Outline of Decommissioning, Contaminated Water and Treated Water Management

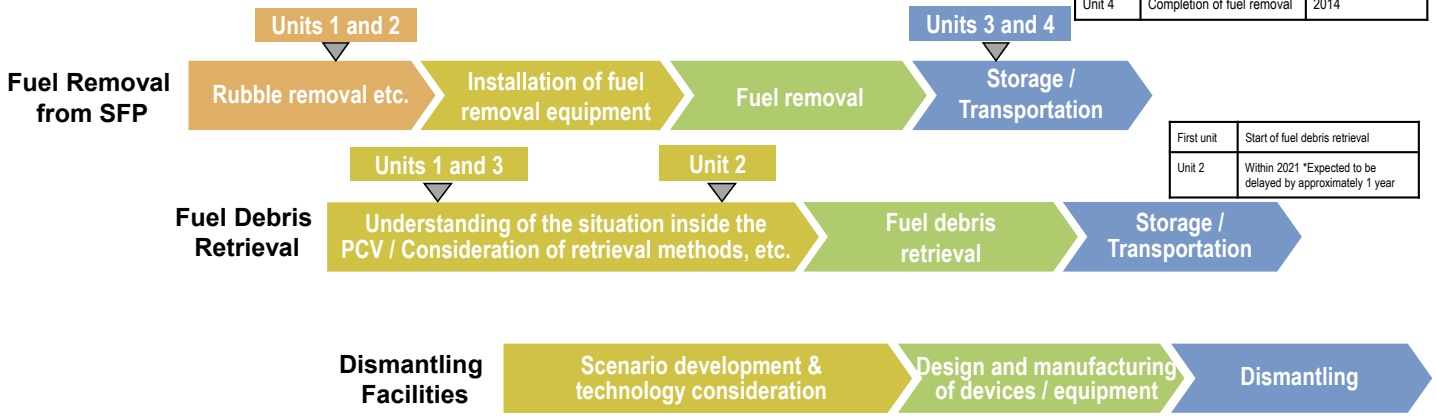
February 24, 2022
Secretariat of the Team for Countermeasures for Decommissioning, Contaminated Water and Treated Water

Main decommissioning work and steps

Fuel removal from the spent fuel pool was completed in December 2014 at Unit 4 and on February 28, 2021 at Unit 3.
Work continues sequentially toward the start of fuel removal from Units 1 and 2 and debris (Note 1) retrieval from Units 1-3.

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

Units 1-6	Completion of fuel removal	Within 2031
Unit 1	Start of fuel removal	FY2027 - FY2028
Unit 2	Start of fuel removal	FY2024 - FY2026
Unit 3	Completion of fuel removal	Within FY2020
Unit 4	Completion of fuel removal	2014

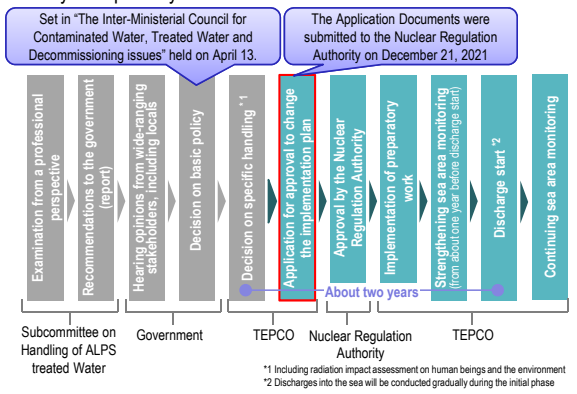


First unit	Start of fuel debris retrieval
Unit 2	Within 2021 *Expected to be delayed by approximately 1 year

Measures of treated water

Handling of ALPS treated water

Regarding the discharge of ALPS treated water into the sea, TEPCO must comply with regulatory and other safety standards to safeguard the public, the surrounding environment and agricultural, forestry and fishery products. To minimize adverse impacts on reputation, monitoring will be further enhanced and objectivity and transparency ensured by engaging with third-party experts and having safety checked by the IAEA. Moreover, accurate information will be disseminated continuously and fully transparently.



Contaminated water management – triple-pronged efforts -

(1) Efforts to promote contaminated water management based on the three basic policies

① "Remove" the source of water contamination ② "Redirect" fresh water from contaminated areas
③ "Retain" contaminated water from leakage

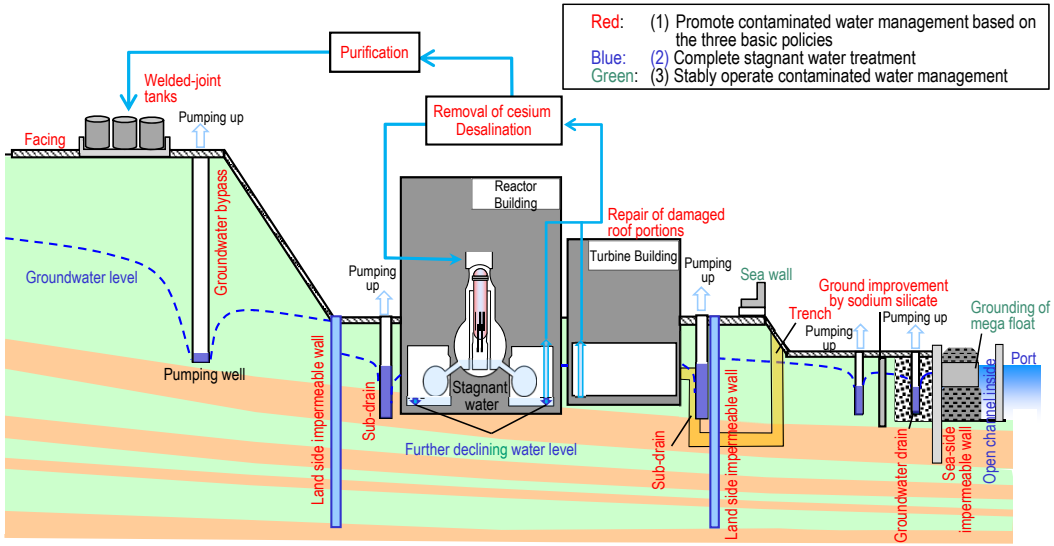
- Strontium-reduced water from other equipment is being re-treated in the Advanced Liquid Processing System (ALPS: multi-nuclide removal equipment) and stored in welded-joint tanks.
- Multi-layered contaminated water management measures, including land-side impermeable walls and sub-drains, have stabilized the groundwater at a low level and the increased 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. 540 m^3/day (in May 2014) to approx. 180 m^3/day (in FY2019) and approx. 140 m^3/day (in 2020).
- Measures continue to further suppress the generation of contaminated water to 100 m^3/day or less within 2025.

(2) Efforts to complete stagnant water treatment

- To lower the stagnant water levels in buildings as planned, work to install additional stagnant water transfer equipment is underway. At present, the floor surface exposure condition can be maintained except for the Unit 1-3 Reactor Buildings, Process Main Building and the High Temperature Incinerator Building.
- In 2020, treatment of stagnant water in buildings was completed, except for the Unit 1-3 Reactor Buildings, Process Main Building and High-Temperature Incinerator Building. For Reactor Buildings, the amount of stagnant water there will be reduced to about half the amount at the end of 2020 during the period FY2022-2024.
- For Zeolite sandbags on the basement floors of the Process Main Building and High-Temperature Incinerator Building, measures to reduce the radiation dose are being examined with stabilization in mind.

(3) Efforts to stably operate contaminated water management

- To prepare for tsunamis, various measures are underway. For heavy rain, sandbags are being installed to suppress direct inflow into buildings while work sealing off openings in buildings and installing sea walls to enhance drainage channels and other measures are being implemented as planned.



Progress status

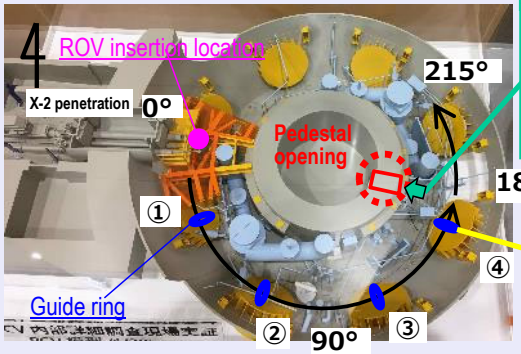
◆ The temperatures of the Reactor and the Primary Containment Vessel of Units 1-3 have been maintained stable.
There was no significant change in the concentration of radioactive materials newly released from Reactor Buildings into the air. It was concluded that the comprehensive cold shutdown condition had been maintained.

Unit 1 A submersible vehicle was inserted into the Primary Containment Vessel(PCV)

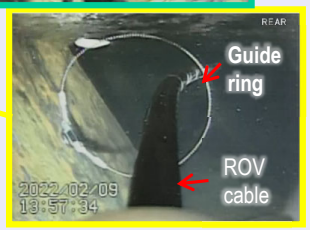
Toward internal investigation of the Unit 1 PCV, the first remotely operated underwater vehicle (ROV-A) was inserted on February 8 to install "guide rings" which will facilitate the investigation. On February 9, installation of four guide rings has been completed.

The investigation detected deposits at the PCV bottom, pedestal opening, pieces of the grating and steel materials, which were likely to be cut during work to create an opening an access route, and pipes of the Primary Loop Recirculation system.

After completing preparation, a detailed investigation by the ROV-A2 will be implemented.

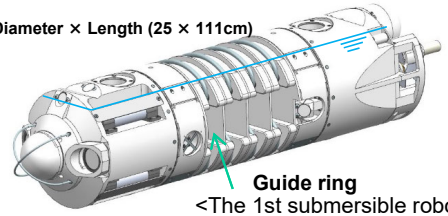


Massive deposits



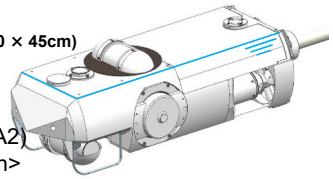
<Status inside the PCV (February 9)>

Diameter × Length (25 × 111cm)

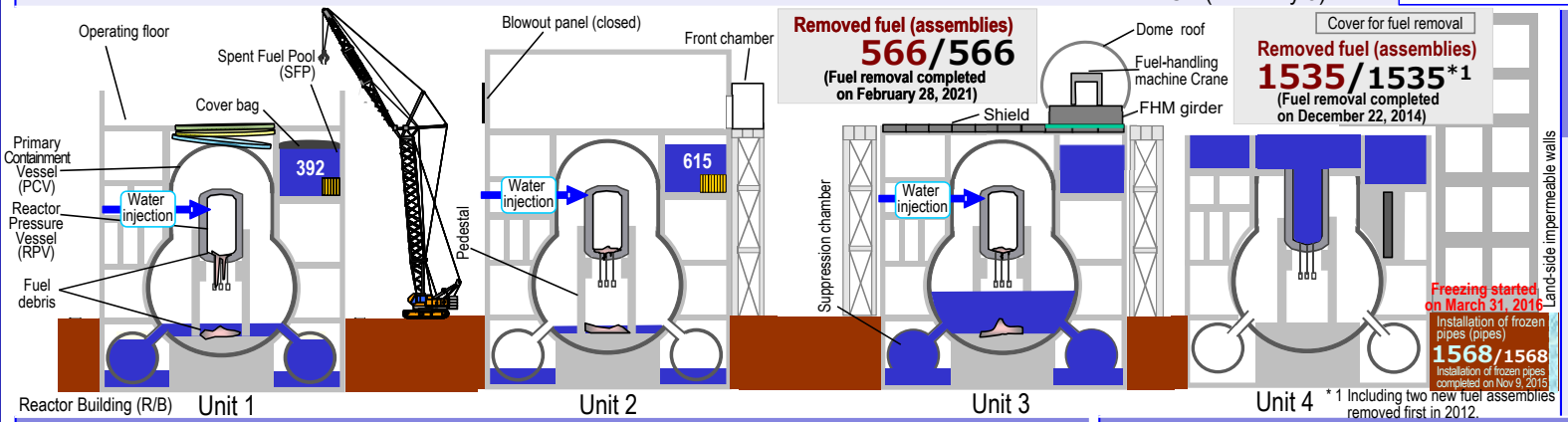


<The 1st submersible robot (ROV-A)>

Height × Width × Length (17.5 × 20 × 45cm)



<The 2nd submersible robot (ROV-A2) for detailed visual investigation>



*1 Including two new fuel assemblies removed first in 2012.

Circulation stirring verification tests were conducted for ten connected tanks of the dilution and discharge facility for ALPS treated water

The dilution and discharge facility for ALPS treated water will use a group of ten tanks for discharge. In sampling before discharge, water within the whole tank group will be circulated to homogenize the concentration.

To verify the concentration homogenization across ten tanks, a circulation stirring verification test was conducted over the period February 7-13.

The stirring effect was confirmed by comparing the theoretical average and actually measuring the concentrations of the reagent injected into the tanks.

Unit 2 The trial retrieval equipment arrived at Naraha, the operation verification test started

Toward the trial retrieval of Unit 2 fuel debris, a performance verification test and operational training of the robot arm in the domestic facility (Kobe) was finished on January 21. The equipment was transported to Naraha Center for Remote Control Technology Development of the Japan Atomic Energy Agency (JAEA),where the test to verify the operation of the robot arm started from February 14.

As a preliminary step for the PCV internal investigation and trial retrieval, work to install an isolated working room started from February 14. Work continues while prioritizing safety.

<Arrival of the robot arm>

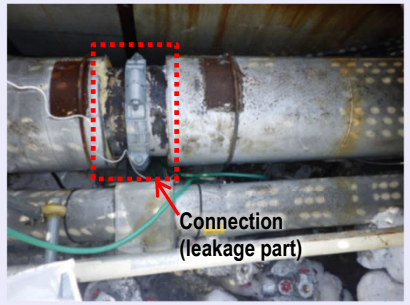
Status of refrigerant leakage at the land-side impermeable walls

On February 15, when the brine supply pump was stopped for the test to reduce the risk of refrigerant (brine*) leakage at the land-side impermeable walls in the event of the Chishima-Trench tsunami arrival, the liquid level decline in the brine tank was detected. The valve was closed as an emergency measure, and the liquid level decline was stopped.

