Main work to help spent fuel removal at Unit 2

- On November 6, 2018, before the investigation toward formulating a work plan to dismantle the Reactor Building rooftop and for other tasks, work to move and contain the remaining objects on the operating floor (1st round) was completed.
- On February 1, 2019, an investigation to measure the radiation dose on the floor, walls and ceiling inside the operating floor and confirm the contamination status was completed. After analyzing the investigative results, the “contamination density distribution” throughout the entire operating floor was obtained, based on which the air dose rate inside the operating floor could be evaluated. A shielding design and measures to prevent radioactive material scattering will be examined.
- From April 8, 2019, work to move and contain the remaining objects on the operating floor (2nd round) started, such as materials and equipment which may hinder installation of the fuel-handling facility and other work. The 2nd round mainly included moving the remaining small objects and placing them in the container. The work also included cleaning the floor to suppress dust scattering and was completed on August 21.
- From September 10, 2019, work to move and contain the remaining objects on the operating floor (3rd round) started, such as materials and equipment which may hinder the installation of the fuel-handling facility and other work. The 3rd round mainly includes moving and containing the remaining large objects as well as transporting containers and remaining objects temporarily stored inside the operating floor outside.

➤ Main process to help fuel removal at Unit 3

- Regarding the fuel-handling machine (FHM) and crane, consecutive defects have occurred since the test operation started on March 15, 2018.
- On August 8, 2018, an alarm was issued during the pre-operation inspection of the FHM, whereupon operation was suspended. This was attributable to disconnection due to rainwater ingress corrosion into the cable connection. Abnormalities were also detected in several control cables.
- On August 15, 2018, an alarm on the crane was triggered during work to clear materials and equipment, whereupon

the crane operation was suspended.

- On September 29, 2018, to determine the risks of defects in fuel-handling facilities, a safety inspection (operation check and facility inspection) started. For 14 defects detected in the safety inspection, measures were completed on January 27, 2019.
  - On February 8, 2019, a function check after cable replacement was completed.
  - On February 14, 2019, review of recovery measures in the event of defects started and training for fuel removal using dummy fuel and the transport container got underway. During the training, seven defects were detected, although it was confirmed that these did not constitute safety problems that could lead to fuel or rubble falling.
  - From March 15, 2019, the rubble removal training inside the pool started.
  - From April 15, 2019, removal of 514 spent fuel assemblies and 52 non-irradiated fuel assemblies (a total of 566 assemblies) stored in the spent fuel pool started. Seven non-irradiated fuel assemblies were then loaded in the transport container and transported to the common pool on April 23. The first fuel removal was completed on April 25.
  - From July 4, 2019, fuel removal was resumed and up until July 21, 28 of all 566 fuel assemblies had been removed.
  - The periodical inspection of the fuel-handling facility, which started on July 24, 2019, was completed on September 2.
  - Some defective rotations of the tensile truss and the mast were detected during the following adjustment work toward resumption of the fuel removal. After adjusting the tensile truss and other related work, rubble removal inside the SFP got underway from September 10, 2019. For the mast, it was confirmed that its defective rotation was attributable to the motor for rotation. So, we are preparing to replace the motor. Due to these defects, fuel removal will resume in October or later.
- Start of work to dismantle the Unit 1/2 exhaust stack
- Regarding dismantling of the Unit 1/2 exhaust stack, cutting work of the top block started on August 7, 2019 and dismantling of the top block was completed on September 1.
  - After the review of the proceeding step, dismantling work of the 2nd block started on September 12, 2019 and was completed on September 26, although there were some malfunction in the communication facility during the preparation and a suspension due to the typhoon.
  - Based on the insights obtained from dismantling of the 2nd block, we proceed with the goal of completing the dismantle of the 3rd and the 4th blocks in late October 2019.

### 3. Retrieval of fuel debris

- Work to create an access route for the internal investigation of the Unit 1 PCV
- For a resume the access route construction for the internal investigation of the Primary Containment Vessel (PCV), examination is underway based on the data acquired so far to optimize the cutting time and more intensively monitor the dust density near the PCV.
  - Specifically, we are considering adding a dust monitor using piping installed near the PCV head. After investigating the closure of piping from the beginning of October, a dust monitor will be installed, and the access route construction work will be resumed from the beginning of November at the earliest.

### 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 the rubble and trimmed trees
- As of the end of August 2019, the total storage volume of the concrete and metal rubble was approx. 274,500 m<sup>3</sup> (+900 m<sup>3</sup> compared to at the end of July with an area-occupation rate of 68%). The total storage volume of trimmed trees was approx. 134,100 m<sup>3</sup> (±0 m<sup>3</sup>, with an area-occupation rate of 76%). The total storage volume of used protective clothing was approx. 56,500 m<sup>3</sup> (-600 m<sup>3</sup>, with an area-occupation rate of 83%). The increase in rubble was mainly attributable to construction related to tanks and general waste on site, while the decrease in used protective clothing was attributable to the operation of the incinerator.
- Management status of secondary waste from water treatment
- As of September 5, 2019, the total storage volume of waste sludge was 597 m<sup>3</sup> (area-occupation rate: 85%), while

that of concentrated waste fluid was 9,391 m<sup>3</sup> (area-occupation rate: 91%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment and other vessels, was 4,471 (area-occupation rate: 70%).

### 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*

- Test to check the cooling condition of the Unit 1 fuel debris
- In May 2019, to optimize the emergency response procedures and for other improvements, a test involving temporarily suspending water injection to the reactor was conducted at Unit 2 and confirmed the precision of temperature evaluation using the heat balance calculation which took heat release into the air into consideration to convey the actual status more accurately.
  - For Unit 1, a similar test suspending water injection to the reactor is planned, which will start from October 15 2019 and suspend water injection for about 48 hours. The estimated maximum temperature increase due to the suspension will be about 9°C.
  - Temperature and dust will be monitored during the test. When any abnormality is detected, water injection will immediately resume and other necessary measures will be taken.
  - Based on the test results at Unit 1, a test suspending water injection to Unit 3 reactor will be conducted within this fiscal year.

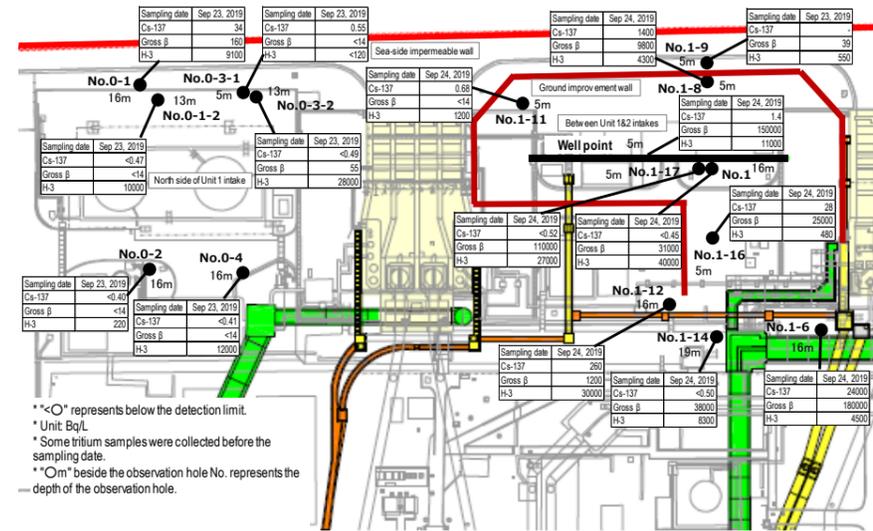
### 6. Reduction in radiation dose and mitigation of contamination

