Outline of Decommissioning, Contaminated Water and Treated Water Management

September 26 2024
Secretariat of the Team for Countermeasures for Decommissioning, Contaminated Water and Treated Water

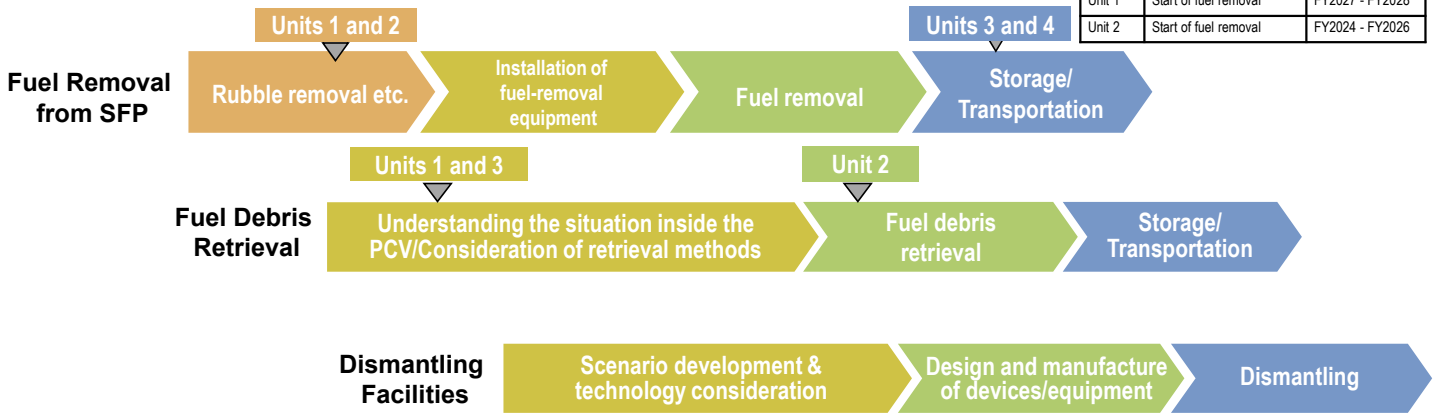
Main decommissioning work and steps

Fuel removal from the spent fuel pool was completed on December 22, 2014 at Unit 4 and February 28, 2021 at Unit 3.
Trial fuel debris retrieval at Unit 2 commenced from September 10, 2024 and a milestone of the Mid- and Long-Term Roadmap "Commencing fuel debris retrieval at the first Unit" was achieved.
Work continues sequentially toward the start of fuel removal from Units 1 and 2 and fuel debris (Note 1) retrieval from Units 1-3.

(Note 1) Fuel assemblies having melted through in the accident with nearby metal materials etc.

<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

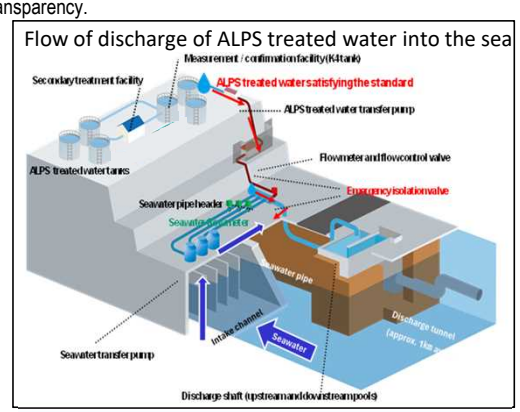


Measures for treated water

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, efforts including enhanced monitoring, ensuring objectivity and transparency by engaging with third-party experts and having safety checked by the IAEA, will continue. Moreover, accurate information will be disseminated with full transparency.

Flow of discharge of ALPS treated water into the sea



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

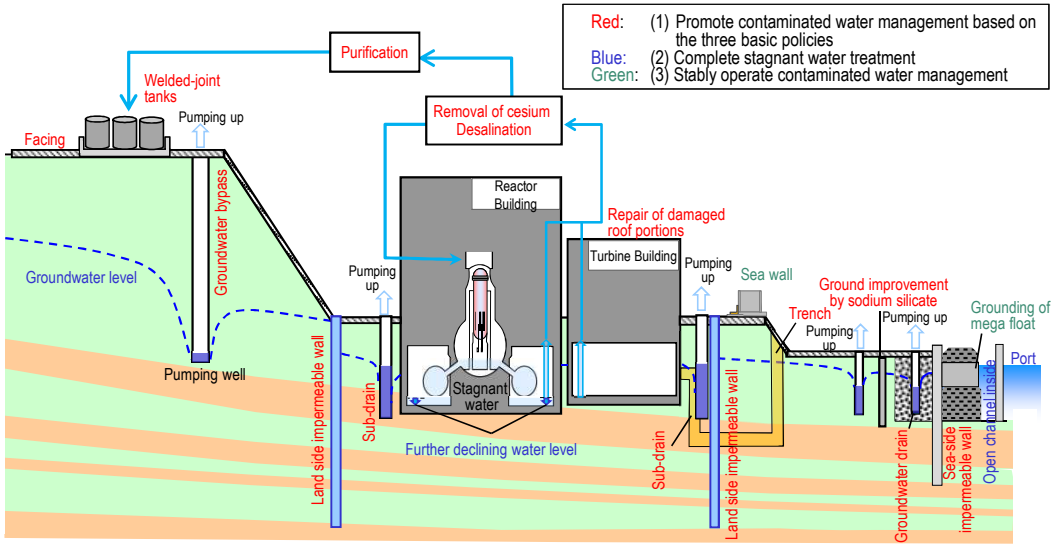
- Strontium-reduced water from other equipment is being re-treated in the Advanced Liquid Processing System (ALPS: multi-nuclide removal equipment) and stored in welded-joint tanks.
- Multi-layered contaminated water management measures, including land-side impermeable walls and sub-drains, have stabilized the groundwater at a low level and the increased contaminated water generated during rainfall is being suppressed by repairing damaged portions of the building roofs facing onsite. Through these measures, the generation of contaminated water has been suppressed and reduced, from approx. 540 m^3/day (in May 2014) before implementing measures to approx. 80 m^3/day (in FY2023), achieving the milestone of "suppressing the amount of contaminated water generated to 100 m^3/day or less during average rainfall within FY2025."
- Measures will proceed to further reduce the amount of contaminated water generated and suppress it to approx. 50-70 m^3/day by FY2028.

(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.
- 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.
- While assessing the dust impact, measures to reduce the stagnant water level were implemented. In March 2023, the target water level in each building was achieved. For the Units 1-3 Reactor Buildings, "reducing stagnant water in the Reactor Buildings to about half the amount at the end of 2020 during the period FY2022-2024" was achieved.
- 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

- As part of the tsunami countermeasures, openings in buildings were closed and work to install sea walls was completed. As countermeasures for heavy rain, sandbags are being installed to suppress direct inflow into buildings while work to enhance drainage channels and other measures is being implemented as planned.



Progress Status and Future Challenges of the Mid- and-Long-Term Roadmap toward Decommissioning of TEPCO Holdings Fukushima Daiichi Nuclear Power Station (Outline)

Progress status

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

Unit 2 Commencement of trial fuel debris retrieval

On September 10, the trial retrieval of fuel debris commenced at Unit 2.

For fuel debris at the bottom of the pedestal, visual confirmation by a camera mounted at the end of the telescopic-type equipment and contact confirmation by the end of the gripper were conducted on September 14.

As preparation for gripping fuel debris, the operation of the telescopic-type equipment was verified on September 17 and it was confirmed that camara images were not being sent to the monitor in the remote control room appropriately.

Afterward, the telescopic-type equipment was replaced inside the enclosure on September 25.

Recovery can be expected by placement in a low-dosage area and maintaining the power-on or -off states to reduce accumulated charge. Subsequently, as part of efforts to identify the cause, the state of camera images will be verified while in standby mode and with relatively low dosage exposure inside the enclosure to verify the impact of radiation.

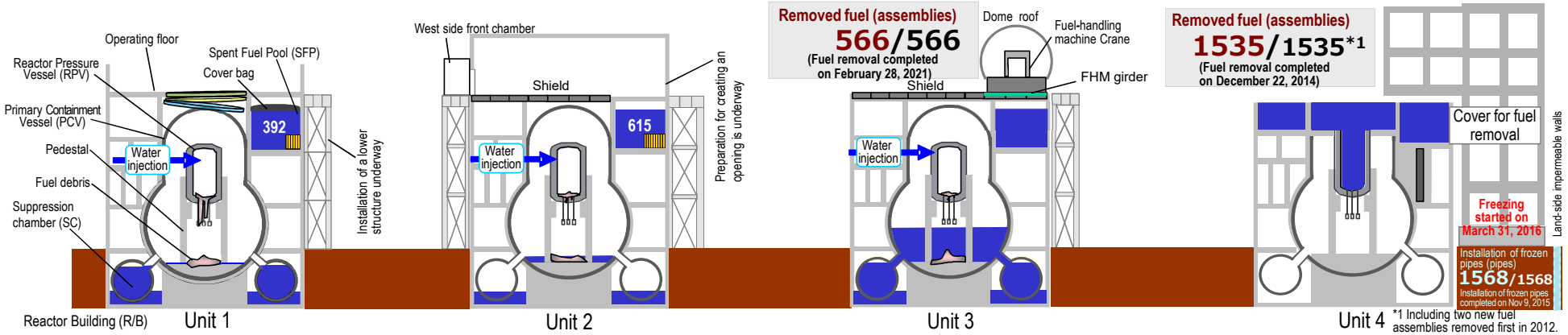
< State at the bottom of the pedestal >

Discharge of ALPS treated water into the sea (5th discharge in FY2024)

In preparation for the 5th discharge of ALPS treated water in FY2024, Tank Group A of the measurement/confirmation facility was analyzed and TEPCO and an external institute confirmed that the analytical results satisfied the discharge requirement. The results were announced on September 24.

Following the confirmation, discharge of ALPS treated water of Tank Group A of the measurement/confirmation facility into the sea commenced from September 26.

Regarding tritium in seawater, TEPCO will continue confirming that it is being discharged safely as planned, while meeting the discharge requirement based on quick daily analyses conducted by TEPCO and others.



Unit 2 Progress of work toward fuel removal

Within the site, before installing the gantry for fuel removal, the foundation of the existing Fuel Handling Machine Operation Room, which interfered with the runway garter, was cut on September 10. An opening will be created on the south side of the Unit 2 Reactor Building operating floor.

