

## Main decommissioning work and steps

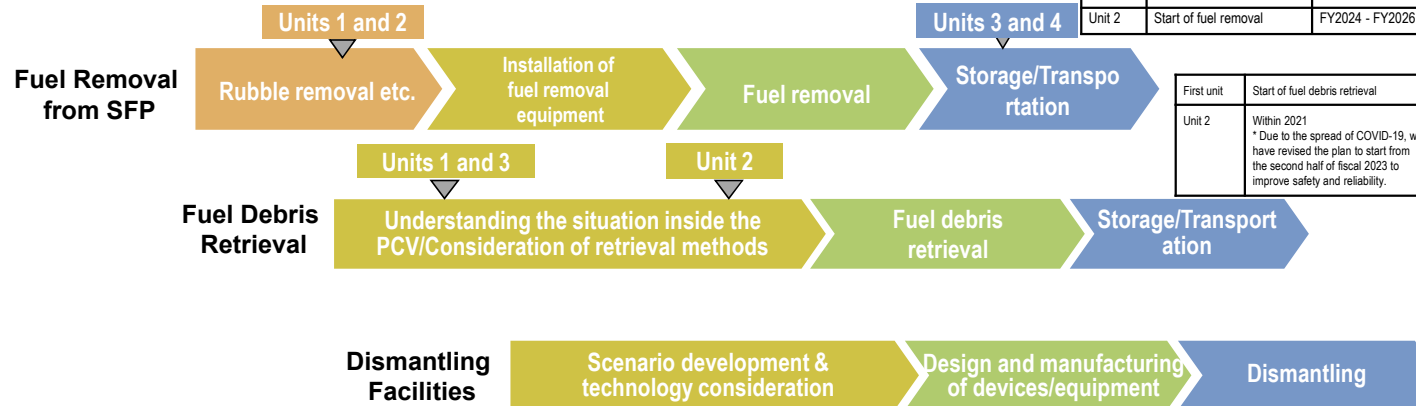
Fuel removal from the spent fuel pool was completed in December 2014 at Unit 4 and on February 28, 2021 at Unit 3.  
Work continues sequentially toward the start of fuel removal from Units 1 and 2 and debris (Note 1) retrieval from Units 1-3.

(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

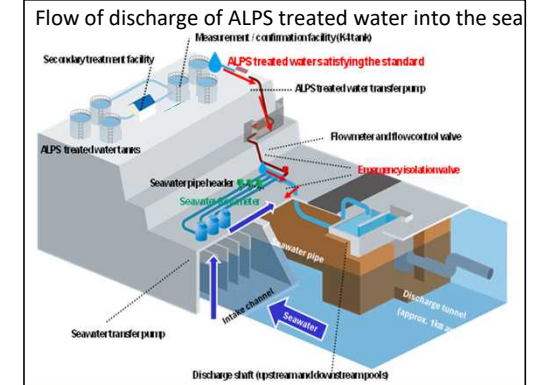
First unit	Start of fuel debris retrieval
Unit 2	Within 2021 * Due to the spread of COVID-19, we have revised the plan to start from the second half of fiscal 2023 to improve safety and reliability.



## 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.



## Contaminated water management - triple-pronged efforts -

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

- "Remove" the source of water contamination
- "Redirect" fresh water from contaminated areas
- "Retain" contaminated water from leakage

