Outline of Decommissioning, Contaminated Water and Treated Water Management

November 30, 2023
Secretariat of the Team for Countermeasures for Decommissioning, Contaminated Water and Treated Water

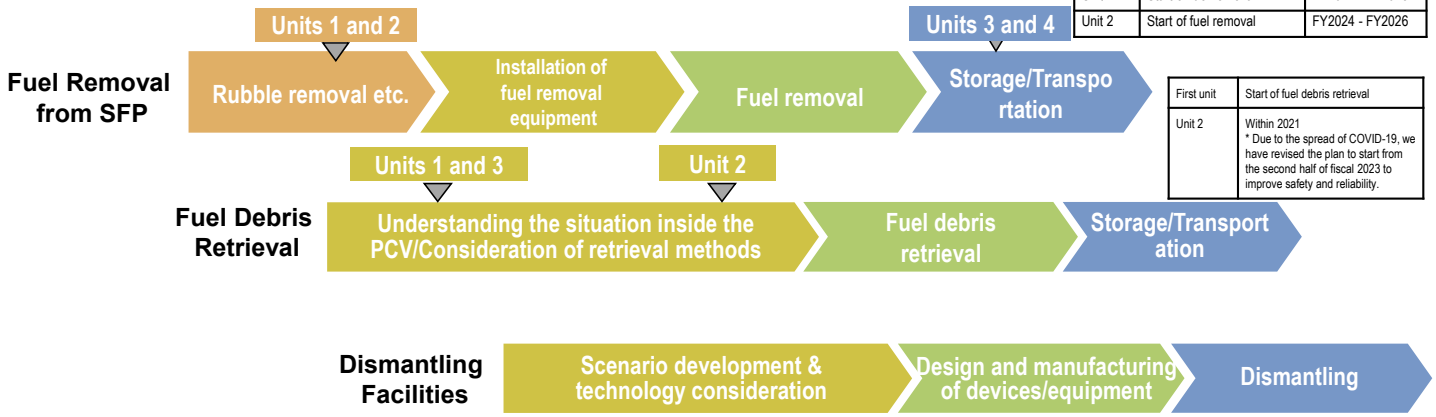
Main decommissioning work and steps

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 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



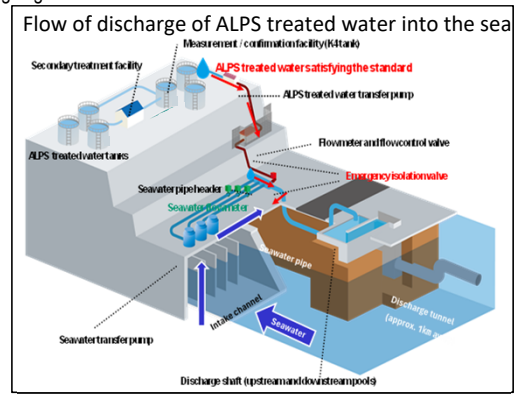
First unit	Start of fuel debris retrieval
Unit 2	Within 2021 * Due to the spread of COVID-19, we have revised the plan to start from the second half of fiscal 2023 to improve safety and reliability.

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.

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

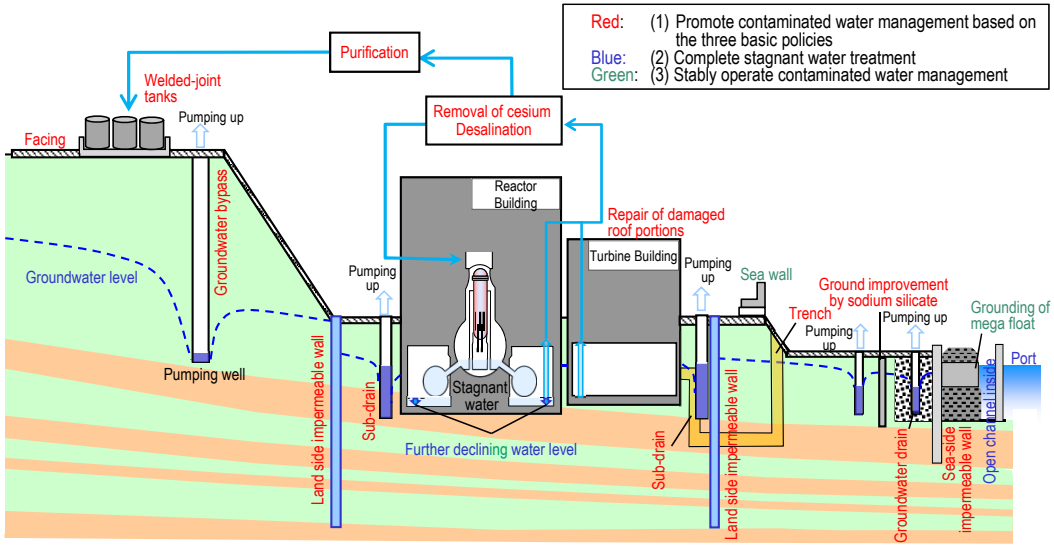
- Strontium-reduced water from other equipment is being re-treated in the Advanced Liquid Processing System (ALPS: multi-nuclide removal equipment) and stored in welded-joint tanks.
- Multi-layered contaminated water management measures, including land-side impermeable walls and sub-drains, have stabilized the groundwater at a low level and the increased contaminated water generated during rainfall is being suppressed by repairing damaged portions of building roofs facing onsite. Through these measures, the generation of contaminated water was reduced from approx. 540 m^3/day (in May 2014) to approx. 90 m^3/day (in FY2022).
- 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.
- 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 conducting the dust impact assessment, 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

- Various measures were carried out to prepare for tsunamis. As countermeasures 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 are being implemented as planned.



Progress status

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

Status of discharge of ALPS treated water into the sea

From November 2, 2023, discharge of ALPS treated water from Tank Group A of the measurement / confirmation facility into the sea (3rd) commenced. Since the commencement of discharge, it has been confirmed that the discharge was conducted safely as planned based on the results of quick analysis conducted daily by TEPCO on tritium in seawater.

The 3rd discharge was conducted safely as planned while confirming that the discharge satisfied the national government's requirement and was completed on November 20. During the discharge period, no abnormality was detected by the sea area monitoring conducted by the national government, Fukushima Prefecture and TEPCO. (Discharge amount 7,753 m^3)

In the next phase, after draining water in the upstream pool to the downstream pool, inspections related to the facilities and operation will be conducted.

< Measurement status for the 3rd discharge of ALPS treated water >
(* Detailed information described on the right on Page 5 >

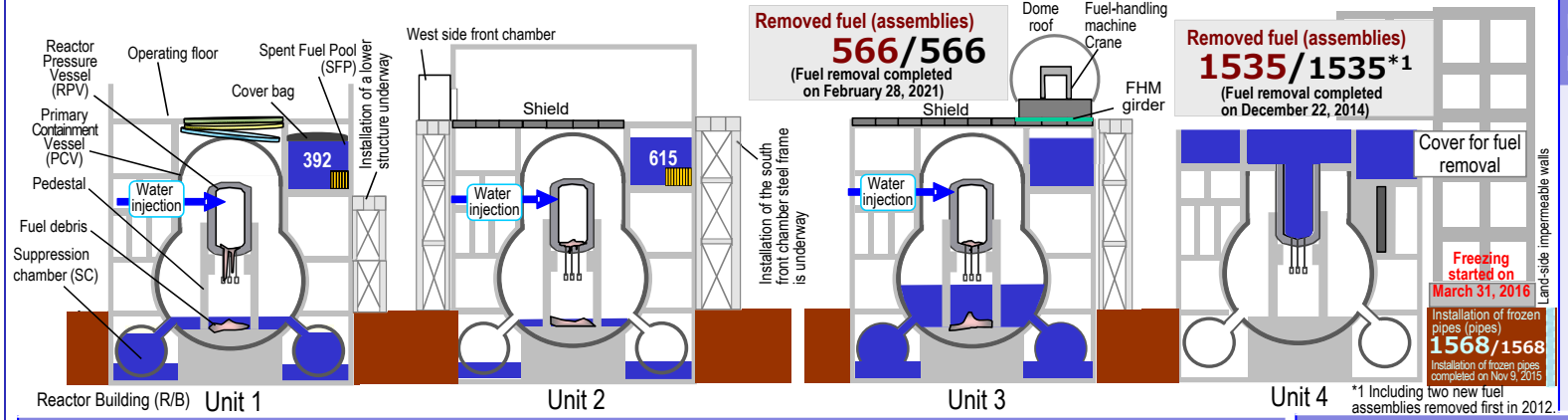
Measurement status	Requirement satisfaction
Attributes of the treated water from Tank Group A (Concentration of the 29 types of radionuclides within the measurement / evaluation scope and regulatory requirements) [TEPCO] (Sampled on July 30)	○
IAEA (ALPS treated water after dilution, published on November 2)	○
Downstream of discharge shaft and seawater pipe header [TEPCO] (As of November 1)	○
Results of sea area monitoring at 10 points within 3km of the Power Station [TEPCO] (Sampled on November 28)	○
Ministry of the Environment (11 points off the coast of Fukushima Prefecture, sampled on November 21 and 23)	○
Fisheries Agency (Flounder and others, sampled on November 28)	○
Fukushima Prefecture (9 points off the coast of Fukushima Prefecture, sampled on November 22)	○

Status of measures to prevent groundwater inflow from around the buildings

Between external walls of each building, gaps were generated when the buildings were constructed adjacently around the Reactor Buildings. There are many penetration pipes in the gaps between the buildings and groundwater may infiltrate from external walls. In response, the method to stop infiltration by boring the external wall ends and placing mortar is being examined.

Based on the results of the mockup test last year, actual-scale level test construction is being conducted this fiscal year between the Units 5/6 Turbine Buildings and Reactor Buildings to verify the boring method and the water stoppage performance.

In the succeeding phases, the inflow amount to the buildings suppressed by the test construction will be confirmed. Moreover, the same method will also be implemented to Unit 3 by FY2025 and subsequently, water stoppage work for gap ends will be conducted in other units.



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

Unit 1 Progress status of work toward fuel removal

Toward installing the large cover, installation of a lower structure has been underway on the west and north sides of the Unit 1 Reactor Building.