Later, leakage from the brine pipe connection was detected. The rubber ring of that connection was replaced and brine supply resumed in all areas on February 21.

The cause of the leakage will be investigated and efforts to maintain the land-side impermeable walls will continue.

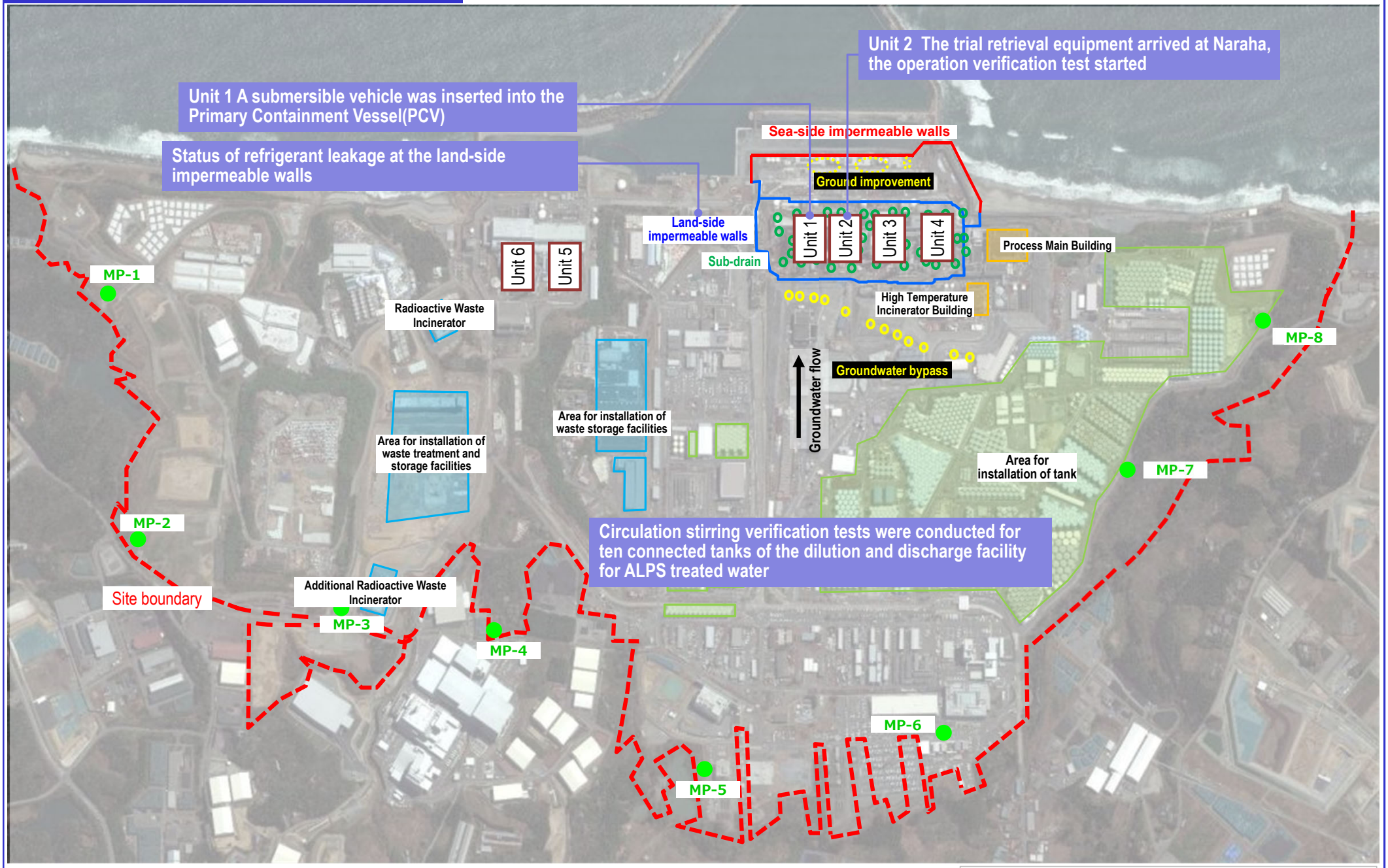
As of February 22, the temperature of the temperature measuring tubes has remained below 0℃.



<Leakage part of the connection after moving insulator>

* Refrigerant (brine): Liquid calcium chloride (the same ingredients as the snow melting agent sprayed on roads during snow fall)

Major initiatives – Locations on site

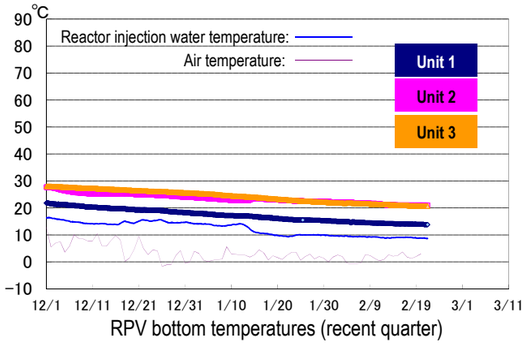


Provided by Japan Space Imaging Corp., photo taken on April 8, 2021
Product (C) [2020] DigitalGlobe, Inc., a Maxar company

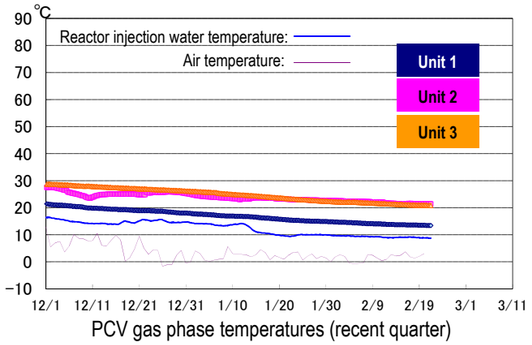
I. Confirmation of the reactor conditions

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. 15 to 25°C for the past month, though it varied depending on the unit and location of the thermometer.

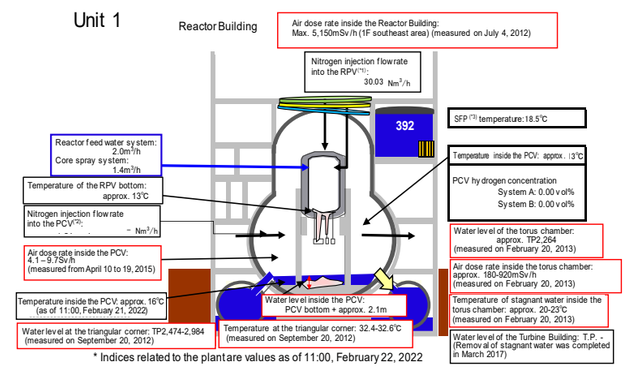


RPV bottom temperatures (recent quarter)

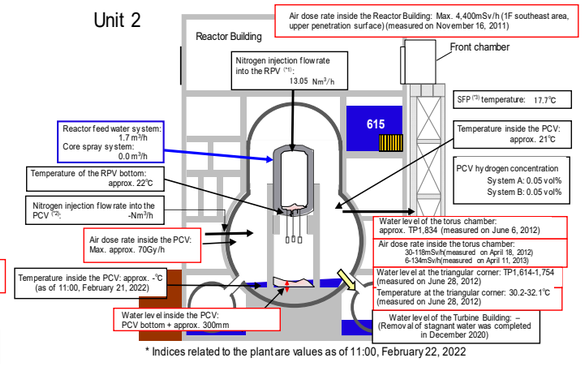


PCV gas phase temperatures (recent quarter)

*1 The trend graphs show part of the temperature data measured at multiple points.
*2 A part of data could not be measured due to maintenance and inspection of the facility and other work.



* Indices related to the plant are values as of 11:00, February 22, 2022



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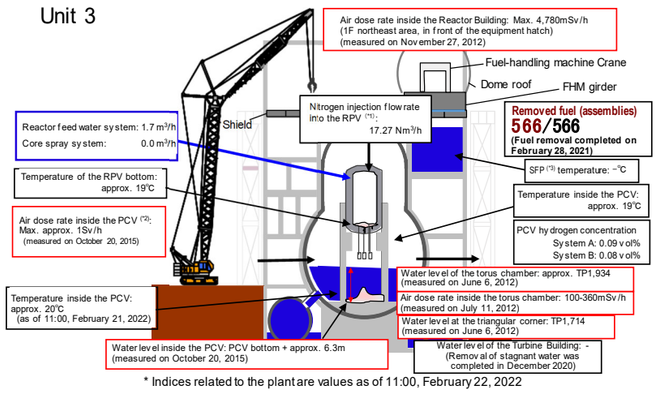


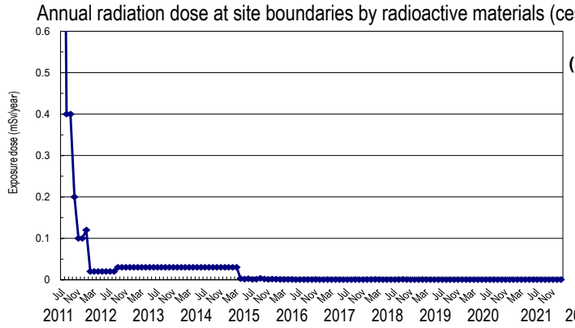
* Indices related to the plant are values as of 11:00, February 22, 2022

(*1) RPV (Reactor Pressure Vessel)
(*2) PCV (Primary Containment Vessel)
(*3) SFP (Spent Fuel Pool)

Release of radioactive materials from the Reactor Buildings

As of January 2022, the concentration of radioactive materials newly released from Reactor Building Units 1-4 into the air and measured at the site boundary was evaluated at approx. 2.3×10^{-12} Bq/cm^3 and 2.1×10^{-12} Bq/cm^3 for Cs-134 and -137 respectively, while the radiation exposure dose due to the release of radioactive materials there was less than 0.00005 mSv/year.

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



(Reference)

* The concentration limit of radioactive materials in the air outside the surrounding monitoring area:
  [Cs-134]: 2×10^{-5} Bq/cm$^{3\text{Marc}}$
  [Cs-137]: 3×10^{-5} Bq/cm^3
* Data of Monitoring Posts (MP1-MP8).
  Data of Monitoring Posts (MPs) measuring the air dose rate around the site boundary showed 0.325 – 1.098 μSv/h (January 26 – February 21, 2022).
  To measure the variation in the air dose rate of MP2-MP8 more accurately, work to improve the environment (trimming trees, removing surface soil, and shielding around the MPs) was completed.

Note 1: 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.

Note 2: Radiation dose was calculated using the evaluation values of release amount from Units 1-4 and Units 5 and 6. The radiation dose of Unit 5 and 6 was evaluated based on expected release amount during operation until September 2019 but the evaluation method was reviewed and changed to calculate based on the actual measurement results of Units 5 and 6 from October.

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 anomaly in the cold shutdown condition or criticality sign detected.

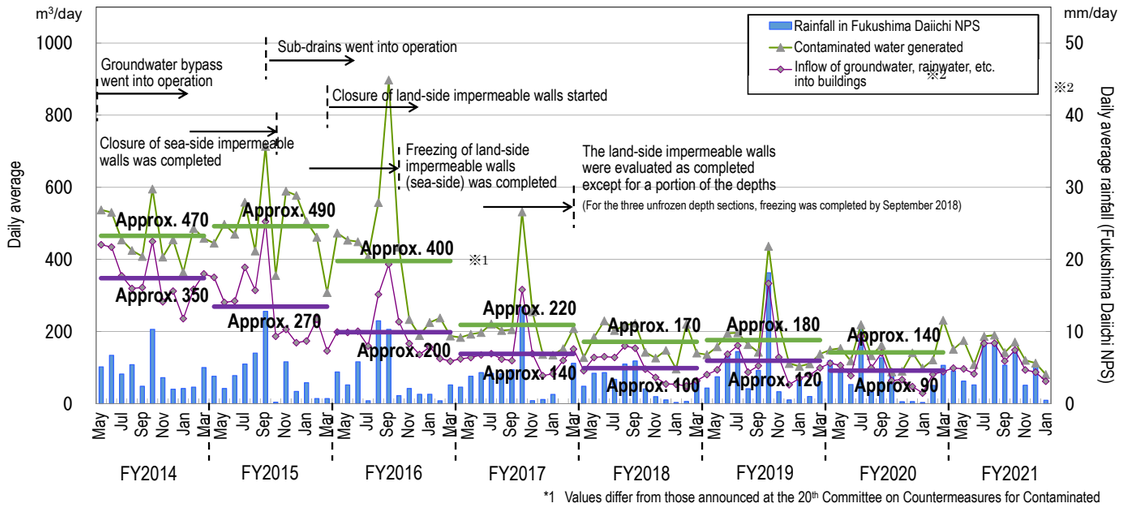
Based on the above, it was confirmed that the comprehensive cold shutdown condition had been maintained and the reactors remained in a stabilized condition.

II. Progress status by each plan_

Progress and others concerning ALPS treated water and others

➢ Status of contaminated water generated

- Multi-layered measures, including pumping up by sub-drains and land-side impermeable walls, which were implemented to control the continued generation of contaminated water, suppressed the groundwater inflow into buildings.
- After implementing “redirecting” measures (groundwater bypass, sub-drains, land-side impermeable walls and others) and rainwater prevention measures, including repairing damaged portions of building roofs, the amount of contaminated water generated within FY2020 declined to approx. 140 m^3/day.
- Measures will continue to further reduce the amount of contaminated water generated.



*1 Values differ from those announced at the 20th Committee on Countermeasures for Contaminated Water Treatment (held on August 25, 2017) because the method of calculating the contaminated water volume generated was reviewed on March 1, 2018. Details of the review are described in the materials for the 50th and 51st meetings of the Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment.

*2: The monthly daily average is derived from the daily average from the previous Thursday to the last Wednesday, which is calculated based on the data measured at 7:00 on every Thursday.