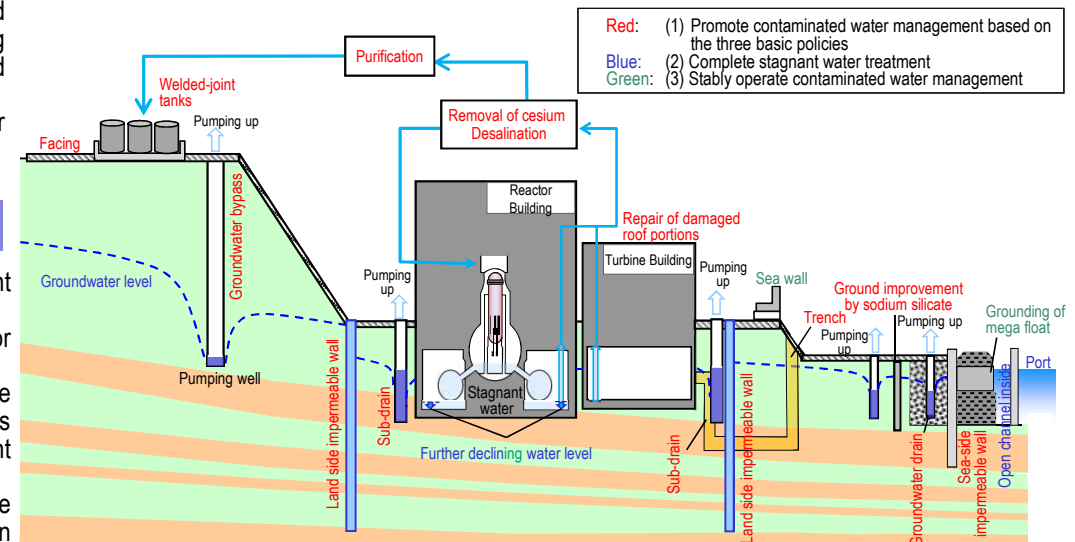
- Strontium-reduced water from other equipment is being re-treated in the Advanced Liquid Processing System (ALPS: multi-nuclide removal equipment) and stored in welded-joint tanks.
- Multi-layered contaminated water management measures, including land-side impermeable walls and sub-drains, have stabilized 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<sup>3</sup>/day (in May 2014) to approx. 90 m<sup>3</sup>/day (in FY2022).
- Measures continue to further suppress the generation of contaminated water to 100 m<sup>3</sup>/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<sup>3</sup>)

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 >)

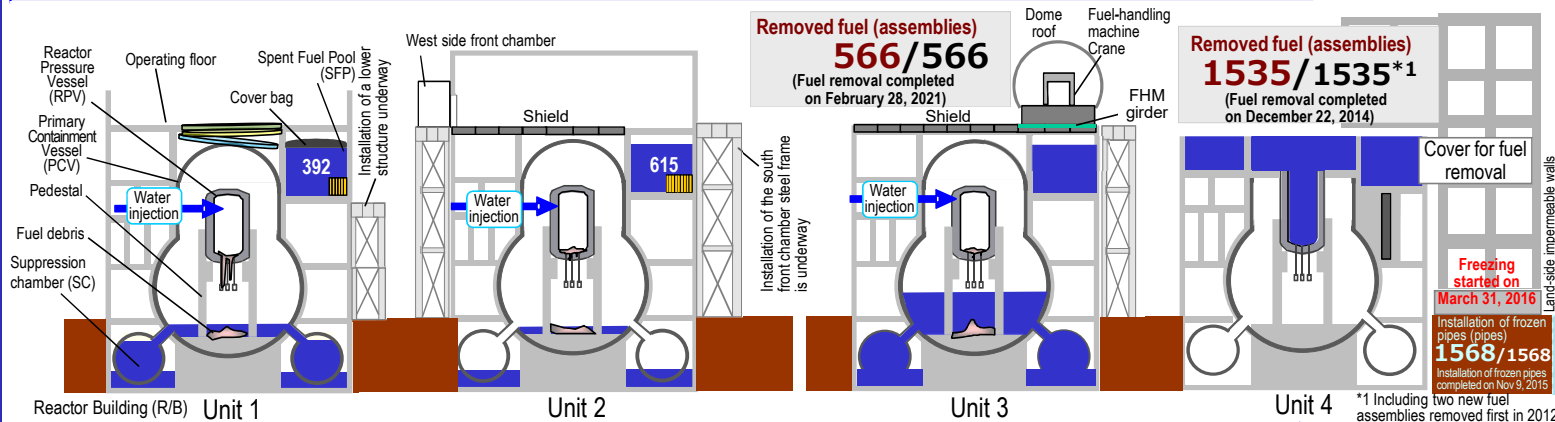
Measurement status	Requirement satisfaction
Attributes of the treated water from Tank Group A (Concentration of the 29 types of radionuclides within the measurement / evaluation scope and regulatory requirements) [TEPCO] (Sampled on July 30)	○
IAEA (ALPS treated water after dilution, published on November 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.