On the east side, following the completion of anchor drilling, installation of base plates has been underway.

On the south side, after preparation for installing the temporary gantry (installing the shielings and others) was completed, anchor drilling has been underway since November 20.

Unit 2 Progress status toward PCV internal investigation and trial retrieval

Toward internal investigation and trial debris retrieval of the Unit 2 Primary Containment Vessel (PCV), the arm-type equipment will be inserted from X-6 penetration into the PCV to remove obstacles inside the PCV and conduct the internal investigation.

Regarding the arm-type equipment, a mockup test simulating the site continues. It was confirmed that the equipment could cut and remove obstacles, but to increase the accuracy assuming multiple kinds and times of accesses, improvement of necessary control program is underway.

Regarding X-6 penetration, cleaning of the X-6 penetration flange surface was completed before removing deposit. Toward future deposit removal inside X-6 penetration, installation of the equipment and other related work is underway.

Before commencing trial retrieval in around the 2nd half of FY2023, based on the status of deposit removal inside the X-6 penetration and the test of the robot arm, work will proceed appropriately.

< Cleaning of X-6 penetration flange surface >

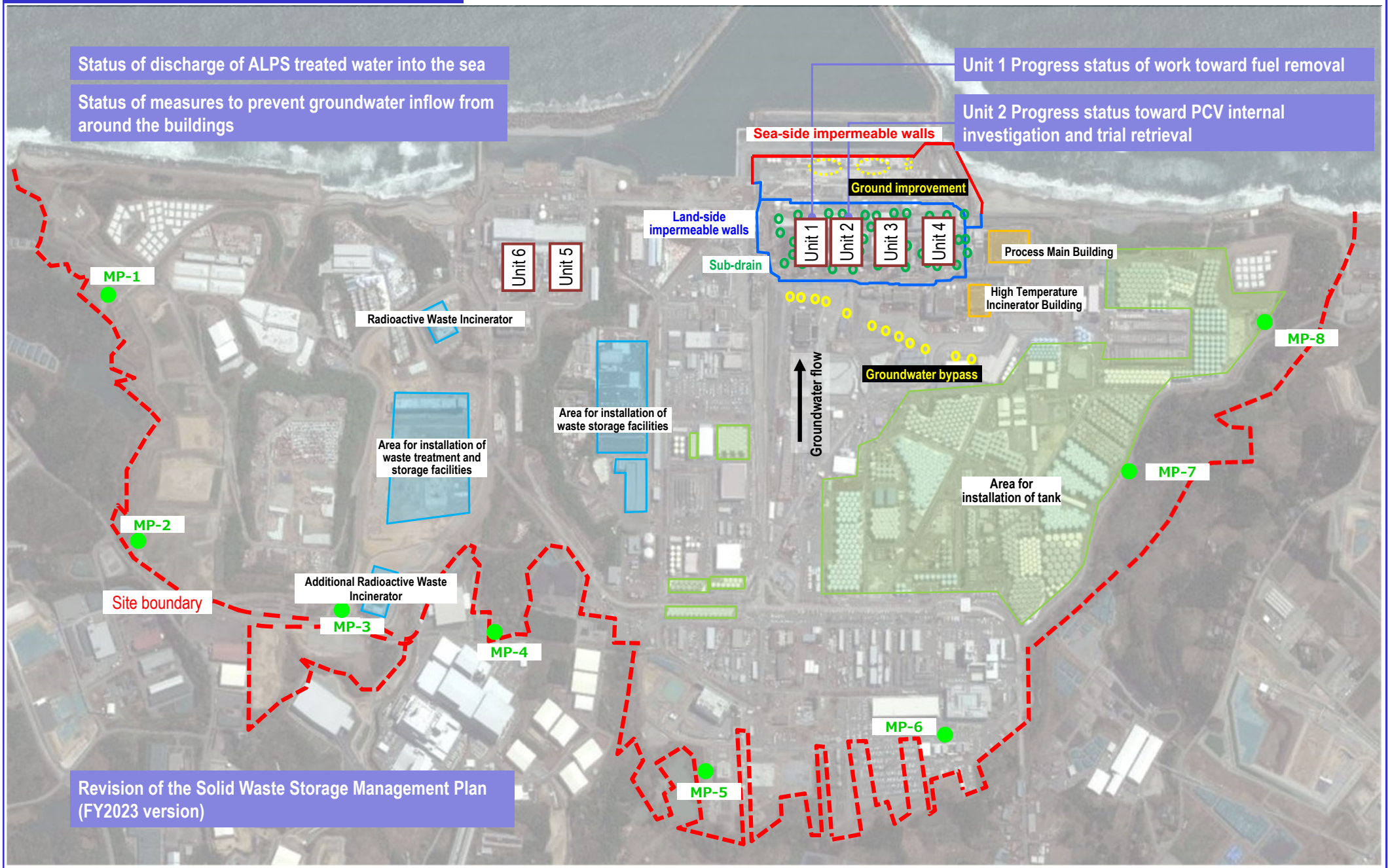
Revision of the Solid Waste Storage Management Plan (FY2023 version)

Regarding the Solid Waste Storage Management Plan, which was formulated based on the Mid-and-Long-Term Roadmap, the seventh revision was issued, in which for "rubble and others" and "water treatment secondary waste," amount to be generated in about next ten years was estimated based on the actual generation result.

For solid waste such as rubble, amount after volume reduction by incineration and others was also calculated (amount to be generated: approx. 760,000m^3, after volume reduction: approx. 290,000m^3).

Regarding the Large Waste Storage-1 and the Additional Solid Waste Storage-11, the completion date was reviewed based on the review of the seismic resistant assessment. However, this review will not affect the achievement of the milestone target in the Mid-and-Long-Term Roadmap "transferring solid waste such as rubble to indoor storage within FY2028."

Major initiatives – Locations on site

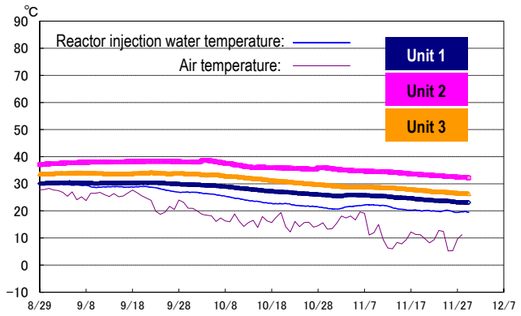


Provided by Japan Space Imaging Corp., photo taken on April 8, 2021
Product (C) [2020] DigitalGlobe, Inc., a Maxar company

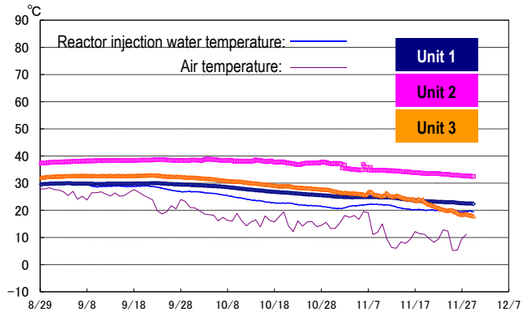
I. Confirmation of the reactor conditions

Temperatures inside the reactors

Through continuous reactor cooling by water injection, the temperatures of the Reactor Pressure Vessel (RPV) bottom and the Primary Containment Vessel (PCV) gas phase were maintained as shown below for recent, though it varied depending on the unit and location of the thermometer.

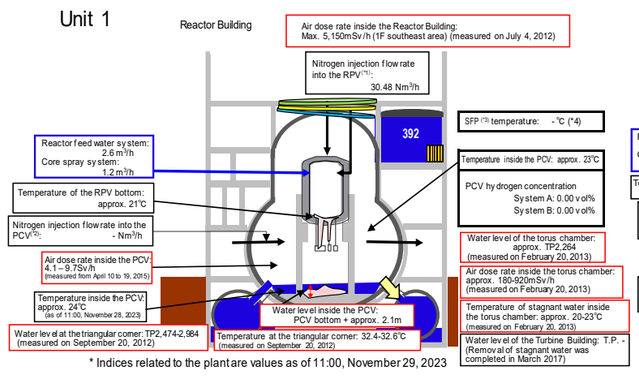


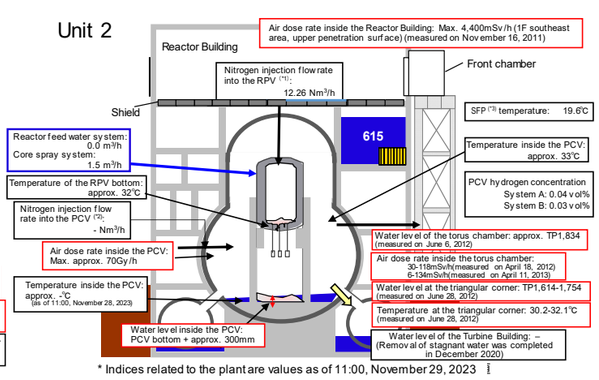
RPV bottom temperatures (recent quarter)

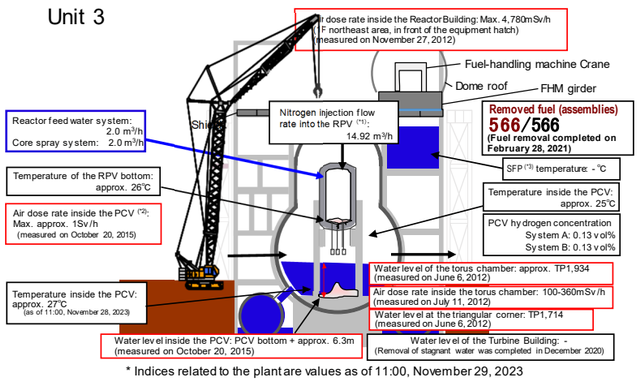


PCV gas phase temperatures (recent quarter)

*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.