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

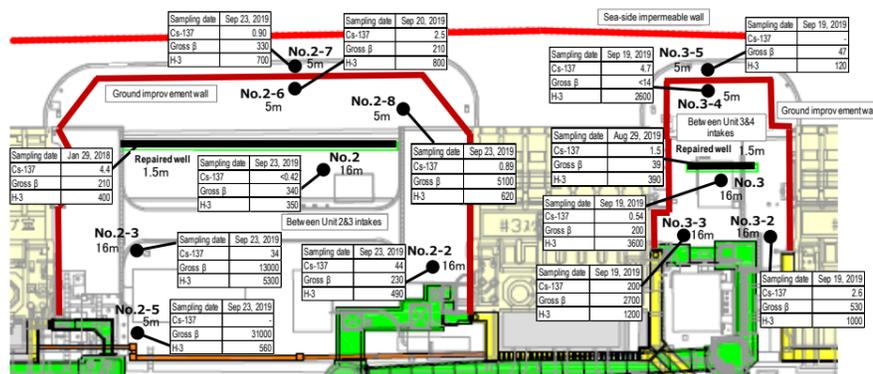
- Status of groundwater and seawater on the east side of Turbine Building Units 1-4
- At No. 1-8, the H-3 density had been increasing from around 2,000 Bq/L since December 2018 and currently stands at around 4,300 Bq/L.
  - At No. 1-9, the density of gross β radioactive materials has been repeatedly increasing and declining from around 20 Bq/L since April 2019 and currently stands at around 40 Bq/L.
  - At No. 1-12, the density of gross β radioactive materials had been increasing from around 200 Bq/L since December 2018 and currently stands at around 1,200 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).
  - At No. 2-3, the H-3 density had been increasing from around 4,000 Bq/L since March 2019 and currently stands at around 5,300 Bq/L. The density of gross β radioactive materials at the same point had been increasing from around 8,000 Bq/L since April 2019 and currently stands at around 13,000 Bq/L.
  - At No. 2-5, the H-3 density had been decreasing from around 2,300 Bq/L to less than 120 Bq/L since June 2019, then increasing and currently stands at around 560 Bq/L. The density of gross β radioactive materials at the same point had been decreasing from around 80,000 Bq/L to around 1,800 Bq/L since June 2019, then increasing and currently stands at around 31,000 Bq/L.
  - At No. 2-6, the density of gross β radioactive materials had been increasing from around 100 Bq/L since May 2019 and currently stands at around 210 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).
  - The densities of radioactive materials in drainage channels have remained constant, despite increasing during rainfall.
  - In the Unit 1-4 intake open channel area, densities of radioactive materials in seawater have remained below the legal discharge limit, while increasing in Cs-137 and Sr-90 below the legal discharge limit during rain. They have also been declining following the completed installation and the connection of steel pipe sheet piles for the sea-side impermeable walls. The density of Cs-137 has varied since March 20, 2019, when the silt fence was transferred to the center of the open channel by mega float-related construction.
  - In the area within the port, densities of radioactive materials in seawater have remained below the legal discharge limit, while increasing in Cs-137 and Sr-90 below the legal discharge limit during rain. They have remained below the

level of those in the Unit 1-4 intake open channel area and been declining following the completed installation and connection of steel pipe sheet piles for the sea-side impermeable walls.

- In the area outside the port, regarding the densities of radioactive materials in seawater, those of Cs-137 and Sr-90 declined and remained low after steel pipe sheet piles for the sea-side impermeable walls were installed and connected.



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



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

Figure 5: Groundwater density on the Turbine Building east side

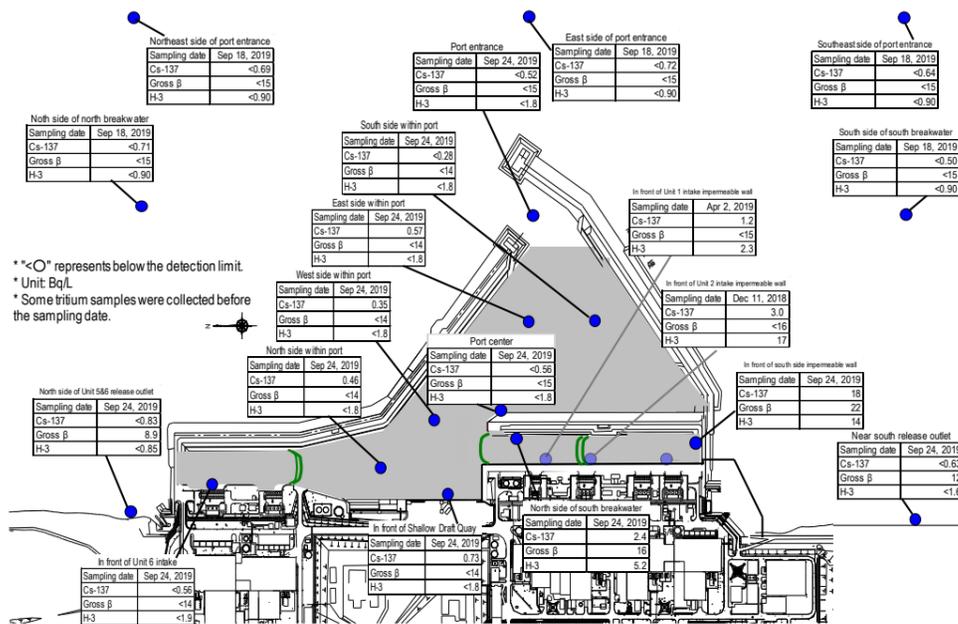


Figure 6: Seawater density around the port

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

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

### Staff management

- The monthly average total of personnel registered for at least one day per month to work on site during the past quarter from May to July 2019 was approx. 8,800 (TEPCO and partner company workers), which exceeded the monthly average number of actual workers (approx. 6,500). Accordingly, sufficient personnel are registered to work on site.
- It was confirmed with the prime contractors that the estimated manpower necessary for the work in October 2019 (approx. 3,700 per day: TEPCO and partner company workers) would be secured at present. The average numbers of workers per day per month (actual values) were maintained, with approx. 3,400 to 5,600 since FY2017 (see Figure 7).
- The number of workers from within and outside Fukushima Prefecture remained constant. The local employment ratio (TEPCO and partner company workers) as of August 2019 has also remained constant at around 60%.
- The monthly average exposure dose of workers remained at approx. approx. 0.39, 0.36 and 0.32 mSv/month during FY2016, FY2017 and FY2018 respectively. (Reference: Annual average exposure dose 20 mSv/year  $\approx$  1.7 mSv/month)
- For most workers, the exposure dose was sufficiently within the limit and allowed them to continue engaging in radiation work.

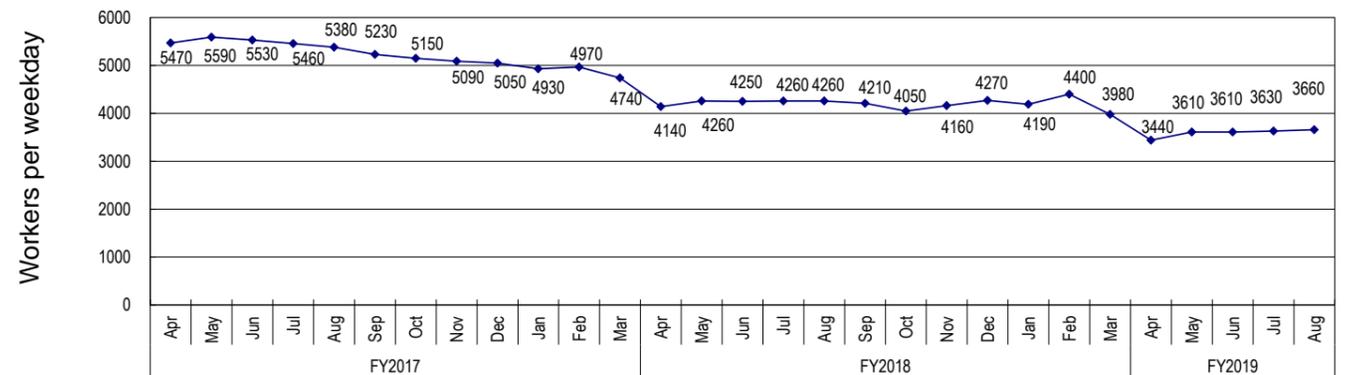


Figure 7: Changes in the average number of workers per weekday for each month since FY2017 (actual values)

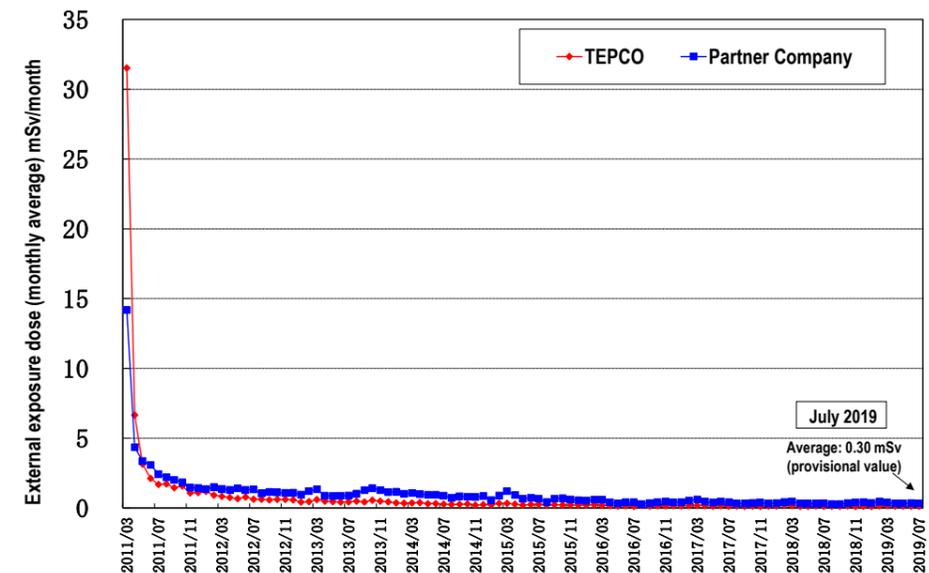


Figure 8: Changes in monthly individual worker exposure dose (monthly average exposure dose since March 2011)

➤ Status of heat stroke cases

- In FY2019, measures to further prevent heat stroke commenced from April to cope with the hottest season.
- In FY2019, 12 workers suffered heat stroke due to work up until September 23 (in FY2018, seven workers up until the end of September). Continued measures will be taken to prevent heat stroke.