### 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)

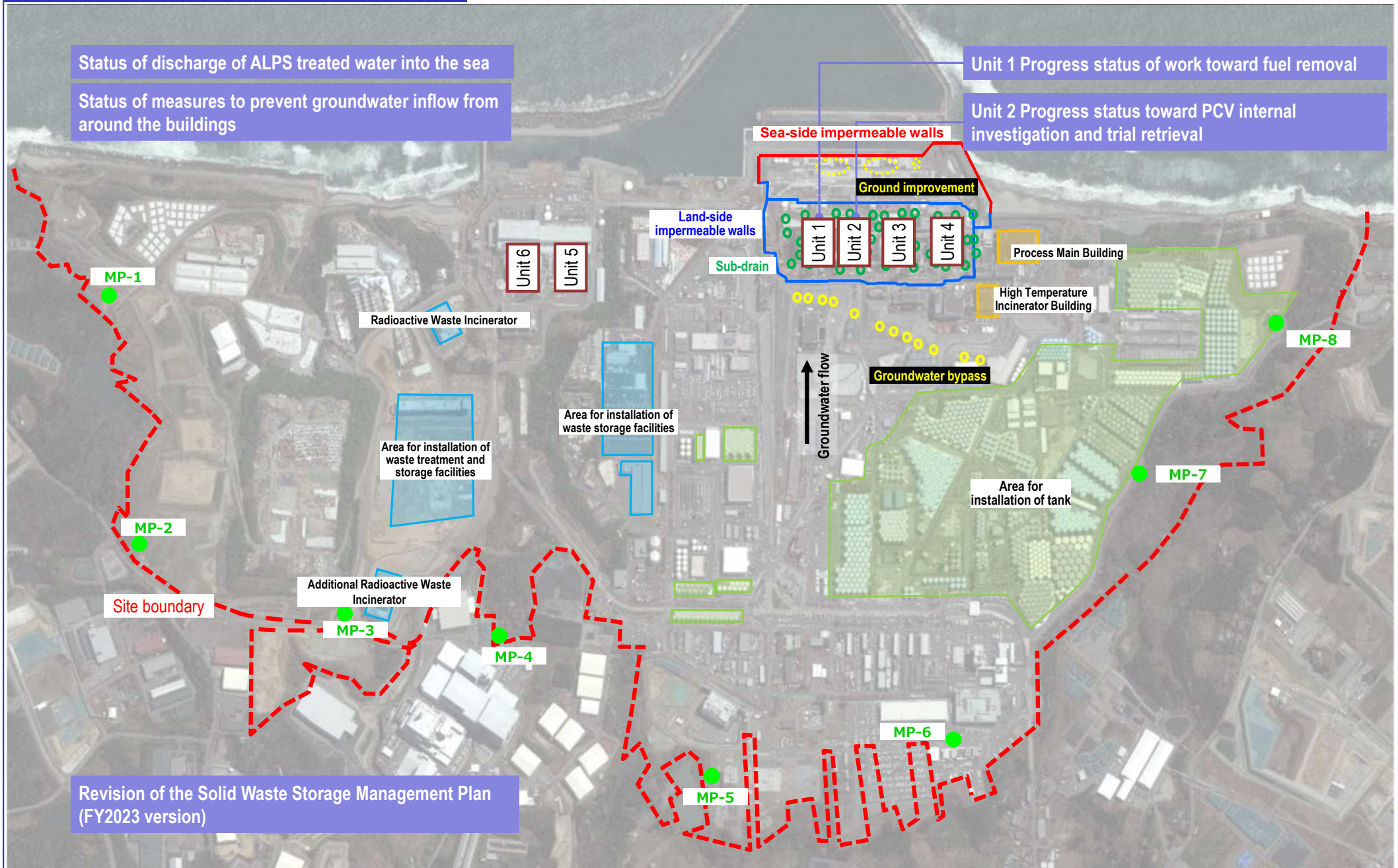
Regarding the Solid Waste Storage Management Plan, which was formulated based on the Mid-and-Long-Term Roadmap, the seventh revision was issued, in which for "rubble and others" and "water treatment secondary waste," amount to be generated in about next ten years was estimated based on the actual generation 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<sup>3</sup>, after volume reduction: approx. 290,000m<sup>3</sup>).