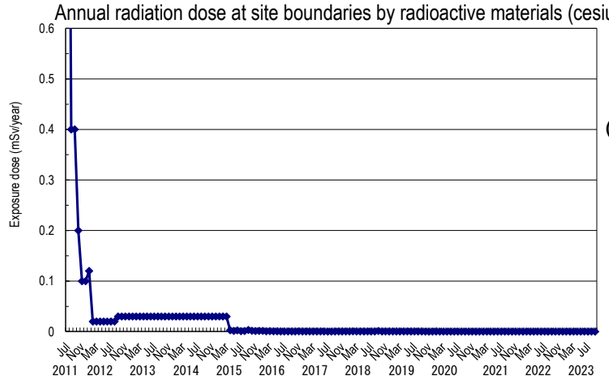


(*1) RPV (Reactor Pressure Vessel)
(*2) PCV (Primary Containment Vessel)
(*3) SFP (Spent Fuel Pool)
(*4) Data missing due to inspection

Release of radioactive materials from the Reactor Buildings

As of October 2023, the concentration of radioactive materials newly released from Reactor Building Units 1-4 into the air and measured at the site boundary was evaluated at approx. 2.3×10^{-12} Bq/cm³ and 1.7×10^{-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 x 10^{-5} Bq/cm³Marc
  [Cs-137]: 3 x 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 0.306–1.029 μSv/h (October 25-November 28, 2023).
  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.

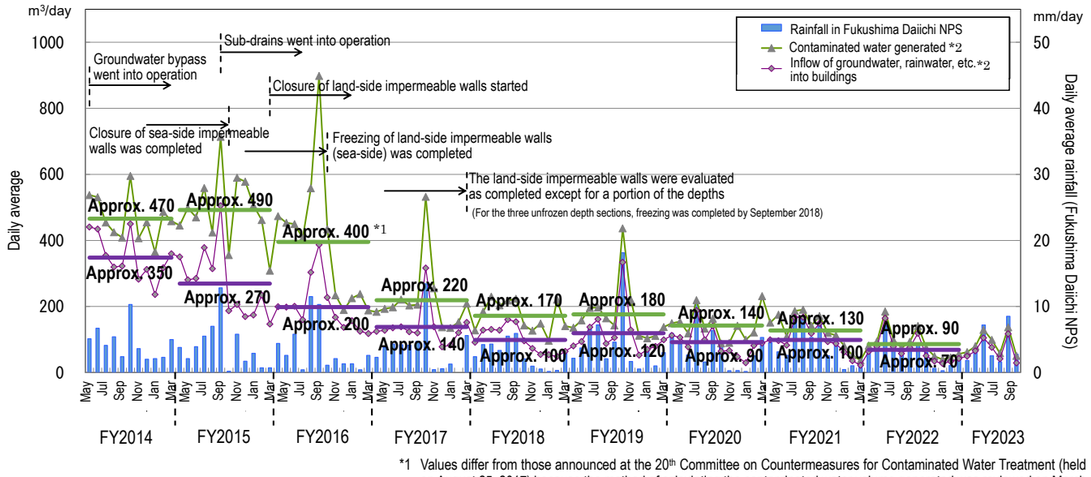
Based on the above, it was confirmed that the comprehensive cold shutdown condition had been maintained and the reactors remained in a stabilized condition.

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 and due to less rainfall than in previous normal years without concentrated heavy rain of 100 mm/day or more, the amount of contaminated water generated within FY2022 declined to approx. 90 m³/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 19, 2023, 2,327 release operations had been conducted.
  The water quality of all temporary storage tanks satisfied the operational target.

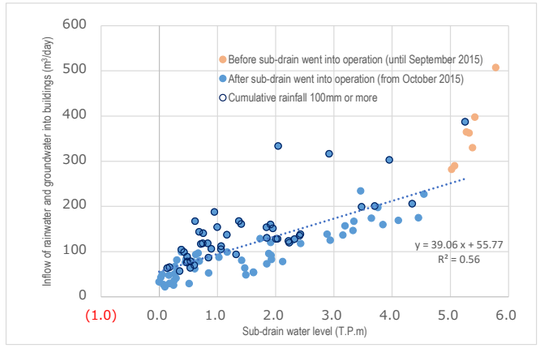


Figure 2: Correlation between inflow such as groundwater and rainwater into buildings and the water level of Units 1-4 sub-drains

➢ 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 2023, 95% of the planned area (1,450,000 m² on site) had been completed. For the area inside the land-side impermeable walls, implementation proceeds appropriately after constructing a yard from implementable zones that leave the decommissioning work unaffected. As of the end of October 2023, 40% of the planned area (60,000 m²) had been completed.

➢ Status of the groundwater level around buildings

- The groundwater level in the area inside the land-side impermeable walls has been declining each 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 to the T.P. 2.5 m area.

➢ Operation of the multi-nuclide removal equipment and other water-treatment facilities

- Regarding the multi-nuclide removal equipment (existing), hot tests using radioactive water had been conducted (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 (NRA) and the entire pre-service inspection was completed. For the multi-nuclide removal equipment (additional), a pre-service inspection certificate was granted by the NRA on October 12, 2017. Regarding the multi-nuclide removal equipment (high-performance), hot tests using radioactive water had been conducted from October 18, 2014. On March 2, 2023, a pre-service inspection certificate was granted by the NRA and the entire pre-service inspection was completed.
- 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 23, 2023, approx. 738,000 m³ had been treated.

➢ Risk reduction of strontium-reduced water

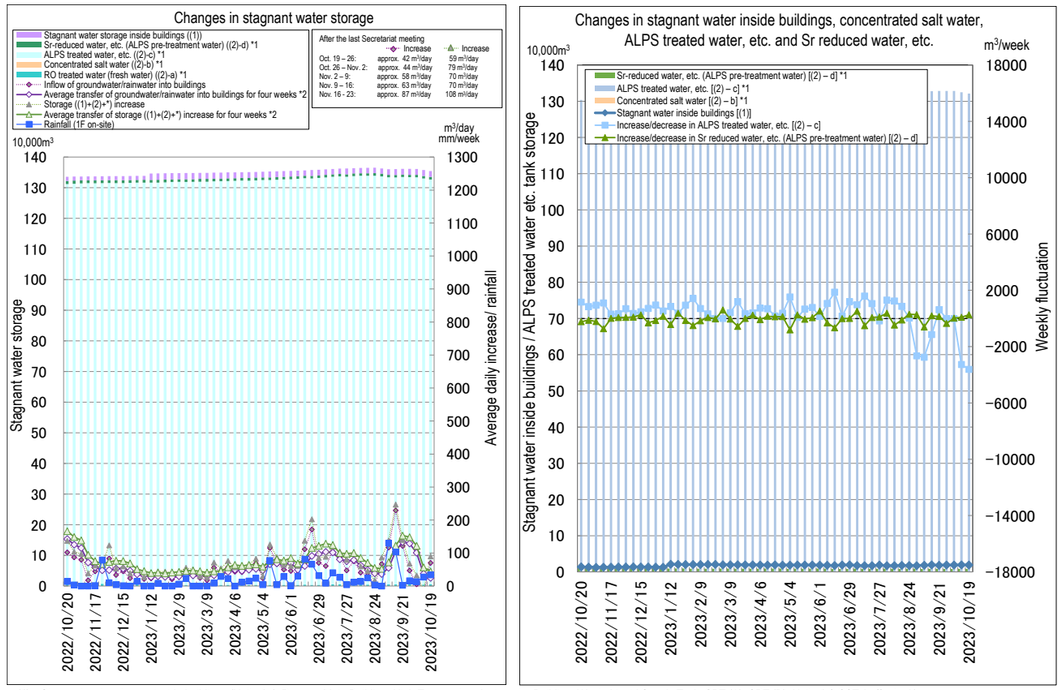
- To reduce the risks of strontium-reduced water, treatment using existing, additional and high-performance multi-nuclide removal equipment is underway. Up until November 23, 2023, approx. 905,000 m³ had been treated.

➢ Storage status of contaminated water and amount of ALPS treated water, etc. stored in tanks

- The amount of ALPS treated water, etc. was approx. 1,315,233 m³ as of November 23, 2023.

- The amount of ALPS treated water discharged into the sea was approx. 23,353 m³ as of November 21, 2023.

As of November 23, 2023



(1): Stagnant water storage inside buildings (Units 1-4, Process Main Building, High Temperature Incinerator Building, Waste Liquid Supply Tank, SPT (A), SPT (B), Units 1-3 CST, buffer tank)
(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)], amount of ALPS treated water discharged was not taken into account.

Figure 3: Status of stagnant water storage

➢ Status of discharge of ALPS treated water

As of November 29, 2023

Measurement Object	Requirement and operation target	Measurement results	Satisfaction of requirement
[TEPCO] Treated water before dilution in tank group A of measurement/confirmation facility in each tank groups (Concentration of the 29 types of radionuclides within the measurement / evaluation scope and regulatory requirements, and tritium concentration)	・Sum of the ratios to regulatory concentrations (excluding tritium): less than 1 ・1 million Bq/L	・0.25 ・130,000 Bq/L	○ ○
[IAEA] Tritium concentrations in seawater (ALPS treated water after dilution, published on November 2)	・Less than 1,500 Bq/L	・Less than 1,500 Bq/L	○
[TEPCO] Tritium concentrations in water in discharge vertical shaft and seawater pipe upstream of discharge vertical shaft (ALPS treated water after dilution)	・Less than 1,500 Bq/L	・Less than 1,500Bq/L	○
[TEPCO] tritium concentrations in seawater (Results of sea area monitoring at 10 points within 3 km from the Power Station)	・Discharge suspension level: 700 Bq/L or less ・Investigation level: 350 Bq/L or less	・700 Bq/L or less ・350 Bq/L or less	○ ○
[Ministry of the Environment] Tritium concentrations in seawater (11 points off the coast of Fukushima Prefecture)	・National safety requirement: 60,000 Bq/L ・WHO drinking water guidelines: 10,000 Bq/L	・Below the lower detection limit (less than 7-8 Bq/L)	○ ○
[Fisheries Agency] Tritium concentrations in marine products (flounder and others)	-	・Below the lower detection limit (less than 8.1 Bq/kg)	○ ○
[Fukushima Prefecture] Tritium concentrations in seawater (9 points off the coast of Fukushima Prefecture)	・National safety requirement: 60,000 Bq/L ・WHO drinking water guidelines: 10,000 Bq/L	・Below the lower detection limit (less than 3.6-3.9 Bq/L)	○ ○

- From November 2 to 20, 2023, a third discharge of ALPS treated water into the sea in FY2023 was conducted.
- Regarding the Tank Group A discharge, the concentration of the 29 types of radionuclides (excluding tritium) within the measurement and assessment scope was 0.25 in terms of the sum of the ratios to regulatory concentrations and met the national government's requirement of less than 1. The concentration of tritium was 130,000 Bq/L. Regarding 39 nuclides for which no significant existence was voluntarily confirmed, the absence of any significant presence was confirmed and the water quality satisfied the requirements of national and prefectural governments. The water temperature was almost the same as the air temperature and after approx. 740x dilution, the same as the seawater used for dilution (unlike the warm water discharged from the power plant).
- The third amount discharged was 7,753 m^3 and the total amount of tritium was approx. 1.0 trillion Bq.
- Analysis before the discharge showed a tritium concentration in the water of the upstream seawater pipe of the discharge shaft (upstream pool) below 1,500 Bq/L as of November 1, indicating no problem. (During discharge, daily checks are performed to ascertain that the calculated values match the actual concentrations and are less than 1,500 Bq/L*.)

