Outline of Decommissioning, Contaminated Water and Treated Water Management

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

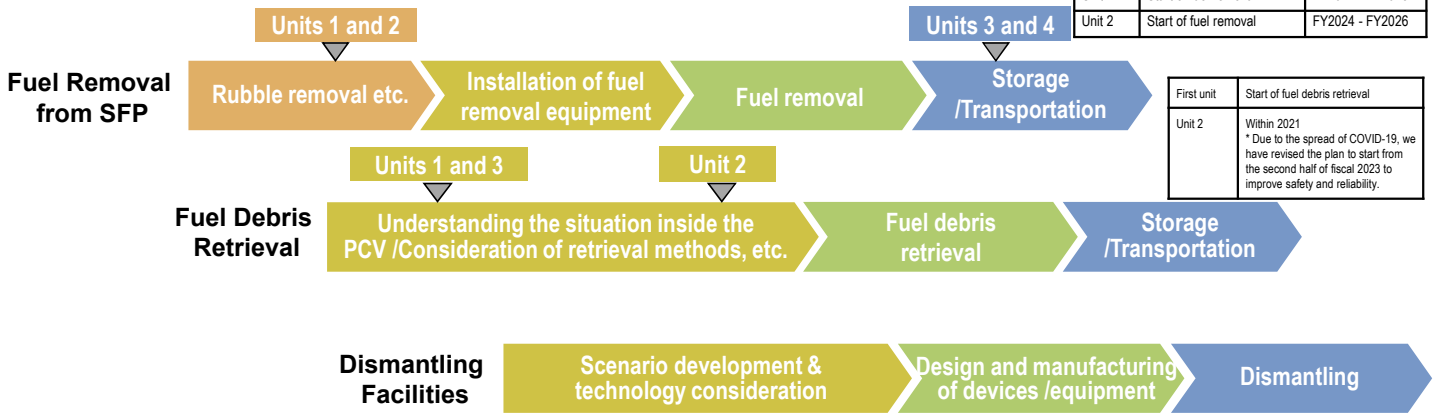
Main decommissioning work and steps

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.

<Milestones in the Mid- and Long-Term Roadmap>

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

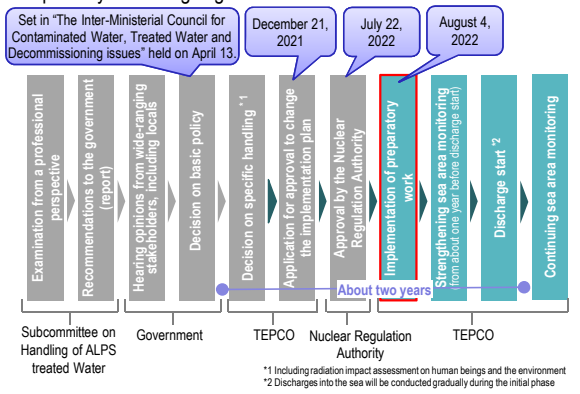


First unit	Start of fuel debris retrieval
Unit 2	Within 2021 * Due to the spread of COVID-19, we have revised the plan to start from the second half of fiscal 2023 to improve safety and reliability.

Measures for 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 with full transparency on an ongoing basis.



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

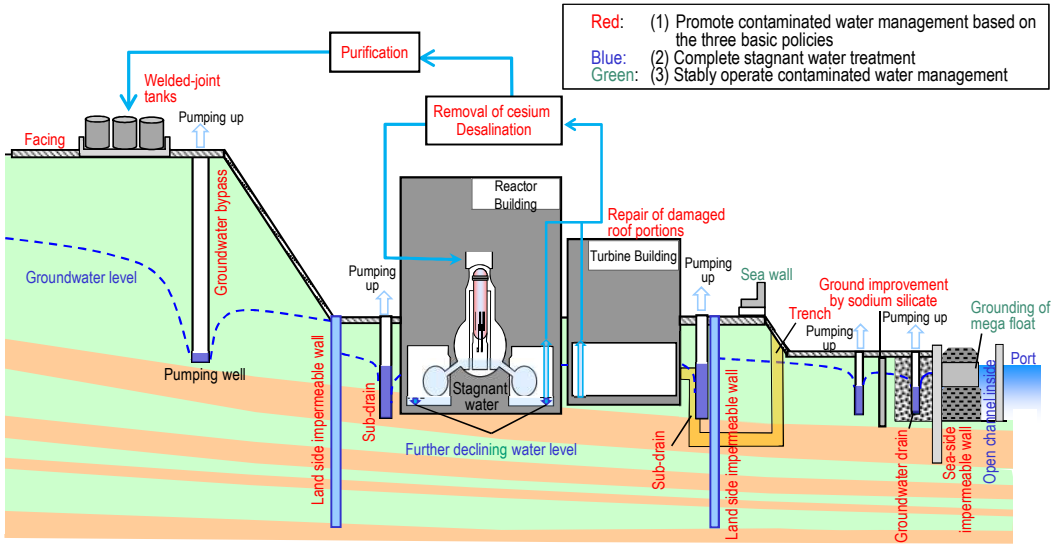
- Strontium-reduced water from other equipment is being re-treated in the Advanced Liquid Processing System (ALPS: multi-nuclide removal equipment) and stored in welded-joint tanks.
- Multi-layered contaminated water management measures, including land-side impermeable walls and sub-drains, have stabilized 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. 130 m^3/day (in FY2021).
- 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 reduce 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

- Various measures are underway to prepare for tsunamis. For heavy rain, sandbags are being installed to suppress direct inflow into buildings while work to close openings in buildings and install sea walls to enhance drainage channels and other measures is 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.

Submission of the Application Documents for Approval to Amend the Implementation Plan regarding the Handling of ALPS treated Water

Additional description and revision were made for the organizational structure within TEPCO such as operation and maintenance management of the ALPS treated water dilution/ discharge facility, nuclides to be measured and assessed to verify that the discharge criteria is satisfied before discharge into the sea and the radiation environmental impact assessment results based on the reviewed nuclides to be measured and assessed. Subsequently, on November 14, TEPCO submitted the Application Documents for Approval to Amend the Implementation Plan to the Nuclear Regulation Agency (NRA).

TEPCO will respond sincerely to the reviews conducted by the NRA.

IAEA review of the safety aspects of ALPS treated water (second review)

From November 14~18, a delegation of the International Atomic Energy Agency (IAEA) visited Japan and reviewed the safety aspects of ALPS treated water.

In the review, based on the IAEA international safety standards, the reflection status of items pointed out by IAEA in the previous review (mainly in the radiation environmental assessment) was examined and discussions were conducted about the details of the “Application Documents for Approval to Amend the Implementation Plan” (review of nuclides to be measured and assessed, revised radiation environmental impact assessment report and others) submitted by TEPCO to the NRA on November 14.

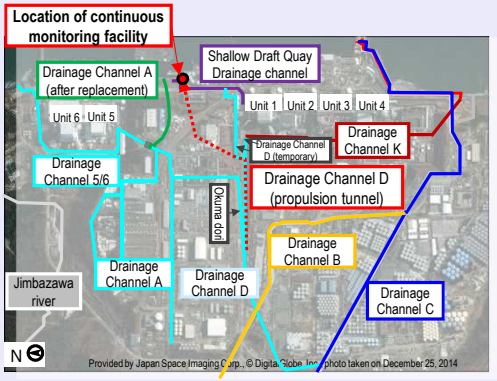
The results of this review will be published as a report from IAEA around the beginning of the following year.

Operation start of continuous monitoring of Drainage Channel D

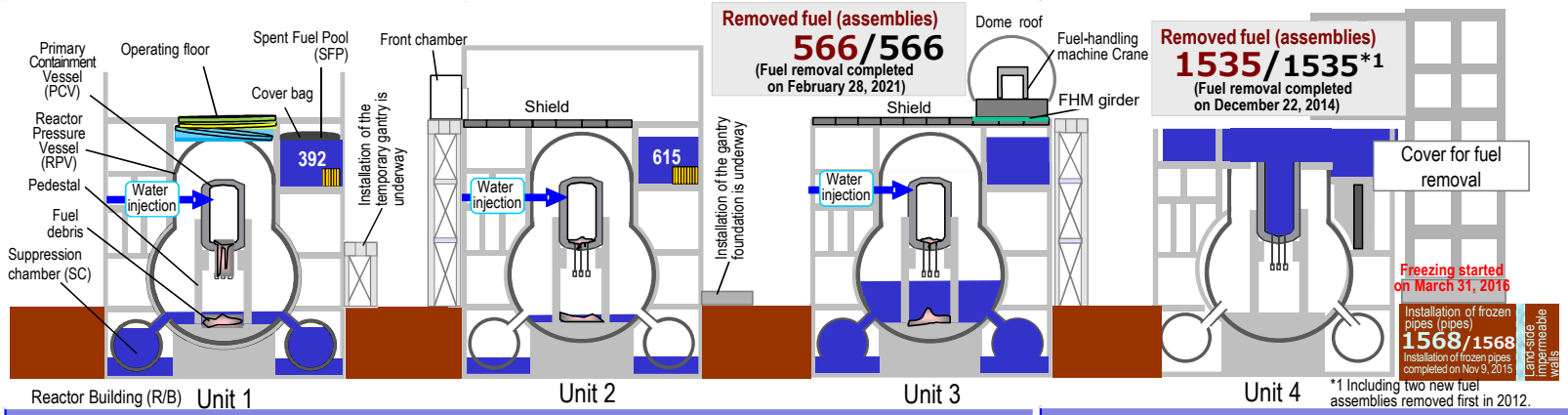
For Drainage Channel D, as part of efforts to eliminate the flooding risk around the Units 1-4 buildings due to heavy rain, a propulsion tunnel was installed and operation started from August 30 mainly in areas with a low dose on the west side of the site

To further mitigate the flooding risk around the Unit 1-4 buildings during heavy rain, a portion of rain in the area of high ground on the mountain side of the Unit 1-4 buildings will be conveyed to Drainage Channel D. Before the connection, continuous monitoring facilities for the drainage concentration have been prepared.

From November 29, remotely operated continuous monitoring will start. Moreover, a portion of the high ground area on the mountain side of the Unit 1-4 buildings will be sequentially connected with Drainage Channel D and monitoring of the drainage will continue.



<Arrangement of on-site drainage>



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

Examination of status monitoring conservation for land-side impermeable wall facilities brine supply pipe

In February, leakage from the refrigerant supply pipe of the land-side impermeable wall facilities was detected. From August, the space of the leakage part was measured. Based on the measurement results, monitoring methods are being examined.

The feasibility of early detection of degradation tendency by installing status monitoring sensors in the leakage part and other locations is being examined. Mockup tests of the sensor will be conducted from the beginning of next year.

Progress of fuel removal from the Unit 2 spent fuel pool

Inside the building, removal of the fuel-handling machine control room which interferes with the installation of the new fuel-handling machine has been underway since August 22. After completing the removal, other hindrances inside the building (existing facilities on the south side of the pool) will be removed.