Among the equipment attached to the gantry for fuel removal, the inspection of the overhead crane was completed on August 9. Test operation of the ventilation equipment is underway from September 3.

At the factory, assembly of the Fuel-Removal System was completed and test operation of each component of the system is underway. The Fuel-Removal System will be installed behind the runway garter and transported by sea after trial operation.

< Fuel-Removal System >

Unit 2 Response to decline in the water level in the skimmer surge tank of the Unit 2 spent fuel pool

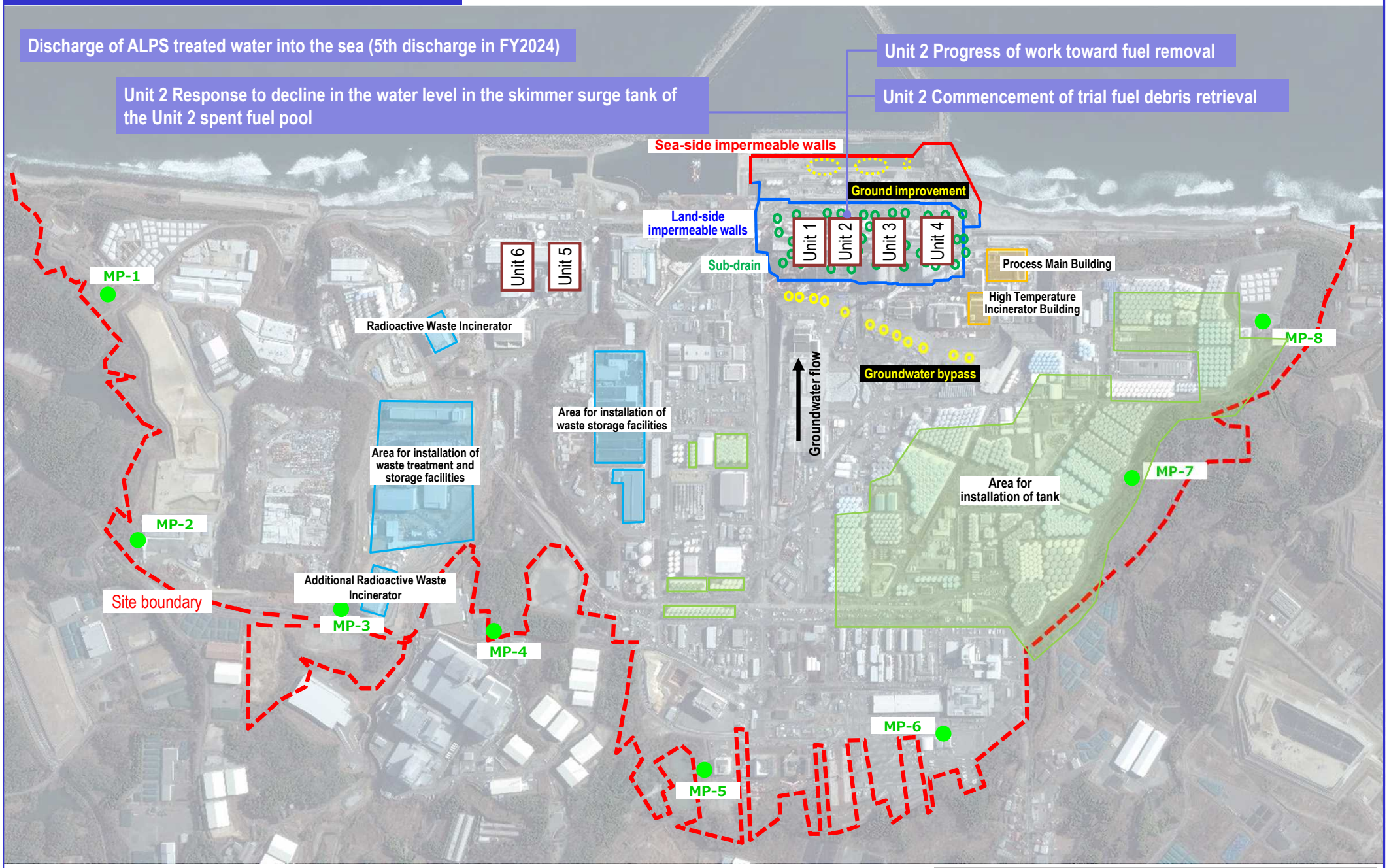
On August 9, the level in the skimmer surge tank of the Unit 2 spent fuel pool (SFP) was observed to be declining. Based on the leakage status, water was confirmed as leaking within the existing fuel pool cooling purification system pump or the heat exchanger installation area.

Given the high dose of radiation in the area, an investigation to identify the leakage point will be conducted in early October via drone.

After identifying the leakage point via drone, a visual inspection by TEPCO will be conducted.

< Investigation drone >

Major initiatives – Locations on site

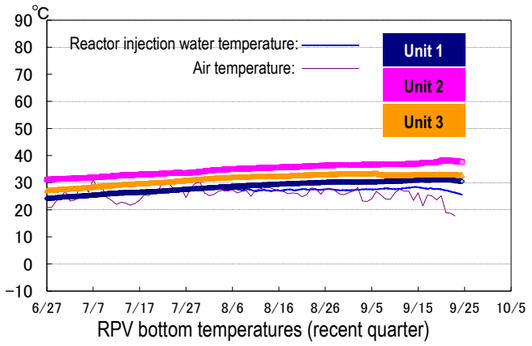


Provided by Japan Space Imaging Corp., photo taken on January 14, 2024
Product (C) [2024] Maxar Technologies.

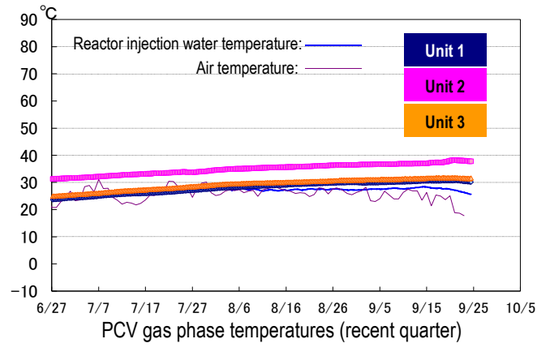
I. Confirmation of the reactor conditions

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 as shown below for recent, though it varied depending on the unit and location of the thermometer.

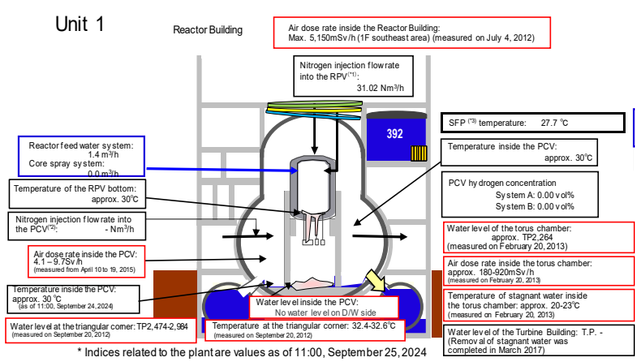


RPV bottom temperatures (recent quarter)

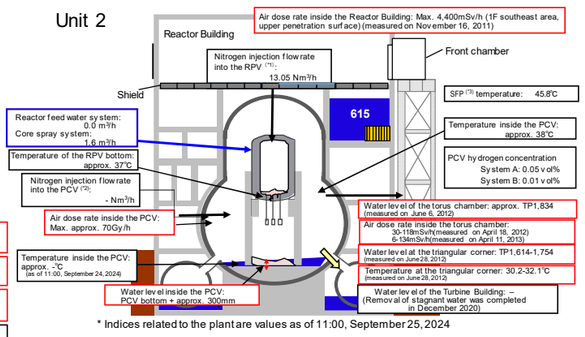


PCV gas phase temperatures (recent quarter)

*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, September 25, 2024



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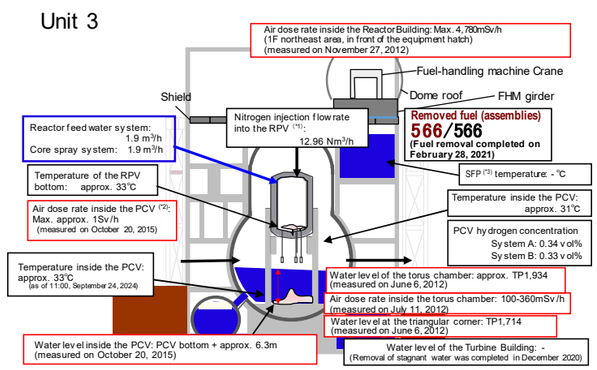


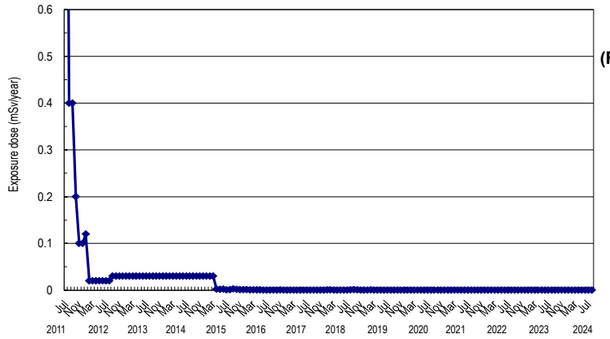
* Indices related to the plant are values as of 11:00, September 25, 2024

(*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 August 2024, 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. 9.6×10^{-12} Bq/cm³ and 8.8×10^{-12} Bq/cm³ 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]: 2×10^{-5} Bq/cm³
  [Cs-137]: 3×10^{-5} Bq/cm³
* Data of Monitoring Posts (MP1-MP8).
  Data of Monitoring Posts (MPs) measuring the air dose rate around the site boundary showed 0.285–1.005 μSv/h (August 28 – September 24, 2024).
  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.
Note 3: Dose assessment has been changed since July 2024 due to the change of standard meteorology, etc. in the implementation plan (effective July 8, 2024).

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.