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

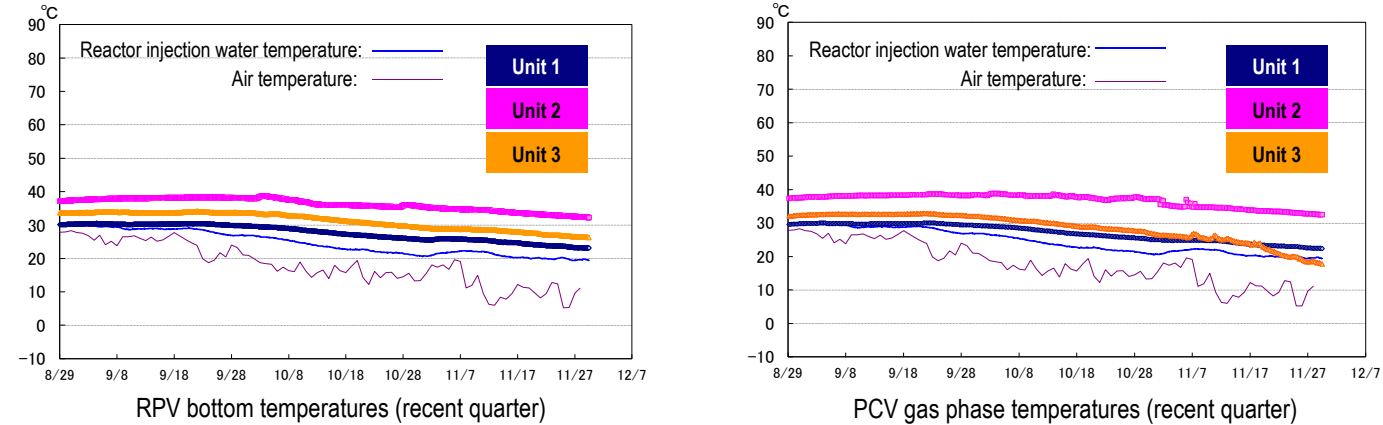


Provided by Japan Space Imaging Corp., photo taken on April 8, 2021  
Product (C) [2020] DigitalGlobe, Inc., a Maxar company

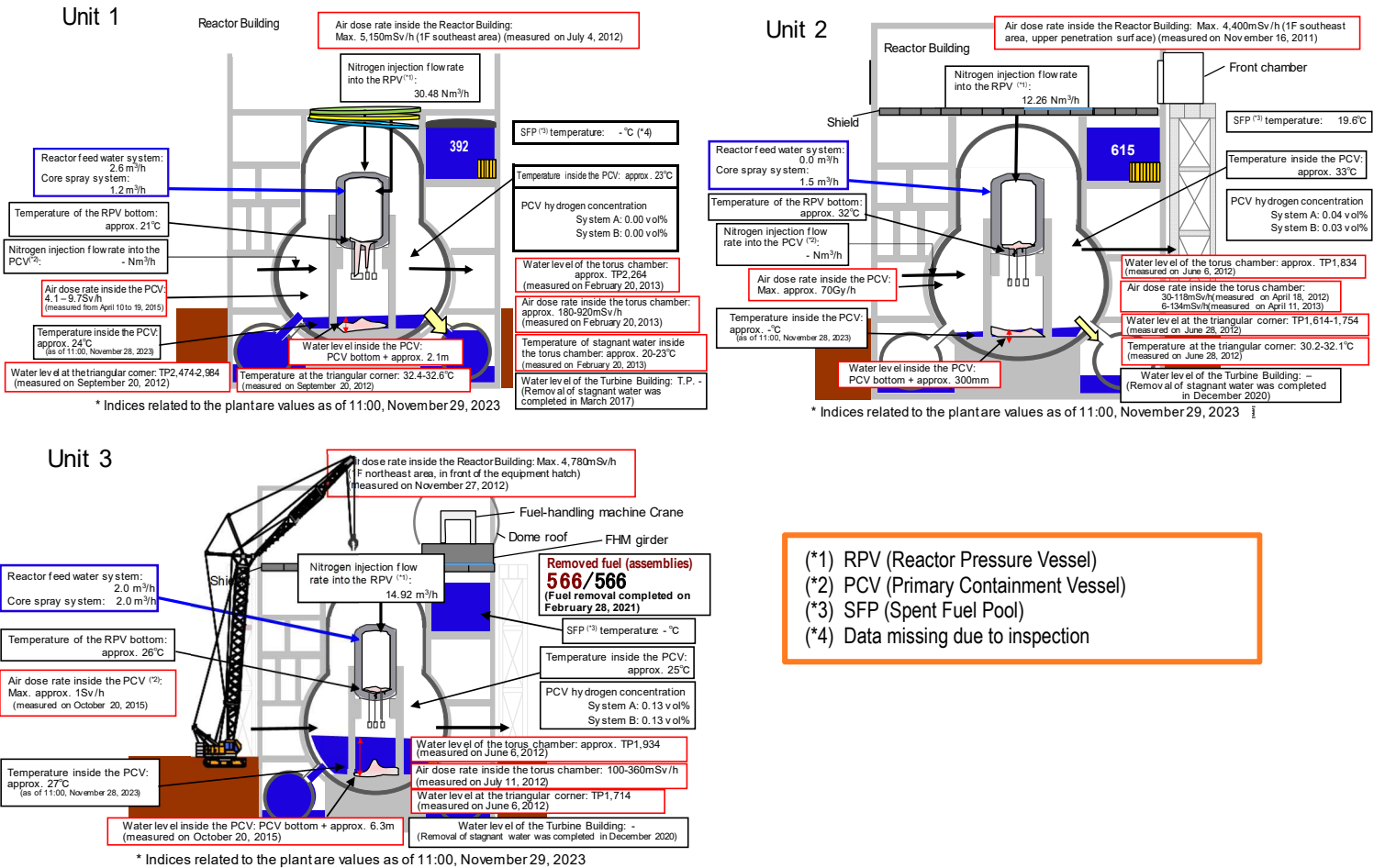
## I. Confirmation of the reactor conditions