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

➢ Operation of the Water-Treatment Facility special for Sub-drain & Groundwater drains

- At the Water-Treatment Facility special for Sub-drain & Groundwater drains, release started from September 14, 2015 and up until February 15, 2022, 1,782 releases were conducted.
- The water quality of all temporary storage tanks satisfied the operation target.

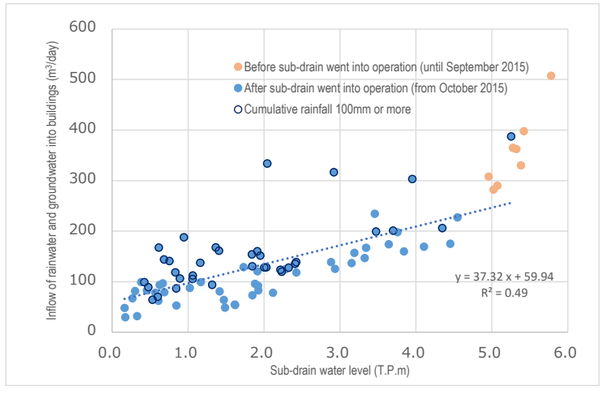


Figure 2: Correlation between inflow such as groundwater and rainwater into buildings and the water level of Units 1-4 sub-drains

➢ Implementation status of facing

- Facing is a measure involving asphalting the on-site surface to reduce the radiation dose, prevent rainwater infiltrating the ground and decrease the amount of underground water flowing into buildings. As of the end of January 2022, 95% of the planned area (1,450,000 m² on site) had been completed. For the area inside the land-side impermeable walls, implementation proceeds appropriately after constructing a yard from implementable zones that leave the decommissioning work unaffected. As of the end of January 2022, 25% of the planned area (60,000 m²) had been completed.

➢ Status of the groundwater level around buildings

- 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 was maintained, despite varying during rainfall. The water level of the groundwater drain observation well has been maintained at approx. T.P. +1.4 m, sufficiently below the ground surface (T.P. +2.5 m).

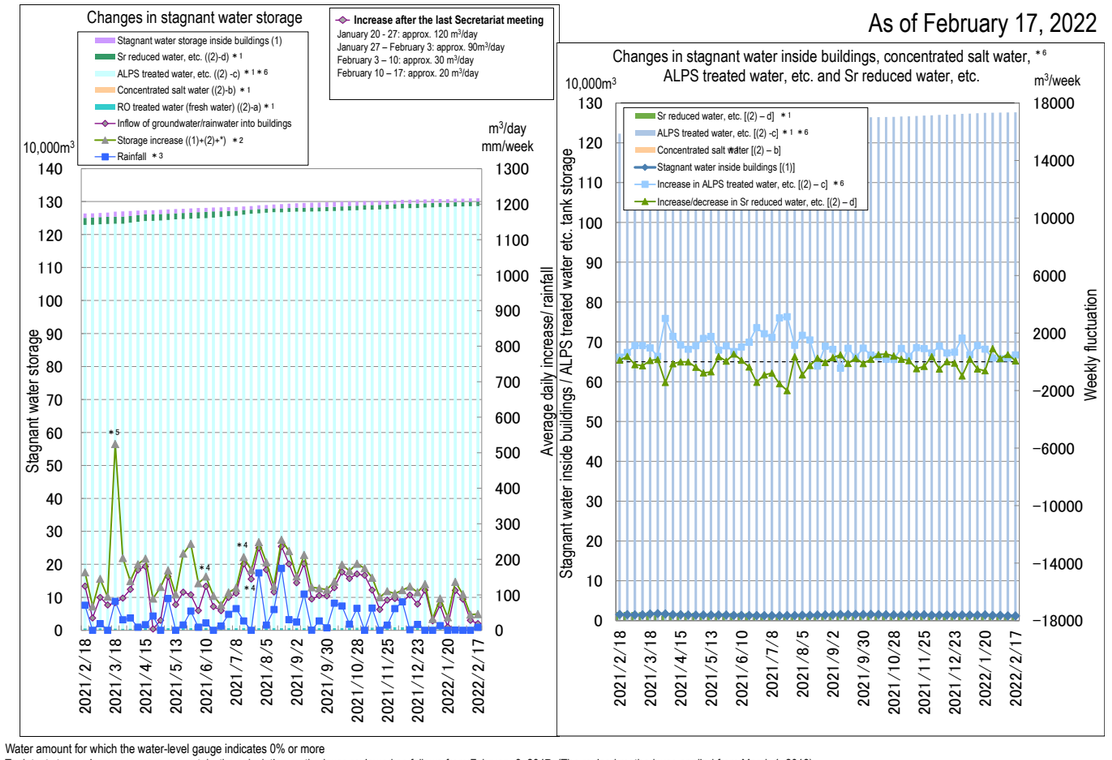
➢ Operation of multi-nuclide removal equipment

- Regarding the multi-nuclide removal equipment (existing and high-performance), hot tests using radioactive water are 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 February 17, 2022, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 481,000, 727,000 and 103,000 m³, respectively (including approx. 9,500 m³ 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).
- Treatment measures comprising the removal of strontium by cesium-adsorption apparatus (KURION), the secondary cesium-adsorption apparatus (SARRY) and the third cesium-adsorption apparatus (SARRY II) continued. Up until February 17, 2022, approx. 670,000 m³ had been treated.

➢ Risk reduction of strontium-reduced water

- To reduce the risks of strontium-reduced water, treatment using existing, additional and high-performance multi-nuclide removal equipment is underway. Up until February 17, 2022, approx. 832,000 m³ had been treated.

As of February 17, 2022



*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: Changed from December 13, 2018 from rainfall in Namie to that within the site.

*4: Considered attributable to the fluctuation inflow of groundwater, rainwater, and others to buildings due to the decline in the level of contaminated water in buildings.
(February 4-11, June 3-10 and July 8-22, 2021)

*5: Stored amount increased due to transfer to buildings in association with decommissioning work on March 18, 2021.
(Major breakdown of the transferred amount: (1) Contaminated water inside the tank fences (water transferred from the Shallow Draft Quay drainage channel) was transferred to the Process Main Building: approx. 390 m³/day, (2) Contaminated water inside the tank fences (water transferred from the Shallow Draft Quay drainage channel) was transferred to the High Temperature Incinerator Building: approx. 10 m³/day, (3) Transfer from the Unit 3 additional FSTR to the Unit 3 Radioactive Waste Treatment Building: approx. 10 m³/day and others)

*6: The notation of treated water by the multi-nuclide removal equipment and others was reviewed in accordance with redefining of ALPS treated water by the Government (April 27, 2021)

Figure 3: Status of stagnant water storage

➢ Temperature increase in the temperature measuring tube 150-7S of the land-side impermeable walls

- To investigate the cause for temperature increase, there was a plan to install steel piles as trial water stoppage. However, the installation could not proceed as planned due to firm ground, which was confirmed during the construction. After changing the construction machine, installation resumed from February 23.
- The results of the boring survey before resuming the installation confirmed that there was a sand layer shallower than around T.P. +6.5 m, that part of the medium sandstone layer deeper than around T.P. +6.5 m included laminated-ground sand mud and there was a mudstone layer deeper than around T.P. +1.5 m.
- Around T.P. +6.5 m, a significant temperature increase was detected. Moreover, the depth was almost identical with the height at which Drainage Channel K is installed and the sand mud layer detected in part of the medium sandstone layer may become a water route. With these factors in mind, the steel piles will be installed until the mudstone layer.
- The effect of installing steel piles will be verified by monitoring temperature changes in the temperature measuring tube, water inflow inside Drainage Channel K and others.
- Due to the leakage of refrigerant (brine) of the land-side impermeable walls on February 15, brine supply was temporarily suspended and a temperature increase was detected at all depth of the temperature measuring tube 150-7S. However, since the brine supply resumed (on February 18), the temperature has remained low.

➢ Results of the geological survey needed to install facilities regarding dilution/discharge of ALPS treated water and progress status of work to improve the environment

- To review the details of the design of intake and discharge facilities regarding the handling of ALPS treated water and ensure the safety of the work, a geological survey was conducted.
- Based on the geological data obtained in this survey and others, it was confirmed that the entire route of the discharge tunnel would be within bedrock and likewise for the tunnel outlet.
- Work to design the discharge tunnel and review the construction continues.

➢ Progress status of discussions regarding the marine creature keeping test

- As discussions on the keeping test have been held and an outline of the detailed plan of keeping tests in “seawater” and “ALPS treated water diluted with seawater” was finalized, tests will start in around September.
- The growth of the marine creature in respective environments will be compared and the tritium concentration within living bodies will be analyzed and assessed.
- Before the keeping tests get underway, trial rearing will start during March (in normal seawater found around the station) with professional and technical support from experts outside the company to gain keeping knowhow and confirm equipment design.
- Tests will continue, with the opinions and cooperation of related people.

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.

➢ Progress status toward Unit 1 PCV internal investigation

- From late April 2021, work to assemble a temporary gantry and others has been underway in a yard outside the site as part of efforts to install a large cover.
- A work yard was prepared around the Reactor Building and work to install a large cover started from August 2021.
- Before installing the anchor of the large cover, the exterior walls of the Reactor Building were investigated. An investigation of representative parts on the west side of the building revealed that both cracks and concrete strength were within the assumed range and that the anchor would be installable as planned.

➢ Main work to help spent fuel removal at Unit 2

- Decontamination to suppress dust scattering on the top floor of the Reactor Building was completed last December. Contamination reduction was confirmed based on the smear sampling results. Installation of shielding will start from February within the range including the reactor well, which shows the highest dose.
- From October 28, 2021, ground improvement work started before installing the gantry for fuel removal. Approx. 34% was completed as of January 26 and the remainder will be completed by April 2022.

➢ Transportation of spent fuel within the site from the common pool to the Temporary Cask Custody Area of the Fukushima Daiichi NPS

- Toward removing Unit 6 spent fuel (1,456 fuel assemblies) scheduled from around mid-FY2022, spent fuel stored in the common pool will be loaded into 22 transportation-storage casks (each of which can store 69 fuel assemblies) and transported from the common pool building to the Temporary Cask Custody Area to be stored there.
- From March 2022, receipt of transportation-storage casks and on-site transportation of spent fuel will start.

Retrieval of fuel debris

➢ Progress status toward Unit 1 PCV internal investigation

- To acquire information related to the construction plan to collect deposits toward fuel debris retrieval, a remotely operated underwater vehicle (ROV) will be inserted into the basement within the PCV from X-2 penetration to investigate inside and outside the pedestal.
- From November 5, preliminary work is underway, such as covering the work area and installing equipment and materials in the on-site headquarters and the remote-control room, before the PCV internal investigation.
- On January 12, when the investigative equipment such as the submersible ROV started to be powered on sequentially, a malfunction was detected, whereby the dosimeter data incorporated in the submersible ROV was not displayed correctly. Work was temporarily suspended.
- For February 4-7, after implementing countermeasures for the above event, operation was verified and no recurrence of the event was confirmed. Work to resume the investigation was conducted.
- On February 8, the submersible ROV-A was inserted into the PCV and guide rings were installed at four points until February 9.
- After completing preparation, a detailed visual investigation by the ROV-A2 will start on the PCV basement floor (outside the pedestal).

➢ Progress status toward Unit 2 PCV internal investigation and trial retrieval

- The trial retrieval equipment for Unit 2 fuel debris, which had been developed in the UK, arrived in Japan on July 10.
- The ongoing performance verification test in a domestic factory (Kobe), which started from August, finished on January 21.
- The equipment was transported from January 28 and the robot arm arrived on January 31 and the enclosure, on February 4, at the Naraha Center for Remote Control Technology Development of the Japan Atomic Energy Agency (JAEA) (hereinafter referred to as the “Naraha mockup facility”).
- From February 14, the performance verification test and operation training started at the Naraha mockup facility.

➢ Results of the investigation on the Unit 1 and 2 Reactor Building roof floor

- As part of efforts to identify the progress of the accident, spatial information and dose data inside the Unit 1 and 2 Reactor Building (ground floor) were collected.
- During measurement by the gamma imager, which obtained a 3D distribution of the gamma-ray source intensity, multiple hot spots were detected. The laser scan also revealed detailed 3D data.
- These investigative results will be utilized as input when formulating the plans for a future detailed investigation and decommissioning and reviewing the seismic soundness.

➢ Status of work to remove a portion of the pipes of the Units 1 and 2 standby gas treatment system

- On February 6, during preliminary work to remove the Units 1/2 SGTS pipes, oil dripping with a frequency of 1 drop per five seconds was detected from the hydraulic oil tank outlet flange at one of two systems of the hydraulic unit.
- The hydraulic oil remained on the reception pan in the lower part within the unit. As emergency measure, the hydraulic tank outlet valve was closed and an adsorption mat was wrapped over the flange to prevent the oil dispersion.

- The leakage of hydraulic oil was considered attributable to the design of the leakage part, which was not pressure-resistant, resulting in an increase in the oil temperature due to the standby operation and a reduction in hydraulic-oil viscosity, pump vibration and other elements.
- The hydraulic unit was carried outside the site. After investigating the cause, repairing the flange and performing a verification operation, no abnormality was confirmed on February 14.
- The flange was replaced with a new one. To reduce effects of vibration, instruction to prohibit a long-time idling was added to the procedures and attention was displayed on-site.

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 January 2022, the total storage volume for concrete and metal rubble was approx. 315,800 m^3 (+1,800 m^3 compared to the end of December with an area-occupation rate of 76%). The total storage volume of trimmed trees was approx. 140,900 m^3 (+100 m^3, with an area-occupation rate of 80%). The total storage volume of used protective clothing was approx. 27,000 m^3 (+400 m^3, with an area-occupation rate of 52%). The increase in rubble was mainly attributable to decontamination of flanged tanks and work around Units 1-4. As of the end of January 2022, there were 13 temporary deposits with storage capacity exceeding 1,000m^3 and a total storage volume of 54,100 m^3.