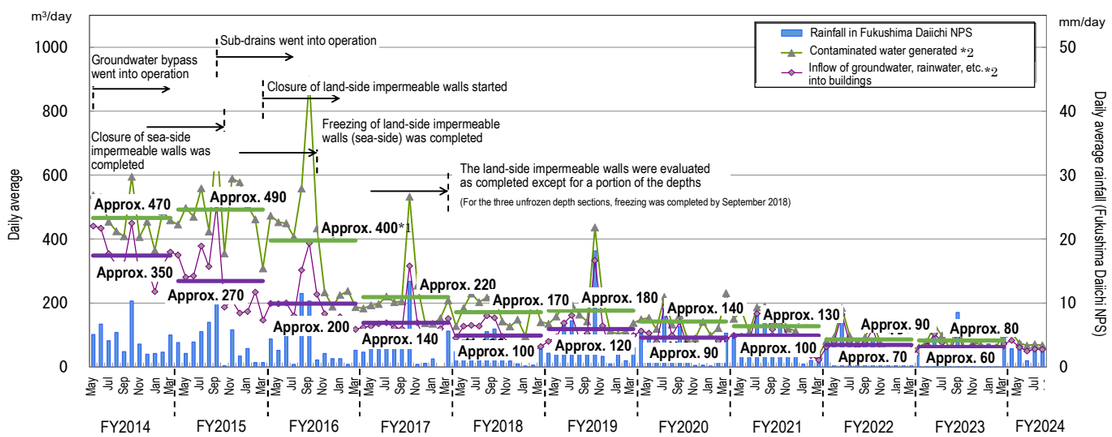
Based on the above, it was confirmed that the comprehensive cold shutdown condition had been maintained and the reactors remained in a stabilized condition.

II. Progress status by each plan

Measures for contaminated water and treated water

➢ Status of contaminated water generated

- Multi-layered 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. Through these measures, the generation of contaminated water has being suppressed and reduced from approx. 540 m³/day (in May 2014) before implementing measures to approx. 80 m³/day (in FY2023), achieving the milestone to “suppress the amount of contaminated water generated to 100 m³/day or less during average rainfall within FY2025.”
- Measures will proceed to further reduce the amount of contaminated water generated and suppress to approx. 50-70 m³/day by FY2028.



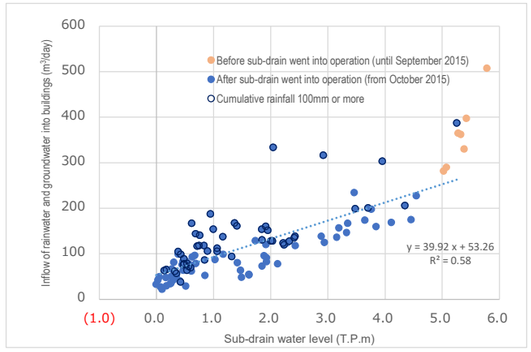
*1 Values differ from those announced at the 20th Committee on Countermeasures for Contaminated Water Treatment (held on August 25, 2017) because the method of calculating the contaminated water volume generated was reviewed on March 1, 2018. Details of the review are described in the materials for the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

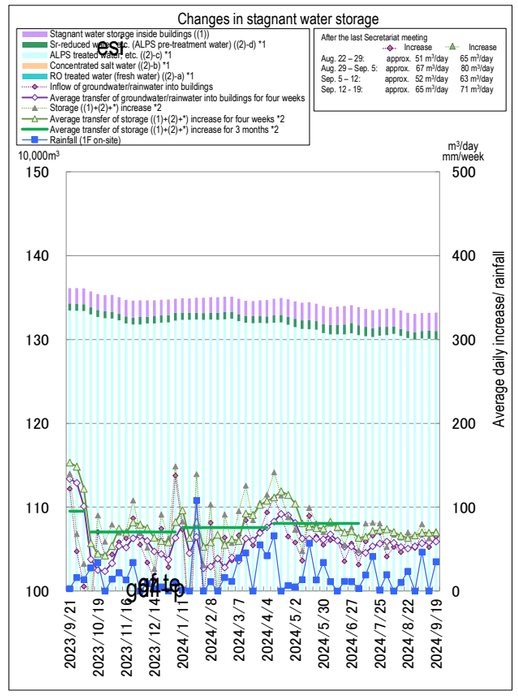
*2: The monthly daily average is derived from the daily average from the previous Thursday to the last Wednesday, which is calculated based on the data measured at 7:00 on every Thursday.

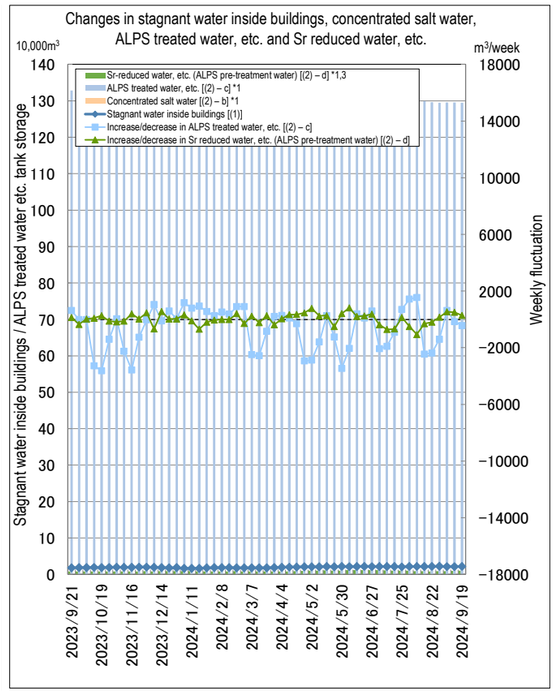
Figure 1: Changes in contaminated water generated and inflow of groundwater and rainwater into buildings

➢ 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 September 17, 2024, 2545 release operations had been conducted.
  The water quality of all temporary storage tanks satisfied the operational target.







➢ 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 August 2024, 96% of the planned area (1,450,000 m² on site) had been completed. For the area inside the breakwater, impermeable walls, implementation proceeds appropriately after constructing a yard from implementable zones that leave the decommissioning work unaffected. As of the end of August 2024, 50% of the planned area (60,000 m²) had been completed.

- From September 26, 2024, the fifth discharge of ALPS treated water into the sea in FY2024 was conducted.
- Regarding the analytical results sampled from Tank Group A toward the fifth discharge, the concentration of the 30 types of radionuclides (excluding tritium) within the measurement and assessment scope was 0.078 in terms of the sum of the ratios to regulatory concentrations and satisfied the national government's requirement of less than 1. The concentration of tritium was 280,000 Bq/L. Regarding 38 nuclides for which no significant existence was voluntarily confirmed, the absence of any significant presence was confirmed and general water quality benchmarks (compliance with which was voluntarily confirmed) satisfied the requirements. An external institute confirmed, as with TEPCO, that the analytical results satisfied the discharge requirement.
- Regarding the status of sea-area monitoring on handling ALPS treated water, more tritium measurement points for seawater and fish were established near the power station and off the coast of Fukushima Prefecture and measurements of tritium and Iodine-129 of seaweed near the power station were added from April 20, 2022. As of September 25, 2024, no significant variation had been detected.
- Regarding sea-area monitoring conducted by TEPCO at 4 points within 3 km of the power station, quick measurements taken of the tritium concentration in the seawater sampled on September 17 showed concentrations under the detection limit (less than 6.2 – 6.3 Bq/L) at all points, which was below the TEPCO operation indices of 700 Bq/L (discharge suspension level) and 350 Bq/L (investigation level).
- Regarding sea-area monitoring conducted by TEPCO at 1 point within 10 km square from the power station, quick measurements taken of the tritium concentration in the seawater sampled on September 19 showed concentrations under the detection limit (less than 7.2 Bq/L) at all points, which was below the TEPCO operation indices of 30 Bq/L (discharge suspension level) and 20 Bq/L (investigation level).
- The quick measurement results obtained by each organization were as follows:
  Ministry of the Environment: The analytical results (obtained via quick measurements) for seawater sampled on September 11 and 12 at 3 points off the coast of Fukushima Prefecture showed tritium concentrations below the lower detection limit (less than 8 Bq/L) at all sampling points, which would have no adverse impact on human health and the environment.
  Fisheries Agency: Quick analytical results for tritium in flounder sampled on September 17 showed tritium concentrations below the lower detection limit (approx. less than 8.9 Bq/kg) in all samples.
  Fukushima Prefecture: On September 6, tritium concentrations in seawater at 9 sampling points off the coast of Fukushima Prefecture below the lower detection limit were recorded (less than 3.8 – 4.0 Bq/L) at all sampling points, which would have no adverse impact on human health and the environment.

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

- To eliminate concerns and reassure the public, a rearing test for marine organisms (flounder) in seawater with ALPS treated water added and normal seawater for comparison is underway.
- Regarding the flounder and abalones, in both series of tanks ("normal seawater" and "ALPS treated water diluted with seawater"), no mass death or abnormality was detected (as of September 19).
- Rearing of flounder and others in diluted ALPS treated water (less than 1,500 Bq/L) will continue.
- The Organically Bound Tritium (OBT) concentration test on flounder (less than 1,500 Bq/L) will continue.
- To commence rearing of flounder and abalones using water released in the environment, water will be sampled from the discharge vertical shaft (downstream storage) during the fifth discharge in FY2024.
- Rearing of flounder and abalones using water released in the environment will commence will commence after early October.

➢ Examination status in response to water leakage including radioactive materials from the High-Temperature Incinerator Building and other incidents

- Based on troubles having occurred since last October, the following responses are being implemented:
- Response A (reevaluating background cause): By the Nuclear Safety Oversight Office (NSOO), progress and effectiveness of the recurrence prevention measures were reevaluated. The evaluation recognized that risk awareness was improved but suggested the need for continued evaluation to confirm that these measures were easing the problems. Moreover, as an effective approach, "pervasive communication from the same perspective as cooperating company workers" was suggested. Based on the NSOO opinion, improvement measures continue to be implemented.
- Response B (identifying the points leading to errors): Documents outlining analytical procedures and actual on-site situations were investigated. More than 1,000 points leading to errors were extracted and categorized.
- Response C (planning multi-layered measures): Software measures will be completed and hardware measures implemented or planned by the end of December 2024.

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 remove spent fuel at Unit 1

- At the Unit 1 Reactor Building, the installation of base plates and the lower structure has been underway.
- To reduce the risk of coming into contact with the large cover upper structure and enhance seismic safety, perimeter steel frames will be installed from around October.
- Removal work will be conducted remotely to limit worker exposure. Moreover, anti-scattering agents will be sprayed in each work area to suppress scattering of dust and monitoring by dust monitors installed on the perimeter steel frames will continue.

➢ Main work to remove the spent fuel at Unit 2

- Within the site, before installing the gantry for fuel removal, the foundation of the existing Fuel Handling Machine Operation Room, which interfered with the runway garter, was cut on September 10. An opening will be created on the south side of the Unit 2 Reactor Building operating floor.
- Among the equipment attached to the gantry for fuel removal, the completion inspection of the overhead crane was finished on August 9. Test operation of the ventilation equipment has been underway since September 3.
- At the factory, assembly of the Fuel-Removal System was completed and the test operation of each system component is underway. The Fuel-Removal System will be installed behind the runway garter and transported by sea after trial operation.