### 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.



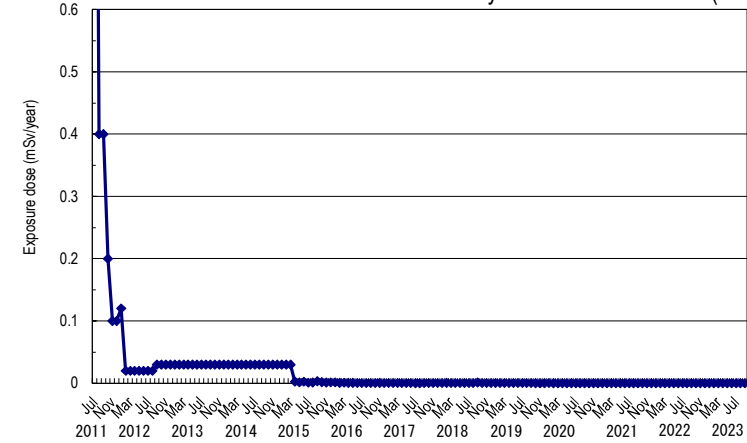
\*1 The trend graphs show part of the temperature data measured at multiple points.  
\*2 A part of data could not be measured due to maintenance and inspection of the facility and other work.



### 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.  $2.3 \times 10^{-12}$  Bq/cm<sup>3</sup> and  $1.7 \times 10^{-12}$  Bq/cm<sup>3</sup> 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]:  $2 \times 10^{-5}$  Bq/cm<sup>3</sup>  
[Cs-137]:  $3 \times 10^{-5}$  Bq/cm<sup>3</sup>  
\* 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.