  * 1,500 Bq/L: The value stipulated by the national government, which is 1/40 of the legal requirement (60,000 Bq/L) and approx. 1/7 of WHO drinking water guidelines (10,000 Bq/L).

  Basic Policy on handling ALPS treated Water (refer to page 9)

  https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/bp_alps.pdf
- Regarding the status of sea area monitoring on handling ALPS treated water, more 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 November 28, 2023, no significant variation was detected.
- Regarding sea area monitoring conducted by TEPCO at ten points within 3 km from the power station, quick measurements taken of the tritium concentration in the seawater sampled on November 28 showed concentrations under the detection limit (less than 5.5-6.8 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).
- The quick measurement results obtained by each organization were as follows:

  Ministry of the Environment: The MOE Japan is to analyze tritium concentrations on a weekly basis to compile a flash report, alongside γ ray nuclides (Cesium-137 and others), for the time being. The analytical results (obtained via quick measurements) for seawater sampled on November 21 and 23 at 11 points off the coast of Fukushima Prefecture showed tritium concentrations below the lower detection limit (less than 7-8 Bq/L) at all sampling points, which would have no adverse impact on human health and the environment.

  Fisheries Agency: Immediately after discharge, analysis is conducted daily as far as possible (including Saturdays and Sundays) for about one month. Quick analytical results for tritium in flounder sampled on November 28 showed tritium concentrations below the lower detection limit (approx. less than 8.1 Bq/kg) of all samples.

  Fukushima Prefecture: Quick analysis of tritium concentration is conducted monthly and as required. On November 22, tritium concentrations in seawater at nine sampling points off the coast of Fukushima Prefecture below the lower detection limit were recorded (less than 3.6-3.9 Bq/L) at all sampling points, which would have no adverse impact on human health and the environment.

➢ Response to the body contamination that occurred during work on ocean pipes of additional ALPS

- On October 25, during work to clean pipes of the additional multi-nuclide removal equipment, body contamination of workers occurred due to splashing of the waste cleaning liquid.
- TEPCO has taken this issue very seriously and asked that the primary contractor implement corrective measures to ensure suitable work plans and field management.
- Moreover, TEPCO is also implementing recurrence prevention measures in response. These measures will also be laterally disseminated to other primary contractors so as to ensure safety during the decommissioning process.

➢ 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 and abalones) in seawater with ALPS treated water added and normal seawater for comparison is underway.
- Regarding the flounder test, on September 5, 2023, in the series 4 tank (ALPS treated water diluted with seawater), one flounder died. Since September 6, no further death or abnormality was detected (as of November 23).
- For abalones, since the test started on October 25, 2022, approx. 40% had survived (43% in normal seawater and 44% in ALPS treated water diluted with seawater) (as of November 23).
- Rearing of flounder and others in diluted ALPS treated water (less than 1,500 Bq/L) will continue.
- Organically bonded tritium (OBT) concentration tests on flounder (less than 1,500 Bq/L) will continue.

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

- Toward installing the large cover, the installation of a lower structure has been underway on the west and north sides of the Unit 1 Reactor Building.
- On the east side, following the completion of anchor drilling, installation of base plates has been underway.
- On the south side, after preparation for installing the temporary gantry (installing shielding and others) was completed, anchor drilling has been underway since November 20.

➢ Main work to remove spent fuel at Unit 2

- Inside the building, decontamination to reduce the radiation dose on the operating floor was completed on October 4. At present, preliminary work for installing the shieling is underway.
- Outside the building, on the south side of the Reactor Building, installation of the concrete floor of the gantry was completed and work to install the front room has been underway. As of October 24, installation of 39 (among 45) units of the gantry for Unit 2 fuel removal was completed.

➢ Construction of siphon break holes for the spent fuel pool water injection pipes

- To prevent the risk of pool water backflow from the spent fuel pool due to the siphon effect when the pipes of the Spent Fuel Pool Cooling and Filtering System were ruptured, siphon break holes will be constructed.
- The construction will be conducted for Units 5 and 6 and the common pool, where the radiation dose is relatively low among the Units 1-6 spent fuel pools and the common pool.
- To construct siphon break holes, drilling equipment for electrical discharge machining will be adopted. After manufacturing the equipment, mockup tests will be conducted to eliminate any assumed risks during work and consequently take all possible measures for on-site work. Construction will commence from December 2023, beginning with Unit 5.
- As countermeasures in the event of rupture of the Spent Fuel Pool Cooling and Filtering System, the check valves (Unit 5 and the common pool) and vacuum breaker valve (Unit 6) were already installed. To further increase reliability, siphon break holes will be constructed.

Retrieval of fuel debris

➢ Sampling of S/C inclusive water to decrease the Unit 1 PCV water level

- To increase the seismic resistance of the Unit 1 Primary Containment Vessel (PCV), the PCV water level will be reduced. Moreover, to decrease the PCV water level, the installation of the water level gauge and water intake equipment is being examined.
- To assess the quality of inclusive water in the Suppression Chamber (S/C) and the status of the S/C bottom more accurately, sampling of S/C inclusive water (including camera investigation of the S/C bottom) was conducted from the CUW pipe, a candidate in which the PCV water level gauge and water intake equipment would be installed, before installing this equipment.
- Within the investigative scope covered on camera, a brownish-looking deposit covered the surface of the S/C bottom, no abnormality was detected in the structure of the S/C bottom (such as any downcomer), nor was any paint removal detected in the structure inside the S/C.
- A visual inspection inside the CUW pipe did not reveal any abnormality that might affect the equipment (water level gauge and water intake equipment), for which the installation was examined.

- Relevant insights, such as investigative and sampling results, will be reflected in the planned examination on procedures to decrease the PCV water level and equipment design. Moreover, the insights will also be utilized to investigate the accident at 1F.

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

- Toward internal investigation and trial debris retrieval of the Unit 2 Primary Containment Vessel (PCV), the arm-type equipment will be inserted from X-6 penetration into the PCV to remove obstacles inside the PCV and conduct an internal investigation.
- Regarding the arm-type equipment, a mockup test simulating the site continues. It was confirmed that the equipment could cut and remove obstacles, but work is underway to improve the necessary control program and increase accuracy, assuming multiple kinds and times of accesses.
- Regarding X-6 penetration, cleaning of the X-6 penetration flange surface was completed before removing the deposit. Toward future deposit removal inside X-6 penetration, installation of the equipment and related work is underway.
- Before commencing trial retrieval in around the 2nd half of FY2023, based on the status of deposit removal inside the X-6 penetration and the test of the robot arm, work will proceed appropriately.

➢ Analytical results of smear of Units 1/2 SGTS pipes removal (part 1) and dose investigation

- In May 2022, the inside of the Unit 2 SGTS pipe was wiped (using smear filter paper) and samples were collected and analyzed at JAEA.
- In the analytical results of the γ-ray nuclide, Cs-137 and -134 were detected but no other nuclides. SEM-EDS observation showed that iron was the main component, and no fission products other than cesium or characteristic fuel-derived components were detected.
- To confirm the impact on surrounding areas during the gamma-camera measurement and examine the radiation protection measures for future work, for the Units 1/2 SGTS pipes temporarily stored on the Unit 1 Turbine Building roof and the Unit 1 Control Building roof, the dose inside the SGTS pipes was investigated using a remotely operated robot (Spot).
- After measuring the pipe dose and gamma camera, the pipes were split into small portions to conduct investigations and assist in the accident analysis. The pipes were then shredded and stored in the solid waste storage.

➢ Results of measurement and analysis of stagnant gas inside Unit 3 S/C

- For the Unit 3 S/C, nitrogen was not enclosed after the earthquake. It is assumed that in addition to the stagnant gas generated at the time of the accident, hydrogen gas generated by water radiolysis remained inside the S/C.
- Stagnant gas inside the S/C, including hydrogen, is considered stable due to sealing by PCV-retained water inside the S/C, but the risk of purging from the S/C, leading to hydrogen combustion, will be reduced to improve nuclear safety.
- Concentrations were measured (hydrogen, oxygen and hydrogen sulfide) and gas was sampled and analyzed (Kr-85) using the gas purge equipment. The results showed the following breakdown of stagnant gas inside the S/C: hydrogen approx. 75%, oxygen approx. 1%, hydrogen sulfide over scale and krypton 85 approx. 1.46×10^{4}Bq/cm^{3}.
- Based on the measurement and analytical results of the stagnant gas detecting krypton 85, it is assumed that gas generated at the time of the accident remained within the S/C. The results will be utilized in the accident investigation.
- In the following phase, after additional measures are implemented to further reduce worker exposure, a purge will commence while confirming the impact on the PCV, followed by a maximum purge that is confirmed to have no impact on the PCV.

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 October 2023, the total storage volume for concrete and metal rubble was approx. 393,600 m³ (+1,000 m³ compared to the end of September with an area-occupation rate of 77%). The total storage volume of trimmed trees was approx. 92,100 m³ (-1,300 m³, with an area-occupation rate of 52%). The total storage volume of used protective clothing was approx. 22,500 m³ (+1,000 m³, with an area-occupation rate of 89%). The total storage volume of radioactive solid waste (incinerated ash and others) was approx. 38,200 m³ (a slight increase, with an area-occupation rate of 60%). The increase in rubble was attributable to decontamination of flanged tanks.