Fuel debris retrieval

➢ Results of the Unit 3 HCU-inclusive water sampling

- A high air dose was detected on the north and south sides of the Unit 3 Reactor Building 1st floor and the Hydraulic Control Unit (HCU) was identified as the source.
- To examine methods to reduce the radiation dose, sampling of HCU-inclusive water was conducted from August 2 to 20.
  Based on the sampling results, methods to reduce the HCU dose and remove the unit will be examined with future fuel debris retrieval in mind.
- The sampling results will also be utilized to investigate the accident at the Fukushima Daiichi Nuclear Power Station.

Plans to store, process and dispose of solid waste and decommission of reactor facilities

Promoting efforts to reduce and store waste generated appropriately and R&D to facilitate adequate and safe storage, processing and disposal of radioactive waste

➢ Management status of rubble and trimmed trees

- As of the end of August 2024, the total storage volume for concrete and metal rubble was approx. 400,300 m³ (+200 m³ compared to the end of June with an area-occupation rate of 75%). The total storage volume of trimmed trees was approx. 80,800 m³ (+300 m³, with an area-occupation rate of 46%). The total storage volume of used protective clothing was approx. 13,500 m³ (-1,900 m³, with an area-occupation rate of 54%). The total storage volume of radioactive solid waste (incinerated ash and others) was approx. 38,300 m³ (a slight increase, with an area-occupation rate of 60%). The increase in rubble was attributable to decontamination of flanged tanks and work related to the area around the Units 1-4 buildings.

➢ Management status of secondary waste from water treatment

- As of September 5, 2024, the total storage volume of waste sludge was 423 m³ (area-occupation rate: 60%), while

that of concentrated waste fluid was 9,514 m³ (area-occupation rate: 92%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment and others, was 5,800 (area-occupation rate: 87%).

Reactor cooling

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

➢ Efforts for Unit 1 Primary Containment Vessel (PCV) water level reduction

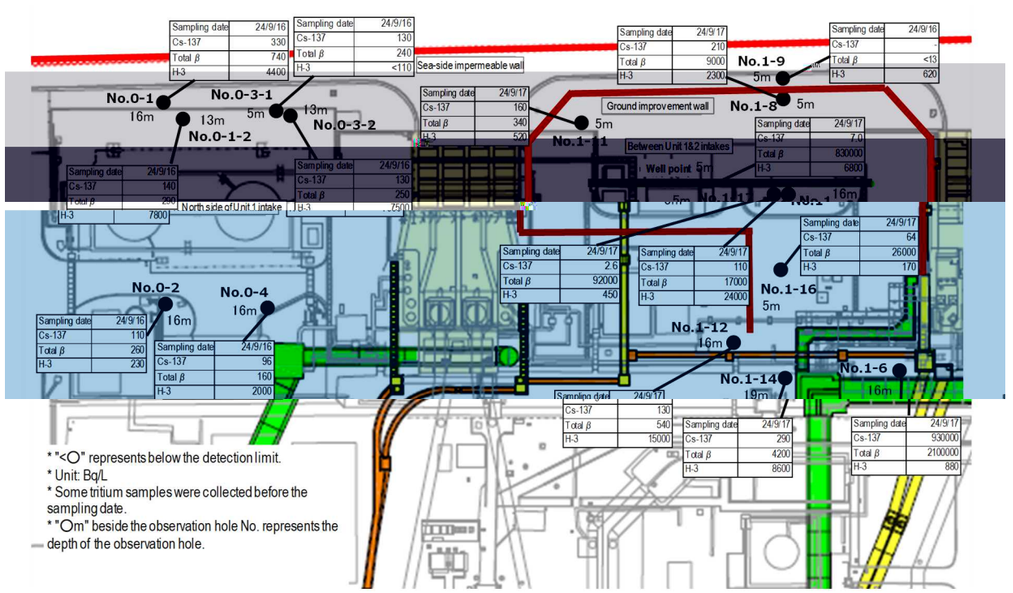
- For Unit 1, due to the high water level in the PCV Suppression Chamber (S/C), a phased reduction in the water level was planned with the need to improve seismic resistance in mind.
- Water level reduction to the hold point (4) commenced from July 29.
- As the PCV water level (measured by the water level gauge installed in the S/C) had remained almost constant since August 14, the reactor water injection rate was further reduced (approx. 2.1 → 1.8m³/h) from August 22, but no impact caused by the reduction in the PCV water level was detected. Based on the water level behavior, it is assumed that most of the leakage from the PCV occurred on the D/W side and any leakage on the S/C side was minimal.
- Also based on the reactions of each parameter acquired in the process of reducing the PCV water level, water level management of the PCV (D/W and S/C) will be examined.
- Given the difficulty of reducing the S/C water level by reducing the reactor water injection rate, methods to reduce the S/C water level (including response to facilities) will be examined.

Reduction in radiation dose and mitigation of contamination

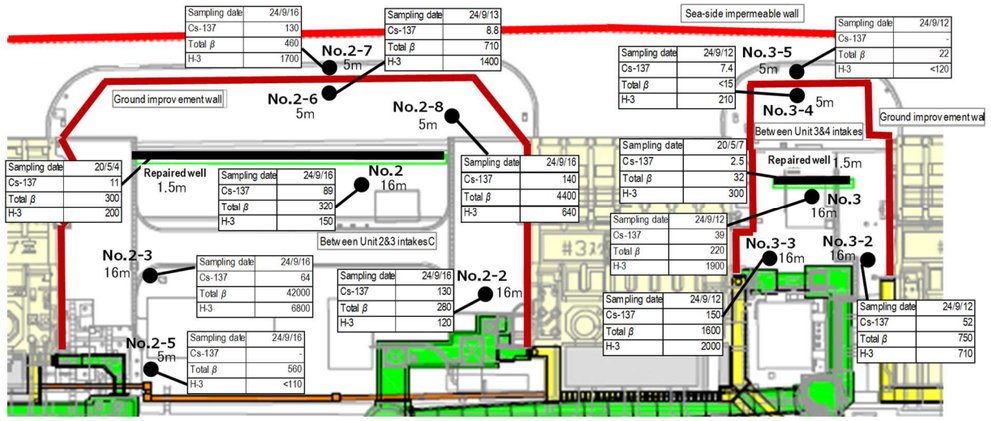
Effective dose-reduction at site boundaries and purification of port water to mitigate the impact of radiation on the external environment

➢ 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, 0-1-2, 0-2, 0-3-1, 0-3-2 and 0-4. The trend continues to be carefully monitored.
- 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 has been increasing at No. 1-6 and increasing or declining at Nos. 1-9 and 1-11 at low concentration. The trend continues to be carefully monitored.
- 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 remained constant or been declining at many observation holes overall. The concentration of total β radioactive materials has remained constant overall but has been increasing or declining at No. 2-5. The trend continues to be carefully monitored.
- 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 Nos. 3-4 and 3-5. The trend continues to be carefully monitored.
- 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 at observation holes with a low concentration and exceeded the previous highest record at some observation holes. Investigations will continue, including to ascertain the impact of rainfall.
- 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. It has remained low, despite concentrations of cesium and total β radioactive materials increasing during rainfall. From November 29, 2022, continuous monitors were installed and drainage around the Units 1 and 2 switch yard started to pass.
- In the open channel area of the 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 the temporary increases in Cs-137 and Sr-90 observed 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 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 was 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. During the period of discharge of ALPS treated water, the tritium concentration increased at the sampling point near the discharge outlet, but this was considered within the assumed range based on the results of the oceanic dispersion simulation.



<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

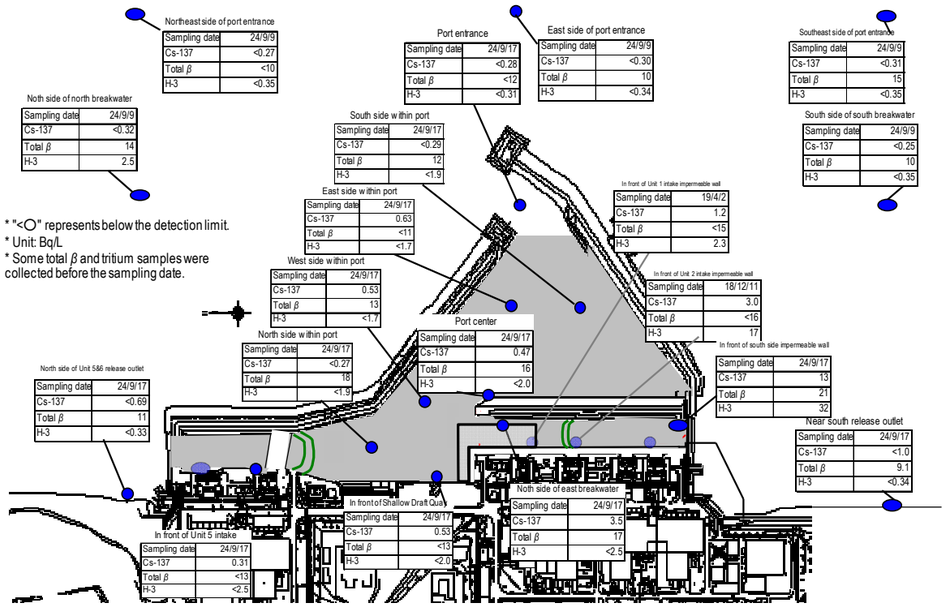


Figure 5: Seawater concentration around the port

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 May to July 2024 was approx. 9,100 (cooperating company workers and TEPCO HD employees), which exceeded the monthly average workforce (approx. 7,700). 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 October 2024 (approx. 4,800 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, at approx. 3,500 to 4,700.

- The number of workers from both within and outside Fukushima Prefecture decreased slightly. As of August 2024, the local employment ratio (cooperating company workers and TEPCO HD employees) remained constant at around 70%.
- The average exposure doses of workers were approx. 2.51, 2.16 and 2.18 mSv/person-year during FY2021 2022 and 2023, respectively (The legal exposure dose limits are 100 and 50 mSv/person-year respectively over five years, the TEPCO HD management target is 20 mSv/person-year).
- For most workers, the exposure dose remained sufficiently within the limit and allowed them to continue engaging in radiation work.