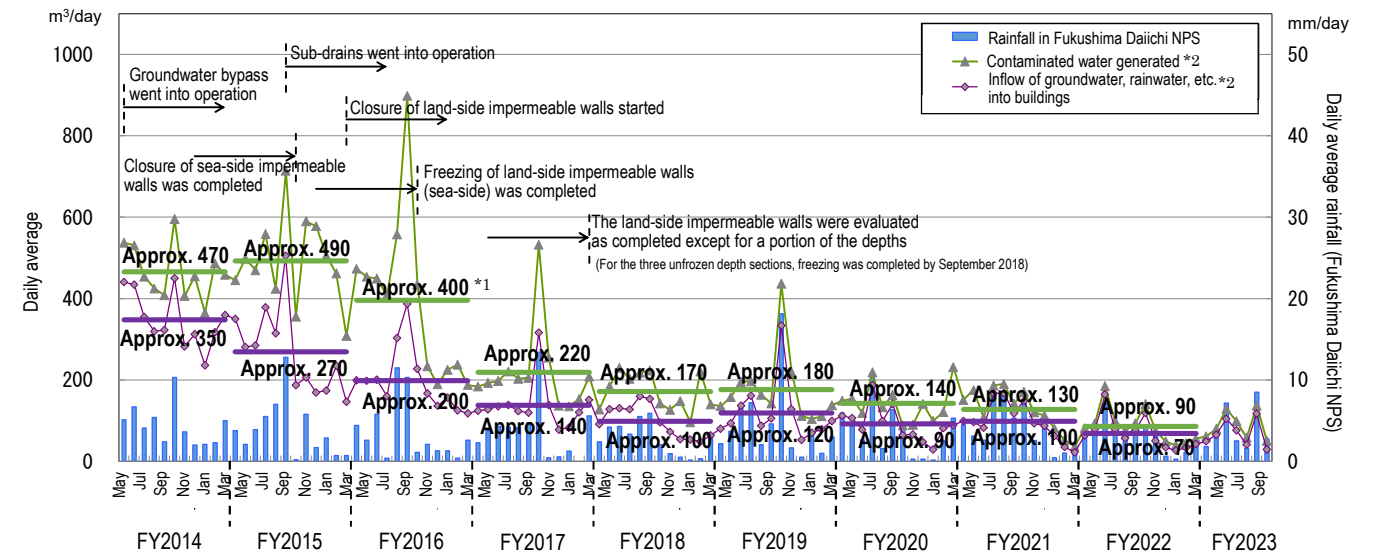
Based on the above, it was confirmed that the comprehensive cold shutdown condition had been maintained and the reactors remained in a stabilized condition.

## 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 m<sup>3</sup>/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.

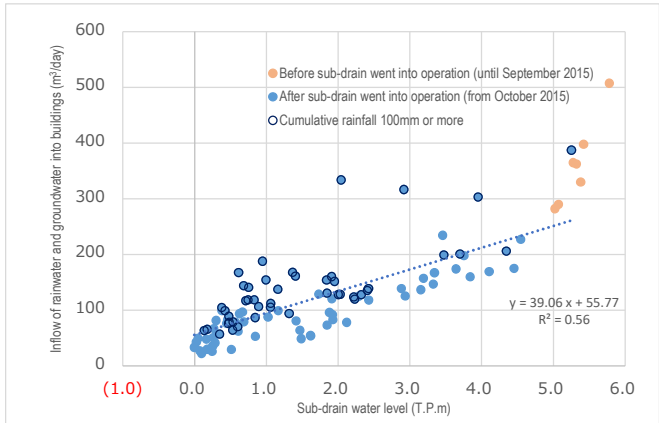


Figure 2: Correlation between inflow such as groundwater and rainwater into buildings and the water level of Units 1-4 sub-drains

- Implementation status of facing
- Facing is a measure that involves asphaltting 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.