➢ Management status of secondary waste from water treatment

- As of November 2, 2023, the total storage volume of waste sludge was 427 m³ (area-occupation rate: 61%), while that of concentrated waste fluid was 9,473 m³ (area-occupation rate: 92%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment and others, was 5,662 (area-occupation rate: 87%).

➢ Report on sampling test of adsorbent for the actual cesium adsorption vessel

- To examine the treatment and disposal policy of solid waste in 1F, the attributes of solid waste are being determined.
- Among water treatment secondary waste, samples have not been taken from adsorption vessels of the cesium-adsorption apparatus (KURION) and the secondary cesium-adsorption apparatus (SARRY) due to high radioactivity.
- In response, to develop the technology to sample adsorbent from the spent adsorption vessel, sampling equipment was developed and a verification test for sampling from actual adsorption equipment was conducted within the 1F site.
- The sampling equipment was built in the high-performance multi-nuclide removal equipment building in 1F and operated remotely.
- For SARRY 1st-3rd vessels and KURION 1st-4th vessels, a series of work comprising drilling, sampling and closure was completed and the developed sampling equipment was evaluated to satisfy the prescribed sampling conditions. Among the SARRY adsorption vessels, the filling height of some vessels was low enough to be outside the scope of this sampling. Developing appropriate methods in response will be part of future work.
- The container storing the adsorbent samples was stored in the transportation cask and transferred to the attributes determination project of JAEA. At present, preparation for analysis commenced at the attribute determination project.

Reactor cooling

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

➢ Results of the test to strengthen the Unit 1 PCV confinement function (flash report)

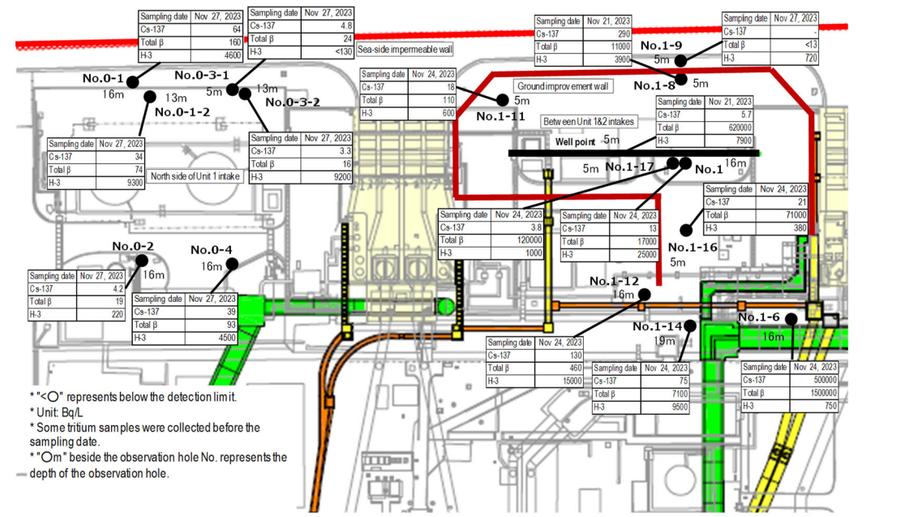
- Regarding the Primary Containment Vessel (PCV), to prevent a hydrogen explosion caused by hydrogen generated by the radiation decomposition of water and stagnant hydrogen at the time of the accident, the inactive state is maintained by injecting nitrogen. Nitrogen injection also prevents oxygen inflow from damaged parts of the PCV and suppresses corrosion inside the PCV.
- In the Unit 1 PCV internal investigation conducted in 2022 and 2023, damage was detected in the pedestal, which underpinned the Reactor Pressure Vessel (RPV). It was evaluated that even if the RPV was to lean or sink, causing radioactive dust to stir up inside the PCV, this would not pose any significant radiation exposure risk to the surrounding public. However, countermeasures are being examined to prepare for circumstances where stirring of radioactive dust inside the PCV is assumed (during work necessary to proceed with decontamination such as fuel debris retrieval (normal time) and at the time of abnormal occurrences attributable to earthquakes).
- From November 1, a test was conducted to check the PCV state and impact on the monitoring equipment when the PCV supply and exhaust flow rate was changed and nitrogen injection was suspended.
- The results of this test showed the following:
  - When the PCV supply and exhaust flow rate was changed, the PCV was able to maintain negative pressure.
  - Even when the nitrogen exhaust flow rate was less than supply, the PCV also became negative pressure.
  - When the supply and exhaust flow rate balance changed, some PCV/RPV temperatures fluctuated, and relatively high temperature increases were observed locally.
  - When nitrogen injection was suspended, the concentration of oxygen increased significantly.
- After reverting to a normal operational state and confirming the stability of the parameters, the test was concluded on November 28.

Reduction in radiation dose and mitigation of contamination

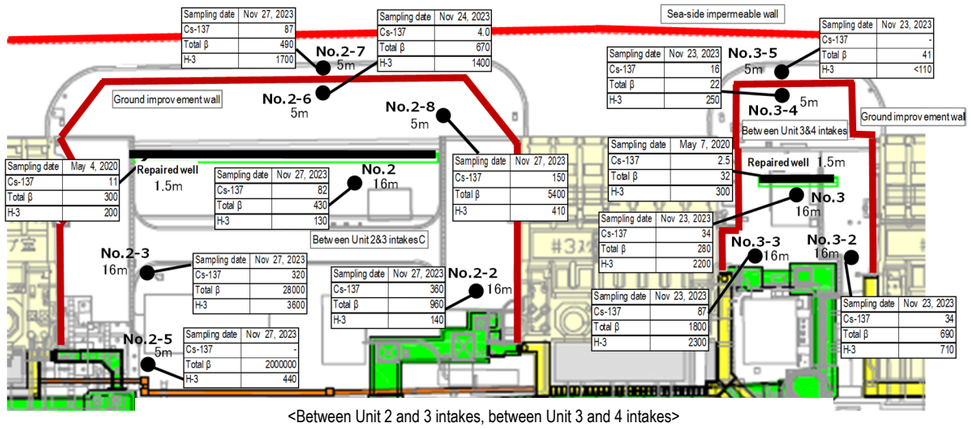
Effective dose-reduction at site boundaries and purification of port water to mitigate the impact of radiation on the external environment

➢ 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, 0-3-1, 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, 1-16 and 1-17 but has otherwise remained constant or been declining overall. The concentration of total β radioactive materials has remained constant overall but has 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 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 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 has been increasing or fluctuating 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 many observation holes, including 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 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. It has remained low, despite increasing in concentrations of cesium and total β radioactive materials 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 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 has 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, concentration of tritium increased at the sampling point near the discharge outlet, but the increase was considered as 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

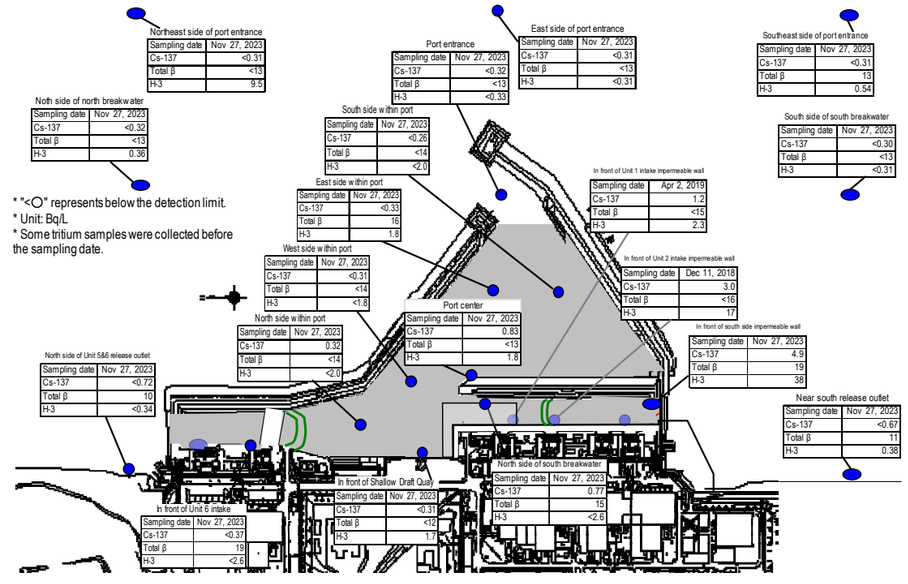


Figure 5: Seawater concentration around the port

➢ Progress status of countermeasures for fish in the port

- Work to re-cover the seabed within the open intake channel of Units 1-4 commenced from October 16 and sand covering to suppress stirring of sedimentary layer is currently underway, to complete the re-covering within the 1st half of FY2024. Mesh refinement of the fish transfer prevention net (5 cm → 2 cm square) at the open channel outlet was completed on September 1.
- Permanent placement (replacement) of the fish transfer prevention net at the east breakwater commenced from July 26 and work to install the jig is currently underway to install the highly durable net to the steel pipe pile. In the initial plan, the scheduled operational launch was within FY2023 and work was scheduled for completion in around March 2024, but based on the progress to date, the latest process would be completed in around February 2024.
- Work continues for early completion while keeping weather, marine meteorology and other factors in mind and prioritizing safety.

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 2023 was approx. 9,300 (cooperating company workers and TEPCO HD employees), which exceeded the monthly average workforce (approx. 7,600). 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 2023 (approx. 4,300 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 4,600.
- The number of workers from within Fukushima Prefecture remained constant and outside, slightly increased. The local employment ratio (cooperating company workers and TEPCO HD employees) as of October 2023 remained constant at around 70%.
- The average exposure doses of workers were approx. 2.60, 2.51 and 2.16 mSv/person-year during FY2020, 2021 and 2022, 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 remained sufficiently within the limit and allowed them to continue engaging in radiation work.