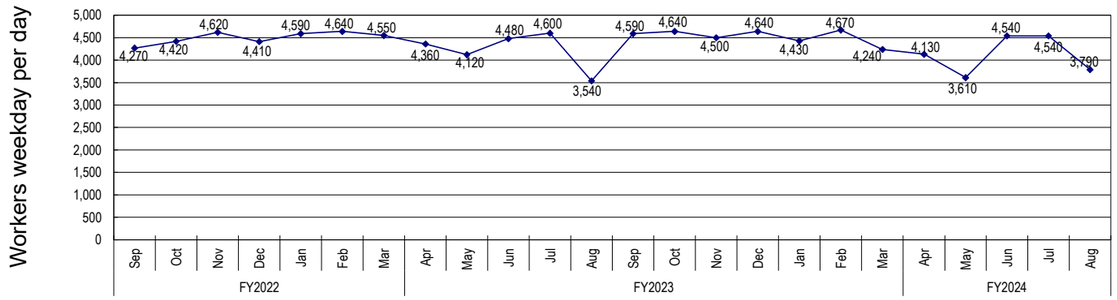


Figure 6: Changes in the average number of workers weekday per day for each month of the most recent 2 years (actual values)

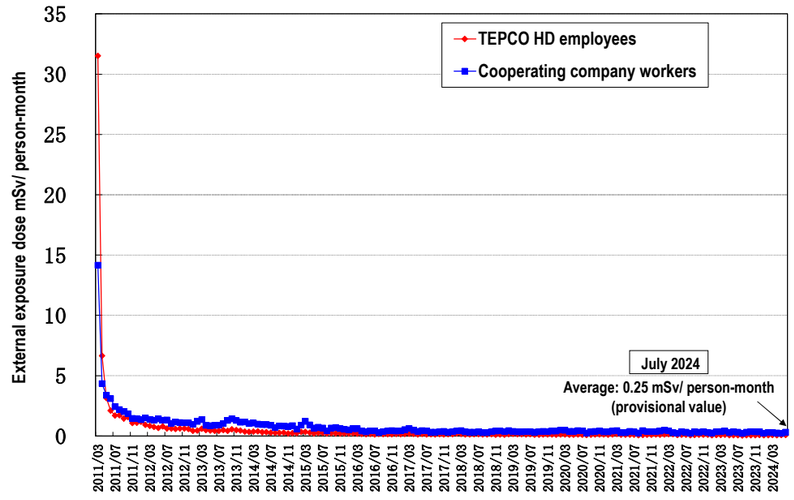


Figure 7: Changes in monthly average exposure dose of individual worker (monthly exposure dose since March 2011)

➢ Status of heat stroke cases

- In FY2024, measures to further prevent heat stroke commenced from April to cope with the hottest season.
- In FY2024, eight workers suffered heat stroke due to work up until September 23 (in FY2023, seven workers up until the end of September). An environment encouraging workers to report any feelings of illness will continue to be created and countermeasures will be taken to prevent heat stroke.

➢ Countermeasures for infectious diseases

- Countermeasures for various infectious diseases (influenza, norovirus, etc.) depend on personal decisions and basic countermeasures (visiting medical institutions when feeling unwell, ventilation, avoidance of the “Three Cs,” frequent handwashing, etc.) being implemented appropriately by each worker and TEPCO proceeds with decommissioning while prioritizing safety.

- Regarding countermeasures for COVID-19, based on the increase in new infections, mask wearing has been strongly recommended, handwashing recommended, an antiseptic solution installed and silent eating requested in the dining room as of July 11, 2024. However, given the fact that the occurrence of infections in the power station has settled, the countermeasures were abolished at the end of August, since which time the decision on whether to implement countermeasures has been made individually in accordance with the above basic countermeasures.

Status of Units 5 and 6

➢ Status of stagnant water treatment in Units 5 and 6

- Low-level stagnant water in the Unit 5 and 6 buildings is being sprinkled on-site after being treated by the purification unit and after confirming that the water satisfies the sprinkling criteria.
- During the next phase, as well as exposing the floor surface of each building, treatment of low-level stagnant water in outdoor pipe trenches and others will proceed as part of work to prepare to systematically inspect the seawater pipes.
- Low-level stagnant water in outdoor pipe trenches and others, with a quality resembling that of low-level stagnant water in the Unit 5 and 6 buildings, will be treated by the purification unit.
- For inclusive water in the Condenser Water Chamber with high chlorine concentration, treatment will be conducted while taking the salinity level into consideration to prevent any decline in adsorption performance of the purification unit adsorption vessel.

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 August 26 - September 23)"; unit (Bq/L); ND represents a value below the detection limit

Summary of TEPCO data as of September 24, 2024

Note: The Total β measurement value is the total radioactivity concentration of radioactive materials that emit β-ray (Potassium-40, Cesium-137, Strontium-90, progeny nuclide Yttrium-90, etc.). In general, (approx. 12 Bq/L of natural nuclide Potassium-40 is included in seawater.

Cesium-134	:	ND(0.35)	
Cesium-137	:	0.54	
Total β	:	ND(15)	
Tritium	:	ND(2.0)	*1

Cesium-134	: 3.3 (H25/12/24)	→	ND(0.32)	Below 1/10
Cesium-137	: 7.3 (H25/10/11)	→	0.30	Below 1/20
Total β	: 69 (H25/8/19)	→	ND(15)	Below 1/4
Tritium	: 68 (H25/8/19)	→	ND(0.31)	Below 1/200

Cesium-134	: 3.3 (H25/10/17)	→	ND(0.30)	Below 1/10
Cesium-137	: 9 (H25/10/17)	→	ND(0.43)	Below 1/20
Total β	: 74 (H25/8/19)	→	13	Below 1/5
Tritium	: 67 (H25/8/19)	→	ND(1.7)	Below 1/30

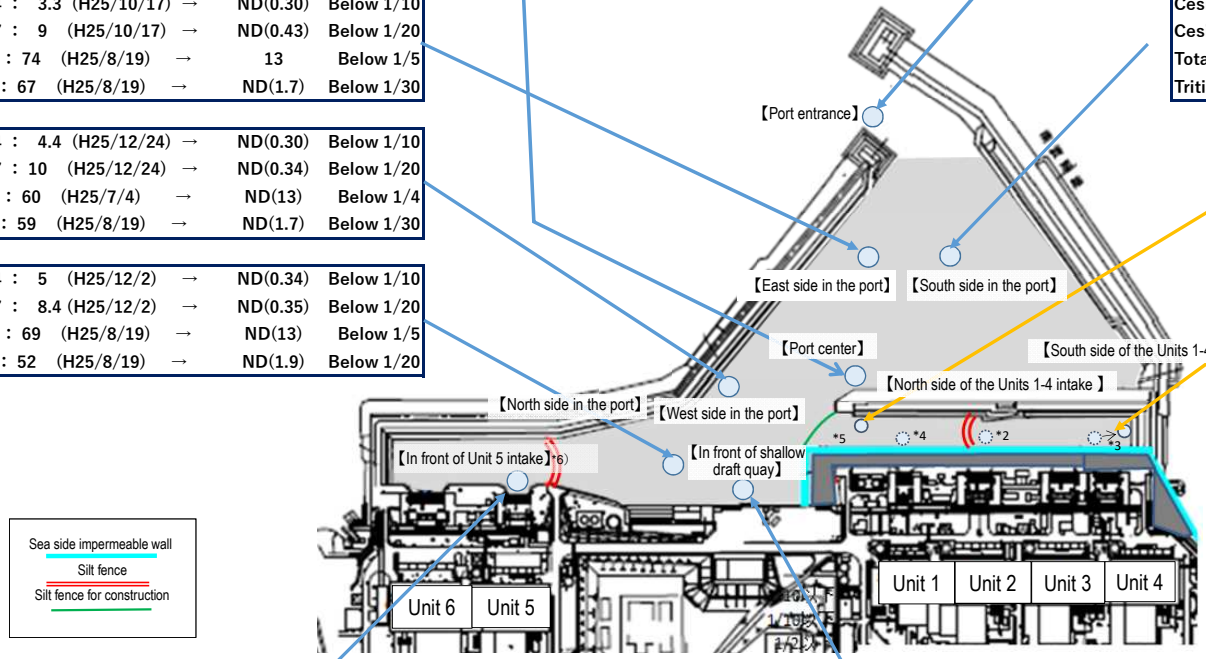
Cesium-134	: 3.5 (H25/10/17)	→	ND(0.28)	Below 1/10
Cesium-137	: 7.8 (H25/10/17)	→	ND(0.36)	Below 1/20
Total β	: 79 (H25/8/19)	→	14	Below 1/5
Tritium	: 60 (H25/8/19)	→	ND(1.9)	Below 1/30

Cesium-134	: 4.4 (H25/12/24)	→	ND(0.30)	Below 1/10
Cesium-137	: 10 (H25/12/24)	→	ND(0.34)	Below 1/20
Total β	: 60 (H25/7/4)	→	ND(13)	Below 1/4
Tritium	: 59 (H25/8/19)	→	ND(1.7)	Below 1/30

Cesium-134	: 32 (H25/10/11)	→	ND(0.35)	Below 1/90
Cesium-137	: 73 (H25/10/11)	→	2.2	Below 1/30
Total β	: 320 (H25/8/12)	→	ND(13)	Below 1/20
Tritium	: 510 (H25/9/2)	→	ND(2.5)	Below 1/200

Cesium-134	: 5 (H25/12/2)	→	ND(0.34)	Below 1/10
Cesium-137	: 8.4 (H25/12/2)	→	ND(0.35)	Below 1/20
Total β	: 69 (H25/8/19)	→	ND(13)	Below 1/5
Tritium	: 52 (H25/8/19)	→	ND(1.9)	Below 1/20

Cesium-134	:	ND(0.27)
Cesium-137	:	19
Total β	:	29
Tritium	:	32 *1



Cesium-134	: 2.8 (H25/12/2)	→	ND(0.30)	Below 1/9
Cesium-137	: 5.8 (H25/12/2)	→	ND(0.26)	Below 1/20
Total β	: 46 (H25/8/19)	→	ND(13)	Below 1/3
Tritium	: 24 (H25/8/19)	→	ND(2.5)	Below 1/9

Cesium-134	: 5.3 (H25/8/5)	→	ND(0.35)	Below 1/10
Cesium-137	: 8.6 (H25/8/5)	→	0.82	Below 1/10
Total β	: 40 (H25/7/3)	→	14	Below 1/2
Tritium	: 340 (H25/6/26)	→	ND(2.0)	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. The point was further moved to the outside of the silt fence from January 20, 2023, to install the silt fence to the Drainage Channel K outlet as a measure for fish in the port. (The sampling point was moved to approx.. 3m east side)

*4: For the point, monitoring was finished from April 3, 2019 due to preparatory work for transfer of mega float.