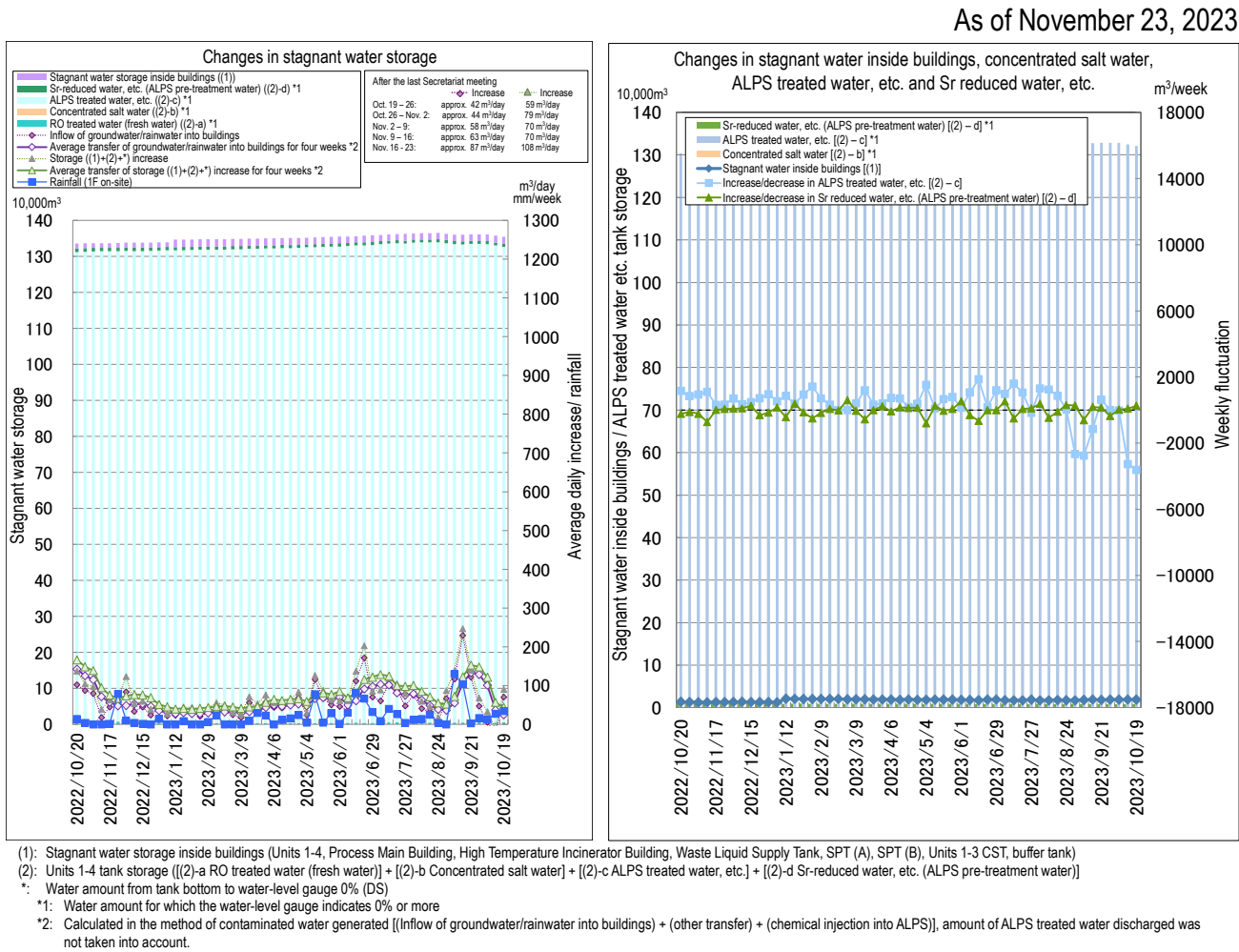


Figure 3: Status of stagnant water storage

- 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)	<ul style="list-style-type: none"><li>Sum of the ratios to regulatory concentrations (excluding tritium): less than 1</li><li>1 million Bq/L</li></ul>	<ul style="list-style-type: none"><li>0.25</li><li>130,000 Bq/L</li></ul>	<div>○</div> <div>○</div>
[IAEA] Tritium concentrations in seawater (ALPS treated water after dilution, published on November 2)	<ul style="list-style-type: none"><li>Less than 1,500 Bq/L</li></ul>	<ul style="list-style-type: none"><li>Less than 1,500 Bq/L</li></ul>	<div>○</div>
[TEPCO] Tritium concentrations in water in discharge vertical shaft and seawater pipe upstream of discharge vertical shaft (ALPS treated water after dilution)	<ul style="list-style-type: none"><li>Less than 1,500 Bq/L</li></ul>	<ul style="list-style-type: none"><li>Less than 1,500Bq/L</li></ul>	<div>○</div>
[TEPCO] tritium concentrations in seawater (Results of sea area monitoring at 10 points within 3 km from the Power Station)	<ul style="list-style-type: none"><li>Discharge suspension level: 700 Bq/L or less</li><li>Investigation level: 350 Bq/L or less</li></ul>	<ul style="list-style-type: none"><li>700 Bq/L or less</li><li>350 Bq/L or less</li></ul>	<div>○</div> <div>○</div>
[Ministry of the Environment] Tritium concentrations in seawater (11 points off the coast of Fukushima Prefecture)	<ul style="list-style-type: none"><li>National safety requirement: 60,000 Bq/L</li><li>WHO drinking water guidelines: 10,000 Bq/L</li></ul>	<ul style="list-style-type: none"><li>Below the lower detection limit (less than 7-8 Bq/L)</li></ul>	<div>○</div> <div>○</div>
[Fisheries Agency] Tritium concentrations in marine products (flounder and others)	-	<ul style="list-style-type: none"><li>Below the lower detection limit (less than 8.1 Bq/kg)</li></ul>	<div>○</div> <div>○</div>
[Fukushima Prefecture] Tritium concentrations in seawater (9 points off the coast of Fukushima Prefecture)	<ul style="list-style-type: none"><li>National safety requirement: 60,000 Bq/L</li><li>WHO drinking water guidelines: 10,000 Bq/L</li></ul>	<ul style="list-style-type: none"><li>Below the lower detection limit (less than 3.6-3.9 Bq/L)</li></ul>	<div>○</div> <div>○</div>