➢ Management status of secondary waste from water treatment

- As of February 3, 2022, the total storage volume of waste sludge was 437 m^3 (area-occupation rate: 62%), while that of concentrated waste fluid was 9,300 m^3 (area-occupation rate: 90%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment and other vessels, was 5,299 (area-occupation rate: 83%).

➢ Progress status concerning optimization of waste management

- As work, including inspection, became complicated due to leakage of radioactive materials from containers in March 2021 and flooding from containers (notch tanks) of contaminated soil in July 2021, the process of accepting rubble within the temporary storage area stagnated. Subsequently, temporary deposits increased and became prolonged.
- In response, a plan to optimize the waste management was formulated and efforts are underway to inspect the optimized storage condition and make the necessary corrections during FY2022.
- A check of the container contents will be finished within February ahead of schedule (at the end of March) and a sheet to cover the containers will be completed within March as scheduled. Regarding the management condition of the temporary deposits, on-site inspection and correction were finished in January.
- To further reduce risks, corroded containers and contaminated soil will be transferred within FY2022 according to a plan.

➢ Progress status of the additional Radioactive Waste Incinerator in the Fukushima Daiichi NPS (The cold test results and hot test overview)

- For the additional Radioactive Waste Incinerator, operation was verified (cold test) for each piece of equipment by incinerating mockup waste for the period from December 6, 2021 to January 18, 2022. Incinerated waste included wood chips (mixed with moisture and soil), paper, plastic and other combustible materials and oil, which were transported from outside the site.
- The test results confirmed that the criteria had been satisfied and the incinerator could maintain stable operation.
- For the period from March 1-4, 2022, a hot test will be conducted by incinerating actual waste to verify stable incineration, as was done in the cold test and the appropriate removal and containment of radioactive materials. The waste to be incinerated will include stems and roots of temporarily stored trimmed trees and waste oil.
- Following the hot test, the construction will be completed in March 2022, whereupon operation will start.

Reactor cooling

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

➢ Work to replace the hose for the Unit 3 RPV nitrogen injection line

- There is a plan to replace the hose for the Unit 3 Reactor Pressure Vessel (RPV) nitrogen injection line inside the Reactor Building. (The replacement was finished for Units 1 and 2.) During the replacement, nitrogen will not temporarily be injected from the RPV but the Primary Containment Vessel (PCV).
- On February 4, ventilation of the PCV nitrogen injection line was inspected and no abnormality was confirmed.
- The RPV line will be replaced on February 25.

➢ Investigation inside the Unit 3 MSIV chamber

- To locate the leakage part from the Unit 3 PCV, the status inside the main steam isolation valve (MSIV) chamber will be investigated in late March.
- The inside of the MSIV chamber was investigated in conjunction with the test involving water injection suspension to the Unit 3 Reactor in April and May 2021. During this investigation, vibration and waves were detected and considered attributable to leakage on the lower side of the mainstream pipe A bellows.
- The assumed leakage portion was invisible to the camera and the actual location could not be identified. This time, the lower side of the mainstream pipe A bellows will be investigated.
- As preliminary work to the investigation, drilling (three parts) is scheduled in mid-March before suspending a camera from the ceiling of the MSIV chamber (the air-conditioning machine room).

Reduction in radiation dose and mitigation of contamination

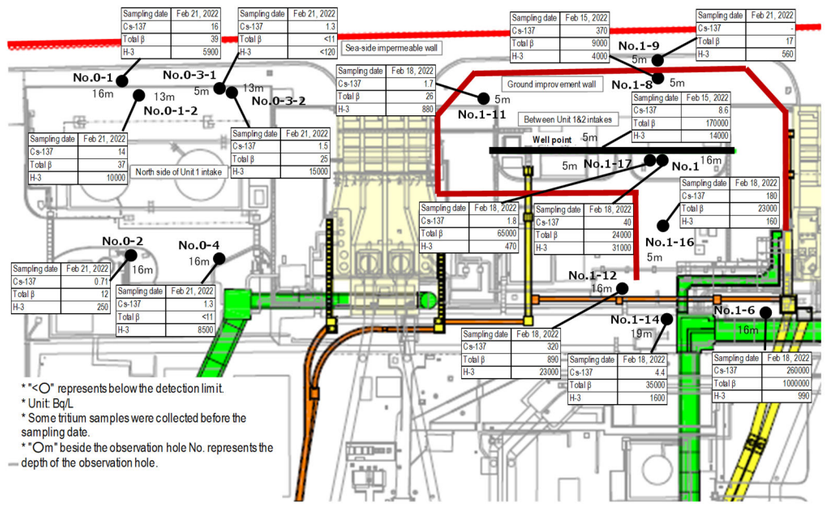
Effective dose-reduction at site boundaries and purification of port water to mitigate the impact of radiation on the external environment

➢ Status of groundwater and seawater on the east side of Turbine Building Units 1-4

- In the Unit 1 intake north side area, the H-3 concentration was below the legal discharge limit of 60,000 Bq/L at all observation holes and remained constant or has been declining overall. The concentration of total β radioactive materials has remained constant overall but increased temporarily from April 2020 and is even increasing or declining at many observation holes at present, including Nos. 0-1-2, 0-3-1, 0-3-2 and 0-4. The trend continues to be monitored carefully.
- In the area between the Unit 1 and 2 intakes, the H-3 concentration has remained below the legal discharge limit of 60,000 Bq/L at all observation holes. It has been increasing or declining at Nos. 1-14, 1-16 and 1-17 but has otherwise remained constant or been declining overall. The concentration of total β radioactive materials has remained constant overall but been increasing at No. 1-6 and increasing or declining at many observation holes including Nos. 1-9, 1-11, 1-12, 1-14, 1-16 and 1-17. The trend continues to be monitored carefully.
- In the area between the Unit 2 and 3 intakes, the H-3 concentration has been below the legal discharge limit of 60,000 Bq/L at all observation holes. It has been increasing and declining at No. 2-3 but has remained constant or been declining overall. The concentration of total β radioactive materials has remained constant overall but been increasing or declining at No. 2-3. The trend continues to be monitored carefully.
- In the area between the Unit 3 and 4 intakes, the H-3 concentration has been below the legal discharge limit of 60,000 Bq/L at all observation holes. It has been increasing or declining at No. 3-3 but has remained constant or been declining overall. The concentration of total β radioactive materials has remained constant overall or been declining overall but been increasing or declining at many observation holes including Nos. 3, 3-2, 3-4 and 3-5. The trend continues to be monitored carefully.
- In the groundwater on the east side of the Turbine Buildings, the same as that of total β radioactive materials, the concentration of cesium has also remained constant but been increasing or declining and exceeding the previous highest record at some observation holes. Investigations are underway.
- The concentration of radioactive materials in drainage channels has remained constant overall, despite increasing

during rainfall.

- In the open channel area of seawater intake for Units 1 to 4, the concentration of radioactive materials in seawater has remained below the legal discharge limit and been declining long term, despite temporary increases in Cs-137 and Sr-90 noted during rainfall. They have also been declining following the completed installation and the connection of steel pipe sheet piles for the sea-side impermeable walls. The concentration of Cs-137 has remained slightly higher in front of the south side impermeable walls and slightly lower on the north side of the east breakwater since March 20, 2019, when the silt fence was transferred to the center of the open channel due to mega float-related construction.
- In the port area, the concentration of radioactive materials in seawater has remained below the legal discharge limit and been declining long term, despite the temporary increases in Cs-137 and Sr-90 observed during rainfall. They have remained below the level of those in the Units 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 concentration 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. Regarding the concentration of Cs-137, a temporary increase was sometimes observed on the north side of the Unit 5 and 6 outlets and near the south outlet due to the influence of weather, marine meteorology and other factors. Regarding the concentration of Sr-90, variation has been observed since last year in the area outside the port (north and south outlets). Monitoring of the tendency continues, including the potential influence of the weather, marine meteorology and others.



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

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

Figure 4: Groundwater concentration on the Turbine Building east side

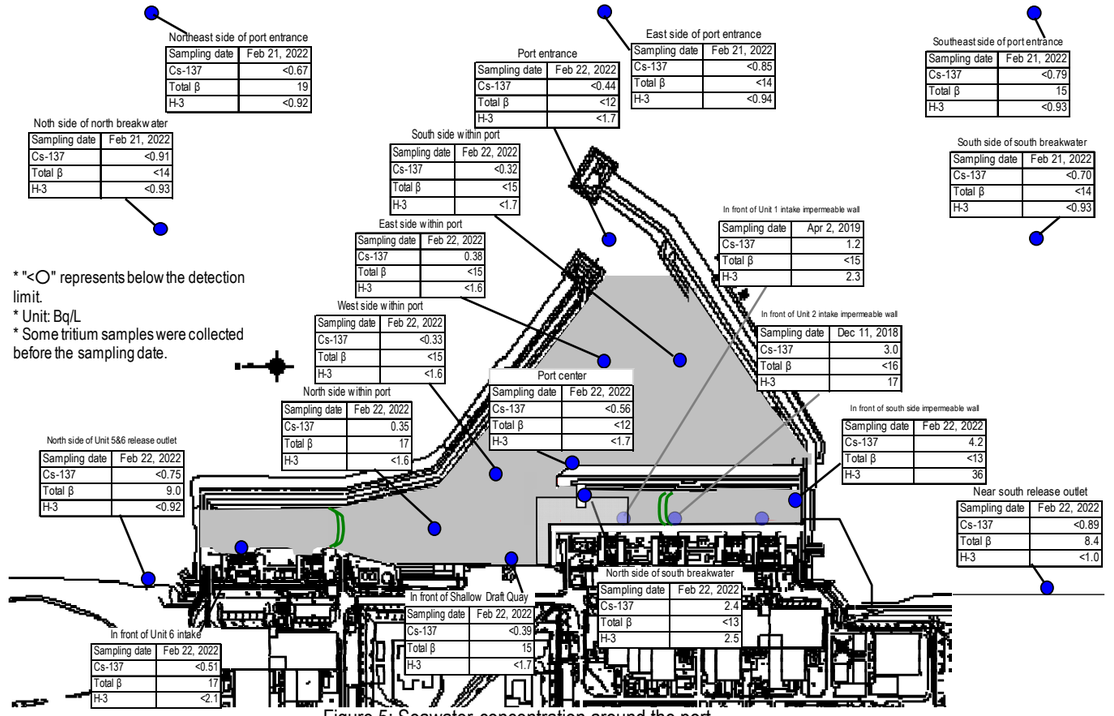


Figure 5: Seawater concentration around the port

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

Adequate number of staff will be secured in the long-term, while firmly implementing radiation control of workers. The work environment and labor conditions will be continuously improved by responding to the needs on the site.

➢ 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 October to December 2021 was approx. 8,900 (cooperating company workers and TEPCO HD employees), which exceeded the monthly average workforce (approx. 6,700). 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 March 2022 (approx. 4,000 workers per day: cooperating company workers and TEPCO HD employees) would be secured at present. The average numbers of workers per day for each month (actual values) for the most recent 2 years were maintained, with approx. 3,000 to 4,200.
- The number of workers from within Fukushima Prefecture increased slightly and that from outside decreased slightly. The local employment ratio (cooperating company workers and TEPCO HD employees) as of January 2022 increased slightly to around 70%.
- The average exposure doses of workers were at approx. 2.44, 2.54 and 2.60 mSv/person-year during FY2018, 2019 and 2020, respectively. (The legal exposure dose limits are 100 mSv/person and 50 mSv/person-year over five years, the TEPCO HD management target is 20 mSv/person-year).
- For most workers, the exposure dose was sufficiently within the limit and allowed them to continue engaging in radiation work.

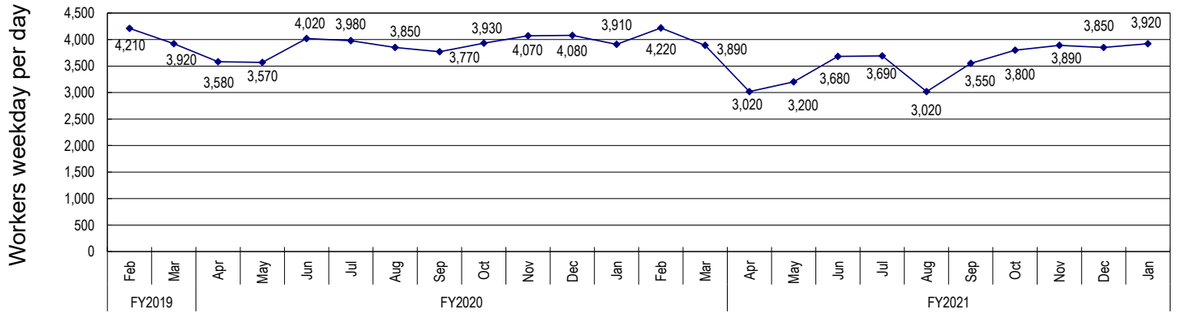


Figure 6: Changes in the average number of workers weekday per day for each month of the past 2 years (actual values)

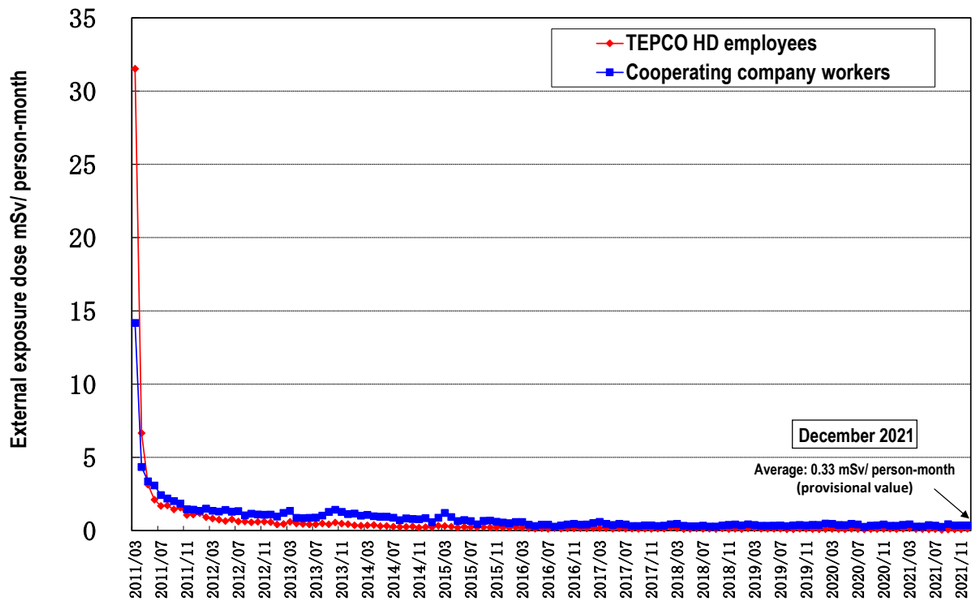


Figure 7: Changes in monthly average exposure dose of individual worker
(monthly exposure dose since March 2011)