*5: For the point, monitoring point was moved to the land side from May 25, 2023 along with work in the surrounding area.

*6: For the point, with the completion of work to install ALPS related facilities and others, monitoring point was moved from "In front of Unit 6 intake" to "In front of Unit 5 intake" from July 3, 2023.

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

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

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

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

(The latest values sampled during August 26 - September 23)

Summary of TEPCO data as of September 24, 2024

	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)	→	–	
Cesium-137	ND (H25)	→	–	
Total β	ND (H25)	→	–	
Tritium	ND (H25)	→	ND(0.35)	

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

Cesium-134	ND (H25)	→	–	
Cesium-137	1.6 (H25/10/18)	→	–	–
Total β	ND (H25)	→	–	
Tritium	6.4 (H25/10/18)	→	ND(0.32)	Below 1/20

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

Cesium-134	ND (H25)	→	–	
Cesium-137	ND (H25)	→	–	
Total β	ND (H25)	→	–	
Tritium	ND (H25)	→	ND(0.35)	

Cesium-134	ND (H25)	→	–	
Cesium-137	ND (H25)	→	–	
Total β	ND (H25)	→	ND(12)	
Tritium	4.7 (H25/8/18)	→	ND(0.33)	Below 1/10

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

Cesium-134	3.3 (H25/12/24)	→	ND(0.32)	Below 1/10
Cesium-137	7.3 (H25/10/11)	→	0.30	Below 1/20
Total β	69 (H25/8/19)	→	ND(15)	Below 1/4
Tritium	68 (H25/8/19)	→	ND(0.31)	Below 1/200

【Port entrance】

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

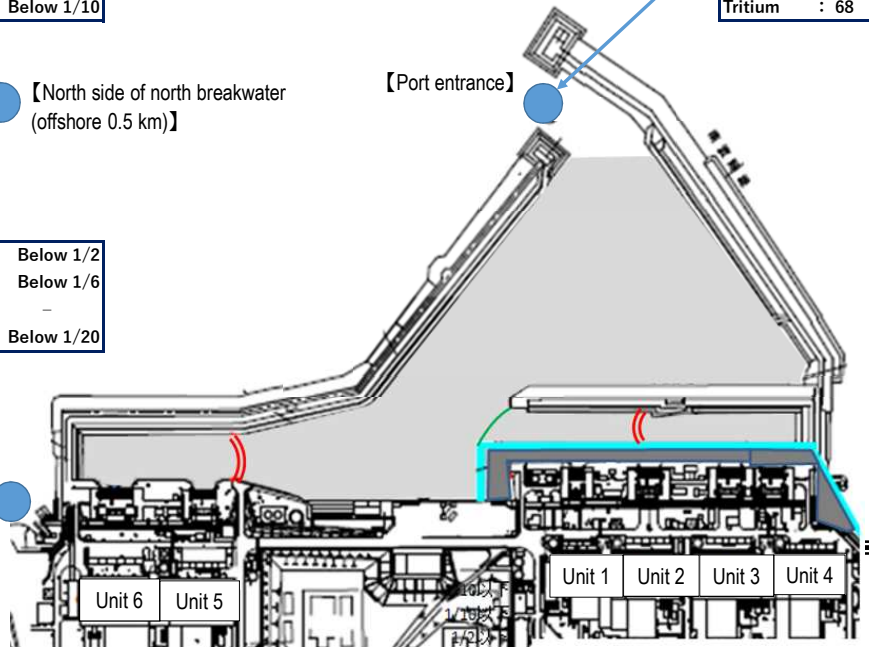
Cesium-134	ND (H25)	→	–	
Cesium-137	ND (H25)	→	–	
Total β	ND (H25)	→	–	
Tritium	ND (H25)	→	ND(0.35)	

Cesium-134	1.8 (H25/6/21)	→	ND(0.72)	Below 1/2
Cesium-137	4.5 (H25/3/17)	→	ND(0.72)	Below 1/6
Total β	12 (H25/12/23)	→	–	–
Tritium	8.6 (H25/6/26)	→	ND(0.34)	Below 1/20

Cesium-134	ND (H25)	→	ND(0.72)	
Cesium-137	3 (H25/7/15)	→	ND(0.86)	Below 1/3
Total β	15 (H25/12/23)	→	6.6	Below 1/2
Tritium	1.9 (H25/11/25)	→	ND(0.34)	Below 1/2

【North side of Unit 5 and 6 release outlet】

【Near south release outlet (*)】



Sea side impermeable wall

Silt fence

Silt fence for construction

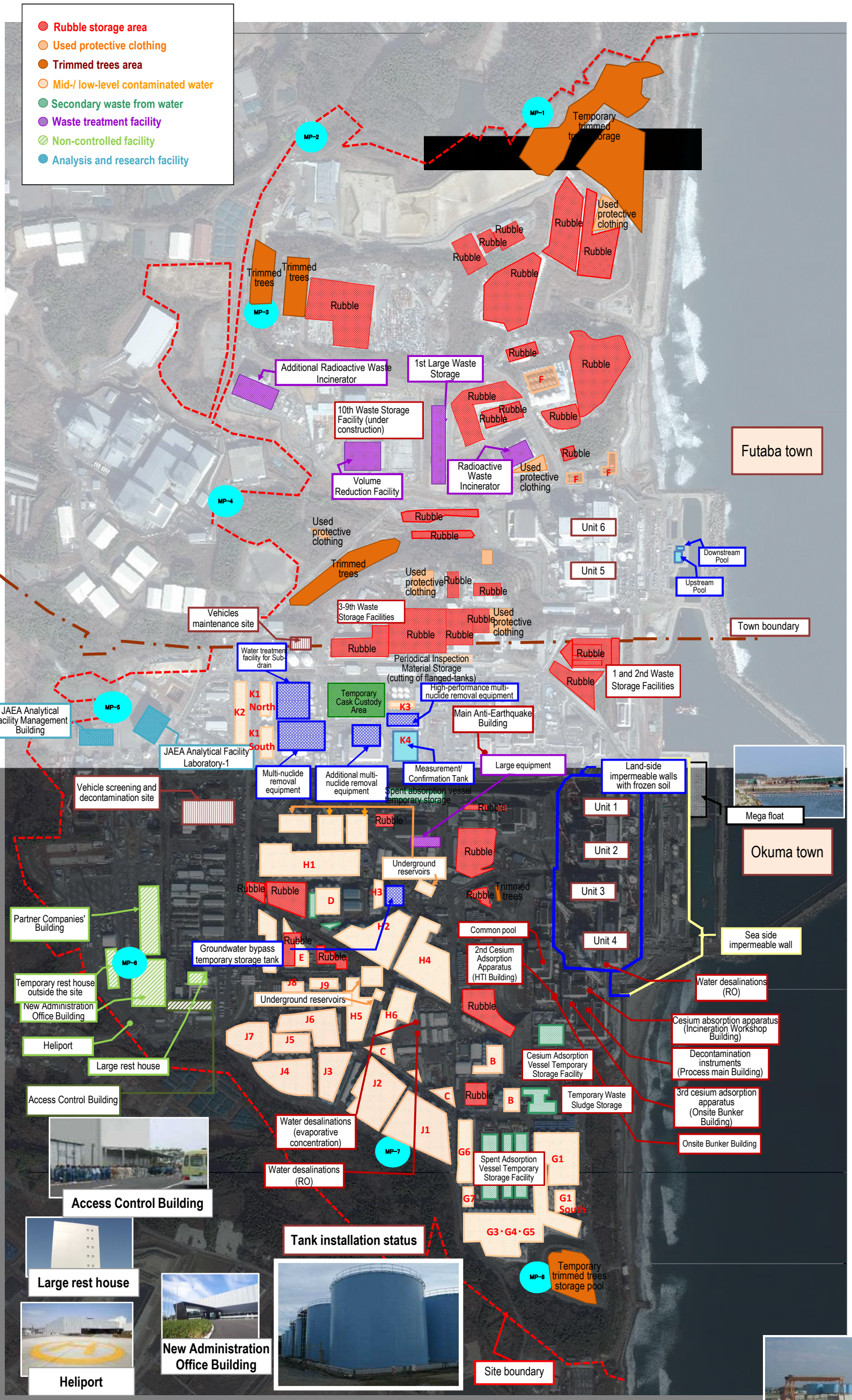
Note: The Total β measurement value is the total radioactivity concentration of radioactive materials that emit β-ray (Potassium-40, Cesium-137, Strontium-90, progeny nuclide Yttrium-90, etc.). In general, (approx. 12 Bq/L of natural nuclide Potassium-40 is included in seawater.

* Due to erosion, the sampling point was moved from approx. 320m south to approx. 1,300m south from the south release outlet in December 2021. In September 2023, since erosion was eliminated, the sampling point was returned to the original point, approx. 320m south from the south release outlet. Moreover, due to erosion, the sampling point has been moved again to approx. 1,300m south from the south release outlet since June 11, 2024.

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

TEPCO Holdings Fukushima Daiichi Nuclear Power Station Site Layout

Appendix 2
September 26, 2024



1st Large Waste Storage Facility

Radioactive Waste Incinerator

10th Waste Storage Facility

Volume Reduction Facility

Solid Waste Storage Facility

Temporary waste sludge storage

Spent adsorption vessel temporary storage facility

Access Control Building

Large rest house

New Administration Office Building

Heliport

Provided by Japan Space Imaging Corporation, photo taken on January 14, 2024
Product(C) [2024] Maxar Technologies.