Outside the building, the gantry is being installed and concrete placement of the 2nd (final) layer for the gantry foundation is underway from September 13. Outside the site, ground assembly of steel frames proceeds from August 31 and assembled steel frames will be carried in from mid-January for on-site assembly.

Work continues prioritizing safety above all.

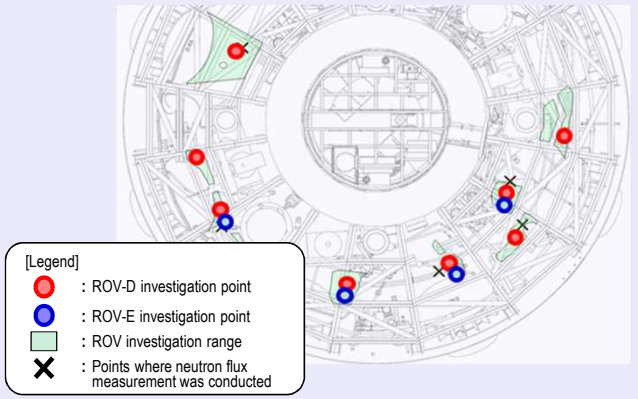
<Steel frame unit connection verification (November 5, 2022)>

The latter half of the Unit 1 PCV internal investigation will commence in early December

The latter half of the Unit 1 Primary Containment Vessel (PCV) internal investigation will commence in early December

First, the debris detection by ROV-D (nuclide analysis of gamma-ray) will be conducted at eight points and investigative results will be evaluated for about 2-4 weeks.

Moreover, preparation is underway to commence deposit sampling by ROV-E from January 2023.



<Points of the PCV internal investigation by ROV-D and E>

Major initiatives – Locations on site

IAEA review of the safety aspects of ALPS treated water (second review)

Submission of the Application Documents for Approval to Amend the Implementation Plan regarding the Handling of ALPS treated Water

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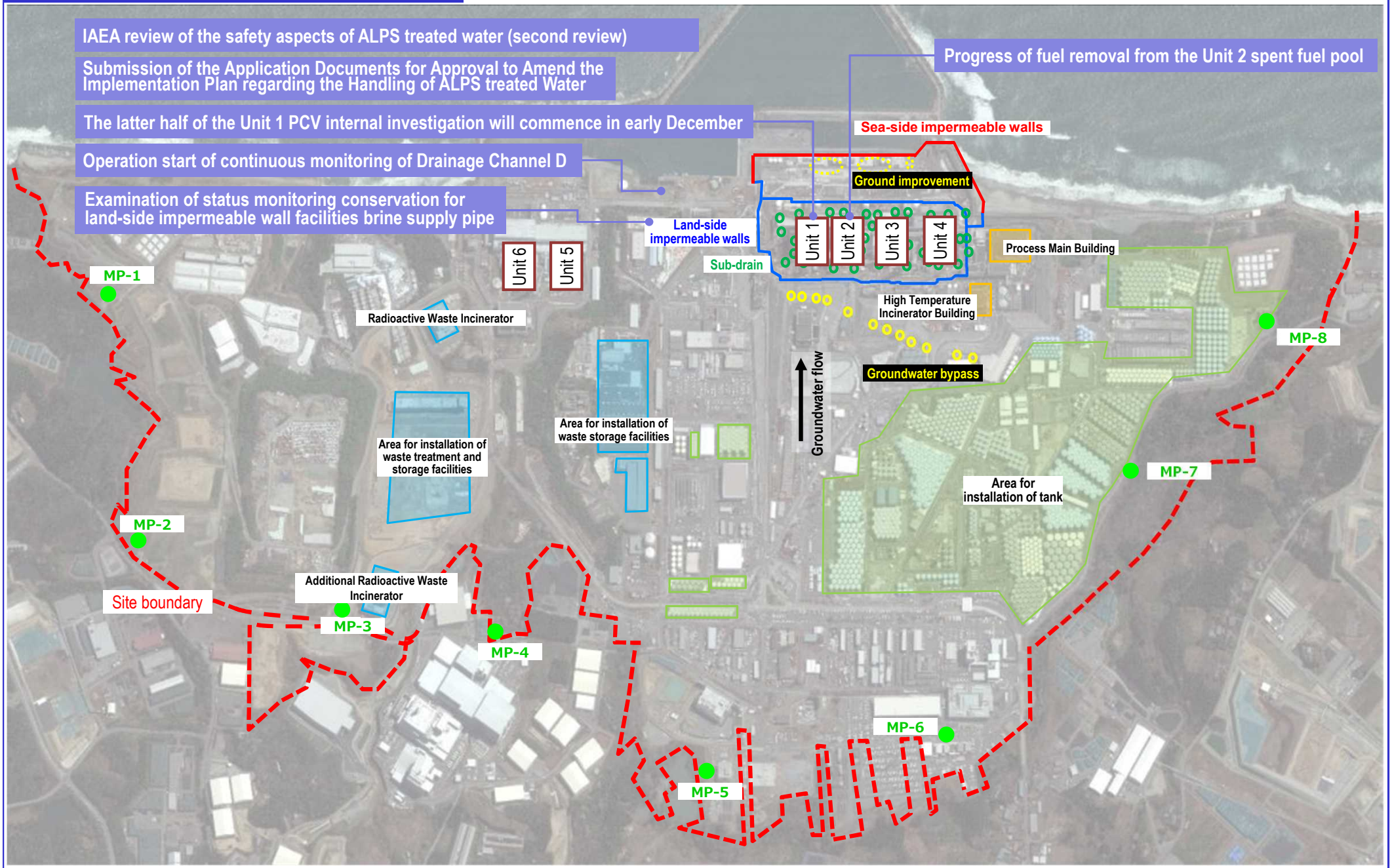
Operation start of continuous monitoring of Drainage Channel D

Examination of status monitoring conservation for land-side impermeable wall facilities brine supply pipe

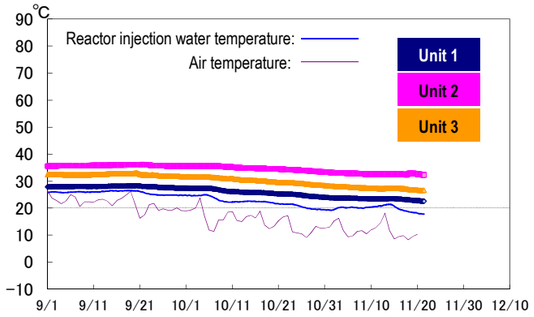


Provided by Japan Space Imaging Corp., photo taken on April 8, 2021
Product (C) [2020] DigitalGlobe, Inc., a Maxar company

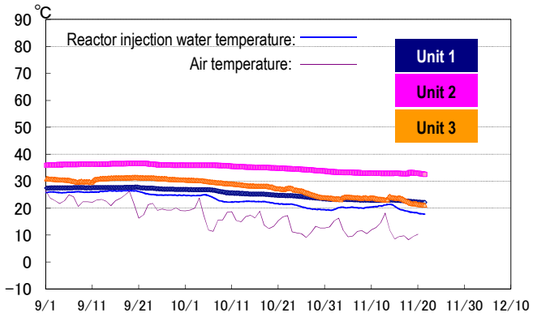
I. Confirmation of the reactor conditions

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. 20 to 35°C for the past month, though it varied depending on the unit and location of the thermometer.

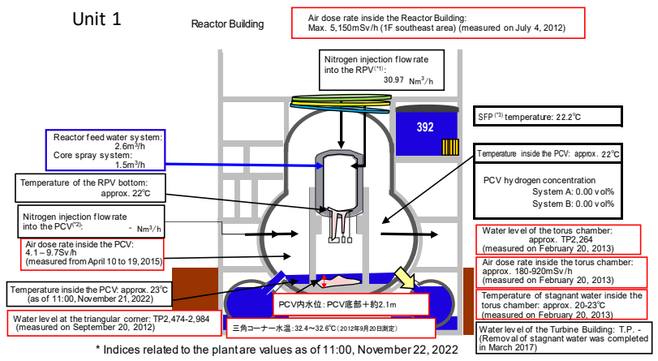


RPV bottom temperatures (recent quarter)

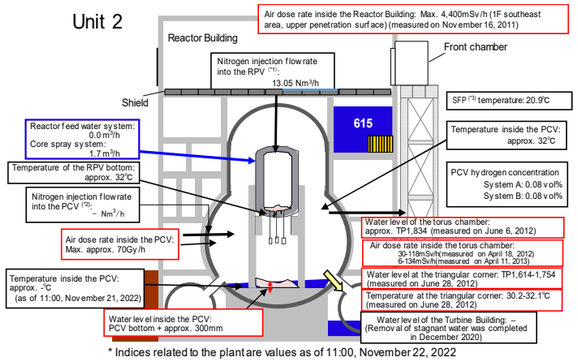


PCV gas phase temperatures (recent quarter)

*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, November 22, 2022



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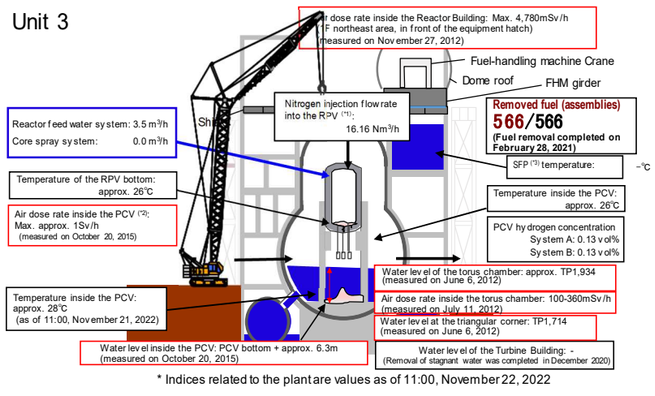


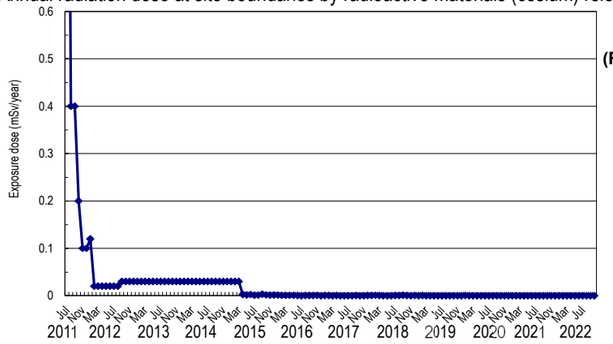
* Indices related to the plant are values as of 11:00, November 22, 2022

(*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 October 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. 1.7×10^{-12} Bq/cm^3 and 2.3×10^{-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 0.00004 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 x 10^{-5} Bq/cm^{3Marc}
[Cs-137]: 3 x 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 0.328 – 1.087 μSv/h (October 26 – November 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.