➢ Countermeasures to suppress the spread of COVID-19 infections

- In response to the rapid increase in the Omicron variant of infection and based on the request by the Minister of Economy, Trade and Industry to each designated public institution that they should implement business continuity plans to function well, even during the COVID-19 crisis, ongoing countermeasures to suppress the spread of COVID-19 infections were enhanced from January 25 to ensure NPS operation could continue uninterrupted.
- As the Omicron variant is more infectious than conventional equivalents, at-home infections are increasing and the time to onset tends to be short, countermeasures are being enhanced, including carefully selecting unnecessary moves outside Fukushima Prefecture. In addition, those who move outside the prefecture must refrain from coming to the NPS for 24 hours after they return to the prefecture (taking leave or working from home), confirm that they are negative by antigen test and strictly check their physical conditions, including of their family members, before coming to work and determine whether or not they can do so.
- Countermeasures to prevent the infection spreading, such as requiring employees to take their temperature before coming to the office, wear masks at all times, avoid the “Three Cs” (Closed spaces, Crowded places, Close-contact settings) by using the rest house in shifts, eat silently and carefully select business travel, will continue to be properly implemented and decommissioning work will proceed with safety first.

- As of 15:00, February 23, 2022, 165 workers (including 21 TEPCO HD employees, 1 temporary worker, 142 cooperating company workers and 1 business partner company employee) of the Fukushima Daiichi NPS had contracted COVID-19. Since January 2022, a total of 61 workers (including 11 TEPCO HD employee and 50 cooperating company workers) had contracted COVID-19.
- No significant influence on decommissioning work, such as a corresponding delay to work processes due to this infection, had been identified.
- From late March, (third time) workplace vaccination of COVID-19 will scheduled to be implemented to employees and cooperating company workers in the Fukushima Daiichi NPS who wish to be vaccinated.
- Acceptance of visitors has been temporarily suspended from January 25.

➢ Measures to prevent infection and expansion of influenza and norovirus

- Since November 2021, measures for influenza and norovirus have been implemented, including free influenza vaccinations (subsidized by TEPCO HD) at medical clinics around the site (from October 11, 2021 to January 29, 2022) for cooperating company workers. As of January 29, 2022, a total of 4,866 workers had been vaccinated. In addition, a comprehensive range of other measures is also being implemented, including daily actions to prevent infection and expansion (measuring body temperature, health checks and monitoring infection status) and response after detecting possible infections (swift exit of possible patients and control of entry, mandatory wearing of masks in working spaces, etc.).

➢ Status of influenza and norovirus cases

- Until the 7th week of 2022 (February 14-20, 2022), no influenza and five norovirus infections were recorded. The totals for the same period for the previous season showed one influenza and one norovirus infection respectively.

Note: The above data is based on reports from TEPCO HD and cooperating companies, which include diagnoses at medical clinics outside the site.
The subjects of this report were cooperating company workers and TEPCO HD employees in Fukushima Daiichi and Daini Nuclear Power Stations.

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 February 7-14)"; unit (Bq/L); ND represents a value below the detection limit

Summary of TEPCO data as of February 15, 2022

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

Cesium-134	:	ND(0.53)		
Cesium-137	:	0.61		
Total β	:	ND(13)		
Toritium	:	ND(1.9)		※1

Cesium-134	:	3.3 (H25/12/24)	→	ND(0.38)	Below 1/8
Cesium-137	:	7.3 (H25/10/11)	→	ND(0.49)	Below 1/10
Total β	:	69 (H25/8/19)	→	20	Below 1/3
Toritium	:	68 (H25/8/19)	→	ND(1.9)	Below 1/30

Cesium-134	:	3.3 (H25/10/17)	→	ND(0.34)	Below 1/9
Cesium-137	:	9 (H25/10/17)	→	ND(0.36)	Below 1/20
Total β	:	74 (H25/8/19)	→	ND(14)	Below 1/5
Toritium	:	67 (H25/8/19)	→	ND(1.7)	Below 1/30

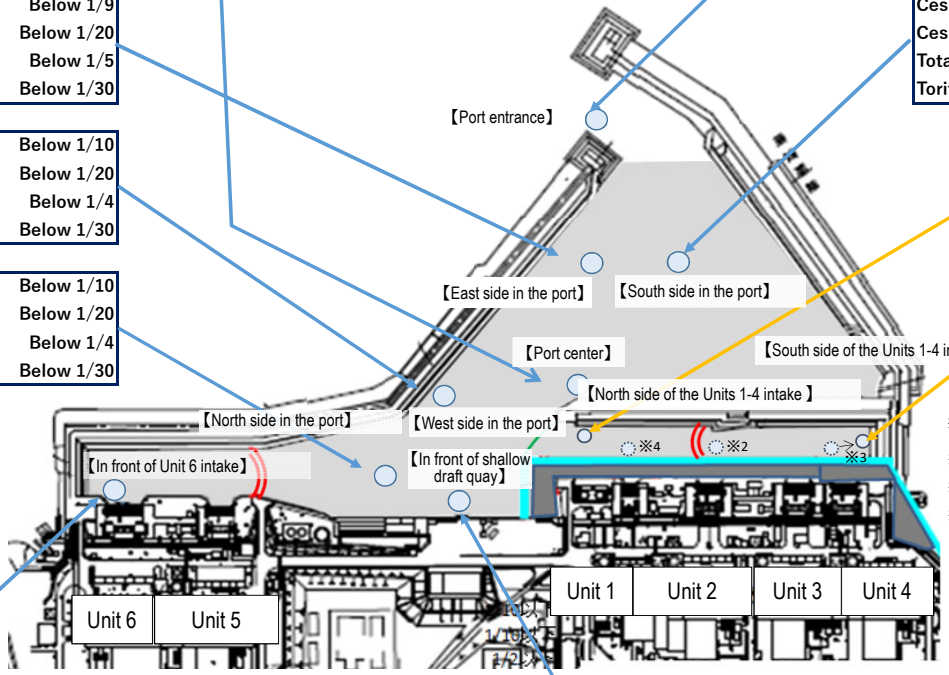
Cesium-134	:	3.5 (H25/10/17)	→	ND(0.30)	Below 1/10
Cesium-137	:	7.8 (H25/10/17)	→	ND(0.31)	Below 1/20
Total β	:	79 (H25/8/19)	→	14	Below 1/5
Toritium	:	60 (H25/8/19)	→	ND(1.7)	Below 1/30

Cesium-134	:	4.4 (H25/12/24)	→	ND(0.30)	Below 1/10
Cesium-137	:	10 (H25/12/24)	→	0.39	Below 1/20
Total β	:	60 (H25/7/4)	→	14	Below 1/4
Toritium	:	59 (H25/8/19)	→	ND(1.7)	Below 1/30

Cesium-134	:	32 (H25/10/11)	→	ND(0.40)	Below 1/80
Cesium-137	:	73 (H25/10/11)	→	0.57	Below 1/100
Total β	:	320 (H25/8/12)	→	14	Below 1/20
Toritium	:	510 (H25/9/2)	→	ND(7.0)	Below 1/70

Cesium-134	:	5 (H25/12/2)	→	ND(0.30)	Below 1/10
Cesium-137	:	8.4 (H25/12/2)	→	ND(0.34)	Below 1/20
Total β	:	69 (H25/8/19)	→	ND(14)	Below 1/4
Toritium	:	52 (H25/8/19)	→	ND(1.7)	Below 1/30

Cesium-134	:	ND(0.55)		
Cesium-137	:	1.7		
Total β	:	ND(12)		
Toritium	:	38		※1



Cesium-134	:	2.8 (H25/12/2)	→	ND(0.50)	Below 1/5
Cesium-137	:	5.8 (H25/12/2)	→	ND(0.41)	Below 1/10
Total β	:	46 (H25/8/19)	→	15	Below 1/3
Toritium	:	24 (H25/8/19)	→	2.3	Below 1/10

Cesium-134	:	5.3 (H25/8/5)	→	ND(0.50)	Below 1/10
Cesium-137	:	8.6 (H25/8/5)	→	ND(0.67)	Below 1/10
Total β	:	40 (H25/7/3)	→	13	Below 1/3
Toritium	:	340 (H25/6/26)	→	ND(1.9)	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.

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

Source: TEPCO website Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station http://www.tepco.co.jp/decommision/planaction/monitoring/index-j.html

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

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

(The latest values sampled during February 7-14)

Summary of TEPCO data as of February 15, 2022

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

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

Cesium-134	: ND	(H25)	→	ND(0.55)	
Cesium-137	: ND	(H25)	→	ND(0.62)	
Total β	: ND	(H25)	→	ND(13)	
Toritium	: ND	(H25)	→	ND(0.94)	

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

Cesium-134	: ND	(H25)	→	ND(0.56)	
Cesium-137	: 1.6	(H25/10/18)	→	ND(0.65)	Below 1/2
Total β	: ND	(H25)	→	ND(13)	
Toritium	: 6.4	(H25/10/18)	→	ND(0.94)	Below 1/6

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

Cesium-134	: ND	(H25)	→	ND(0.71)	
Cesium-137	: ND	(H25)	→	ND(0.70)	
Total β	: ND	(H25)	→	ND(13)	
Toritium	: ND	(H25)	→	0.94	

Cesium-134	: ND	(H25)	→	ND(0.85)	
Cesium-137	: ND	(H25)	→	ND(0.47)	
Total β	: ND	(H25)	→	ND(15)	
Toritium	: 4.7	(H25/8/18)	→	ND(0.94)	Below 1/5

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

Cesium-134	: 3.3	(H25/12/24)	→	ND(0.38)	Below 1/8
Cesium-137	: 7.3	(H25/10/11)	→	ND(0.49)	Below 1/10
Total β	: 69	(H25/8/19)	→	20	Below 1/3
Toritium	: 68	(H25/8/19)	→	ND(1.9)	Below 1/30

【Port entrance】

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

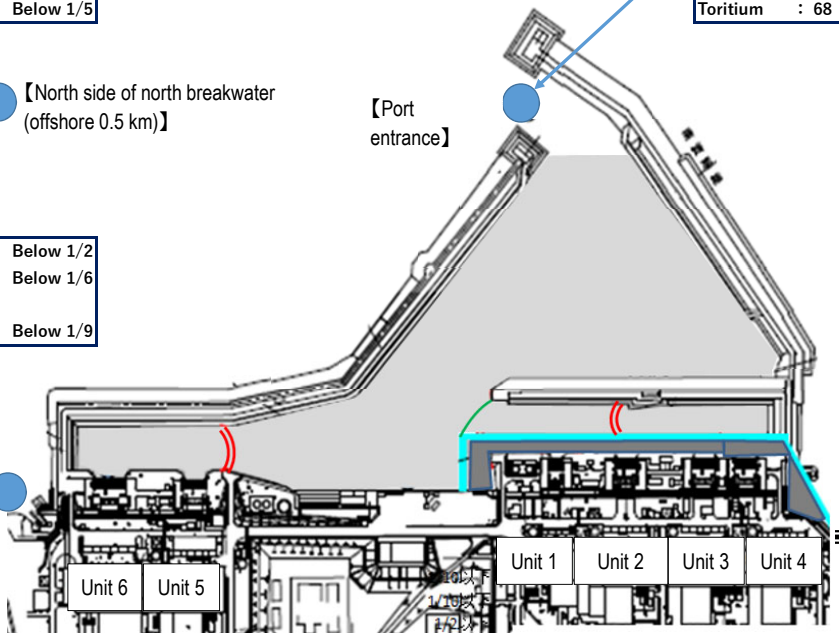
Cesium-134	: ND	(H25)	→	ND(0.74)	
Cesium-137	: ND	(H25)	→	ND(0.79)	
Total β	: ND	(H25)	→	ND(14)	
Toritium	: ND	(H25)	→	ND(0.94)	

Cesium-134	: 1.8	(H25/6/21)	→	ND(0.67)	Below 1/2
Cesium-137	: 4.5	(H25/3/17)	→	ND(0.66)	Below 1/6
Total β	: 12	(H25/12/23)	→	8.5	
Toritium	: 8.6	(H25/6/26)	→	0.95	Below 1/9

【North side of Unit 5 and 6 release outlet】

Cesium-134	: ND	(H25)	→	ND(0.52)	
Cesium-137	: 3	(H25/7/15)	→	ND(0.53)	Below 1/5
Total β	: 15	(H25/12/23)	→	8.0	
Toritium	: 1.9	(H25/11/25)	→	ND(0.95)	Below 1/2

【Near south release outlet】



Sea side impermeable wall

Silt fence

Silt fence for construction

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

Note: Because safety of the sampling points was unassured due to the influence of Typhoon No. 10 in 2016, samples were taken from approx. 330 m south of the Unit 1-4 release outlet.
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.