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)
- [Completed] Suppressing the amount of contaminated water generated to 100 m³/day or less (within 2025)
- [Completed] Treatment of stagnant water in buildings was completed* (within 2020) *Except for Units 1-3 Reactor Buildings, Process Main Building and High Temperature Incinerator Building.
- [Completed] stagnant water in Reactor Buildings was reduced to about a half of the level at the end of 2020 (FY2022-FY2024)

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024

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)
- ▽Pre-service inspection granted (2023.3.2)

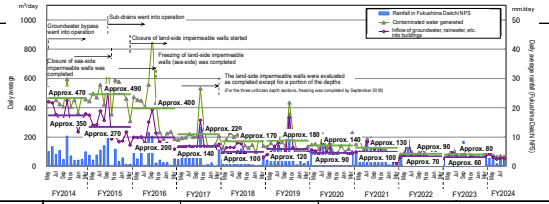
Cesium Adsorption Apparatus (KURION)

Landing of the second Cesium Adsorption Apparatus (SARRY)

Multi-nuclide removal equipment (ALPS)

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

Unit 2 seawater pipe trench Shaft D filling work



Contaminated water management【Redirect】

Groundwater bypass
- ▽Installation start of groundwater bypass
- **▽Operation start of groundwater bypass (drainage started from 2014.5.21)**

Suppressing the average amount of contaminated water generated to approx. 90 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** (2000m³/day)

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 east side▽
- **▽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

Sub-drain purification system

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
- ▽Completion of waterproof pavement (facing) (except for around Unit 1-4)

Placement of seaside impermeable walls complete

Contaminated water management【Retain】

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

Construction of welded-joint tanks

Flanged and welded-joint tanks

Treatment of stagnant water
- ▽Installation of stagnant water transfer equipment/transfer start
- ▽Completion of work to improve reliability of transfer line (replacement with PE pipes)
- ▽Start to maintain water-level difference with sub-drain water level
- ▽Transfer start from each building to Central Rw Building
- **▽Treatment of stagnant water in buildings complete**
- **▽Reduction of stagnant water in the Reactor Buildings to approx. half of the level at the end of 2020 achieved**
- ▽Floor exposure of Unit 1 T/B
- ▽Separation of stagnant water between Units 1 and 2
- ▽Floor exposure of Unit 1 RwB
- ▽Separation of stagnant water between Units 3 and 4
- ▽Floor exposure of Unit 2 T/B, RwB
- ▽Floor exposure of Unit 3 T/B, RwB
- ▽Floor exposure of Unit 4 R/B, T/B, RwB
- ▽Completed lowering to target water level of Unit 2 R/B
- ▽Completed lowering to target water level of Unit 1, 3 R/B

Countermeasures to tsunami

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 Chishima Trench Tsunami Seawall
- Japan Trench tsunami seawall ▽Completion of installation ▽On-site start
- **Japan Trench Tsunami Seawall Completion of main wall construction▽**

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

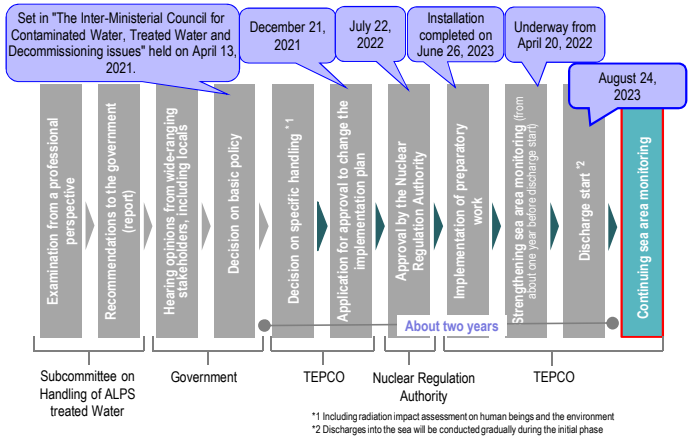
Chishima Trench Tsunami Seawall complete

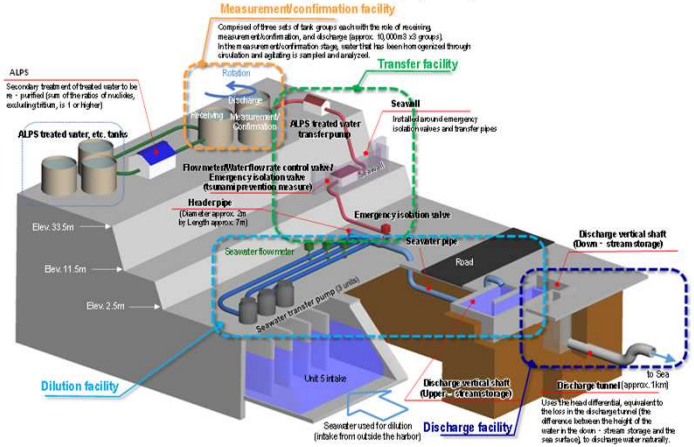
Japan Trench Tsunami Seawall

2 Handling of ALPS treated water

In “The Inter-Ministerial Council for Contaminated Water, Treated water and Decommissioning” held on April 13, 2021, 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.





Information provision and communication to foster understanding

■ Occasions to deepen the understanding are organized by communications related to decommission via various media and visit to the power station.

■ On the dedicated website “Treated Water Portal Site” (Japanese, English, Chinese and Korean) within the TEPCO website, monitoring results of radioactive materials are published timely.


Dialogue meeting

■ Visit and dialogue meeting of Fukushima Daiichi Nuclear Power Station have been held since 2019 for 13 cities, towns and villages.

■ Through various opportunities such as visit and on-site explanations, communications continue where opinions of related parties are heard, their thought is taken seriously, and TEPCO conveys its efforts, thought and countermeasures for reputational damage.

● Status of discharge of ALPS treated water into the sea

Discharge of ALPS treated water into the sea commenced from August 24, 2023, and the 1st discharge was completed on September 11.

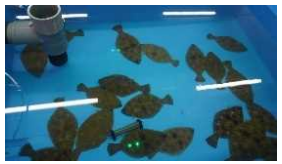
During the discharge period, no abnormality was detected by the sea area monitoring conducted by the national government, Fukushima Prefecture and TEPCO.

<Discharges in FY2024>

Tank group discharged	Tank Group C	Tank Group A	Tank Group B	Tank Group C
Tritium concentration	190,000 Bq/L	170,000 Bq/L	170,000 Bq/L	200,000 Bq/L
Discharge commencement	April 19, 2024	May 17, 2024	June 28, 2024	August 7, 2024
Discharge termination	May 7, 2024	June 4, 2024	July 16, 2024	August 25, 2024
Discharge amount	7,851 m^3	7,892 m^3	7,846 m^3	7,897 m^3
Total tritium amount	1.5 trillion Bq	1.3 trillion Bq	1.3 trillion Bq	1.6 trillion Bq

● 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.
- External experts also confirmed that there was no difference in rearing statuses between the tanks of the original seawater controls and those of seawater containing ALPS treated water.
- As shown in the existing research results conducted in Japan and overseas, it was confirmed that “tritium in vivo reached equilibrium in a certain time period and the concentration of tritium in vivo reaching equilibrium did not exceed the level in the growing environment.”


Flounder in rearing preparation tank


Overall view of mockup tanks

- Daily rearing status is published in the TEPCO website and Twitter
  - TEPCO website: http://www.tepco.co.jp/decommission/information/newsrelease/breedingtest/index-j.html
  - TEPCO X (Old Twitter): https://twitter.com/TEPCOfishkeeper

● Publication of the Comprehensive Report of the IAEA safety review

The Comprehensive Report on the safety review concerning handling of ALPS -treated water was published by the IAEA on July 4, 2023.

In the Executive Summary of the IAEA Comprehensive Report, the IAEA concluded the following: (1) the activities by Japan associated with the discharge of ALPS treated water into the sea are consistent with relevant international safety standards, (2) the discharge of the ALPS treated water will have a negligible radiological impact on people and the environment.

We will continue to share necessary information with the IAEA, while striving to foster further understanding of the international community about the discharge of ALPS treated water into the sea.

https://www.iaea.org/topics/response/fukushima-daiichi-alps-treated-water-discharge-comprehensive-reports

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)

2021.4.13 The basic policy on the handling of ALPS treated water was set
2021.4.16 The response of TEPCO was announced

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

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

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

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 (amendment of organizational structure, and nuclides to be measured and assessed, and others)

2023.2.14, 20 Application for the Application Documents for Approval to Amend the Implementation Plan was submitted (amendment of organizational structure, and nuclides to be measured and assessed, and others)

2023.5.10 Approval

2023.6.26 Completion of installation

2023.7.7 Receipt of Certificate of Completion for Pre-service Inspections

2023.8.24 Commencement of discharge

2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

3 Removal of fuel from spent pool

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

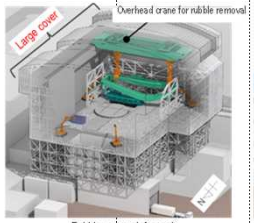
- Completion of Unit 1-6 fuel removal (within 2031)
- Completion of installation of Unit 1 large cover (around FY2023), start of Unit 1 fuel removal (FY2027-2028)
- Start of Unit 2 fuel removal (FY2024-2026)

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

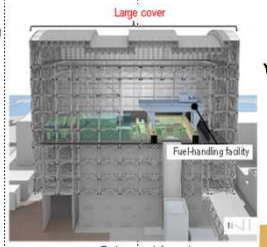
Unit 1

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

<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.



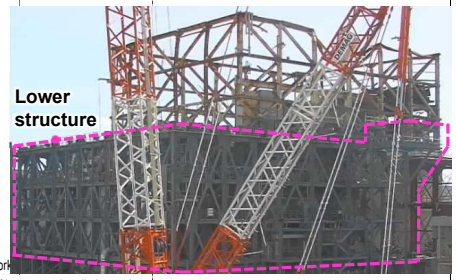
Rubble removal (image)



Fuel removal (image)

In order to install a large cover at Unit 1 reactor building, a high-dose locations were identified on the south exterior wall, and as a measure to reduce exposure, shielding was installed over the high-dose locations.
The need to implement safety measures for high-dose locations on the walls of the reactor buildings, the construction of the Unit 1 large cover should be completed around the summer of FY2025.
Among the milestones of the Mid-and-Long-term RM, the start of Unit 1 fuel removal, which is set from FY2027 to FY2028, is not expected to be affected by the close examination of the process after the installation of the large 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
▼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
▼2021.8 Start of large cover pre-work
▼2022.4 Start of large cover installation work

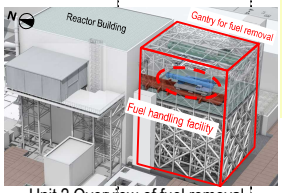


<Unit 1 northwest side 2024.1.24>

Unit 2

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.