8. Status of Units 5 and 6

➤ Status of spent fuel storage in Units 5 and 6

- Regarding Unit 5, fuel removal from the reactor was completed in June 2015. A total of 1,374 spent and 168 non-irradiated fuel assemblies, respectively, were stored in the spent fuel pool (storage capacity: 1,590 assemblies).
- Regarding Unit 6, fuel removal from the reactor was completed in November 2013. A total of 1,456 spent and 198 non-irradiated fuel assemblies (180 of which transferred from the Unit 4 spent fuel pool) are stored in the spent fuel pool (storage capacity: 1,654), while 230 non-irradiated fuel assemblies are stored in the storage facility of non-irradiated fuel assemblies (storage capacity: 230).

➤ Status of contaminated water treatment in Units 5 and 6

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

9. Others

➤ Review of the concept about measures for earthquakes and tsunami

- Important safety facilities are being evaluated and measures implemented in a phased manner according to the scale of anticipated earthquakes and tsunami. For the evaluation and measures, tsunami risks were reviewed from the perspectives of influence (inventory) and frequency (regarding the occurrence of tsunami of height exceeding the limit from which each risk source may be affected).
- The result showed that regarding liquids (including sludge), risks were expected to be mitigated as ongoing (planned) tsunami measures for decontamination equipment sludge, which had relatively high risks, and contaminated water in buildings progressed. Regarding solids, the influence of the tsunami for review on the common pool was evaluated and safety was confirmed.

➤ Status of construction to install a tide embankment for the Chishima trench tsunami

- In preparation for the potentially urgent hazard of the Chishima trench tsunami, a tide embankment is being installed.
- Following preparatory work, including removal and transfer of the existing facilities and site preparation and raising, installation of L-shaped retaining walls started from September 23, 2019. The tide embankment (approx. 600m long) is divided into eight areas and work will be implemented in a phased manner to be completed in the 1st half of FY2020.

➤ Status of examination to formulate a long-term maintenance plan for onsite facilities and other equipment

- For facilities which are being used in measures for decommissioning and contaminated water management, levels required for maintenance are set based on the manual and inspections are implemented according to the long-term inspection plan.
- Based on the post-earthquake environmental change, risks to which special attention should be paid in the decommissioning process are identified and for facilities (equipment) to which such risks apply, a long-term maintenance plan will be formulated according to the aging degradation modes.
- For high-priority items, the plan will be formulated by around the end of this fiscal year, with measures based on the same to be implemented from the following fiscal year.

➤ Publication of the Technical Strategic Plan 2019

- The Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) made and published the "Technical Strategic Plan 2019 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc." on September 9, 2019 aiming to provide a firm technical basis for the government's

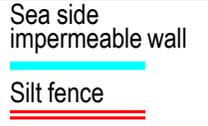
"Mid- and long-term Roadmap" and facilitate the smooth and steady implementation of decommissioning.

- This plan provides strategic proposals concerning the methods used to retrieve fuel debris from the first unit.

# 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 16-24)”; 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>



Cesium-134: 3.3 (2013/10/17) → ND(0.29) Below 1/10  
Cesium-137: 9.0 (2013/10/17) → 0.57 Below 1/10  
Gross β: **74** (2013/ 8/19) → ND(14) Below 1/5  
Tritium: 67 (2013/ 8/19) → ND(1.8) Below 1/30

Cesium-134: 4.4 (2013/12/24) → ND(0.30) Below 1/10  
Cesium-137: **10** (2013/12/24) → 0.35 Below 1/20  
Gross β: **60** (2013/ 7/ 4) → ND(14) Below 1/4  
Tritium: 59 (2013/ 8/19) → ND(1.8) Below 1/30

Cesium-134: 5.0 (2013/12/2) → ND(0.30) Below 1/10  
Cesium-137: 8.4 (2013/12/2) → 0.46 Below 1/10  
Gross β: **69** (2013/8/19) → ND(14) Below 1/4  
Tritium: 52 (2013/8/19) → ND(1.8) Below 1/20

Cesium-134: 2.8 (2013/12/2) → ND(0.43) Below 1/6  
Cesium-137: 5.8 (2013/12/2) → ND(0.56) Below 1/10  
Gross β: **46** (2013/8/19) → ND(14) Below 1/3  
Tritium: 24 (2013/8/19) → ND(1.9) Below 1/10

Cesium-134: ND(0.44)  
Cesium-137: ND(0.56)  
Gross β: ND(15)  
Tritium: ND(1.8) \*1

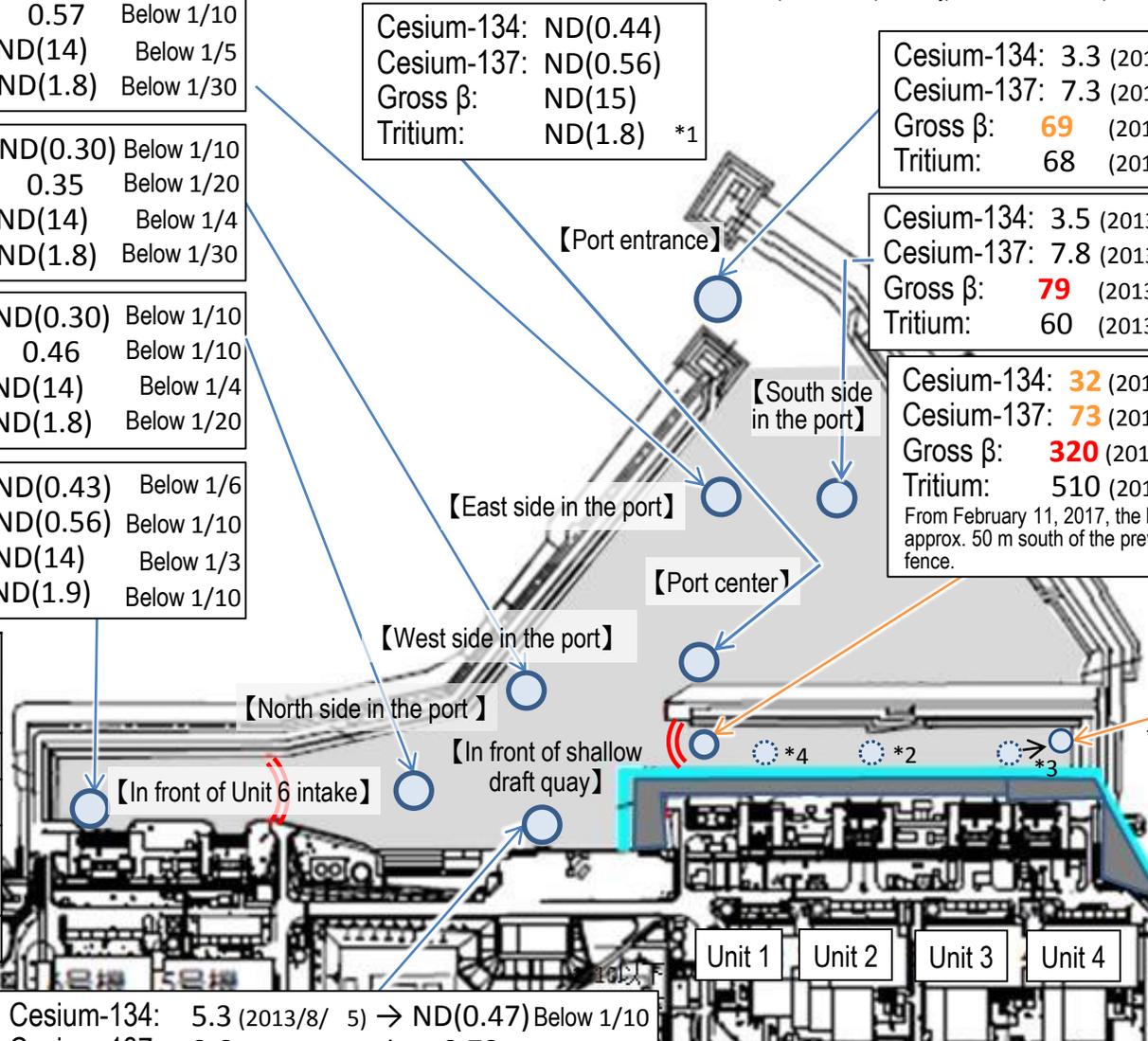
Cesium-134: 3.3 (2013/12/24) → ND(0.56) Below 1/5  
Cesium-137: 7.3 (2013/10/11) → ND(0.52) Below 1/10  
Gross β: **69** (2013/ 8/19) → ND(15) Below 1/4  
Tritium: 68 (2013/ 8/19) → ND(1.8) Below 1/30