Source: TEPCO website, Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station http://www.tepco.co.jp/decommision/planaction/monitoring/index-j.html

TEPCO Holdings Fukushima Daiichi Nuclear Power Station Site Layout

Appendix 2

February 24, 2022

- Rubble storage area
- Rubble storage area (planned)
- Used protective clothing
- Trimmed trees area
- Mid-/ low-level contaminated water tank (existing)
- Mid-/ low-level contaminated water tank (planned)
- Secondary waste from water treatment (existing)
- Secondary waste from water treatment
- Waste treatment facility
- Non-controlled facility
- Analysis and research facility

Trimmed trees (outdoor accumulation)

Temporary trimmed trees storage pool

Temporary soil-covered type

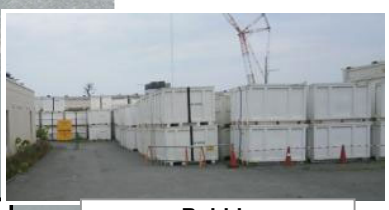
Rubble (outdoor accumulation)

Rubble storage tent

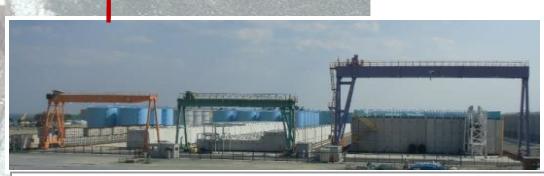
Inside the rubble storage tent

Rubble (covered by sheet)

Solid waste storage facility



Rubble (container storage)



Spent adsorption vessel temporary storage facility

Temporary waste sludge storage

Tank installation status

MP-1, MP-2, MP-3, MP-4, MP-5, MP-6, MP-7, MP-8

Futaba town

Okuma town

Rubble, Used protective clothing, Trimmed trees, Temporary trimmed trees storage pool, Additional Radioactive Waste Incinerator, Large Waste Storage, Radioactive Waste Incinerator, Vehicles maintenance site, Water treatment facility for Sub-drain, Water treatment facility for Sub-drain and others, Periodical Inspection Material Storage (cutting of flanged-tanks), Temporary Cask Custody Area, Main Anti-Earthquake Building, JAEA Analytical Facility Management Building, JAEA Analytical Facility Laboratory-1, Vehicle screening and decontamination site, Multi-nuclide removal equipment, Additional multi-nuclide removal equipment, High-performance multi-nuclide removal equipment, Spent absorption vessel temporary storage, Large equipment decontamination facility, Land-side impermeable walls with frozen soil, Land-side impermeable walls freezing plant, Underground reservoirs, Pipe route, Groundwater bypass temporary storage tank, Partner Companies' Building, Temporary rest house outside the site, New Administration Office Building, Heliport, Large rest house, Access control facility, Common pool, Water desalinations (RO), Water desalinations (evaporative concentration), Cesium absorption apparatus (Incineration Workshop Building), Decontamination instruments (Process Building), 3rd cesium adsorption apparatus (Onsite Bunker Building), 2nd cesium adsorption apparatus (HTI Building), Cesium absorption vessel temporary storage, Sea side impermeable wall, Mega float, Unit 1, Unit 2, Unit 3, Unit 4, Unit 5, Unit 6, Town boundary, Site boundary

K1, K2, K3, K4, H1, H2, H3, H4, H5, H6, H8, H9, J1, J2, J3, J4, J5, J6, J7, J8, J9, G1, G1 South, G3・G4・G5, G6, G7, B, C, D, E, F

Provided by Japan Space Imaging Corporation, photo taken on April 8, 2021
Product(C) [2020] DigitalGlobe, Inc., a Maxar company

0m 100m 500m 1000m

1-1 Contaminated water management

- Efforts to promote contaminated water management based on three basic policies:
  ① “Remove” the source of water contamination ② “Redirect” fresh water from contaminated areas
  ③ “Retain” contaminated water from leakage

Milestones of the Mid- and-Long-Term Roadmap (major target processes)
- [Completed] Suppressing the amount of contaminated water generated to 150 m³/day or less (within 2020)
- Suppressing the amount of contaminated water generated to 100 m³/day or less (within 2025)

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

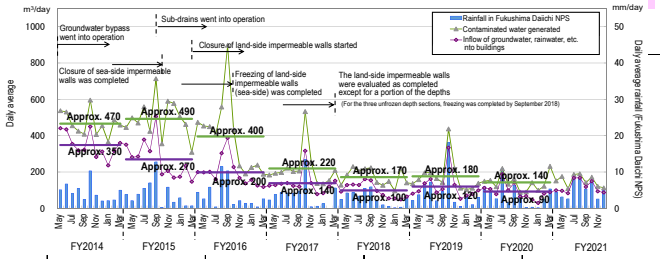
Contaminated water management【Remove】

Contaminated water treatment facility
- ▽Reception start of contaminated water to Central Waste Treatment Building
- ▽Decontamination equipment (AREVA)
- ▽Evaporative concentration equipment
- ▽Cesium Adsorption Apparatus (KURION)
- ▽2nd Cesium Adsorption Apparatus (SARRY)
- ▽Treatment of RO-condensed salt water complete
- ▽Reduction of strontium by Cesium Adsorption Apparatus (KURION) (from 2015.1.6)
- ▽Reduction of strontium by 2nd Cesium Adsorption Apparatus (SARRY) (from 2014.12.26)
- ▽Purification of strontium-reduced water in flanged tanks complete
- ▽Purification of strontium-reduced water complete
- ▽Reduction of strontium by 3rd Cesium Adsorption Apparatus (SARRY II) (from 2019.7.12)
- ▽Treatment start of strontium-reduced water (ALPS: from 2015.12.4, additional: from 2015.5.27, high-performance: from 2015.4.15)
- ▽Multi-nuclide Removal Equipment (ALPS) (System A: from 2013.3.30, System B: from 2013.6.13, System C: from 2013.9.27, hot tests conducted)
- ▽Multi-nuclide Removal Equipment (additional ALPS)
- ▽Start of full-scale operation (from 2017.10.16)
- ▽Multi-nuclide Removal Equipment (high performance ALPS) (from 2014.10.18, hot tests conducted)


Cesium Adsorption Apparatus (KURION)


Landing of 2nd Cesium Adsorption Apparatus (SURRY)


Multi-nuclide removal equipment (ALPS)



Removal of contaminated water from seawater pipe trench
- ▽Trench Purification by mobile equipment
- ▽Completion of tunnel filling
- ▽Transfer of stagnant water complete
- ▽Completion of shaft filling
- Unit 2
- ▽Completion of tunnel filling
- ▽Transfer of stagnant water complete
- ▽Completion of shaft filling (except for upper part of
- 【Removal of contaminated water in seawater pipe trench】
- Unit 3
- ▽Completion of tunnel filling
- ▽Filling of openings II and III complete
- ▽Transfer stagnant water complete
- ▽Completion of filling parts running ove
- Unit 4


Unit 2 seawater pipe trench Shaft D filling work

Contaminated water management【Redirect】

Groundwater bypass
- ▽Installation start of groundwater bypass
- **▽Operation start of groundwater bypass (drainage started from 2014.5.21)**
- **▽Suppressing the average amount of contaminated water generated to approx. 140 m3/day**

Sub-drain
- ▽Recovery of existing sub-drain pit and start of new installation
- ▽Installation start of Water-Treatment Facility special for Sub-drain & Groundwater drains
- **▽Operation start of sub-drain (drainage started from 2015.9.14)** (Treatment capacity: 1000 m3/day)
- **▽Enhancement of treatment capacity** (2000 m3/day)

Land-side impermeable wall
- ▽Start of maintenance operation on north and south sides
- ▽Freezing completion
- ▽Start of maintenance operation in all sections
- ▽Installation start of land-side impermeable walls
- **▽Freezing start**
- Start of maintenance operation ▽
- **▽Freezing completion (except for some parts)**

Facing
- ▽Completion of waterproof pavement (facing) (except for areas of 2.5 and 6.5m above sea level and around Unit 1-4)
- ▽Completion of waterproof pavement (facing) (except for around Unit 1-4)

Contaminated water management【Retain】

Bank groundwater measures
- High concentration of radioactive materials detected from observation well of bank
- ▽Area 2.5m above sea level – Start of ground improvement by water glass
- ▽Completion
- ▽Start of pumping of water from contaminated areas (well point)
- ▽Installation start of seaside impermeable walls
- **▽Installation of seaside impermeable walls complete**
- ▽Operation start of groundwater drain (pumping-up started on 2015.11.5)

Storage facility
- ▽Purification of RO-condensed salt water complete
- ▽Storage in steel square tanks
- ▽Replacement of steel square tanks complete
- ▽Removal of steel horizontal tanks complete (except for condensed waste liquid storage tank)
- ▽Water leakage (300L) from flanged tank
- ▽Water leakage (100t) from flanged tank
- ▽Storage in flanged cylindrical tanks
- ▽Completion of fence to prevent leakage expanding
- ▽Water leakage (10L) from flanged tank
- ▽Work to raise fence height complete
- **▽Purification of strontium-reduced water in flanged tanks complete**
- ▽Transfer and storage of all treated water in welded-joint tanks
- ▽Leakage of contaminated water from underground reservoir => Start of transfer to tanks
- ▽Transfer of contaminated water to tanks complete
- ▽Storage in cylindrical steel welded-joint tanks
- ▽Purification of strontium-reduced water complete
- ▽Sprinkling start of rainwater within tank fences by rainwater treatment facility (from 2014.5.21)

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


Pumping well


Sub-drain purification system


Land-side impermeable wall brine (refrigerant) circulation pipe

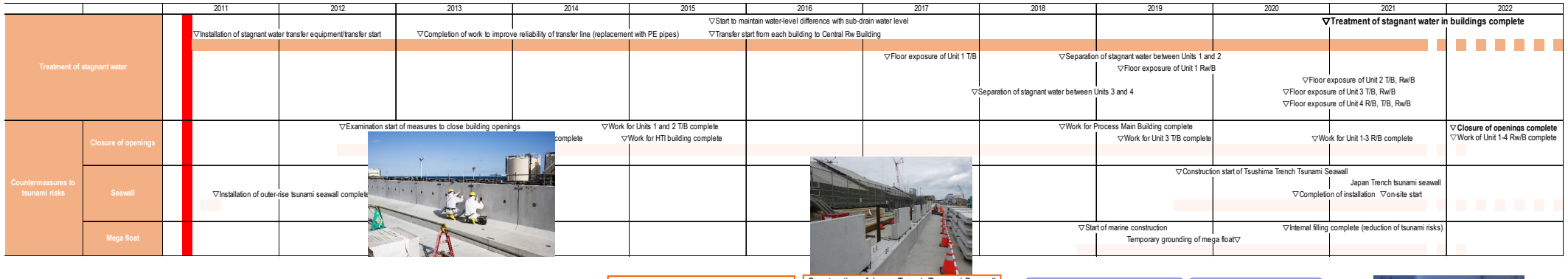

Construction of welded-joint tanks


Placement of seaside impermeable walls complete


Flanged and welded-joint tanks

1-2 Contaminated water management

Milestones of the Mid- and-Long-Term Roadmap (major target processes)
- [Completed] Treatment of contaminated water in buildings* (within 2020)
  * Except for Unit 1-3 Reactor Buildings, Process Main Building and High-Temperature Incinerator Building
- Reducing contaminated water in Reactor Buildings to about half the amount at the end of 2020 (FY2022-2024)



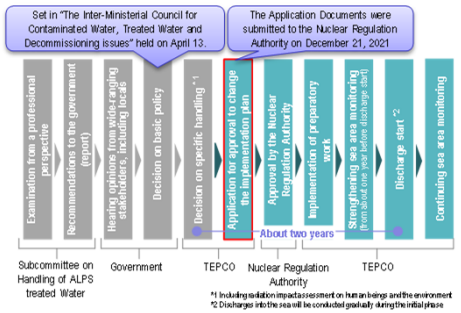
Chishima Trench Tsunami Seawall complete

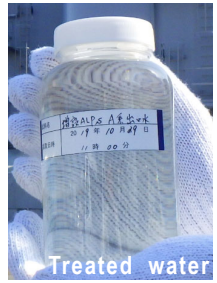
Construction of Japan Trench Tsunami Seawall

2 Handling of ALPS treated water

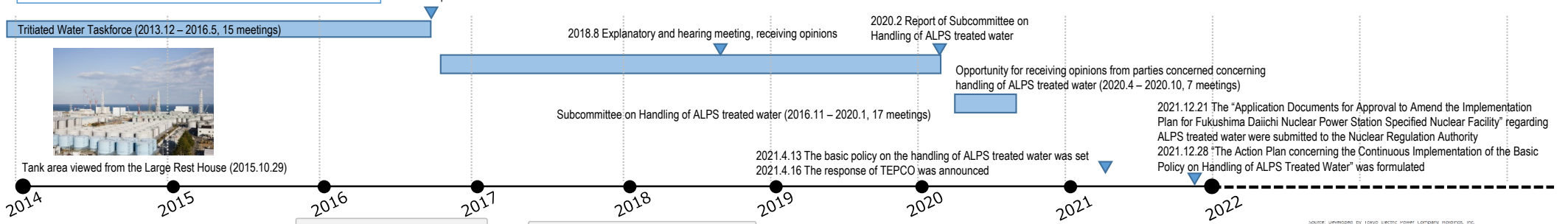
In “The Inter-Ministerial Council for Contaminated Water, Treated water and Decommissioning” held on April 13, the basic policy on how to handle ALPS treated water was set. Based on this, the response of TEPCO was announced on April 16.

Regarding the discharge of ALPS treated water into the sea, TEPCO must comply with regulatory and other safety-related standards to ensure the safety of the public, surrounding environment and agricultural, forestry and fishery products. To minimize adverse impacts on reputation, monitoring will be further enhanced, objectivity and transparency ensured by engaging with third-party experts and safety checked by the IAEA. Moreover, accurate information will be disseminated continuously and in a highly transparent manner.