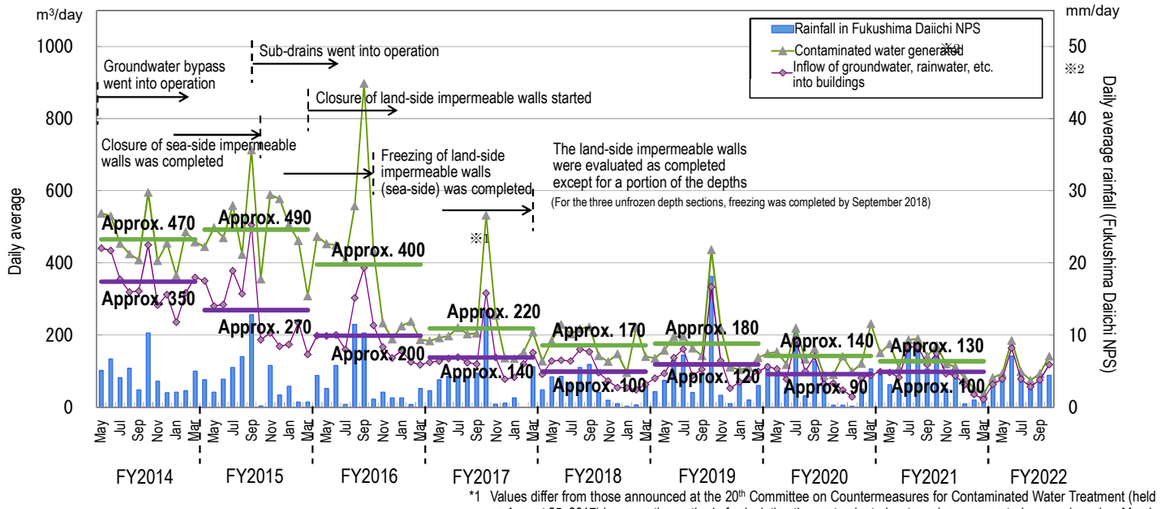
Based on the above, it was confirmed that the comprehensive cold shutdown condition had been maintained and the reactors remained in a stabilized condition.

II. Progress status by each plan

Measures for contaminated water and treated water

➢ 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 FY2021 declined to approx. 130 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 November 15, 2022, 2,036 release operations had been conducted.
  The water quality of all temporary storage tanks satisfied the operational target.

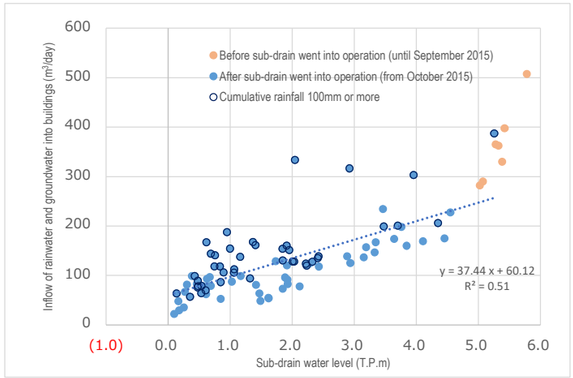


Figure 2: Correlation between inflow such as groundwater and rainwater into buildings and the water level of Units 1-4 sub-drains

➢ Implementation status of facing

- Facing is a measure that involves asphalting the on-site surface to reduce the radiation dose, prevent rainwater infiltrating the ground and reduce the amount of underground water flowing into buildings. As of the end of October 2022, 95% of the planned area (1,450,000 m^2 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 October 2022, 30% of the planned area (60,000 m^2) 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 due to the land-side impermeable walls and the decline in the set water level of the sub-drains. On the mountain side, the average difference between the inside and outside has remained at 4-5 m. The water level in the bank area has also remained low (T.P. 1.4 m) relative to the ground surface (T.P. 2.5 m).
- As the set water level of the sub-drains declined slightly (T.P. -0.55 ⇒ -0.65 m) and others in FY2021, the groundwater level on the sea side of the Unit 1-4 buildings remained low (except during heavy rainfall) compared with the T.P. 2.5 m area.

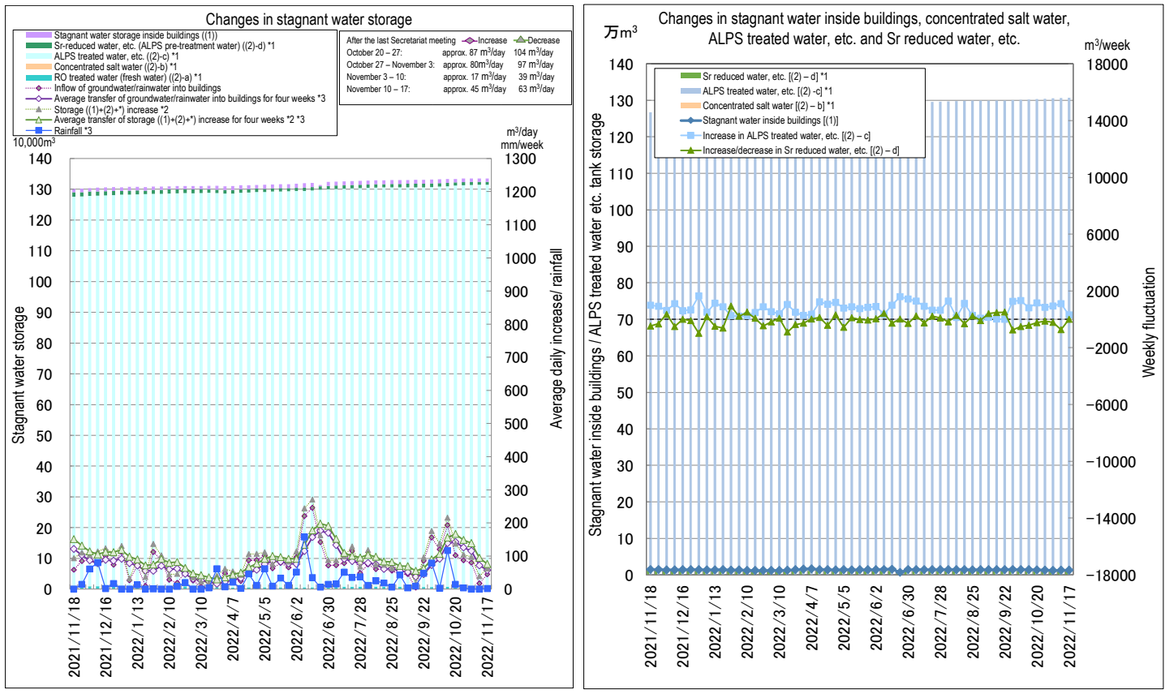
➢ Operation of the multi-nuclide removal equipment

- Regarding the multi-nuclide removal equipment (existing), hot tests using radioactive water are ongoing (System A: from March 30, 2013, System B: from June 13, 2013, System C: from September 27, 2013). On March 23, 2022, a pre-service inspection certificate was granted by the Nuclear Regulation Authority and the entire pre-service inspection was completed. The multi-nuclide removal equipment (additional) went into full-scale operation from October 16, 2017. Regarding the multi-nuclide removal equipment (high-performance), hot tests using radioactive water have been underway (from October 18, 2014).
- As of November 17, 2022, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 494,000, 743,000 and 103,000 m^3, respectively (including approx. 9,500 m^3 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 November 17, 2022, approx. 695,000 m^3 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 November 17, 2022, approx. 861,000 m^3 had been treated.

As of November 17, 2022



(1) Stagnant water storage inside buildings (Units 1-4, Process Main Building, High Temperature Incinerator Building, Waste Liquid Supply Tank, SPT (B))
(2) Units 1-4 tank storage {[(2)-a RO treated water (fresh water)] + [(2)-b Concentrated salt water] + [(2)-c ALPS treated water, etc.] + [(2)-d Sr-reduced water, etc. (ALPS pre-treatment water)]
*: Water amount from tank bottom to water-level gauge 0% (DS)
*1: Water amount for which the water-level gauge indicates 0% or more
*2: Calculated in the method of contaminated water generated [(Inflow of groundwater/rainwater into buildings) + (other transfer) + (chemical injection into ALPS)]
*3: Average transfer of storage increase and groundwater/rainwater into buildings for four weeks was added (November 24, 2022)

Figure 3: Status of stagnant water storage

➢ Status of sea area monitoring related to the handling of ALPS treated water

- The concentration of tritium in seawater within 2km of the port has remained constant for the past year and also remained low at new measurement points within the fluctuation range of seawater in Japan*. The concentration of Cesium-137 increased temporarily, which was considered due to rainfall as in the past fluctuation in seawater around the Fukushima Daiichi Nuclear Power Station. However, it remained constant relative to measurement benchmarks for the past year and at new measurement points and also low within the fluctuation range of seawater in Japan*. For tritium, monitoring has been conducted with a lower detection limit since April 18.
- Both concentrations of tritium and Cesium-137 in seawater within 20km of the coast had remained constant for the past year and low within the fluctuation range of seawater in Japan*.
- The concentration of tritium in seawater further than 20km from the coast remained low, including at new measurement points, within the fluctuation range of seawater in Japan*. The concentration of Cesium-137 remained constant over the past year within the fluctuation range of seawater in Japan*.

* : The range of the minimum – maximum values detected during April 2019 – March 2021 were as follows in the database below:

In Japan (including off the coast of Fukushima Prefecture):
Tritium concentration: 0.043 - 20 Bq/L
Cesium-137 concentration: 0.0010 - 0.45 Bq/L
Off the coast of Fukushima Prefecture
Tritium concentration: 0.043 – 2.2 Bq/L

Cesium-137 concentration: 0.0010 - 0.45 Bq/L

Source: Environmental Radioactivity and Radiation in Japan, Environmental Radiation Database
https://www.kankyo-hoshano.go.jp/data/database/

- For the status of fish and seaweed, no samples were collected in April. The concentration of tritium in fish sampled at the sampling point T-S8 had remained constant for the past year and low within the fluctuation range of seawater in Japan*. Regarding fish at other sampling points, measurement data is being verified.

  * : The range of the minimum – maximum values detected during April 2019 – March 2021 was as follows in the database below:

  In Japan (including off the coast of Fukushima Prefecture)

  Tritium concentration: 0.064 – 0.12 Bq/L

➢ Announcement related to work to install the ALPS treated Water Dilution/Discharge Facility and related facilities

- Regarding the work to install the discharge tunnel and others that started on August 4, installation of the discharge outlet caisson was completed on November 18. Subsequently, mortar concrete will be placed around the discharge outlet caisson. During the backfill work, the shield machine will be stayed at a safe position in front of the discharge outlet caisson. Effectively utilizing the backfill work period, the downstream pool will be constructed ahead of schedule.
- Specifically, excavation of the discharge outlet tunnel will be temporarily suspended at about 800m from the discharge tunnel around the end of November and construction of the downstream pool will start from December.
- After the construction of the downstream pool is completed, installation of the discharge tunnel will be resumed.

➢ Progress of the rearing test of marine organisms in the Fukushima Daiichi Nuclear Power Station

- Regarding the rearing test of marine organisms, scheduled numbers of flounder and abalones were carried into the tanks. No deconditioning or death has been detected since October 21 for flounder and October 25 (when abalones were carried in) for abalones.
- The rearing test remained controllable almost within the management target value, despite slight variation detected in the water quality data.
- Subsequently, an additional rearing test to adjust the tritium concentration of seawater to approx. 30 Bq/L will start from the end of November. Moreover, Free Water Tritium (FWT) of flounder and abalones will also be measured. For flounder, FWT will also be measured by a third-party institution and their test results will be compared with those of TEPCO.
- The timing for starting the rearing test of seaweed will be announced as soon as decided.