Cesium-134: 3.5 (2013/10/17) → ND(0.29) Below 1/10  
Cesium-137: 7.8 (2013/10/17) → ND(0.28) Below 1/20  
Gross β: **79** (2013/ 8/19) → ND(14) Below 1/5  
Tritium: 60 (2013/ 8/19) → ND(1.8) Below 1/30

Cesium-134: **32** (2013/10/11) → ND(0.50) Below 1/60  
Cesium-137: **73** (2013/10/11) → 2.4 Below 1/30  
Gross β: **320** (2013/ 8/12) → 16 Below 1/20  
Tritium: 510 (2013/ 9/ 2) → 5.2 Below 1/90  
From February 11, 2017, the location of the sampling point was shifted approx. 50 m south of the previous point due to the location shift of the silt fence.

Cesium-134: 1.5  
Cesium-137: 18  
Gross β: 22  
Tritium: 14 \*1

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



Cesium-134: 5.3 (2013/8/ 5) → ND(0.47) Below 1/10  
Cesium-137: 8.6 (2013/8/ 5) → 0.73 Below 1/10  
Gross β: **40** (2013/7/ 3) → ND(14) Below 1/2  
Tritium: 340 (2013/6/26) → ND(1.8) Below 1/100

\*1: Monitoring commenced in or after March 2014. Monitoring inside the sea-side impermeable walls was finished because of the landfill.  
\*2: For the point, monitoring was finished from December 12, 2018 due to preparatory work for transfer of mega float.  
\*3: For the point, monitoring point was moved from February 6, 2019 due to preparatory work for transfer of mega float.  
\*4: For the point, monitoring was finished from April 3, 2019 due to preparatory work for transfer of mega float.

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 September 25, 2019

# 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 16-24)

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

	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

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

Cesium-134: ND (2013) → ND (0.74)  
 Cesium-137: ND (2013) → ND (0.69)  
 Gross β: ND (2013) → ND (15)  
 Tritium: ND (2013) → ND (0.90)

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

Cesium-134: ND (2013) → ND (0.56)  
 Cesium-137: 1.6 (2013/10/18) → ND (0.72) Below 1/2  
 Gross β: ND (2013) → ND (15)  
 Tritium: 6.4 (2013/10/18) → ND (0.90) Below 1/7

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

Cesium-134: ND (2013) → ND (0.65)  
 Cesium-137: ND (2013) → ND (0.64)  
 Gross β: ND (2013) → ND (15)  
 Tritium: ND (2013) → ND (0.90)

Cesium-134: ND (2013) → ND (0.65)  
 Cesium-137: ND (2013) → ND (0.71)  
 Gross β: ND (2013) → ND (15)  
 Tritium: 4.7 (2013/ 8/18) → ND (0.90) Below 1/5

【Port entrance】

Cesium-134: 3.3 (2013/12/24) → ND (0.56) Below 1/5  
 Cesium-137: 7.3 (2013/10/11) → ND (0.52) Below 1/10  
 Gross β: 69 (2013/ 8/19) → ND (15) Below 1/4  
 Tritium: 68 (2013/ 8/19) → ND (1.8) Below 1/30

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

Cesium-134: ND (2013) → ND (0.84)  
 Cesium-137: ND (2013) → ND (0.50)  
 Gross β: ND (2013) → ND (15)  
 Tritium: ND (2013) → ND (0.90)

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

【North side of Unit 5 and 6 release outlet】

Cesium-134: 1.8 (2013/ 6/21) → ND (0.67) Below 1/2  
 Cesium-137: 4.5 (2013/ 3/17) → ND (0.64) Below 1/7  
 Gross β: 12 (2013/12/23) → 8.9  
 Tritium: 8.6 (2013/ 6/26) → ND (0.85) Below 1/10

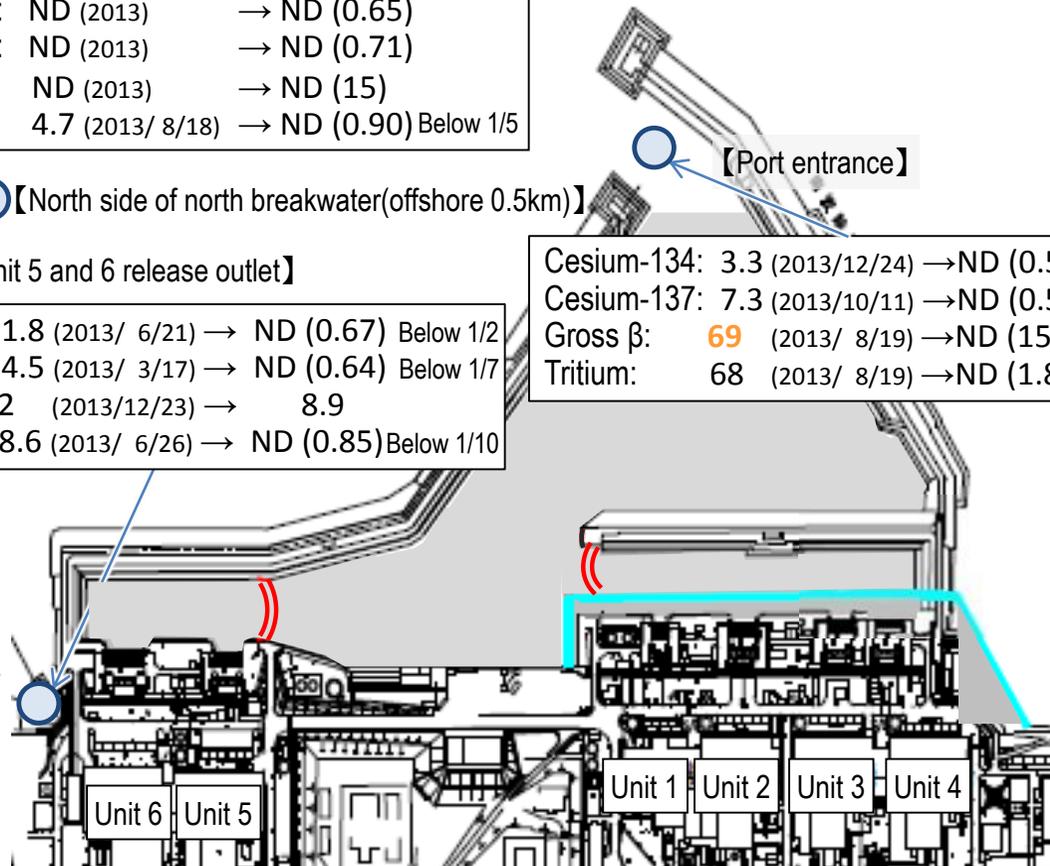
Cesium-134: ND (2013) → ND (0.71)  
 Cesium-137: 3.0 (2013/ 7/15) → ND (0.63) Below 1/4  
 Gross β: 15 (2013/12/23) → 12  
 Tritium: 1.9 (2013/11/25) → ND (0.85) Below 1/2