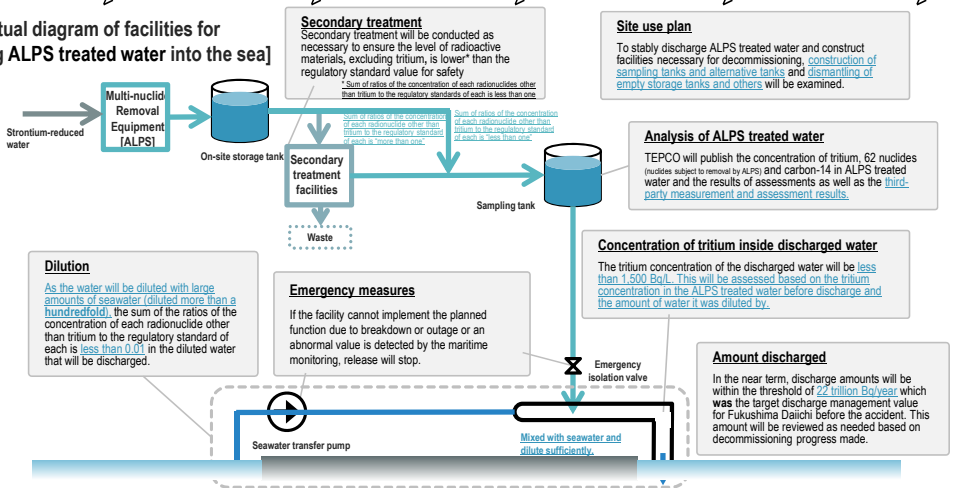


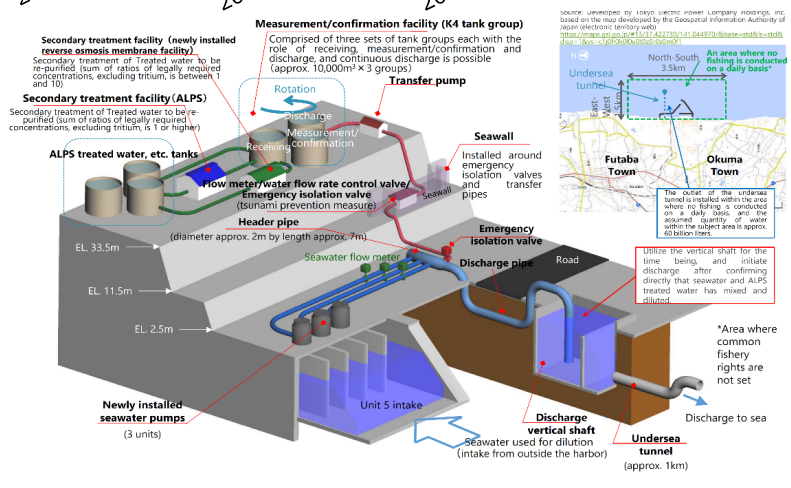


Examination concerning handling of ALPS treated water



[Conceptual diagram of facilities for releasing ALPS treated water into the sea]





3 Removal of fuel from spent pool

Milestones of the Mid- and-Long-Term Roadmap (major target processes)

- Completion of Unit 1-6 fuel removal (within 2031)
- Completion of installation of Unit 1 large cover (around FY2023), start of Unit 1 fuel removal (FY2027-2028)
- Start of Unit 2 fuel removal (FY2024-2026)

Legend: Rubble removal, etc. | Installing a fuel removal machine | Fuel removal | Storage and handling of fuel

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

▼ 2011.11- 2012.7 Removal of rubble on the Reactor Building top floor
▼ 2012.4-2013.3 Ground improvement and foundation work
▼ 2013.4-2013.7 Installation of external walls and roof panels
▼ 2013.6-2013.10 Installation of overhead crane and fuel-handling machine
▼ 2013.8-2013.10 Removal of rubble inside the reactor well and pool
▼ 2013.11.18 Start of fuel removal

All fuel assemblies from Unit 4 had been removed by December 2014.


<Unit 4 Cover for fuel removal>

In the Mid- and-Long-Term Roadmap, the Phase 1 target involved starting to remove fuel from inside the spent fuel pool (SFP) of the 1st Unit within two years of completing Step 2 (by December 2013).
On November 18, 2013, fuel removal from Unit 4, namely the first Unit, got underway and Phase 2 of the roadmap started.
On November 5, 2014, within a year of commencing fuel removal work, 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. (two 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.


Fuel removal

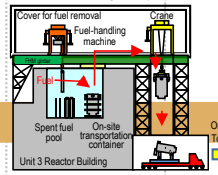
Unit 4 ▼ 2014.12.22 Fuel removal was completed (1533 assemblies)

All fuel assemblies from Unit 3 had been removed by February 2021.

Before installing a cover for fuel removal, the process of removing large rubble from the spent fuel pool was completed in November 2015. To ensure safe and steady fuel removal, training via remote control was conducted at the factory using the actual fuel-handling machine to be installed on site (February – December 2015). Installation of the fuel removal cover was completed on February 23, 2018.
With fuel removal in mind, rubble retrieval training inside the pool, which was scheduled in conjunction with fuel removal training, started from March 15, 2019 and fuel removal started from April 15, 2019. Fuel removal was completed on February 28, 2021.

▼ 2013.10 Completion of removal of large rubble on the Reactor Building top floor
▼ 2015.8 Completion of removal of the fuel-handling machine B within the spent fuel pool
▼ 2016.12 Completion of shielding on the Reactor Building top floor
▼ 2017.1 Installation start of a cover for fuel removal
▼ 2019.4.15 Start of fuel removal

Overview of the fuel-handling facility inside the cover



<Unit 3 Cover for fuel removal (dome roof) 2019.2.21>

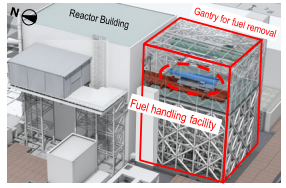
Unit 3 ▼ 2021.2.28 Fuel removal completed (566 assemblies)

For Unit 2, with the removal of spent fuel in mind, a “gantry for fuel removal” (gantry and front room) will be constructed on the south side of the building.

▼ 2015.3-2016.11 Yard construction


<Unit 2 Construction of gantry for fuel removal>

▼ 2016.9-2017.4 West-side gantry installation work
▼ 2017.5 Opening a hole in the west-side external wall
▼ 2018.8-2020.12 Moving and containment of remaining objects
▼ 2020.6 Investigation inside the spent fuel pool
▼ 2021.10 Start of ground improvement work



Unit 2
Overview of fuel removal
(bird's-eye view)

As part of efforts to remove fuel from the Unit 2 spent fuel pool and based on findings from internal operating floor investigations from November 2018 to February 2019, instead of fully dismantling the upper part of the building, the decision was made to install a small opening on the south side and use a boom crane. Examination continues to initiate fuel removal from FY2024 to FY2026.

<Reference> Progress to date
Previously, scope to recover the existing overhead crane and the fuel-handling machine was examined. However, the high radiation dose inside the operating floor meant the decision was taken to dismantle the upper part of the building in November 2015. Findings from internal investigations of the operating floor from November 2018 to February 2019 underlined the potential to conduct limited work there and the means of accessing from the south side was examined.

Unit 2

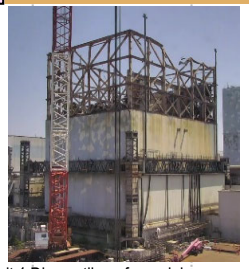
▼ 2020.3-6 Installation of spent fuel pool cover
▼ 2020.9-11 Measures to prevent and alleviate rubble falling
▼ 2020.11-2021.6 Dismantling of remaining cover
▼ 2017.12 Completion of building cover dismantling and windbreak fence installation
▼ 2018.1-2020.12 Rubble removal on the north side of Reactor Building
▼ 2018.9-12 Removal of X-braces
▼ 2021.8 Start of large cover pre-work

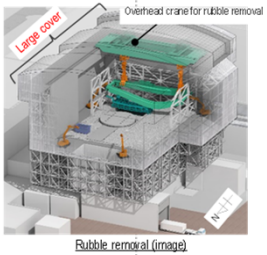
For Unit 1, a large cover will be installed over the whole building, within which rubble will be removed.

As part of efforts to remove fuel from the Unit 1 spent fuel pool, investigations are underway to ascertain the conditions of the fallen roof on the south side and the contamination of the well plug. Based on the results, “the method initially installing a large cover over the Reactor Building, then removing rubble within the cover” was selected to ensure safer and more secure removal. Work to install a large cover started from August 2021. Work to complete the installation of a large cover by around FY2023 is ongoing, with fuel removal scheduled to run from FY2027 to FY2028.

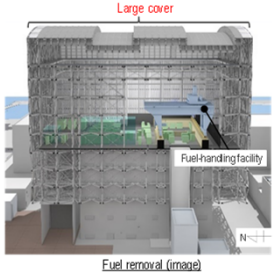
<Reference> Progress to date
Rubble removal on the north side of the operating floor started from January 2018 and has been implemented sequentially. In July and August 2019, the well plug, which was misaligned, was investigated, followed in August and September by the conditions of the overhead crane. Based on the results of these investigations, as the removal requires more careful work taking dust scattering into consideration, two methods were examined: Installing a cover after rubble removal, initially installing a large cover over the Reactor Building, then removing rubble inside the cover.

Unit 1


<Unit 1 Dismantling of remaining cover>



Rubble removal (image)



Fuel removal (image)

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

* Part of the photo is corrected because it includes machine information related to nuclear material protection.

4 Work toward fuel debris retrieval

Milestones of the Mid- and-Long-Term Roadmap (major target processes)

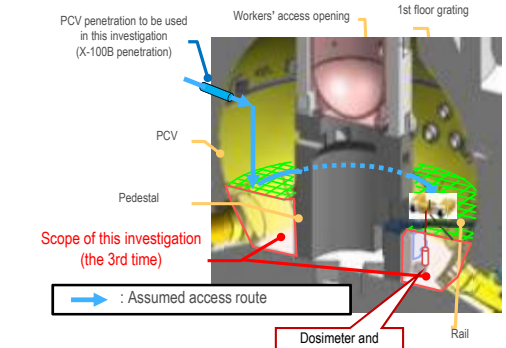
Start of fuel debris retrieval from the first unit (Unit 2). Expanding the scale in stages (within 2021 * The schedule will be extended for about 1 year due to the spread of COVID-19 infections)

Before removing fuel debris, investigations inside the Primary Containment Vessel (PCV) are conducted to inspect the conditions there, including locations of fuel debris.

Unit 1 Investigation overview

・In April 2015, a device having entered the inside of the PCV via a narrow opening (bore:φ100 mm) collected information such as images and airborne dose inside the PCV 1st floor.

・In March 2017, an investigation using a self-propelled investigation device was conducted to inspect the spreading of debris to the basement floor outside the pedestal, with images taken of the PCV bottom status for the first time. The conditions inside the PCV will continue to be examined, based on the imagery and dose data obtained.



<Image of investigation>

<Image near the bottom>

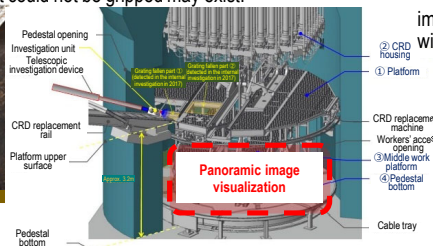
Unit 2 Investigation overview

・In January 2017, a camera was inserted from the PCV penetration to inspect the conditions of the rail on which the robot traveled. The results of a series of investigations confirmed some gratings had fallen and deformed as well as a quantity of deposit inside the pedestal.

・In January 2018, the conditions below the platform inside the pedestal were investigated. Based on the analytical results of images obtained in the investigation, deposits, probably including fuel debris, were found at the bottom of the pedestal. Moreover, multiple parts exceeding the surrounding deposits were also detected. We presumed that there were multiple instances of fuel debris falling.

・In February 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.

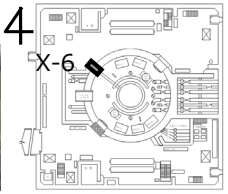
Bottom of the pedestal (after being processed in panoramic image visualization)



・In October 2020, as part of work to prepare for the PCV internal investigation and trial retrieval, a contact investigation to study deposits inside the penetration (X-6 penetration) was conducted, which involved inserting a guide pipe incorporating an investigative unit into the penetration. This confirmed that deposits inside the penetration had not deformed and come unstuck. The investigative information obtained will be utilized in the mockup test of the equipment to remove deposits inside the X-6 penetration.

<Conditions of deposits before and after contact>

<Work in front of the penetration>



<Unit 2 Reactor Building 1st floor Location of the penetration>

Unit 3 Investigation overview

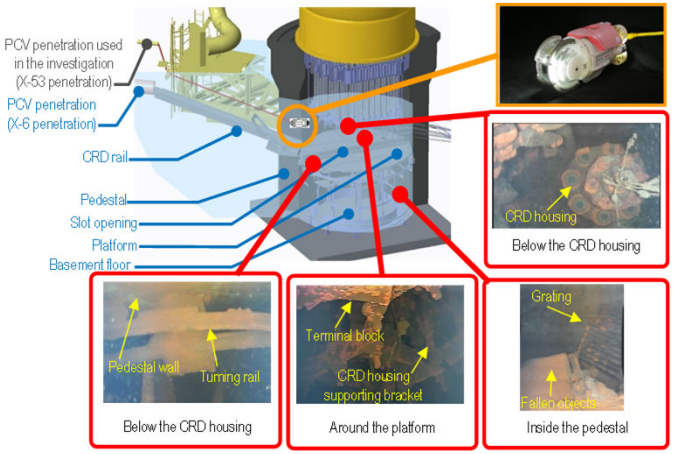
・In October 2014, the conditions of X-53 penetration, which may be under water and which is scheduled for use to investigate the inside of the PCV, was investigated via remote-controlled ultrasonic test equipment. The results showed that the penetration was not under water.

・In October 2015, to confirm the conditions inside the PCV, an investigative device was inserted into the PCV from X-53 penetration to obtain images, data on dosage and temperature and sample stagnant water. No damage to the structure and walls inside the PCV was identified and the water level was almost identical to estimated values. 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 the imagery obtained in the investigation identified damage to multiple structures and the supposed core internals.