➢ Progress status of work to install the ALPS treated Water Dilution/Discharge Facility and related facilities

- For the measurement and confirmation/transfer facilities, work to install a pipe support, piping and others for these facilities started from August 4 from around K4 area tanks.
- For the discharge facility, the bedrock layer is being drilled by the shield machine from August 4 to start construction of the discharge tunnel. At present, no water leakage or others have been detected within the drilling range.
- For the dilution facility, precast blocks for the discharge shaft (upper stream pool) have been manufactured since September 14 at a factory within Fukushima Prefecture and ground improvement for that shaft has also been conducted since October 7 as part of seismic countermeasures.
- From August 4, as part of efforts to install the partition weir, preparatory work, including constructing a runway for heavy-duty machines, is being implemented. In the sea-side area for Units 5 and 6, removal of sedimentation inside the open intake channels will be conducted simultaneously and after installing the partition weir, anti-permeation work will be removed.
- On November 18, installation of the discharge outlet caisson was completed.

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.

➢ Main work to help spent fuel removal at Unit 1

- 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. The ground assembly was completed for the temporary gantry and lower structure and approx. 50%, for the upper structure.
- A work yard was prepared around the Reactor Building and preliminary work to install a large cover started from August 2021.
- From April 13, 2022, drilling to install an anchor in the Reactor Building started. A temporary gantry is also being installed from the portion where anchors and base plates are installed.
- The Isolation Condenser secondary side pipe (IC pipe)*, which hinders the installation of anchors and baseplates, was removed in late September.

  * Isolation Condenser secondary-side pipe: The secondary-side pipe of the Isolation Condenser, which cools the inside of the Reactor Pressure Vessel when the external power source is lost and is currently unused.

➢ 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 in December 2021 and contamination reduction was confirmed, based on smear sampling results before and after decontamination. Work to install shielding within a range including above the reactor well, where the highest level of dose was observed, was completed at the end of May. Due to interference with the installation of the new fuel-handling machine, work to remove the control room of the fuel-handling machine (hereinafter FHM control room) has been underway since August. After the removed of the FHM control room is completed, preliminary work to dismantle the existing facility on the south side will commence (rearrangement of site, inspection of remotely operated heavy machines (annual inspection), and measures to prevent scattering of rubble and dust).
- Outside the building, construction of a gantry foundation has been underway since June 2022. After the construction is completed, steel structure erection will commence. Outside the site, before erecting the steel structure, ground assembly continues.

Retrieval of fuel debris

➢ Unit 1 PCV internal investigation (the latter half)

- The start of the investigation by ROV-D is expected to shift from the initial schedule at the end of November to early December because of the added mockup test to examine scope to expand the range for deposit 3D mapping by ROV-B.
- Examination is underway toward a latter half investigation. Images near the pedestal opening revealed that massive objects, previously considered deposits, existed on the opening wall akin to shelf deposits and the space under them would allow ROV-A2 to pass with ease. This would make penetrating the inside of the pedestal more feasible.

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

- Using the Naraha mockup facility, a mockup test simulating the actual site is underway.
- At present, after modifying the control program to position the arm more accurately, a permeability test using the X-6 penetration mockup continues. For improvements extracted in the performance verification test at Naraha, measures and improvement will continue to be implemented.
- Regarding work to install an isolation room as a boundary during opening of the X-6 penetration, a metal plate was installed as part of measures to prevent damage to the box-shaped rubber part housing the penetration flange handle. The isolation room was connected and pressure applied to verify the installation status. When foaming liquid was applied to the shielding door, bubble generation was detected. In response, the installation of the isolation room will be adjusted.
- Work continues safely and carefully.

➢ Stagnant gas in the pipe for the Unit 1 RCW heat exchanger inlet header

- In response to the high air dose rate observed in the south side area of the Unit 1 Reactor Building 1st and 2nd floors, inclusive water in the heat exchanger of the Reactor Building Closed Cooling Water System (RCW) will be removed to reduce the dose.
- Before opening a hole for water removal and others, drilling to check stagnant gas was conducted for the period October 24 – November 14. Analysis of stagnant gas in the pipe after opening a hole revealed the presence of hydrogen, krypton 85 and others.
- The evaluation results showed that the effective dose at the site boundaries when the stagnant gas was exhausted was sufficiently low, which meant the risk of radiation exposure to the surrounding public was considered extremely small. Based on these, inactive gas started to be enclosed inside the pipe (stagnant gas was exhausted into the Reactor Building) for several days from November 16.
- After confirming that the hydrogen concentration inside the pipe was below the inflammability limit (4%) (there was no risk of hydrogen fire), drilling for water removal by mechanical drilling equipment and other works continue, prioritizing safety above all.

➢ Unit 2 Reactor Building internal investigation (status inspection to examine the accessibility of the 1st basement floor)

- Regarding Unit 2, the Reactor Core Isolation Cooling System (RCIC) operated for about three days, including before and after the tsunami arrival and one of the points to clarify was precisely why the RCIC stopped. Due to the difficulty in accessing the RCIC room, which is located on the 1st basement floor, access methods for the 1st basement floor, including the investigation of other facilities, are being considered.
- As part of a preliminary investigation, the status of the triangle corner on the 1st basement floor will be inspected from December 2022 to acquire information that will help when examining the access method to the 1st basement floor of the Reactor Building.

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 October 2022, the total storage volume for concrete and metal rubble was approx. 329,400 m^3 (-700 m^3 compared to the end of September with an area-occupation rate of 88%). The total storage volume of trimmed trees was approx. 127,900 m^3 (-1,600 m^3 with an area-occupation rate of 73%). The total storage volume of used protective clothing was approx. 22,000 m^3 (-2,700 m^3, with an area-occupation rate of 42%). The decrease in rubble was attributable to a transfer for area arrangement. As of the end of October 2022, there were six temporary deposits with storage capacity exceeding 1,000m^3, storage 55,200m^3.

➢ Management status of secondary waste from water treatment

- As of November 3, 2022, the total storage volume of waste sludge was 437 m^3 (area-occupation rate: 62%), while that of concentrated waste fluid was 9,345 m^3 (area-occupation rate: 91%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment and other vessels, was 5,453 (area-occupation rate: 86%).

➢ Collection of adsorbent samples from KURION and SARRY cesium adsorption vessels

- Aiming at examining measures to treat and dispose of water treatment secondary waste (adsorbent), which is solid waste generated in the Fukushima Daiichi Nuclear Power Station, technologies to collect adsorbent samples from the spent adsorption vessels of cesium adsorption apparatus have been developed. It is expected that this will allow the acquisition of basic information necessary for concrete treatment and disposal methods of water treatment secondary waste.
- A real-scale mockup of the sampling equipment manufactured last year applied glove box compartment, for which a temporary house, ventilation system with various filters and dust monitor were installed in layers.
- This fiscal year, to ensure safe and secure sampling, ancillary equipment developed in the JAEA Naraha Center for Remote Control Technology Development for the site was assembled and using unused real cesium adsorption vessels of the cesium adsorption apparatus (KURION) and the second apparatus (SARRY), an integration test and practical training were conducted.
- The next step will involve carrying equipment into the power station site to conduct cold and hot tests using real machines and eventually collecting real absorbent samples.

➢ Recent results to determine the properties of waste or major risk sources

- To establish technology concerning waste management (determining the properties, storage, treatment and disposal) of solid waste, research and development in each field is underway.
- To determine the relevant properties, rubble, secondary waste of contaminated water treatment and others were analyzed to clarify their properties and methods for analysis, inventory estimation and others were developed.
- The next step will involve utilizing the Radioactive Material Analysis and Research Facility Laboratory-1 to accelerate analysis, continuously reduce the uncertainty of waste properties and proceed to develop technology.

➢ Status of the additional Radioactive Waste Incinerator in the Fukushima Daiichi Nuclear Power Station

- Regarding the additional Radioactive Waste Incinerator, operation of which had been suspended since June 10, inspection and repair of malfunctions was completed and operation resumed from October 17.
- After operation resumed, an alert indicating an overload of the exhaust gas cooler ash discharge equipment was issued on October 23.
- From the perspective of preventive maintenance for the equipment, incineration was suspended on October 27 to inspect the bottom of the exhaust gas cooler and its ash discharge equipment. After declogging the chute and inspecting the ash discharge equipment, operation resumed from November 7 and stable incineration has continued.
- Due to the power source suspension by upper power panel remodeling work, the plan was suspended from November 16 and operation will be resumed from early December.

Reduction in radiation dose and mitigation of contamination

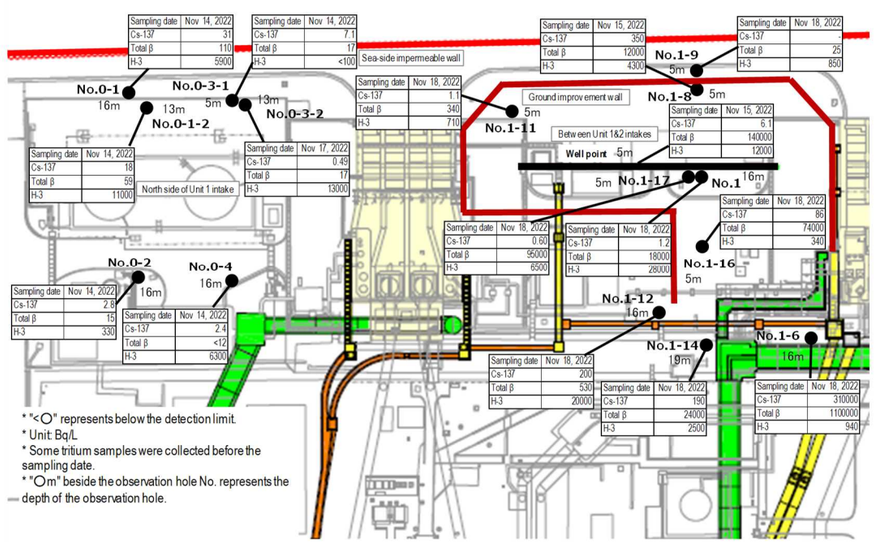
Effective dose-reduction at site boundaries and purification of port water to mitigate the impact of radiation on the external environment

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

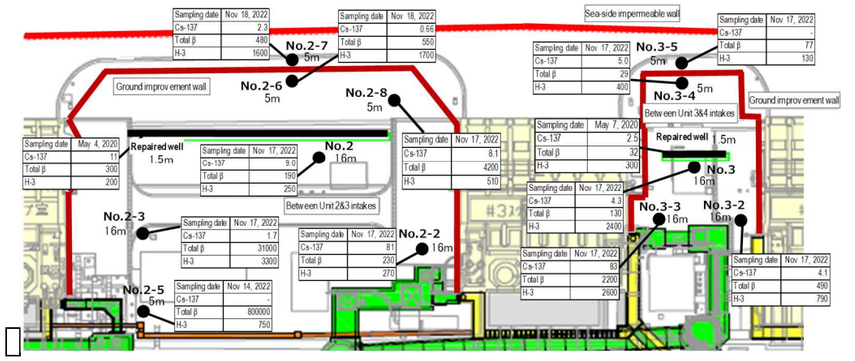
- In the Unit 1 intake north side area, the H-3 concentration was below the legal discharge limit of 60,000 Bq/L at all observation holes and remained constant or has been declining overall. The concentration of total β radioactive materials has remained constant overall but increased temporarily from 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 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 or declining at many observation holes, including Nos. 1-6, 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 Nos. 2-3, 2-5, 2-6 and 2-7 but has remained constant overall. The concentration of total β radioactive materials has remained constant overall but been increasing or declining at No. 2-5. 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 and remained constant or been declining overall. The concentration of total β radioactive

materials has remained constant overall but has been increasing or declining at many observation holes, including Nos. 3-4 and 3-5. The trend continues to be monitored carefully.