【Near south release outlet】

Sea side impermeable wall  
 Silt fence

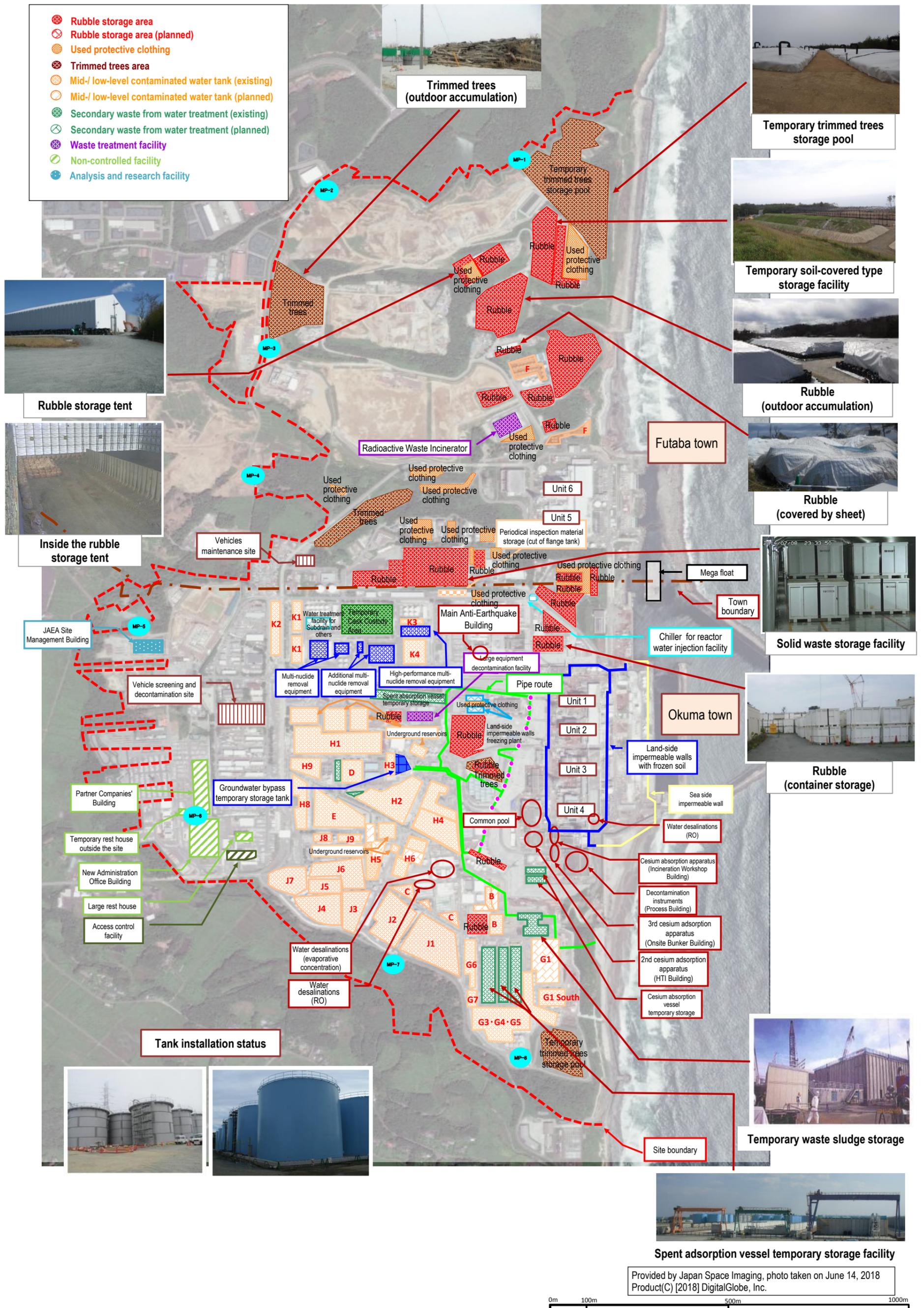
Note: Because safety of the sampling points was unassured due to the influence of Typhoon No. 10 in 2016, samples were taken from approx. 330 m south of the Unit 1-4 release outlet. Samples were also taken from a point approx. 280m south from the same release outlet from January 27, 2017 and approx. 320m from March 23, 2018

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 September 25, 2019

# TEPCO Holdings Fukushima Daiichi Nuclear Power Station Site Layout



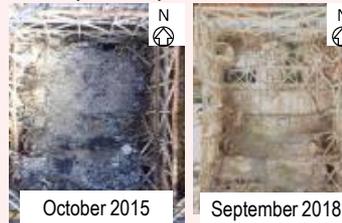
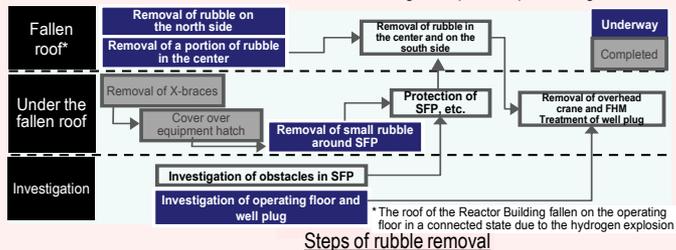
## Progress toward decommissioning: Fuel removal from the spent fuel pool (SFP)

Immediate target

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

## Unit 1

Toward fuel removal from the spent fuel pool, there is a plan to install a dedicated cover for fuel removal over the top floor of the Reactor Building (operating floor). On November 10, 2016, removal of all roof panels and wall panels of the building cover was completed. On May 11, 2017, removal of pillars and beams of the building cover was completed. On December 19, 2017, modification of the pillars and beams of the building cover and installation windbreak fences were completed. From March 18, 2019, removal of small rubble in the east-side area around the SFP started as an initial step using pliers and suction equipment. From July 9, 2019, small rubble removal on the south side of the SFP started. Rubble removal and investigation prior to protecting the SFP, etc. are currently underway.

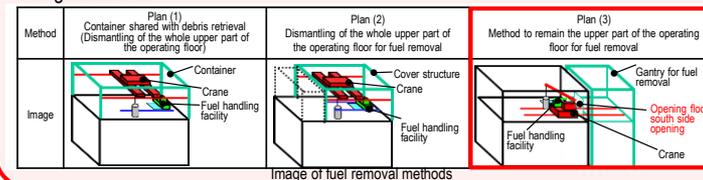


&lt;Status of the operating floor&gt;

## Unit 2

Toward fuel removal and debris retrieval in the Unit 2 spent fuel pool, the scope of dismantling and modification of the existing Reactor Building rooftop is examined. Based on the investigative results inside the operating floor, etc., methods are being examined from the perspective of ensuring safety during work, controlling influence on the outside of the power station, and removing fuel rapidly to reduce risks.

In addition to Plan (1) in which the whole upper part of the operating floor is dismantled and the container of poor fuel is shared with debris retrieval and Plan (2) in which a cover for pool fuel retrieval is separately installed, a method which minimizes the range of dismantling the upper part of the operating floor and accesses from the south side is being examined.



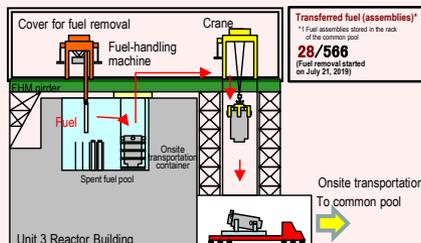
## Unit 3

Prior to the installation of a cover for fuel removal, removal of large rubble from the spent fuel pool was completed in November 2015. To ensure safe and steady fuel removal, training of remote control was conducted at the factory using the actual fuel-handling machine which will be installed on site (February – December 2015). Measures to reduce dose on the Reactor Building top floor (decontamination, shields) were completed in December 2016. Installation of a cover for fuel removal and a fuel-handling machine is underway from January 2017. Installation of the fuel removal cover was completed on February 23, 2018.

Toward fuel removal, the rubble retrieval training inside the pool, which was scheduled in conjunction with fuel removal training, started from March 15, 2019, and started fuel removal from April 15, 2019.



Installation of dome roof (February 21, 2019)



Fuel removal status (April 15, 2019)

## 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 1<sup>st</sup> Unit within two years of completion of Step 2 (by December 2013). On November 18, 2013, fuel removal from Unit 4, or the 1<sup>st</sup> Unit, commenced and Phase 2 of the roadmap started.

On November 5, 2014, within a year of commencing work to fuel removal, 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)

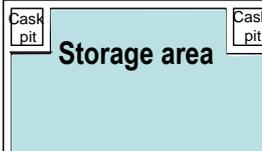
This marks the completion of fuel removal from the Unit 4 Reactor Building. Based on this experience, fuel assemblies will be removed from Unit 1-3 pools.