・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.

<Conditions inside the pedestal>



Unit 1 PCV internal investigation

Investigations inside the PCV	1st (2012.10)	- Acquiring images - Measuring the air temperature and dose rate - Measuring the water level and temperature - Sampling stagnant water - Installing permanent monitoring instrumentation
	2nd (2015.4)	Confirming the status of the PCV 1st floor - Acquiring images - Measuring the air temperature and dose rate - Replacing permanent monitoring instrumentation
	3rd (2017.3)	Confirming the status of the PCV 1st basement floor - Acquiring images - Measuring the dose rate - Sampling deposit - Replacing permanent monitoring instrumentation
Leakage points from PCV	- PCV vent pipe vacuum break line bellows (identified in 2014.5) - Sand cushion drain line (identified in 2013.11)	
Evaluation of the location of fuel debris inside the reactor by measurement using muons Confirmed that there was no large fuel in the reactor core. (2015.2-5)		

Unit 2 PCV internal investigation

Investigations inside the PCV	1st (2012.1)	- Acquiring images - Measuring the air temperature
	2nd (2012.3)	- Confirming water surface - Measuring the water temperature - Measuring the dose rate
	3rd (2013.2 – 2014.6)	- Acquiring images - Sampling stagnant water - Measuring water level - Installing permanent monitoring instrumentation
	4th (2017.1-2)	- Acquiring images - Measuring the dose rate - Measuring the air temperature
	5th (2018.1)	- Acquiring images - Measuring the dose rate - Measuring the air temperature
	6th (2019.2)	- Acquiring images - Measuring the dose rate - Measuring the air temperature - Determining characteristics of a portion of deposit
Leakage points from PCV	- No leakage from the torus chamber rooftop - No leakage from any internal/external surfaces of S/C	
Evaluation of the location of fuel debris inside the reactor by measurement using muons The existence of high-density materials, which were considered to constitute fuel debris, was confirmed at the bottom of RPV and in the lower part and outer periphery of the reactor core. It was assumed that a significant portion of fuel debris existed at the bottom of RPV. (2016.3-7)		

Unit 3 PCV internal investigation

Investigations inside the PCV	1st (2015.10-12)	- Acquiring images - Measuring the air temperature and dose rate - Measuring the water level and temperature - Sampling stagnant water - Installing permanent monitoring instrumentation (2015.12)
	2nd (2017.7)	- Acquiring images - Installing permanent monitoring instrumentation (2017.8)
Leakage points from PCV	- Main steam pipe bellows (identified in 2014.5)	
Evaluation of the location of fuel debris inside the reactor by measurement using muons The evaluation confirmed that no large lump existed in the core area where fuel had been placed and that a portion of the fuel debris potentially existed at the bottom of the RPV. (2017.5-9)		

Images are provided by the International Research Institute for Nuclear Decommissioning (IRID)

5 Management of solid radioactive waste

Reference
February 24, 2022
Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment
5／6

Milestones of the Mid- and-Long-Term Roadmap (major target processes)
Eliminating temporary outdoor storage of rubble and others * Except for secondary waste of water treatment and materials for reuse or recycling (within FY2028)

★ 2017.6 Revision ★ 2018.6 Revision ★ 2019.6 Revision ★ 2020.7 Revision ★ 2021.7 Revision

★ 2016.3 Announcement of Storage Management Plan of Solid Waste (Ver. 1)

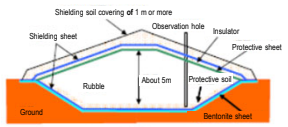
▼ 2012.9 Transfer start of rubble to the soil-covered temporary storage facility

▼ 2015.6 Transfer start of rubble to the soil-covered temporary storage facility (Tank 3)

▼ 2013.1 Start of volume reduction of trimmed trees and storage in temporary storage tank A

▼ 2019.6 Start of building construction
1st Large Waste Storage

1st Large Waste Storage Roof construction (from the inside)



<Outline of soil-covered temporary storage facility>


External view of the 9th Solid Waste Storage

▼ 2014.7 Start of pre-work
9th Solid Waste Storage


Whole view of the soil-covered temporary storage facility Tank 3

▼ 2018.2 Operation start


2021.1.18

2021.3 High alert issued from the Shallow Draft Quay drainage channel PS monitor▼
(leakage from temporary storage Area W)

▼ 2021.7 Leakage of radioactive materials from a notch tank stored in temporary storage Area P

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

▼ 2013.5 Installation work gets underway
Solid Waste Incinerator

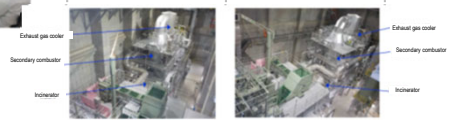
▼ 2016.3 Operation start

▲2016.8-11 Manual stop (due to pin-hole incidence)


Whole view of Solid Waste Incinerator


Electrical room


Control room



Whole view of Solid Waste Incinerator (Left: System A; right: System B)

▼ 2017.4 Start of pre-work
Additional Solid Waste Incinerator


External view of
Large Equipment Decontamination Facility

2017.10 Installation work gets

▼ 2018.5 Operation start
Large Equipment Decontamination Facility

▼ 2020.9 Start of pre-work
Compaction Facility

Site of Volume Reduction Faciility

Present status Note

Storage of rubble and others

Present storage
Approx.480,000 m³
(as of 2021.3)

Rubble (combustible), trimmed trees, used protective clothing

Contaminated soil (0.005 - 1 mSv/h)

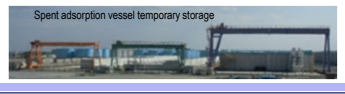
Rubble (metal, concrete, others)

More than 1 mSv/h

0.005-1 mSv/h

Less than 0.005mSv

Storage of water treatment secondary waste



Estimate for the next decade (or so)
Approx.**790,000** m³
(*2)

Approx. 290,000 m³ → To (A) (*1) → Incineration

Approx. 60,000 m³ → Stored and managed in Solid Waste Storage as done for rubble

Approx. 60,000 m³ → (B)

Approx. 170,000 m³ → To (A) (*1) → Volume reduction

Approx. 220,000 m³ → Volume reduction

Approx. 6,500 tanks → Treatment measures and others will be examined

Status after a decade

Legend: Newly installed equipment and facility

Incineration

Incinerator Pre-treatment Facility
(scheduled for completion in FY2025)


Crusher example

Radioactive Waste Incinerator

Additional Radioactive Waste Incinerator (scheduled for completion in FY2021)


Work of main part

2021.3
The installation process was reviewed
Toward an operation launch within FY2021, installation work continues

Volume reduction

Compaction Facility
(scheduled for completion in FY2022)


Concrete crusher example


Metal cutter example

Melting

Melting equipment


Electric furnace example

(*3) Approx. **270,000** m³ (*2)

Storage /management

Approx. 20,000 m³ → Solid Waste Storage
(Storage capacity: approx. 260,000 m³)

Existing Solid Waste Storage
1st-8th (existing)
9th (Operation launch in 2018.2)

Approx. 60,000 m³ → Stored and managed in Solid Waste Storage as done for rubble

(*1) (A) Approx. 60,000 m³ → **Additional Solid Waste Storage**
10th-11th
(Scheduled for completion after FY2022)

(B) Approx. 60,000 m³

Approx. 70,000 m³ → Based on the estimates for the amount of waste to be generated, the storage capacity (approx. 260,000 m³) will be reached in around 2032. Scope to install an additional solid waste facility and others will be examined

(*1) Approx. 170,000 m³ → Reuse will be examined

Approx. 220,000 m³ → Spent Adsorption Vessel Temporary Storage

To (B) → **Large Waste Storage**
(scheduled for completion in FY2022)
Toward an operation launch within FY2022, installation work is underway


Work of main part

(*1) Items for which incineration, compaction, melting or reuse is difficult are stored directly in Solid Waste Storage without being treated
(*2) As values less than 10,000 m³ are rounded, they may not be consistent with the total of breakdown
(*3) In the estimate, approx. 250,000 m³ of waste will be stored in Solid Waste Storage at the end of FY2028.

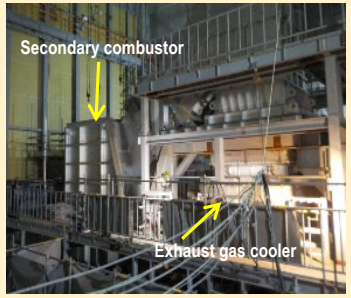
Note: Used protective clothing before incineration and BG-level concrete waste for which treatment and reuse is decided at present are not included.

- The exposure dose at the site boundaries will be reduced by aggregation to indoor storage and eliminating outdoor storage.
- The exposure dosage in exhaust gas from incinerators and at site boundaries is measured and announced on the website and others.

●Efforts to eliminate temporary outdoor storage of rubble and others

To incinerate trimmed trees and combustible rubble (woods, packing materials, paper and others), work to install the Additional Solid Waste Facility is underway.


Whole view of the Additional Solid Waste Incinerator Building

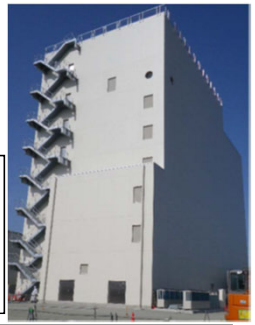


Main equipment

6 Improvement of work environment

While ensuring reliable exposure dose management for workers, sufficient personnel are secured. Moreover, while getting a handle on on-site needs, the work environment and labor conditions are continuously improved.

Regarding the site-wide reduction in the radiation dose and prevention of contamination spreading, the radiation dose on site was reduced by removal of rubble, topsoil and facing. Moreover, the operation was improved to use environmentally-improved areas as a Green Zone, within which workers are allowed to wear general work clothes and disposable dust-protective masks which are less of a physical burden.



To help workers in the Fukushima Daiichi NPS precisely understand the conditions of their workplaces, a total of 86 dose-rate monitors were installed by January 2015. These monitors allow workers to confirm on-site dose rates at their workplaces in real time.

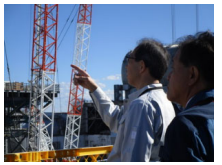
In February 2017, operation started at the Partner Companies' Building next to the New Administration Office Building.

External view of Access Control Facility

In June 2013, operation of the Access Control Facility started near the main gate of the Fukushima Daiichi NPS, to which duties conducted at J-village were shifted, including contamination examination, decontamination, switching protective equipment on and off and distribution/collection of dosimeters.

A large rest house for workers was established and its operation commenced in May 2015. Spaces in the large rest house are also installed for office work and collective worker safety checks as well as taking rest.
In March 2016, a convenience store opened in the large rest house. In April, the shower room went into operation.

In May 2017, a heliport for emergency transport was installed inside the Fukushima Daiichi NPS and went into operation.
Compared to the previous operation (at Koriyama Coast, Futaba Town or Fukushima Daini NPS, relaying to a doctor helicopter), a faster response is available for seriously ill patients requiring treatment at external medical institutions.



Visit by Governor of Fukushima Prefecture to the Fukushima Daiichi NPS (2018.11.1)

Visit by Prime Minister Kishida to the Fukushima Daiichi NPS (2021.10.17)

From March 12, 2011, in response to the increased airborne concentration of radioactive materials, instructions were issued to wear full-face masks throughout the Fukushima Daiichi NPS site, excluding the Main Anti-Earthquake Building and the rest house.

In March 2015, the Fukushima revitalization meal service center opened.

From November 2018, from the west-side high-ground area, where Unit 1-4 can be viewed, visitors can see the site in their normal clothes without having to change.

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

Changes in operation of controlled area

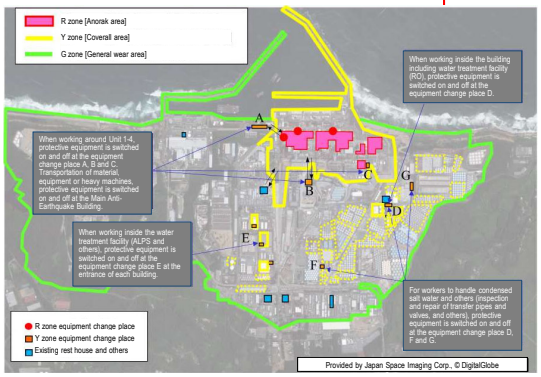
From May 2013, full-face mask unnecessary area was expanded sequentially.

In May 2015, full-face mask unnecessary area was expanded to cover about 90% of the site.

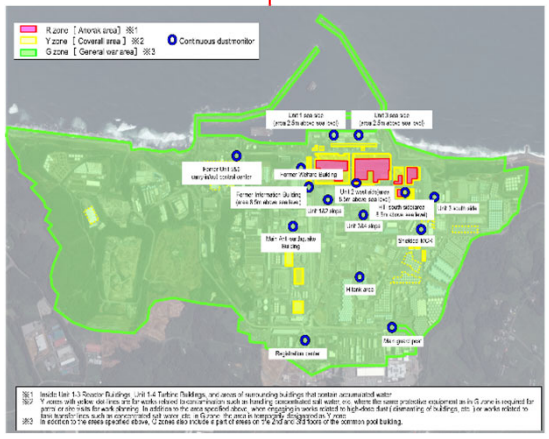
In March 2017, the G-zone area was expanded (to cover 95% of the whole site).

In August 2021, operation started while eliminating the need for the DS2 mask during light work in G-zone outside the protection area around Unit 1-4 (except for inside Units 5 and 6).

In May 2013, areas excluding those around Unit 1-4, tank areas and rubble storage areas were set to full-face mask unnecessary areas.



In March 2016, based on the progress of measures to reduce the environmental dosage on site, the site was categorized into two zones: Highly contaminated area around Unit 1-4 buildings, etc. and other areas where limited operation started to optimize protective equipment according to each category.



In May 2018, within about 96% of the site, workers are allowed to wear light equipment such as general workwear and disposable dust-protective masks.

<Travel survey results of major roads within the site>
The dose rate has been declining every year.

Measured in August 2016

Measured in August 2018

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