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


<Unit 2 Construction of gantry for fuel removal>

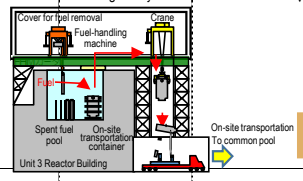
As part of efforts to remove fuel from the Unit 2 spent fuel pool and based on findings from internal operating floor investigations from November 2018 to February 2019, instead of fully dismantling the upper part of the building, the decision was made to install a small opening on the south side and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

▼2018.8-2020.12 Moving and containment of remaining objects
▼2020.6 Investigation inside the spent fuel pool
▼2021.6-2022.1 Decontamination of R/B operating floor (1)
▼2021.9-2022.5 Shielding installation in R/B operating floor (1)
▼2022.5-2022.6 Transfer of FHM
▼2022.7-2023.1 Removal and clean-up of FHM operation room
▼2022.12-2023.3 Removal of existing facilities in operating floor
▼2023.4-2023.11 Decontamination of R/B operating floor (2)
▼2023.11- Shielding of R/B operating floor (2)
▼2024.6- Completion of installation of gantry for fuel removal
▼2016.9-2017.4 West-side gantry installation work
▼2017.5 Opening a hole in the west-side external wall
▼2021.10-2022.4 Ground improvement work
▼2023.1 Start of steel erection
▼2023.2 Start of south-side existing facilities dismantling

Unit 3

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

Overview of the fuel-handling facility inside the cover



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
▼2021.2.28 Fuel removal completed (566 assemblies)

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

Unit 4

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

▼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
▼2014.12.22 Fuel removal was completed (1533 assemblies)


<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

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

4 Work toward fuel debris retrieval

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

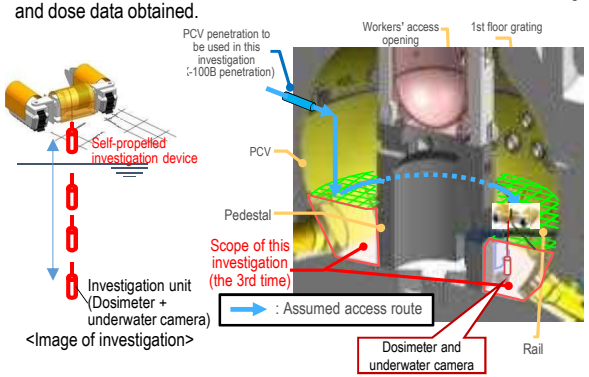
Commencement of fuel debris retrieval from the first unit (Unit 2). Expanding the scale in stages (From September 10, 2024, trial fuel debris retrieval commenced)

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

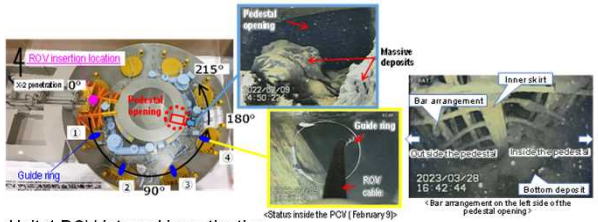
・In April 2015, a device having entered the inside of the PCV via a narrow opening (bore:φ100 mm) collected information such as images and airborne dose inside the PCV 1st floor.

・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 2022, "the guide ring" was installed to facilitate the investigation. From March 28, 2023, the investigation inside the pedestal by ROV-A2 started and confirmed that a portion of the bar arrangement was exposed. Regarding the soundness of the pedestal, based on the past earthquake resistant evaluation by the International Research Institute for Nuclear Decommissioning (IRID), it was evaluated that even though a portion of the pedestal was lost, there would be no serious risk. However, as the present information is very limited, the investigation will continue to acquire as much information as possible for continued evaluation.



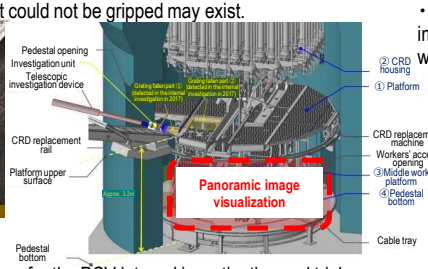
Unit 2 Investigation overview

・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.

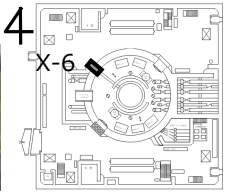

Bottom of the pedestal (after being processed in panoramic image visualization)



・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

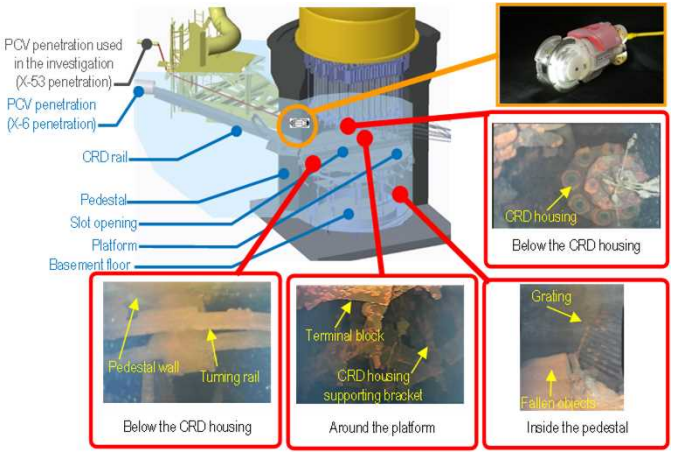
・In October 2014, the conditions of X-53 penetration, which may be under water and which is scheduled for use to investigate the inside of the PCV, was investigated via remote-controlled ultrasonic test equipment. The results showed that the penetration was not under water.

・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
	4th (From 2022.2)	Acquiring information inside PCV (inside/outside of the pedestal) - Acquiring images - Measuring deposit thickness and sampling deposit - Detecting deposit debris, 3D mapping
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 ★2023.2 Revision ★2023.11 Revision

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

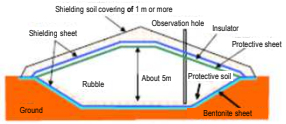
▼ 2012.9 Transfer start of rubble to the soil-covered temporary storage facility

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

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

▼ 2019.6 Start of building construction
1st Large Waste Storage

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



<Outline of soil-covered temporary storage facility>


External view of the 9th Solid Waste Storage

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


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

▼ 2018.2 Operation start


2021.1.18

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

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

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

▼ 2013.5 Installation work gets underway
Solid Waste Incinerator

▼ 2016.3 Operation start

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


Whole view of Solid Waste Incinerator


Electrical room


Control room

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

2017.10 Installation work gets

▼ 2017.4 Start of pre-work
Additional Solid Waste Incinerator

▼ 2018.5 Operation start
Large Equipment Decontamination Facility

Large Equipment Decontamination Facility

▼2022.5 Start of operation

▼ 2020.9 Start of pre-work
Compaction Facility

2024.2 Start of operation ▼


[2023/4/25]
Site of Volume Reduction Facility

Present status Note

Storage of rubble and others

Present storage Approx.520,000 m³ (as of 2023.3)

Rubble (combustible), trimmed trees, used protective clothing)
Outdoor deposit / Trimmed trees temporary storage / Container storage

Contaminated soil (0.005 - 1 mSv/h)
Outdoor deposit / Container storage

Rubble (metal, concrete, others)
More than 1 mSv/h: Container storage / Soil-covered temporary storage facility / Solid waste storage
0.005-1 mSv/h: Outdoor storage / Container storage / Sheet covering
Less than 0.005mSv: Container storage (tank pieces after decontamination) / Outdoor deposit

Storage of water treatment secondary waste

Spent adsorption vessel temporary storage

Estimate for the next decade (or so) Approx.**760,000** m³

(*2)

Approx. 300,000 m³ → To (A) (*1) → Incineration
Approx. 70,000 m³ → Stored and managed in Solid Waste Storage as done for rubble
Approx. 60,000 m³ → (B)
Approx. 140,000 m³ → To (A) (*1) → Volume reduction
Approx. 180,000 m³ → To (A) (*1) → Volume reduction
Approx. 7,400 tanks → Treatment measures and others will be examined

Status after a decade

Legend: Newly installed equipment and facility

Incineration

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

- Radioactive Waste Incinerator
- Additional Radioactive Waste Incinerator (Completion in May 2022)

Volume reduction

Compaction Facility (scheduled for completion in FY2022)
Concrete crusher example / Metal cutter example

Melting

Melting equipment (under consideration)
Electric furnace example

To (B)

(*3) Approx. **290,000** m³ (*2)

Storage /management

- Approx. 20,000 m³ → Solid Waste Storage (Storage capacity: approx. 250,000 m³)
- Approx. 70,000 m³ → Existing Solid Waste Storage 1st-8th (existing) 9th (Operation launch in 2018.2)
- (A) (*1) Approx. 80,000 m³ → **Additional Solid Waste Storage** 10th-11th (Scheduled for completion after FY2024)
- (B) Approx. 60,000 m³
- Approx. 50,000 m³ (*1) → Based on the estimates for the amount of waste to be generated, the storage capacity (approx. 250,000 m³) will be reached in around 2031. 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 FY2025) The earthquake-resistant design is being reviewed based on the Fukushima prefecture offshore earthquake in FY2021


Work of main part

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

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.

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

▼ 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.


External view of Access Control Facility

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

▼ 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.


Large rest house under construction (2014.9.30)


Access Control Facility (2014.11.7)

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

▼ 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.

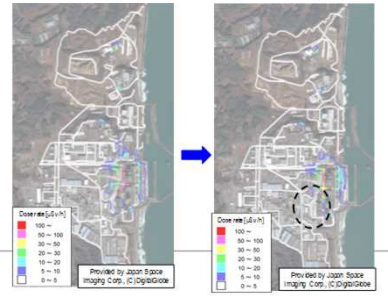

Visit by Governor of Fukushima Prefecture to the Fukushima Daiichi NPS (2018.11.1)


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


Visit by Prime Minister Kishida to the Fukushima Daiichi NPS (2023.8.21)
Observation of ALPS Treated Water Dilution/Discharge Facilities from high ground on Units 5 and 6 side

<Travel survey results of major roads within the site>
It was confirmed that compared with the last fiscal year, the dose rate has been declining on roads on the west and south sides of the High Temperature Incinerator Building (area circled by black dot line).

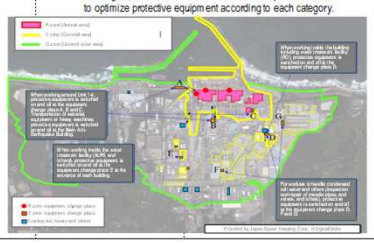
<FY2022 4th Quarter> (Measured in February2023) <FY2023 4th Quarter> (Measured in February2024)



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

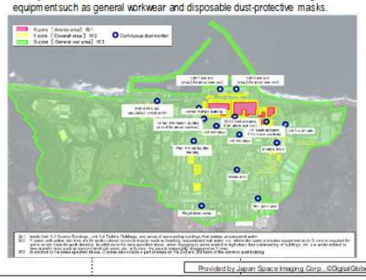
▼ In May 2015, full-face mask unnecessary area was expanded to cover about 90% of the site.

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

▼ 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.



▼ 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).


Move in general working clothes (2016.1.7)


Facing (2017.4.13)