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



Fuel removal status

## Common pool

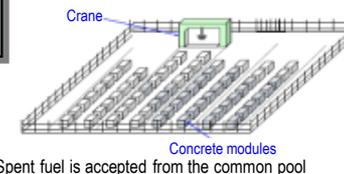


An open space will be maintained in the common pool (Transfer to the temporary cask custody area)

## 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 removal from the Unit 4 spent fuel pool began to be received (November 2013 - November 2014)
- Fuel removal from the Unit 3 spent fuel pool began to be received (from April 2019)

## Temporary cask (\*) custody area



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.

## &lt;Glossary&gt;

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

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

### 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<sup>(1)</sup>. (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<sup>(2)</sup> (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<sup>(3)</sup>)

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

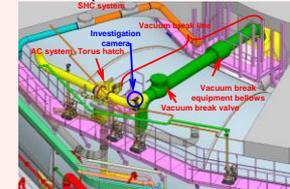
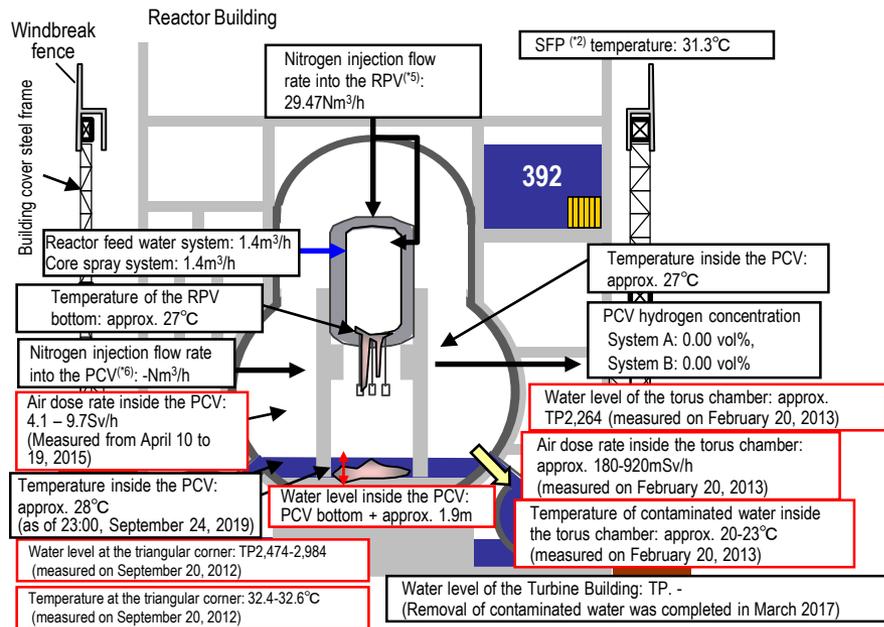


Image of the S/C upper part investigation

## Unit 1

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



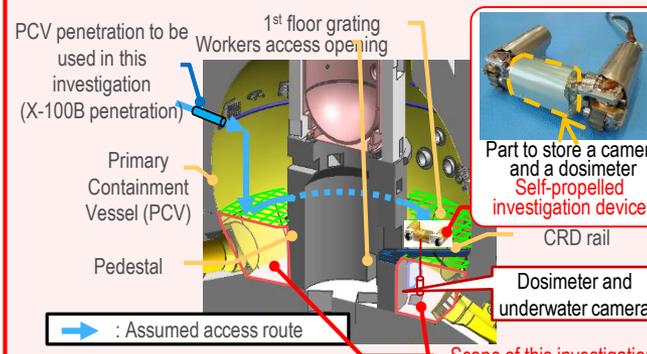
\* Indices related to the plant are values as of 11:00, September 25, 2019

### Status of investigation inside the PCV

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

[Investigative outline]

- In April 2015, a device, which entered the inside of the PCV through a narrow access opening (bore:  $\phi$  100 mm), collected information such as images and airborne dose inside the PCV 1st floor.
- In March 2017, the investigation using a self-propelled investigation device, conducted to inspect the spreading of debris to the basement floor outside the pedestal, took images of the PCV bottom status for the first time. The status inside the PCV will continue to be examined based on the collected image and dose data.



<Image of investigation inside the PCV>

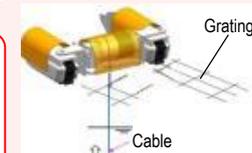


Image of hanging of dosimeter and camera



Image near the bottom

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

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

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

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

September 26, 2019

Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment 3/6

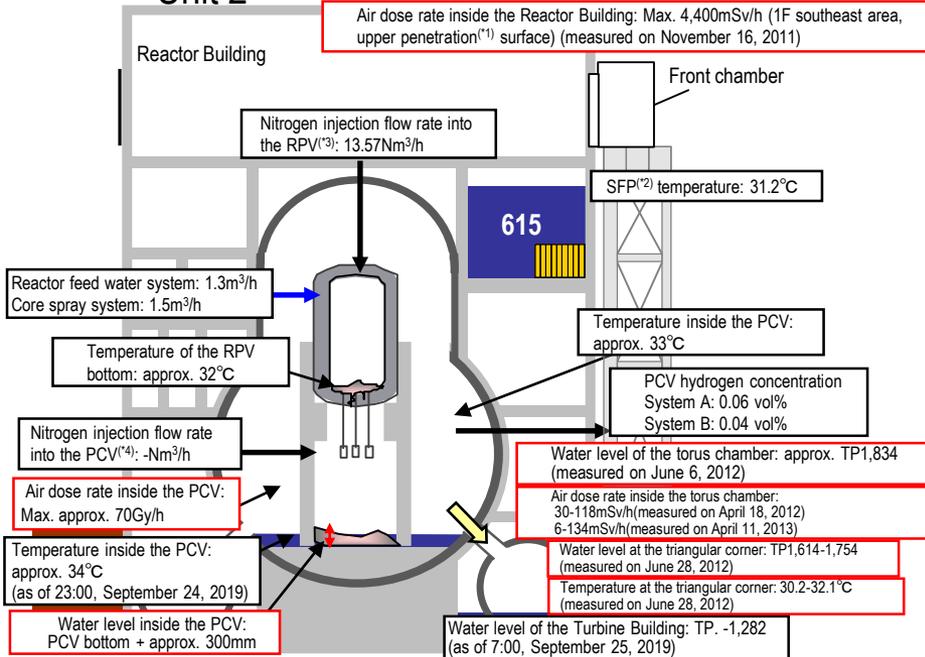
**Immediate target**

**Identify the plant status and commence R&D and decontamination toward fuel debris retrieval**

## Installation of an RPV thermometer and permanent PCV supervisory instrumentation

- 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.
  - In April 2014, removal of the broken thermometer failed and was suspended. Rust-stripping chemicals were injected and the broken thermometer was removed in January 2015. A new thermometer was reinstalled in March. The thermometer has been used as a part of permanent supervisory instrumentation since April.
- 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 in May 2014 and new instruments were reinstalled in 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

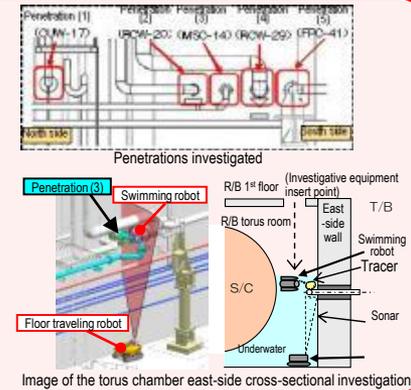


\* Indices related to plant are values as of 11:00, September 25, 2019

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 contaminated water - Measuring water level - Installing permanent monitoring instrumentation
	4th (Jan – Feb 2017)	- Acquiring images - Measuring dose rate - Measuring air temperature
Leakage points from PCV	- No leakage from torus chamber rooftop - No leakage from all inside/outside surfaces of S/C	

## Investigative results on torus chamber walls

- The torus chamber walls were investigated (on the north side of the east-side walls) using equipment specially developed for that purpose (a swimming robot and a floor traveling robot).
- At the east-side wall pipe penetrations (five points), "the status" and "existence of flow" were checked.
- A demonstration using the above two types of underwater wall investigative equipment showed how the equipment could check the status of penetration.
- Regarding Penetrations 1 - 5, the results of checking the sprayed tracer (\*) by camera showed no flow around the penetrations. (investigation by the swimming robot)
- Regarding Penetration 3, a sonar check showed no flow around the penetrations. (investigation by the floor traveling robot)



## Status of investigation inside the PCV

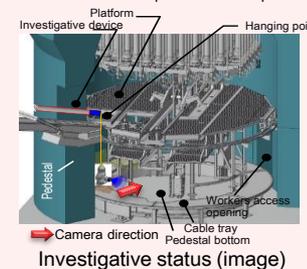
Prior to fuel debris retrieval, an investigation inside the PCV will be conducted to inspect the status there including the location of fuel debris.