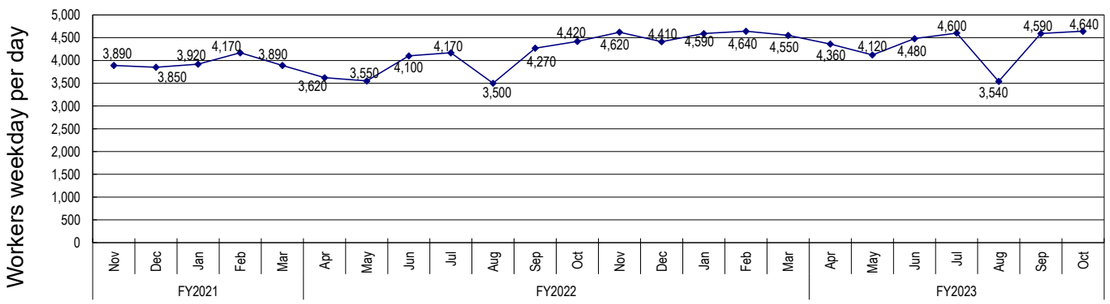


Figure 6: Changes in the average number of workers weekday per day for each month of the most

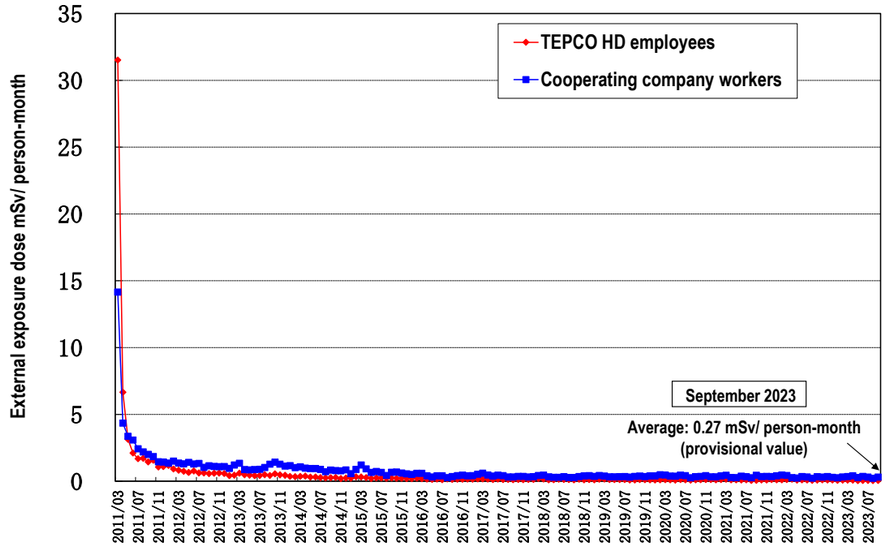


Figure 7: Changes in monthly average exposure dose of individual worker
(monthly exposure dose since March 2011)

➢ Status of heat stroke cases

- In FY2023, measures to further prevent heat stroke commenced from April to October to cope with the hottest season.
- FY2023, seven workers suffered heat stroke due to work up until November 27 (in FY2022, ten workers up until the end of November). Continued measures will be taken to prevent heat stroke.
- This fiscal year, in addition to the FY2022 measures, efforts were enhanced including heat acclimatization and setting breaks by managing actual work time for “workers wearing full-face masks,” “workers at heat stroke risk [medical history (heat stroke, diabetes, pretension and others)” and “those who have no experience of working in the Fukushima Daiichi Nuclear Power Station in summer (April-October in the previous year).” As a result, three heat stroke cases decreased from the total in FY2022.
- In F2024, as well as ongoing measures from this fiscal year, the necessary prevention measures will be reviewed based on the factors and characteristics of heat stroke occurrence in FY2023 to further improve the work environment.

➢ Countermeasures for infectious diseases

- Countermeasures for various infectious diseases (influenza, norovirus, COVID-19, 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.
- As in 2022, to prevent the spread of influenza infections and serious infections, a vaccination program of influenza has been implemented since October for TEPCO HD employees and cooperating company workers in the Fukushima Daiichi Nuclear Power Station who wish to be vaccinated.

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

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.

Summary of TEPCO data as of November 28, 2023

Cesium-134	:	ND(0.39)		
Cesium-137	:	0.83		
Total β	:	ND(13)		
Toritium	:	2.4		*1

Cesium-134	:	3.3	(H25/12/24)	→ ND(0.29)	Below 1/10
Cesium-137	:	7.3	(H25/10/11)	→ ND(0.32)	Below 1/20
Total β	:	69	(H25/8/19)	→ ND(13)	Below 1/5
Toritium	:	68	(H25/8/19)	→ 1.4	Below 1/40

Cesium-134	:	3.3	(H25/10/17)	→ ND(0.30)	Below 1/10
Cesium-137	:	9	(H25/10/17)	→ ND(0.33)	Below 1/20
Total β	:	74	(H25/8/19)	→ 16	Below 1/4
Toritium	:	67	(H25/8/19)	→ –	

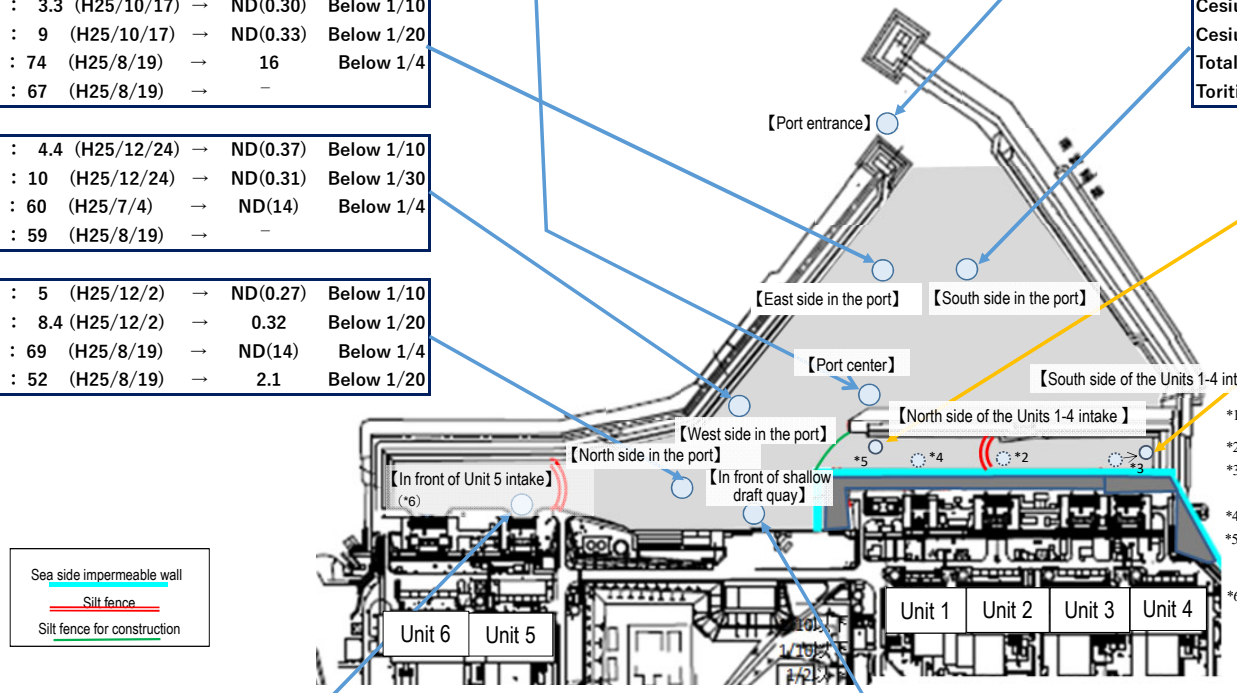
Cesium-134	:	3.5	(H25/10/17)	→ ND(0.38)	Below 1/9
Cesium-137	:	7.8	(H25/10/17)	→ ND(0.26)	Below 1/30
Total β	:	79	(H25/8/19)	→ ND(14)	Below 1/5
Toritium	:	60	(H25/8/19)	→ –	

Cesium-134	:	4.4	(H25/12/24)	→ ND(0.37)	Below 1/10
Cesium-137	:	10	(H25/12/24)	→ ND(0.31)	Below 1/30
Total β	:	60	(H25/7/4)	→ ND(14)	Below 1/4
Toritium	:	59	(H25/8/19)	→ –	

Cesium-134	:	32	(H25/10/11)	→ ND(0.34)	Below 1/90
Cesium-137	:	73	(H25/10/11)	→ 0.77	Below 1/90
Total β	:	320	(H25/8/12)	→ 15	Below 1/20
Toritium	:	510	(H25/9/2)	→ 6.6	Below 1/70

Cesium-134	:	5	(H25/12/2)	→ ND(0.27)	Below 1/10
Cesium-137	:	8.4	(H25/12/2)	→ 0.32	Below 1/20
Total β	:	69	(H25/8/19)	→ ND(14)	Below 1/4
Toritium	:	52	(H25/8/19)	→ 2.1	Below 1/20

Cesium-134	:	ND(0.26)
Cesium-137	:	4.9
Total β	:	19
Toritium	:	33 *1



Cesium-134	:	2.8	(H25/12/2)	→ ND(0.33)	Below 1/8
Cesium-137	:	5.8	(H25/12/2)	→ ND(0.37)	Below 1/10
Total β	:	46	(H25/8/19)	→ 19	Below 1/2
Toritium	:	24	(H25/8/19)	→ –	

Cesium-134	:	5.3	(H25/8/5)	→ ND(0.30)	Below 1/10
Cesium-137	:	8.6	(H25/8/5)	→ ND(0.31)	Below 1/20
Total β	:	40	(H25/7/3)	→ ND(12)	Below 1/3
Toritium	:	340	(H25/6/26)	→ 2.2	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/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 16-27)

Summary of TEPCO data as of November 28, 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

【Northeast 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)	→	ND(13)	
Toritium	: ND	(H25)	→	0.71	

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

Cesium-134	: ND	(H25)	→	ND(0.31)	
Cesium-137	: 1.6	(H25/10/18)	→	ND(0.31)	Below 1/2
Total β	: ND	(H25)	→	ND(13)	
Toritium	: 6.4	(H25/10/18)	→	0.40	Below 1/10