- In the groundwater on the east side of the Turbine Buildings, as with the total β radioactive materials, the concentration of cesium has also remained constant as the overall area but been increasing or declining and exceeded the previous highest record at some observation holes. Investigations into the fluctuation are underway for Nos. 0-3-2, 1, 1-6, 2-5, 2-6 and 3-3.
- The concentration of radioactive materials in drainage channels has remained constant overall, despite increasing during rainfall. In Drainage Channel D, drainage of the low-dose area on the west side of the site started to pass from August 30, 2022, and the concentration has remained low. From November 29, 2022, continuous monitors will be installed and drainage around the Units 1 and 2 switch yard will start to pass.
- 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 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 in FY2021 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

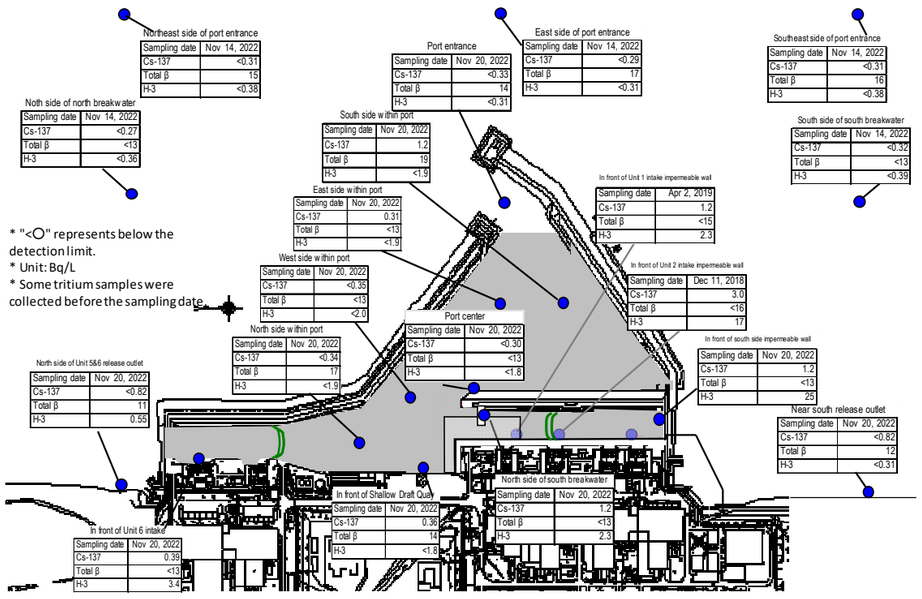


Figure 5: Seawater concentration around the port

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 July to September 2022 was approx. 9,400 (cooperating company workers and TEPCO HD employees), which exceeded the monthly average workforce (approx. 7,200). Accordingly, sufficient personnel were registered to work on site.
- It was confirmed with the prime contractors that the estimated manpower necessary for the work in December 2022 (approx. 4,100 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 4,400.
- The number of workers both from within and outside Fukushima Prefecture remained constant. The local employment ratio (cooperating company workers and TEPCO HD employees) as of October 2022 remained constant at around 70%.

- The average exposure doses of workers were approx. 2.54 and 2.60 and 2.51 mSv/person-year during FY2019, 2020 and 2021, 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.

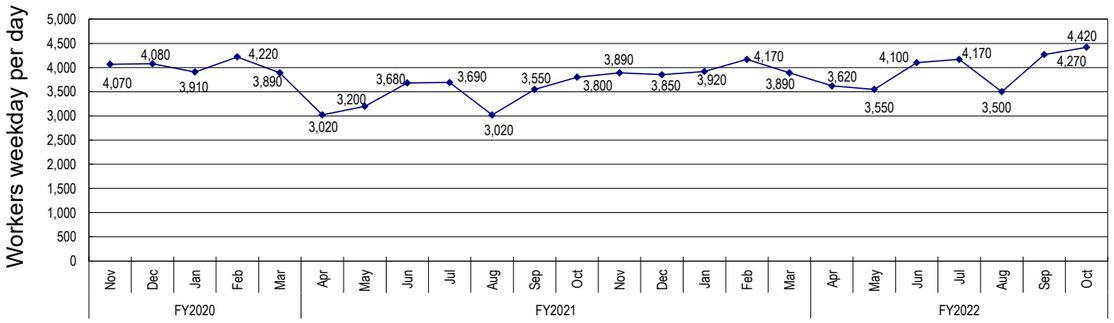


Figure 6: Changes in the average number of workers weekday per day for each month of the past 2 years (actual values)

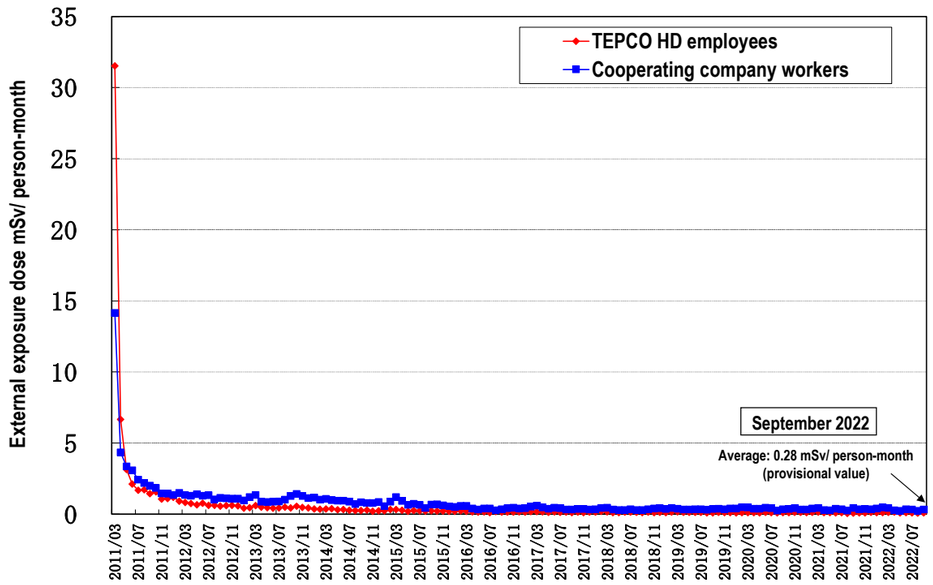


Figure 7: Changes in monthly average exposure dose of individual worker
(monthly exposure dose since March 2011)

➢ Status of heat stroke cases

- In FY2022, measures to further prevent heat stroke commenced from April to cope with the hottest season.
- FY2022, ten workers suffered heat stroke due to work up until November 21 (in FY2021, eight workers up until the end of November). Continued measures will be taken to prevent heat stroke.
- This fiscal year, in addition to the FY2021 measures, as review of the prevention rule, “full-face mask” and “workers with heat stroke risk [medical history (heat stroke, diabetes, hypertension and others), those who have no experience of working in the Fukushima Daiichi Nuclear Power Station in summer (April-October in the previous year)]” were added to the supplementary items of WBGT value and rest time was set by managing actual working time. However, two more heat stroke cases were recorded compared to the number in FY2021.
- In F2023, as well as ongoing measures from this fiscal year, the necessary prevention rules will be reviewed based on the factors and characteristics of heat stroke occurrence in FY2022 to further improve the work environment.

➢ Countermeasures to suppress the spread of COVID-19 infections

- From mid-September, infections have been decreasing. However, the ongoing basic countermeasures to prevent infection spreading, such as requiring employees to take their temperature before coming to the office, wear masks at all times, avoid the “Three Cs” by using the rest house in shifts, eat silently and carefully select business travel, continued to be properly implemented to proceed with decommissioning work, prioritizing safety above all.
- As of November 23, 2022, 1,411 workers (including 200 TEPCO HD employees, 1,206 cooperating company workers, 3 business partner company employees and 2 temporary workers) of the Fukushima Daiichi Nuclear Power Station had contracted COVID-19, an increase of 100 workers (including 30 TEPCO HD employees, 69 cooperating company workers and 1 temporary worker) from the figures in the previous published material (as of October 26).
- From November 28, 2022, a workplace vaccination program of COVID-19 (for the omicron variant) will be implemented for TEPCO HD employees and cooperating company workers in the Fukushima Daiichi Nuclear Power Station who wish to be vaccinated.
- No significant influence on decommissioning work, such as a corresponding delay to work processes due to this infection, had been identified.

➢ Measures to prevent infection and expansion of influenza and norovirus

- Since November, measures for influenza and norovirus have been implemented, including free influenza vaccinations (subsidized by TEPCO HD) at medical clinics around the site (from October 11, 2022 to January 28, 2023) for cooperating company workers. As of November 15, 2022, a total of 1,847 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 46th week of 2022 (November 14-20, 2022), no influenza or norovirus infections were recorded. The totals for the same period for the previous season also showed no influenza or norovirus infections.