[Investigative outline]

- Investigative devices such as a robot will be injected from Unit 2 X-6 penetration (\*) and access the inside of the pedestal using the CRD rail.

[Progress status]

- On January 26 and 30, 2017, a camera was inserted from the PCV penetration to inspect the status of the CRD replacement rail on which the robot will travel. On February 9, deposit on the access route of the self-propelled investigative device was removed and on February 16, the inside of the PCV was investigated using the device.
- The results of this series of investigations confirmed fallen and deformed gratings and a quantity of deposit inside the pedestal.
- On January 19, 2018, the status below the platform inside the pedestal was investigated using an investigative device with a hanging mechanism. From the analytical results of images obtained in the investigation, deposits probably including fuel debris were found at the bottom of the pedestal. In addition, multiple parts higher than the surrounding deposits were also detected. We presumed that there were multiple routes of fuel debris falling. Obtained data were processed in panoramic image visualization to acquire clearer images.
- On February 13, 2019, an investigation touching the deposits at the bottom of the pedestal and on the platform was conducted and confirmed that the pebble-shaped deposits, etc. could be moved and that hard rock-like deposits that could not be gripped may exist.
- In addition, images, etc. would help determine the contour and size of the deposits could be collected by moving the investigative unit closer to the deposits than the previous investigation.



Bottom of the pedestal (after being processed in panoramic image visualization)

## 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> (\*) Penetration: Through-hole of the PCV (\*\*) SFP (Spent Fuel Pool) (\*\*\*) RPV (Reactor Pressure Vessel) (\*\*\*\*) PCV (Primary Containment Vessel) (\*\*\*\*) 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 retrieval

### Water flow was detected from the Main Steam Isolation Valve\* room

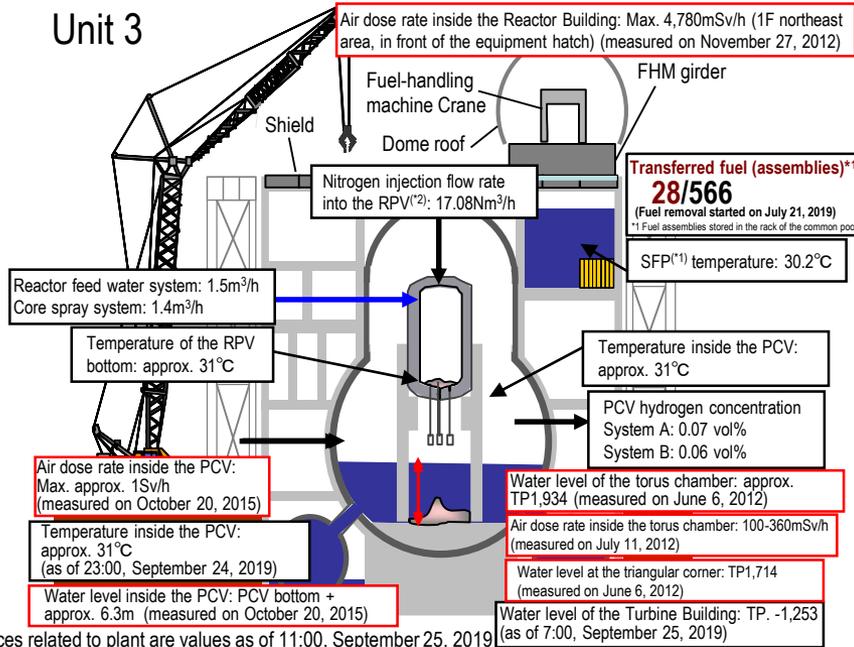
On January 18, 2014, a flow of water from around the door of the Steam Isolation Valve room in the Reactor Building Unit 3 1st floor northeast area to the nearby floor drain funnel (drain outlet) was detected. As the drain outlet connects with the underground part of the Reactor Building, there is no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



### 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 retrieval, 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.

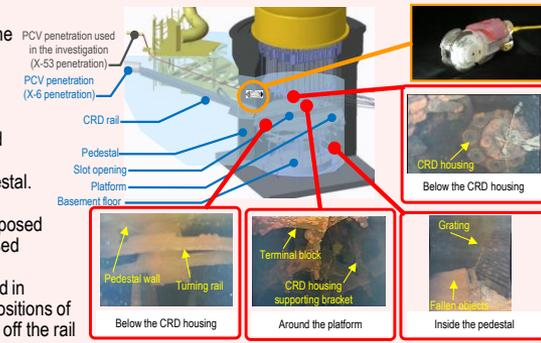


### Investigation inside the PCV

Prior to fuel debris retrieval, the inside of the Primary Containment Vessel (PCV) was investigated to identify the status there including the location of the fuel debris.

#### [Investigative outline]

- The status of X-53 penetration<sup>(\*)4</sup>, 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. The results showed that the penetration was not under the water (October 22-24, 2014).
- 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 contaminated 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 July 2017, the inside of the PCV was investigated using the underwater ROV (remotely operated underwater vehicle) to inspect the inside of the pedestal.
- Analysis of image data obtained in the investigation identified damage to multiple structures and the supposed core internals. Consideration about fuel removal based on the obtained information will continue.
- Videos obtained in the investigation were reproduced in 3D. Based on the reproduced images, the relative positions of the structures, such as the rotating platform slipping off the rail with a portion buried in deposits, were visually understood.



Status inside the pedestal

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

Period	Evaluation results
May – Sep 2017	The evaluation confirmed that no large lump existed in the core area where fuel had been placed and that part of the fuel debris potentially existed at the bottom of the RPV.

<Glossary>

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

Investigations inside PCV	1st (Oct – Dec 2015)	- Acquiring images - Measuring air temperature and dose rate - Measuring water level and temperature - Sampling contaminated water - Installing permanent monitoring instrumentation (December 2015)
	2nd (Jul 2017)	- Acquiring images - Installing permanent monitoring instrumentation (August 2017)
Leakage points from PCV	- Main steam pipe bellows (identified in May 2014)	

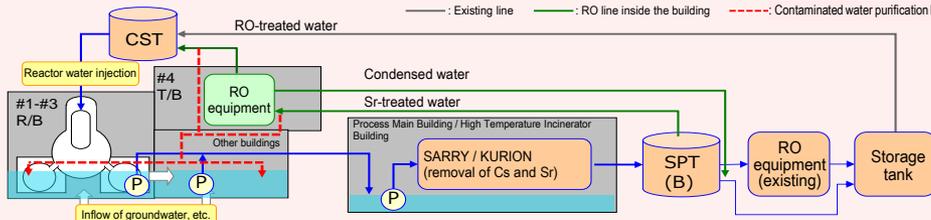
## Immediate target

Stably continue reactor cooling and contaminated water treatment, and improve reliability

### Work to improve the reliability of the circulation water injection cooling system and pipes to transfer contaminated water.

- Operation of the reactor water injection system using Unit 3 Condensate Storage Tank (CST) as a water source commenced (from July 5, 2013). Compared to the previous systems, the reliability of the reactor water injection system was enhanced, e.g. by increasing the amount of water-source storage and enhancing durability.
- To reduce the risk of contaminated-water leakage, the circulation loop was shortened by installing a reverse osmosis (RO) device in the Unit 4 Turbine Building within the circulation loop, comprising the transfer of contaminated water, water treatment and injection into the reactors. Operation of the installed RO device started from October 7 and 24-hour operation started from October 20. Installation of the new RO device inside the building shortened the circulation loop from approx. 3 to 0.8 km.
- To accelerate efforts to reduce the radiation density in contaminated water inside the buildings, circulating purification of contaminated water inside the buildings started on the Unit 3 and 4 side on February 22 and on the Unit 1 and 2 side on April 11.
- For circulating purification, a new pipe (contaminated water purification line) divided from the water treatment equipment outlet line was installed to transfer water purified at the water treatment equipment to the Unit 1 Reactor Building and the Unit 2-4 Turbine Buildings.
- The risks of contaminated water inside the buildings will continue to be reduced in addition to reduction of its storage.