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

Cesium-134	: ND	(H25)	→	ND(0.22)	
Cesium-137	: ND	(H25)	→	ND(0.31)	
Total β	: ND	(H25)	→	13	
Toritium	: ND	(H25)	→	ND(0.33)	

Cesium-134	: ND	(H25)	→	ND(0.27)	
Cesium-137	: ND	(H25)	→	ND(0.32)	
Total β	: ND	(H25)	→	ND(13)	
Toritium	: 4.7	(H25/8/18)	→	1.3	Below 1/3

【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(0.32)	Below 1/20
Total β	: 69	(H25/8/19)	→	ND(13)	Below 1/5
Toritium	: 68	(H25/8/19)	→	1.4	Below 1/40

【Port entrance】

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

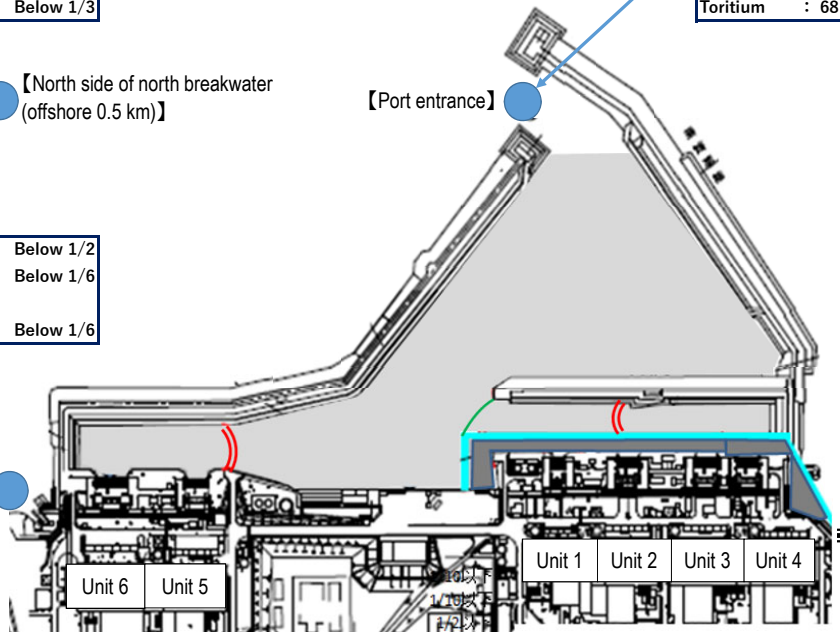
Cesium-134	: ND	(H25)	→	ND(0.30)	
Cesium-137	: ND	(H25)	→	ND(0.30)	
Total β	: ND	(H25)	→	ND(13)	
Toritium	: ND	(H25)	→	1.0	

Cesium-134	: 1.8	(H25/6/21)	→	ND(0.80)	Below 1/2
Cesium-137	: 4.5	(H25/3/17)	→	ND(0.72)	Below 1/6
Total β	: 12	(H25/12/23)	→	10	
Toritium	: 8.6	(H25/6/26)	→	1.3	Below 1/6

【North side of Unit 5 and 6 release outlet】

Cesium-134	: ND	(H25)	→	ND(0.69)	
Cesium-137	: 3	(H25/7/15)	→	ND(0.67)	Below 1/4
Total β	: 15	(H25/12/23)	→	11	
Toritium	: 1.9	(H25/11/25)	→	0.80	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.

*: 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.

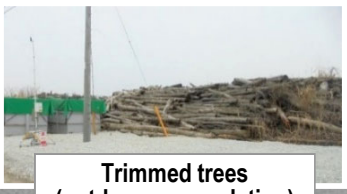
Source: TEPCO website, Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station http://www.tepco.co.jp/decommision/planaction/monitoring/index-j.html

Appendix 2

November 30, 2023

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 (covered by sheet)

Solid waste storage facility

Covered by sheet (container storage)

Spent adsorption vessel temporary storage facility

Temporary waste sludge storage

Tank installation status

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.
- [Completed] Contaminated water in Reactor Buildings was reduced to about a half of the level at the end of 2020 (FY2022-FY2024)

November 30, 2023
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 2024

Contaminated water management [Remove]

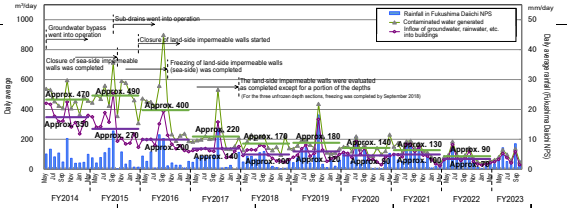
Contaminated water treatment facility
- ▽Reception start of contaminated water to Central Waste Treatment Building
- ▽Decontamination equipment (AREVA)
- ▽Evaporative concentration equipment
- ▽Cesium Adsorption Apparatus (KURION)
- ▽2nd Cesium Adsorption Apparatus (SARRY)
- Cesium Adsorption Apparatus (KURION)
- ▽Treatment of RO-condensed salt water complete
- ▽Purification of strontium-reduced water in flanged tanks complete
- ▽Purification of strontium-reduced 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)
- ▽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)


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
- 【Removal of contaminated water in seawater pipe trench】
- ▽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)
- 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)


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
- Although no influence was detected on the impermeable function of the land-side impermeable walls but test investigation is underway for the stoppage effect
- ▽Installation start of land-side impermeable walls
- Start of maintenance operation on east side▽
- **▽Freezing start**
- **▽Freezing completion (except for some parts)**


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
- ▽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)
- ▽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

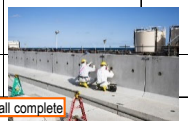

Flanged and welded-joint tanks

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**
- **▽Reduction of contaminated 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 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
- ▽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 Units 1 and 2 T/B complete
- ▽Work for common pool 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


Chishima Trench Tsunami Seawall complete

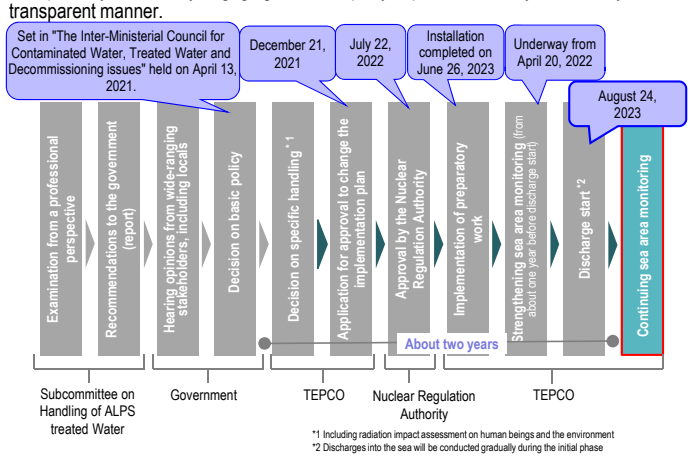

Construction of Japan Trench Tsunami Seawall

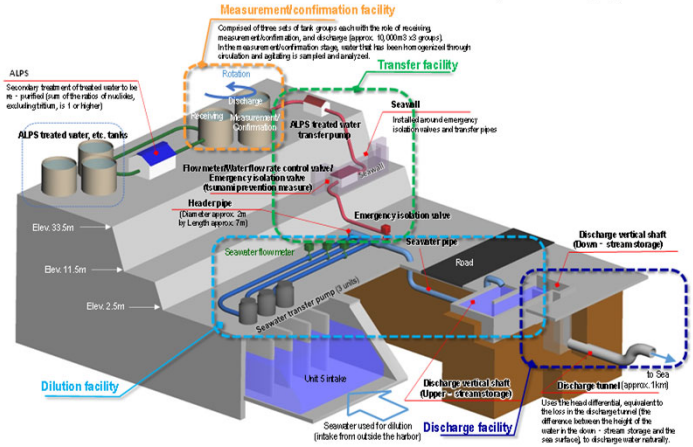
Mega float
- ▽Start of marine construction
- Temporary grounding of mega float▽
- ▽Internal filling complete (reduction of tsunami risks)

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.





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.

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

● Status of discharge of ALPS treated water into the sea

On August 22, 2023, as the 1st phase of the 1st discharge of ALPS treated water, a small amount of ALPS treated water (approx. 1 m3) was diluted with seawater (approx. 1,200 m3), and to confirm that ALPS treated water was diluted as assumed, diluted ALPS treated water was stored in the discharge shaft (upstream pool) and sampled.

On August 24, regarding tritium concentration of diluted ALPS treated water, it was confirmed the analytical value was within the range of uncertainty of calculated concentration and below 1,500 Bq/L. Subsequently, discharge of ALPS treated water into the sea commenced from the same day (August 24) and the 1st discharge was completed on September 11.

From October 5, 2023, discharge of ALPS treated water from Tank Group C of the measurement / confirmation facility into the sea (2nd discharge) commenced.

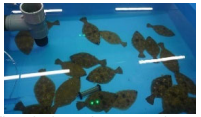
The 2nd discharge was conducted safely as planned while confirming that the discharge satisfied the national government's requirement and was completed on October 23. During the discharge period, no abnormality was detected by the sea area monitoring conducted by the national government, Fukushima Prefecture and TEPCO.

Tank group discharged	Tank Group B	Tank Group C
Tritium concentration	140,000 Bq/L	140,000 Bq/L
Discharge commencement	August 24, 2023	October 5, 2023
Discharge termination	September 11, 2023	October 23, 2023
Discharge amount	7,788 m^3	7,810 m^3
Total tritium amount	1.1 trillion Bq	1.1 trillion Bq

Operation by duty staff (Tank Group B, 2nd phase)

● 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.