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 October 31 - November 14)"; unit (Bq/L); ND represents a value below the detection limit

Summary of TEPCO data as of November 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(0.27)				
Cesium-137	0.34				
Total β	12				
Toritium	ND(1.9)	※1			

Cesium-134	: 3.3	(H25/12/24)	→	ND(0.29)	Below 1/10
Cesium-137	: 7.3	(H25/10/11)	→	ND(0.31)	Below 1/20
Total β	: 69	(H25/8/19)	→	17	Below 1/4
Toritium	: 68	(H25/8/19)	→	0.44	Below 1/100

Cesium-134	: 3.3	(H25/10/17)	→	ND(0.34)	Below 1/9
Cesium-137	: 9	(H25/10/17)	→	ND(0.37)	Below 1/20
Total β	: 74	(H25/8/19)	→	ND(13)	Below 1/5
Toritium	: 67	(H25/8/19)	→	ND(1.9)	Below 1/30

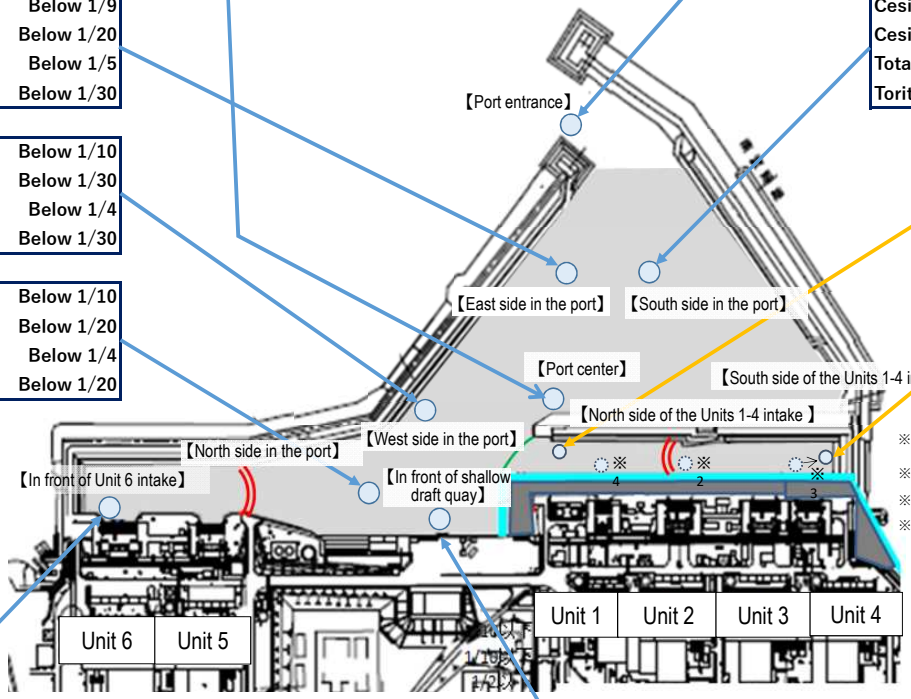
Cesium-134	: 3.5	(H25/10/17)	→	ND(0.30)	Below 1/10
Cesium-137	: 7.8	(H25/10/17)	→	0.26	Below 1/30
Total β	: 79	(H25/8/19)	→	ND(13)	Below 1/6
Toritium	: 60	(H25/8/19)	→	ND(1.9)	Below 1/30

Cesium-134	: 4.4	(H25/12/24)	→	ND(0.25)	Below 1/10
Cesium-137	: 10	(H25/12/24)	→	ND(0.33)	Below 1/30
Total β	: 60	(H25/7/4)	→	ND(13)	Below 1/4
Toritium	: 59	(H25/8/19)	→	ND(1.9)	Below 1/30

Cesium-134	: 32	(H25/10/11)	→	ND(0.26)	Below 1/100
Cesium-137	: 73	(H25/10/11)	→	ND(0.30)	Below 1/200
Total β	: 320	(H25/8/12)	→	ND(12)	Below 1/20
Toritium	: 510	(H25/9/2)	→	ND(2.4)	Below 1/200

Cesium-134	: 5	(H25/12/2)	→	ND(0.31)	Below 1/10
Cesium-137	: 8.4	(H25/12/2)	→	0.35	Below 1/20
Total β	: 69	(H25/8/19)	→	14	Below 1/4
Toritium	: 52	(H25/8/19)	→	ND(1.9)	Below 1/20

Cesium-134	ND(0.31)
Cesium-137	1.9
Total β	ND(12)
Toritium	72 ※1



Sea side impermeable wall
Silt fence
Silt fence for construction

Cesium-134	: 2.8	(H25/12/2)	→	ND(0.36)	Below 1/7
Cesium-137	: 5.8	(H25/12/2)	→	0.55	Below 1/10
Total β	: 46	(H25/8/19)	→	ND(12)	Below 1/3
Toritium	: 24	(H25/8/19)	→	ND(2.4)	Below 1/10

Cesium-134	: 5.3	(H25/8/5)	→	ND(0.29)	Below 1/10
Cesium-137	: 8.6	(H25/8/5)	→	ND(0.34)	Below 1/20
Total β	: 40	(H25/7/3)	→	ND(12)	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/decommission/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 October 31 - November 14)

Summary of TEPCO data as of November 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(0.25)	
Cesium-137	: ND	(H25)	→	ND(0.31)	
Total β	: ND	(H25)	→	15	
Toritium	: ND	(H25)	→	_	

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

Cesium-134	: ND	(H25)	→	ND(0.24)	
Cesium-137	: 1.6	(H25/10/18)	→	ND(0.29)	Below 1/2
Total β	: ND	(H25)	→	17	
Toritium	: 6.4	(H25/10/18)	→	_	

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

Cesium-134	: ND	(H25)	→	ND(0.31)	
Cesium-137	: ND	(H25)	→	ND(0.31)	
Total β	: ND	(H25)	→	16	
Toritium	: ND	(H25)	→	_	

Cesium-134	: ND	(H25)	→	ND(0.25)	
Cesium-137	: ND	(H25)	→	ND(0.27)	
Total β	: ND	(H25)	→	ND(13)	
Toritium	: 4.7	(H25/8/18)	→	_	

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

Cesium-134	: 3.3	(H25/12/24)	→	ND(0.29)	Below 1/10
Cesium-137	: 7.3	(H25/10/11)	→	ND(0.31)	Below 1/20
Total β	: 69	(H25/8/19)	→	17	Below 1/4
Toritium	: 68	(H25/8/19)	→	0.44	Below 1/100

【Port entrance】

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

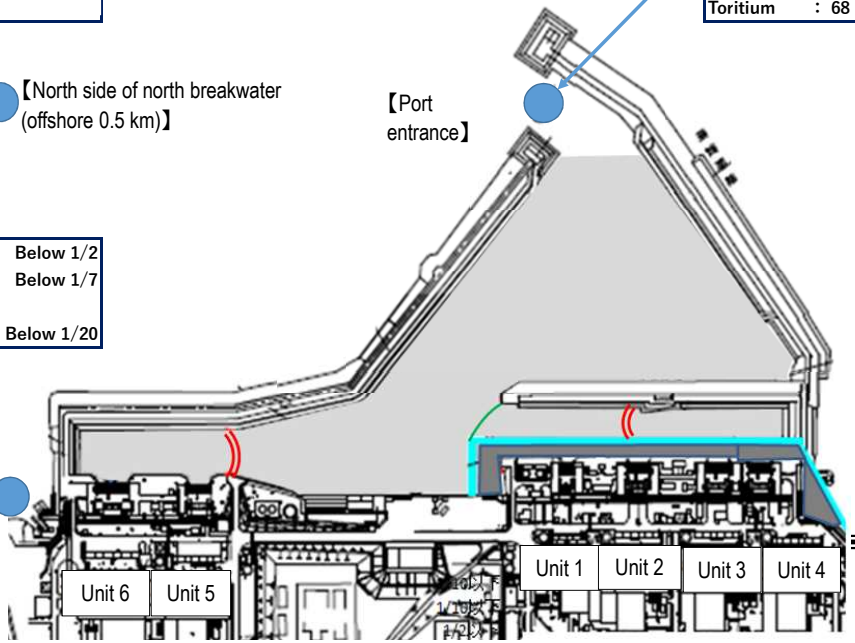
Cesium-134	: ND	(H25)	→	ND(0.24)	
Cesium-137	: ND	(H25)	→	ND(0.32)	
Total β	: ND	(H25)	→	ND(13)	
Toritium	: ND	(H25)	→	_	

Cesium-134	: 1.8	(H25/6/21)	→	ND(0.69)	Below 1/2
Cesium-137	: 4.5	(H25/3/17)	→	ND(0.61)	Below 1/7
Total β	: 12	(H25/12/23)	→	11	
Toritium	: 8.6	(H25/6/26)	→	ND(0.32)	Below 1/20

【North side of Unit 5 and 6 release outlet】

Cesium-134	: ND	(H25)	→	ND(0.94)	
Cesium-137	: 3	(H25/7/15)	→	ND(0.46)	Below 1/6
Total β	: 15	(H25/12/23)	→	11	
Toritium	: 1.9	(H25/11/25)	→	ND(0.32)	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

Appendix 2

November 24, 2022

TEPCO Holdings Fukushima Daiichi Nuclear Power Station Site Layout

- 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 (planned)
- 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)

Tank installation status

Temporary waste sludge storage

Spent adsorption vessel temporary storage facility

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

Futaba town

Okuma town

Town boundary

Site boundary

Trimmed trees

Used protective clothing

Rubble

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

Large equipment decontamination facility

Spent absorption vessel temporary storage

Land-side impermeable walls with frozen soil

Land-side impermeable walls freezing plant

Mega float

Pipe route

Underground reservoirs

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

Sea side impermeable wall

Water desalinations (RO)

Cesium absorption apparatus (Incineration Workshop Building)

Decontamination instruments (Process Building)

3rd cesium adsorption apparatus (Onsite Bunker Building)

2nd cesium adsorption apparatus

Cesium absorption vessel temporary storage

Water desalinations (evaporative concentration)

Water desalinations (RO)

Unit 1 Unit 2 Unit 3 Unit 4 Unit 5 Unit 6

K1 K2 K3 K4

H1 H2 H3 H4 H5 H6 H8 H9

J1 J2 J3 J4 J5 J6 J7 J8 J9

B C D E F G1 G1 South G3・G4・G5 G6 G7

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 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)
- [Completed] Treatment of contaminated water in buildings was completed* (within 2020) *Except for Units 1-3 Reactor Buildings, Process Main Building and High Temperature Incinerator Building.
- Contaminated water in Reactor Buildings was reduced to about a half of the level at the end of 2020 (FY2022-FY2024)

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

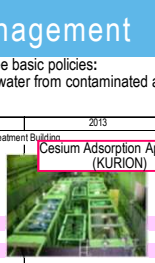
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

Contaminated water management [Remove]

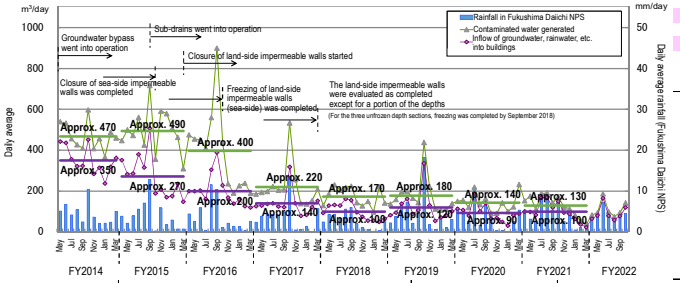
Contaminated water treatment facility
- ▽Reception start of contaminated water to Central Waste Treatment Building
- ▽Decontamination equipment (AREVA)
- ▽Evaporative concentration equipment
- ▽Cesium Adsorption Apparatus (KURION)
- ▽2nd Cesium Adsorption Apparatus (SARRY)
- ▽Treatment of RO-condensed 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)


Multi-nuclide removal equipment (ALPS)


Cesium Adsorption Apparatus (KURION)


Unit 2 seawater pipe trench Shaft D filling work



Removal of contaminated water from seawater pipe trench
- ification 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 S
- Unit 3
- ▽Completion of tunnel filling
- ▽Filling of openings II and III complete
- ▽Transfer stagnant water complete
- ▽Completion of filling parts running over
- Unit 4
- 【Removal of contaminated water in seawater pipe trench】