\* 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 flanged tanks, dismantling of flanged tanks started in H1 east/H2 areas in May 2015. Dismantling of all flanged tanks was completed in H1 east area (12 tanks) in October 2015, in H2 area (28 tanks) in March 2016, in H4 area (56 tanks) in May 2017, in H3 B area (31 tanks) in September 2017, in H5 and H5 north areas (31 tanks) in June 2018, in G6 area (38 tanks) in July 2018, H6 and H6 north areas (24 tanks) in September 2018 and G4 south area (17 tanks) in March 2019.



Start of dismantling in H1 east area

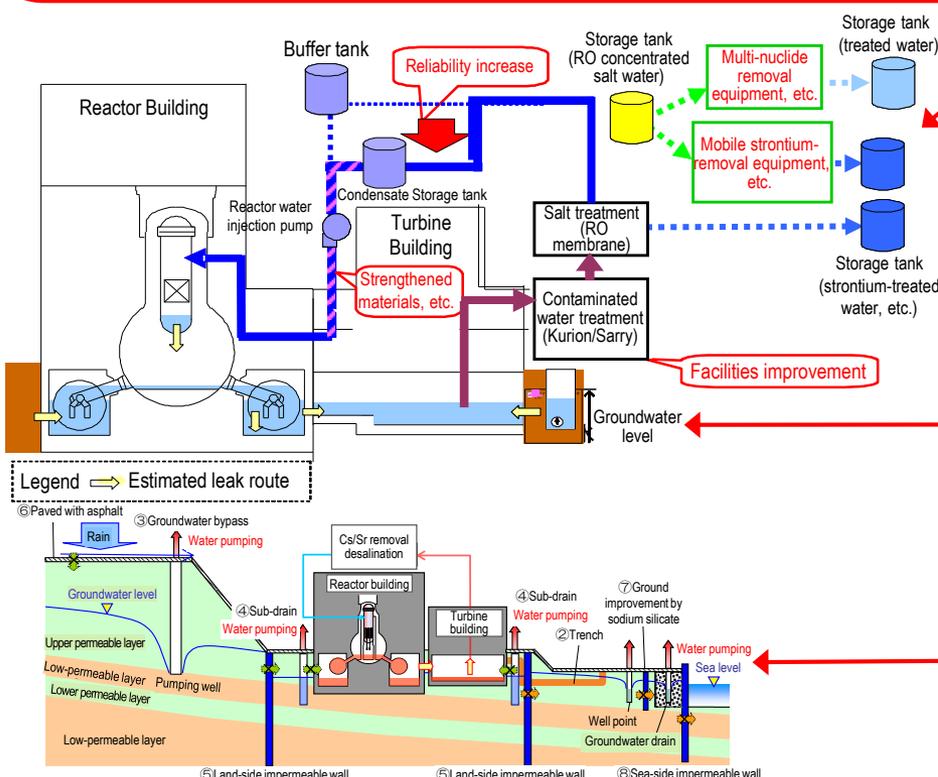


After dismantling in H1 east area

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

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

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



### Preventing groundwater from flowing into the Reactor Buildings

#### Reducing groundwater inflow by pumping sub-drain water

To reduce groundwater flowing into the buildings, pumping-up of groundwater from wells (sub-drains) around the buildings started on September 3, 2015. Pumped-up groundwater was purified at dedicated facilities and released after TEPCO and a third-party organization confirmed that its quality met operational targets.

#### Via a groundwater bypass, reduce the groundwater level around the Building and groundwater inflow into the Building

Measures to pump up groundwater flowing from the mountain side upstream of the Building to reduce the groundwater inflow (groundwater bypass) have been implemented.

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

Through periodical monitoring, pumping of wells and tanks is operated appropriately.

At the observation holes installed at a height equivalent to the buildings, the trend showing a decline in groundwater levels is checked.

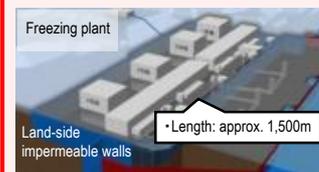
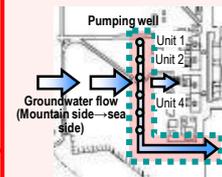
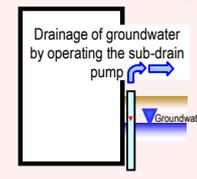
The analytical results on groundwater inflow into the buildings based on existing data showed a declining trend.

#### Installing land-side impermeable walls with frozen soil around Units 1-4 to prevent the inflow of groundwater into the building

To prevent the inflow of groundwater into the buildings, installation of impermeable walls on the land side is planned. Freezing started on the sea side and at a part of the mountain side from March 2016 and at 95% of the mountain side from June 2016. Freezing of the remaining unfrozen sections advanced with a phased approach and freezing of all sections started in August 2017.

In March 2018, construction of the land-side impermeable walls was completed, except for a portion of the depth, based on a monitoring result showing that the underground temperature had declined below 0°C in almost all areas, while on the mountain side, the difference between the inside and outside increased to approx. 4-5 m. The 21st Committee on Countermeasures for Contaminated Water Treatment, held on March 7, 2018, evaluated that together with the function of sub-drains, etc., a water-level management system to stably control groundwater and isolate the buildings from it had been established and had allowed a significant reduction in the amount of contaminated water generated.

For the unfrozen depth, a supplementary method was implemented and it was confirmed that temperature of the part declined below 0°C by September 2018. From February 2019, maintenance operation started at all sections.



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

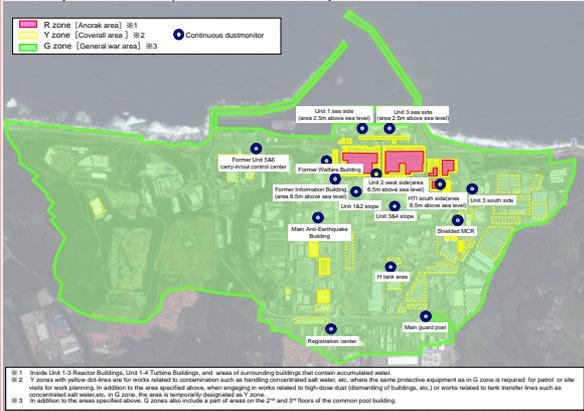
### Immediate targets

- 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

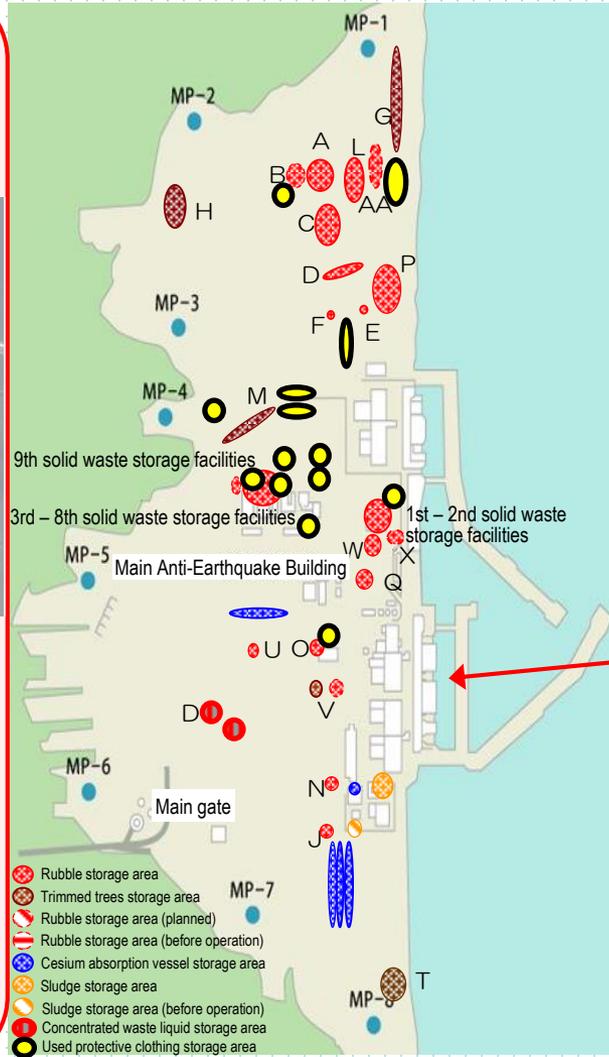
Based on the progress of measures to reduce environmental dosage on site, the site is categorized into two zones: highly contaminated area around Unit 1-4 buildings, etc. and other areas to optimize protective equipment according to each category aiming at improving safety and productivity by reducing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

From March 2016, limited operation started. From March and September 2017, the G Zone was expanded.



R zone (Anorak area)	Y zone (Coverall area)	G zone (General wear)
Full-face mask 	Full-face or half-face masks 	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.