Flounder in rearing preparation tank

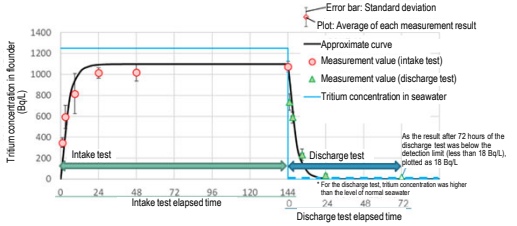
Overall view of mockup tanks

● Measurement of tritium concentration of flounder (tritium concentration less than 1,500 Bq/L) and analysis of results

Based on the measurement results of tritium concentration, the following was confirmed as in the past insight:

[Intake test]
- The tritium concentration did not exceed the level in the growing environment (in this test, the concentration exceeding the level in ALPS treated water diluted with seawater)
- The tritium concentration reached equilibrium in a certain period

[Discharge test]
- When flounder having reached equilibrium in the tritium concentration higher than the level of normal seawater is returned to normal seawater, the concentration decreased over time



- 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.

Sampling of ALPS treated water in the presence of the IAEA

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 30, 2023
Secretariat of the Team for Countermeasures for Decommissioning, Contaminated Water and Treated Water

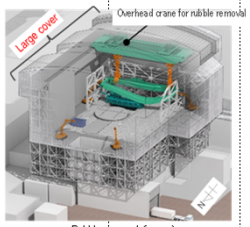
Legend: Rubble removal, etc. | Installing a fuel removal machine | Fuel removal | Storage and handling of fuel

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

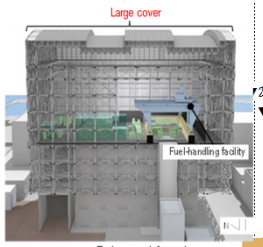
Unit 1

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)

▼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

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.

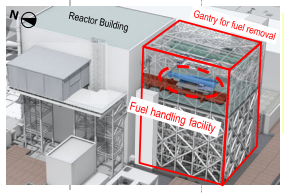

<Unit 1 northwest side 2023.2.9>

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)



▼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
▼2020.6 Investigation inside the spent fuel pool
▼2023.1 Start of steel erection
▼2023.2 Start of south-side existing facilities dismantling

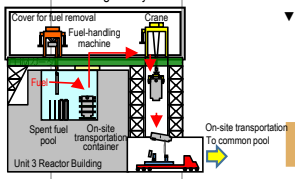

<Unit 2 Construction of gantry for fuel removal>

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.

Unit 3

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

Overview of the fuel-handling facility inside the cover



▼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)

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.

<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)

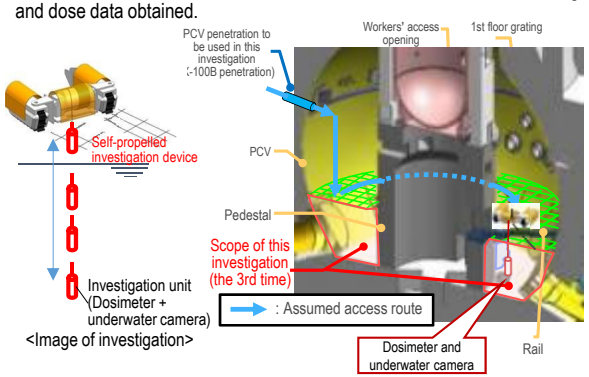
Start of fuel debris retrieval from the first unit (Unit 2). Expanding the scale in stages (within 2021 * The schedule will be extended for about 1 year due to the spread of COVID-19 infections)

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

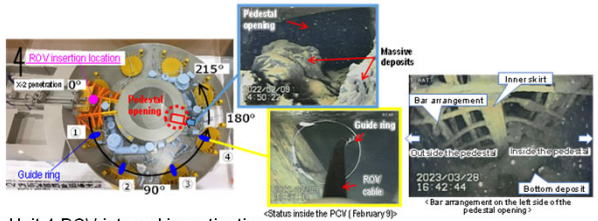
・In April 2015, a device having entered the inside of the PCV via a narrow opening (bore:φ100 mm) collected information such as images and airborne dose inside the PCV 1st floor.

・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 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.



<Status inside the PCV (February 9)>
<Bar arrangement on the left side of the pedestal opening>

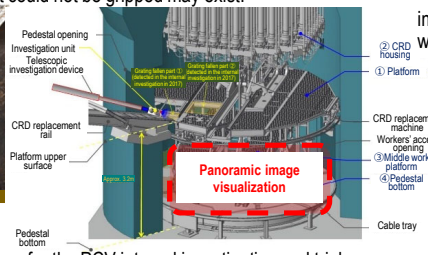
Unit 2 Investigation overview

・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.

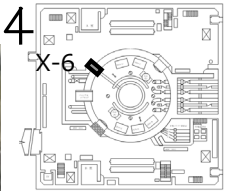

Bottom of the pedestal (after being processed in panoramic image visualization)



・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

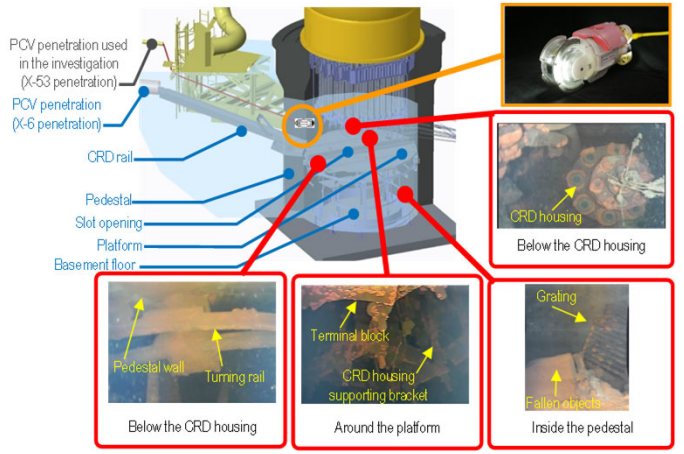
・In October 2014, the conditions of X-53 penetration, which may be under water and which is scheduled for use to investigate the inside of the PCV, was investigated via remote-controlled ultrasonic test equipment. The results showed that the penetration was not under water.

・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

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

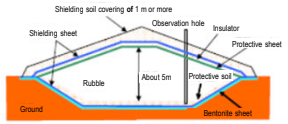
▼ 2012.9 Transfer start of rubble to the soil-covered temporary storage facility

▼ 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

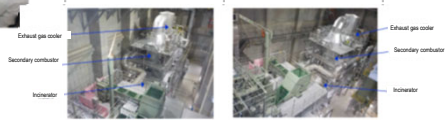
▼ 2016.3 Operation start

▲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)

2017.10 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

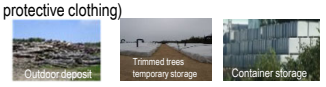
Site of Volume Reduction Faciility

Present status Note

Storage of rubble and others

Present storage Approx.540,000 m³ (as of 2022.3)

Rubble (combustible), trimmed trees, used protective clothing)



Contaminated soil (0.005 - 1 mSv/h)

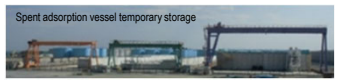
Rubble (metal, concrete, others)

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.**810,000** m³

(*2)

Approx. 360,000 m³
Approx. 70,000 m³
Approx. 60,000 m³
Approx. 130,000 m³
Approx. 180,000 m³
Approx. 7,100 tanks

Status after a decade

(*3) Legend : Newly installed equipment and facility

Approx. **270,000** m³ (*2)

Incineration

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


Crusher example

Radioactive Waste Incinerator

Additional Radioactive Waste Incinerator (Completion in May 2022)

To (A) (*1)

Volume reduction

Compaction Facility (scheduled for completion in FY2022)


Concrete crusher example


Metal cutter example

To (A) (*1)

Melting

Melting equipment (under consideration)


Electric furnace example

To (B)

Stored and managed in Solid Waste Storage as done for rubble

Treatment measures and others will be examined

(A) (*1)
(B)

Approx. 20,000 m³
Approx. 70,000 m³
Approx. 70,000 m³
Approx. 60,000 m³
Approx. 50,000 m³

Storage /management

Solid Waste Storage (Storage capacity: approx. 250,000 m³)

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

Additional Solid Waste Storage 10th-11th (Scheduled for completion after FY2024)

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 FY2023)
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.

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

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.

Large rest house under construction (2014.9.30)

▼ 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.

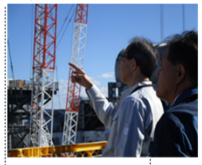
▼ A large rest house for workers was established and its operation commenced in May 2015.
Spaces in the large rest house are also installed for office work and collective worker safety checks as well as taking rest.
In March 2016, a convenience store opened in the large rest house. In April, the shower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

Access Control Facility (2014.11.7)

▼ 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.



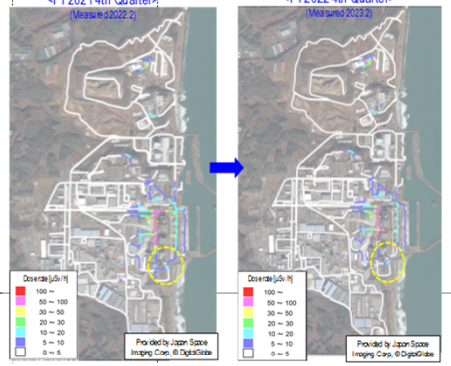
Visit by Governor of Fukushima Prefecture to the Fukushima Daiichi NPS (2018.11.1)

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 6side

<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 near the southeast side of the Unit 4 Turbine Building and the west side of the Process Main Building (area circled by yellow dot line).

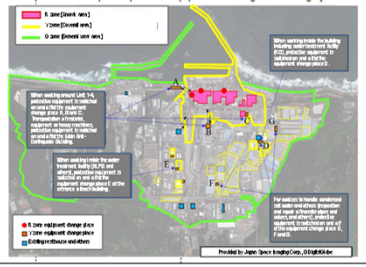
<FY2021 4th Quarter> (Measured 2022.2)
<FY2022 4th Quarter> (Measured 2023.2)



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

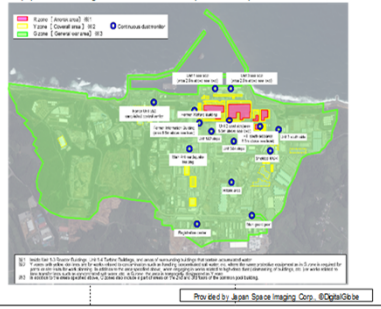
▼ In May 2015, full-face mask unnecessary area was expanded to cover about 90% of the site.

▼ 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)