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. 130 m3/day ▽**


Pumping well

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)


Sub-drain purification system

Land-side impermeable wall
- ▽Start of maintenance operation on north and south sides
- ▽Freezing completion
- ▽Start of maintenance operation in all sections
- In some temperature measurement tubes near the K drainage channel cross, temperature exceeded 0℃ locally ▽
- ▽Installation start of land-side impermeable walls
- **▽Freezing start**
- Start of maintenance operation on north▽
- **▽Freezing completion (except for some parts)**
- Although no influence was detected on the impermeable function of the land-side impermeable walls but test investigation is underway for the stoppage effect


Land-side impermeable wall brine (refrigerant) circulation pipe

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)


Placement of seaside impermeable walls complete

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
- ▽RO濃縮塩水の浄化処理完了
- ▽Storage in steel square tanks
- ▽鋼製角形タンクのリプレース完了
- ▽Removal of steel horizontal tanks complete (except for condensed waste liquid storage tank)
- ▽Water leakage (300L) from flanged tank
- ▽Water leakage (100l) 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)


Construction of welded-joint tanks

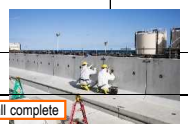

Flanged and welded-joint tanks

Treatment of stagnant water
- ▽Start to maintain water-level difference with sub-drain water level
- ▽Installation of stagnant water transfer equipment/transfer start
- ▽Completion of work to improve reliability of transfer line (replacement with PE pipes)
- ▽Transfer start from each building to Central Rw Building
- **▽Treatment of stagnant water in buildings complete**
- ▽Floor exposure of Unit 1 T/B
- ▽Separation of stagnant water between Units 1 and 2
- ▽Floor exposure of Unit 1 Rw/B
- ▽Separation of stagnant water between Units 3 and 4
- ▽Floor exposure of Unit 2 T/B, Rw/B
- ▽Floor exposure of Unit 3 T/B, Rw/B
- ▽Floor exposure of Unit 4 R/B, T/B, Rw/B

Countermeasures to tsunami risks

Closure of openings
- ▽Examination start of measures to close building openings
- ▽Work for common pool complete
- ▽Work for Units 1 and 2 T/B complete
- ▽Work for HTI building complete
- ▽Work for Process Main Building complete
- ▽Work for Unit 3 T/B complete
- ▽Work for Unit 1-3 R/B complete
- **▽Measures to close openings were completed**
- ▽Work for Units 1-4 RwB was completed

Seawall
- ▽Installation of outer-rise tsunami seawall complete
- ▽Construction start of Tsushima Trench Tsunami Seawall
- Japan Trench tsunami seawall
- ▽Completion of installation ▽On-site start


Chishima Trench Tsunami Seawall complete

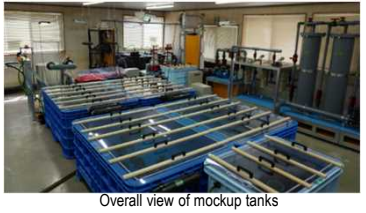

Construction of Japan Trench Tsunami Seawall

Mega float
- ▽Start of marine construction
- Temporary grounding of mega float▽
- ▽Internal filling complete (reduction of tsunami risks)

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.


Overall view of mockup tanks


Flounder in rearing preparation tank

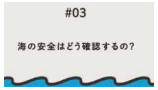
Enhancement of communication activities

- Measures for decommissioning, contaminated water and treated water of the Fukushima Daiichi Nuclear Power Station need efforts to reduce risks over a long term. Regarding handling of ALPS treated water as a part of decommissioning, to local residents, those who in the fishery industry and related parties, we will thoroughly explain about the policies and responses concerning the facility design, operation and management to ensure safety, monitoring of radioactive materials and others, and proceed with **efforts to sincerely face their concerns and interests and respond to each of them**.
- Moreover, to **further deepen the understanding** of everyone in Japan and overseas, efforts to **coherently disseminate** measurement results of ALPS treated water and information concerning facility operation, radiation impact assessment and others will continue and be enhanced.

● Information dissemination via media in Japan and overseas and others
- To help deliver information based on scientific evidence, press release, press conference, disclosure of power plant site, briefing and others are held.
- For overseas major media, diplomatic corps and others, briefing and press tour are held. Information dissemination to neighboring countries is also being enhanced. Information dissemination to overseas media and information provision to embassies is focused.
  Ex.) May 10, 2022 Diplomatic corps and others, overseas media and others


Press conference

Completely revised in January 2022



“Understand by video. ALPS Treated Water” series
Now available on youtube (Japanese and English)

● Safety review of International Atomic Energy IAgency (IAEA)
- In February 2022, IAEA officials and international professionals (US/ UK/ France/ Russia/ China/ others) visited Japan to conduct technical inspection based on the international safety standard and on April 29, the report of safety assessment was published.
- The report states that in regards to the safety of the facility, the IAEA has found that, “TEPCO successfully incorporated prevention measures in the design of the facility as well as in the associated operating procedures.” In regards to the Radiological Environmental Impact Assessment, “it acknowledged that the doses to the assumed representative person are expected to be very low and significantly below the dose constraint set by the Japanese regulatory body.”


IAEA onsite investigation

● Communication with related parties taking various opportunities
- Efforts to explain about policies and safety measures for handling of ALPS treated water, countermeasures to rumors and others to people in the Metropolitan area, local residents and related parties and hear their opinions proceed. (In FY2021, approx. 3,000 times)
- Visits and Discussion Meetings of the Fukushima Daiichi Nuclear Power Station have been held since FY2019 for 13 municipalities in Hamadori. In FY2021 and FY2022, the Visits and Discussion Meetings were expanded to within Fukushima Prefecture. (In FY2022, a total of 17 times are scheduled)
- Moreover, online visits (connecting visitors and guide online) utilizing the “Fukushima Daiichi Virtual Tour” video, which is now being published on the TEPCO web site, and others are also offered in response to the need of people in Japan and overseas.
  (From August 2020 to July 2022 Online visitors: 59 organizations, 2,250 persons including overseas organizations)


Discussion meeting (face-to-face dialogue)

● Rearing test of marine organisms
- To alleviate concerns and lead to relief of local residents, related parties and the everyone in society, marine orgasms are being reared in tanks of seawater containing ALPS treated water and the status is compared with the original seawater controls. The progress will be shown coherently and clearly.
- Regarding behaviors of tritium and others, a lot of research has been conducted in Japan and overseas. Based on the experimental results, firstly experimental data for a half year will be collected and subsequently, the same as past experimental results, the theory “tritium in vivo is not concentrated and the concentration of tritium in vivo will not exceed the level in the growing environment” will also be reaffirmed.
- Froom March 2022, practice to rear flounder started using coastal seawater around the nuclear power station to learn how to rear marine organisms, verify the equipment design and others.
- From September 30, the stage was shifted to the next “rearing test” and on October 3, ALPS treated water was added.

- From March 17, daily rearing status is published on the TEPCO HD homepage and twitter.
  - Homepage address: http://www.tepco.co.jp/decommission/information/newsrelease/breedingtest/index-j.html
  - Twitter address: https://twitter.com/TEPCOfishkeeper

Examination concerning handling of ALPS treated water

Tritiated Water Taskforce (2013.12 – 2016.5, 15 meetings)


Tank area viewed from the Large Rest House (2015.10.29)

2016.6 Report of Tritiated Water Taskforce

Subcommittee on Handling of ALPS treated water (2016.11 – 2020.1, 17 meetings)

2018.8 Explanatory and hearing meeting, receiving opinions

2020.2 Report of Subcommittee on Handling of ALPS treated water

Opportunity for receiving opinions from parties concerned concerning handling of ALPS treated water (2020.4 – 2020.10, 7 meetings)

Review meeting concerning the implementation plan on handling of ALPS treated water (from 2021.7 to 2022.4, 15 meetings)

2021.12.21 The “Application Documents for Approval to Amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station Specified Nuclear Facility” regarding ALPS treated water were submitted to the Nuclear Regulation Authority

2021.12.28 “The Action Plan concerning the Continuous Implementation of the Basic Policy on Handling of ALPS Treated Water” was formulated

2022.4.28, 5.13, 7.15 Application to partially revise the Application Documents for Approval to Amend the Implementation Plan was submitted

2022.7.22 Application for the Application Documents for Approval to Amend the Implementation Plan was approved

2022.8.4 Work has commenced

2021.4.13 The basic policy on the handling of ALPS treated water was set

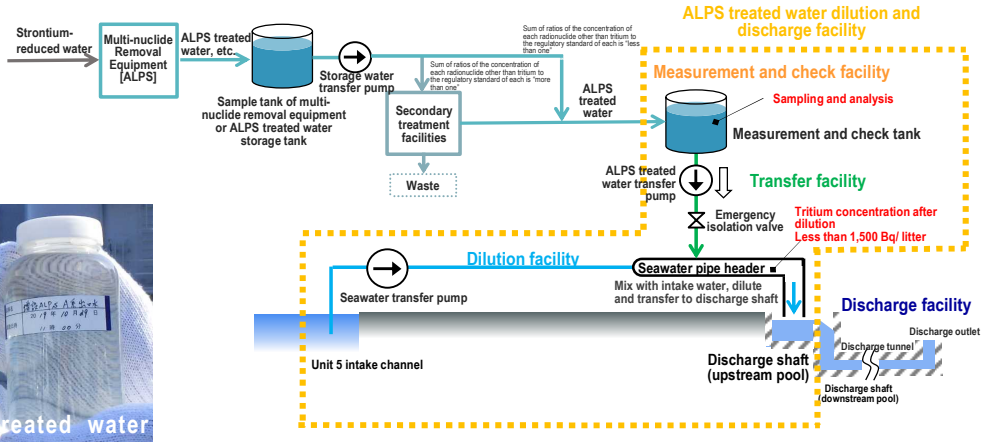
2021.4.16 The response of TEPCO was announced

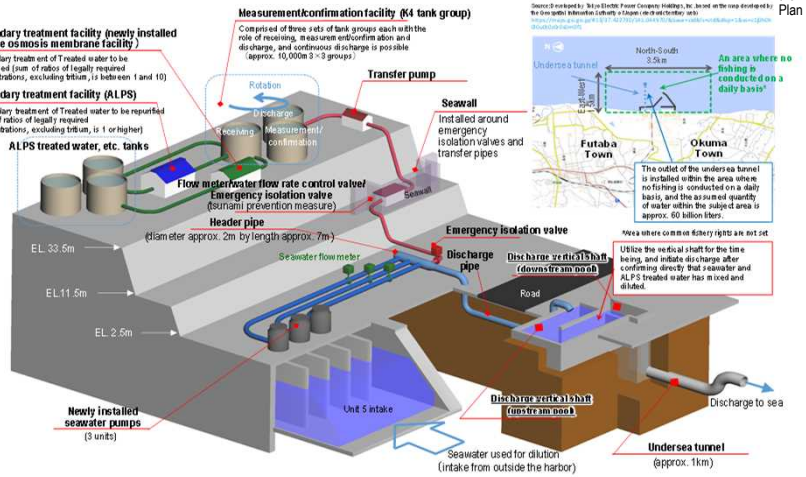
2022/8/30 The "Approach to Strengthening and Expansion of Measures in the Handling of ALPS Treated Water" was summarized

2022.11.14 Application for the Application Documents for Approval to Amend the Implementation Plan was submitted

2014 2015 2016 2017 2018 2019 2020 2021 2022

【Overview of ALPS treated water dilution and discharge facility】





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)

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

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

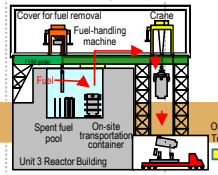
Unit 4 ▼ 2014.12.22 Fuel removal was completed (1533 assemblies)

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>

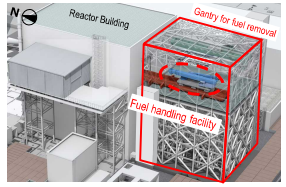
Unit 3 ▼ 2021.2.28 Fuel removal completed (566 assemblies)

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
▼ 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
▼ 2021.10-2022.4 Ground improvement work


<Unit 2 Construction of gantry for fuel removal>

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

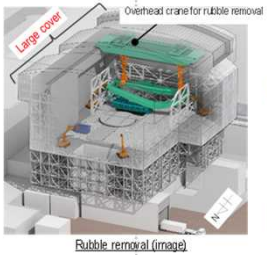
For Unit 1, a large cover will be installed over the whole building, within which rubble will be removed.

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.

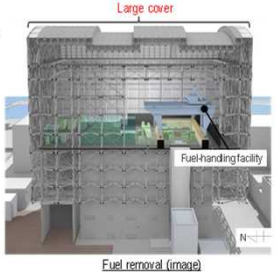
<Reference> Progress to date
Rubble removal on the north side of the operating floor started from January 2018 and has been implemented sequentially. In July and August 2019, the well plug, which was misaligned, was investigated, followed in August and September by the conditions of the overhead crane. 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

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

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

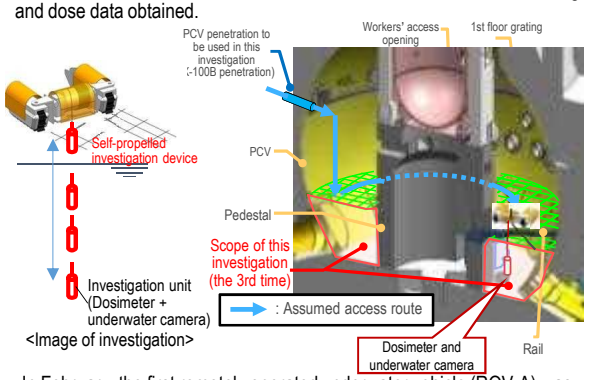
Start of fuel debris retrieval from the first unit (Unit 2). Expanding the scale in stages (within 2021 * The schedule will be extended for about 1 year due to the spread of COVID-19 infections)

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

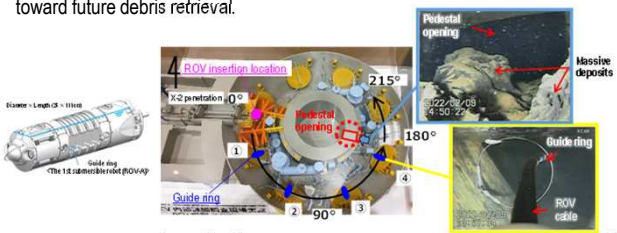
・In April 2015, a device having entered the inside of the PCV via a narrow opening (bore:φ100 mm) collected information such as images and airborne dose inside the PCV 1st floor.

・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>

In February, the first remotely operated underwater vehicle (ROV-A) was inserted to install "guide rings" which will facilitate the investigation. As installation of guide rings has been completed, then a detailed investigation will be implemented.
In this investigation, distribution of deposits outside the pedestal and their characteristics or others will also be investigated. The results of these investigations will be utilized in the examination of method and procedures toward future debris retrieval.



<Status inside the PCV (February 9)>

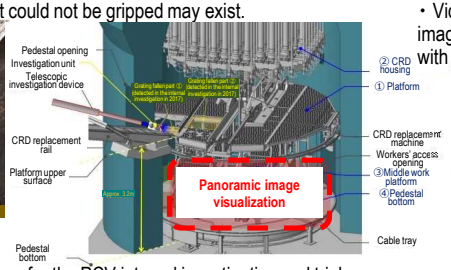
Unit 2 Investigation overview

・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.

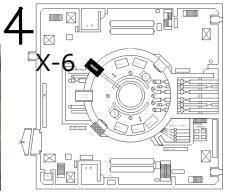

Bottom of the pedestal (after being processed in panoramic image visualization)



・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

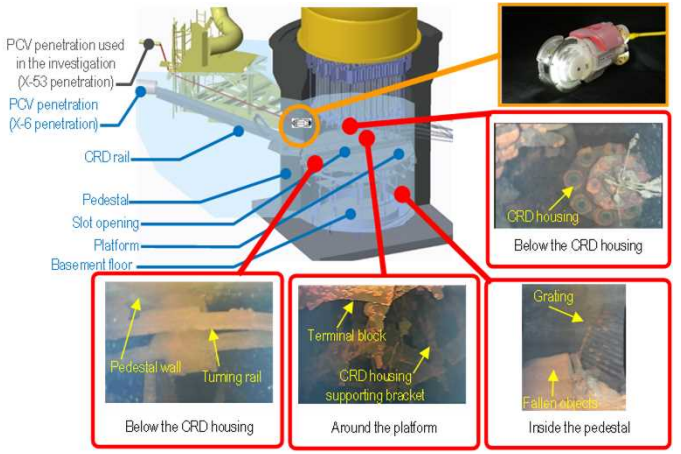
・In October 2014, the conditions of X-53 penetration, which may be under water and which is scheduled for use to investigate the inside of the PCV, was investigated via remote-controlled ultrasonic test equipment. The results showed that the penetration was not under water.

・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

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)

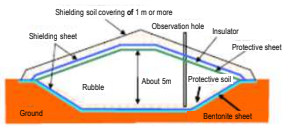
▼ 2012.9 Transfer start of rubble to the soil-covered temporary storage facility

▼ 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

2021.3 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

▼2022.5 Start of operation

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 Facility

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 → Additional Radioactive Waste Incinerator (A) / (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)

- Radioactive Waste Incinerator
- Additional Radioactive Waste Incinerator

Volume reduction

Compaction Facility (scheduled for completion in FY2022)

Melting

Melting equipment

To (B)

(*3) Approx. **270,000** m³ (*2)

Storage /management

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

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

Additional Solid Waste Storage
10th-11th
(Scheduled for completion after FY2022)

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

Reuse will be examined

Spent Adsorption Vessel Temporary Storage

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


Work of main part

Approx. 20,000 m³ → Solid Waste Storage
Approx. 60,000 m³ → Existing Solid Waste Storage
(A) Approx. 60,000 m³ (*1) → Additional Solid Waste Storage
(B) Approx. 60,000 m³ → Additional Solid Waste Storage
Approx. 70,000 m³ (*1) → Additional Solid Waste Storage
Approx. 60,000 m³ → Large Waste Storage

(*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. 240,000 m³ of waste will be stored in Solid Waste Storage at the end of FY2028.

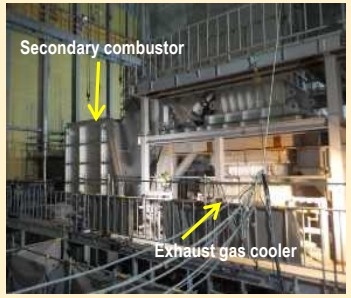
Note: Used protective clothing before incineration and BG-level concrete waste for which treatment and reuse is decided at present are not included.

- 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.

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.

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.

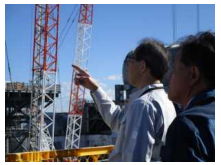
From March 12, 2011, in response to the increased airborne concentration of radioactive materials, instructions were issued to wear full-face masks throughout the Fukushima Daiichi NPS site, excluding the Main Anti-Earthquake Building and the rest house.

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

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.

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.



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)

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

Changes in operation of controlled area

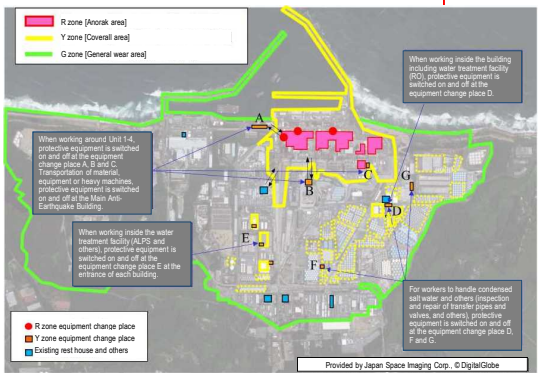
From May 2013, full-face mask unnecessary area was expanded sequentially.

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

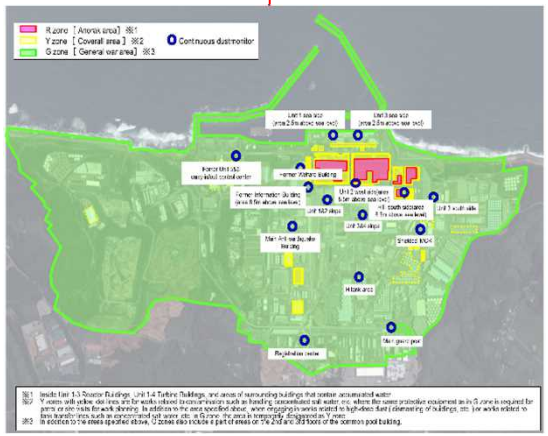
In March 2017, the G-zone area was expanded (to cover 95% of the whole site).

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.

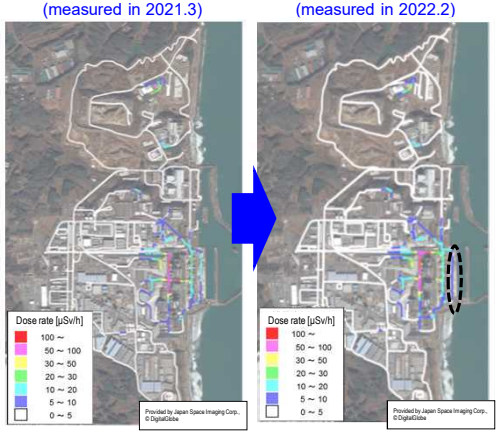


In May 2018, within about 96% of the site, workers are allowed to wear light equipment such as general workwear and disposable dust-protective masks.

<Travel survey results of major roads within the site>
The dose rate has been declining every year.
In particular, in the area on the east side of the Turbine Building shown a black dotted line, the dose rate declined by facing related to installation of the seawall as the countermeasure to the Japan Trench tsunami.

FY2020 4th Quarter (measured in 2021.3)

FY2021 4th Quarter (measured in 2022.2)



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