- 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<sup>3</sup> 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](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  $\gamma$ -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.  $1.46 \times 10^4 \text{ Bq/cm}^3$ .
- 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 m<sup>3</sup> (+1,000 m<sup>3</sup> compared to the end of September with an area-occupation rate of 77%). The total storage volume of trimmed

trees was approx. 92,100 m<sup>3</sup> (-1,300 m<sup>3</sup>, with an area-occupation rate of 52%). The total storage volume of used protective clothing was approx. 22,500 m<sup>3</sup> (+1,000 m<sup>3</sup>, with an area-occupation rate of 89%). The total storage volume of radioactive solid waste (incinerated ash and others) was approx. 38,200 m<sup>3</sup> (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 m<sup>3</sup> (area-occupation rate: 61%), while that of concentrated waste fluid was 9,473 m<sup>3</sup> (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  $\beta$  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  $\beta$  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  $\beta$  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  $\beta$  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  $\beta$  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  $\beta$  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.

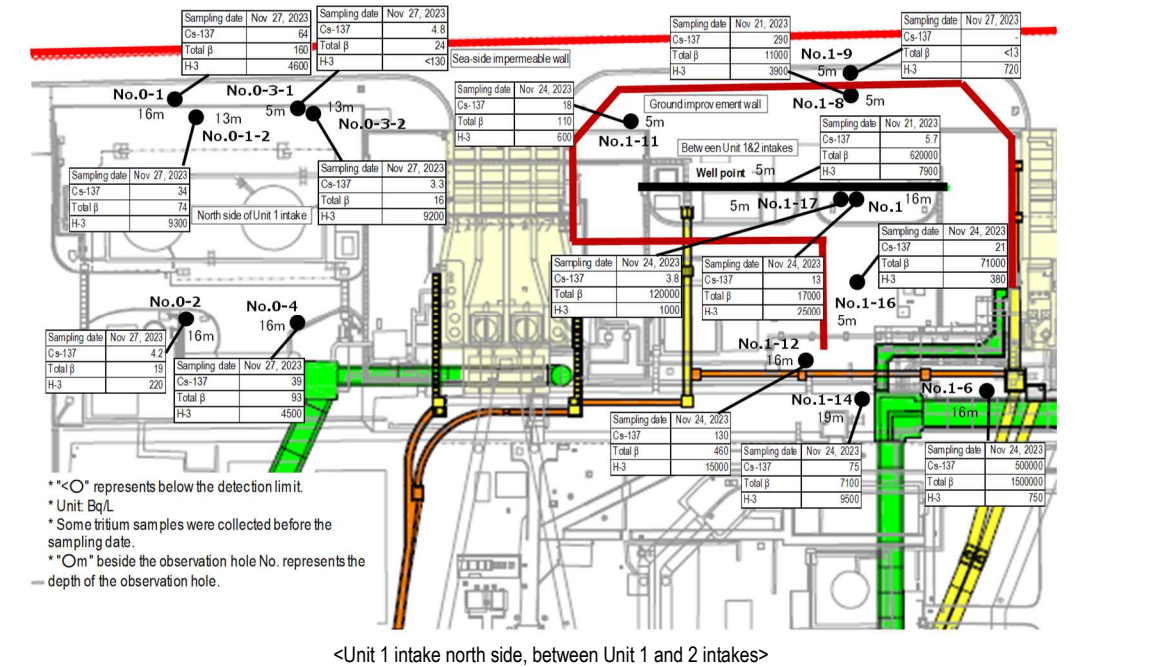


Figure 4: Groundwater concentration on the Turbine Building east side

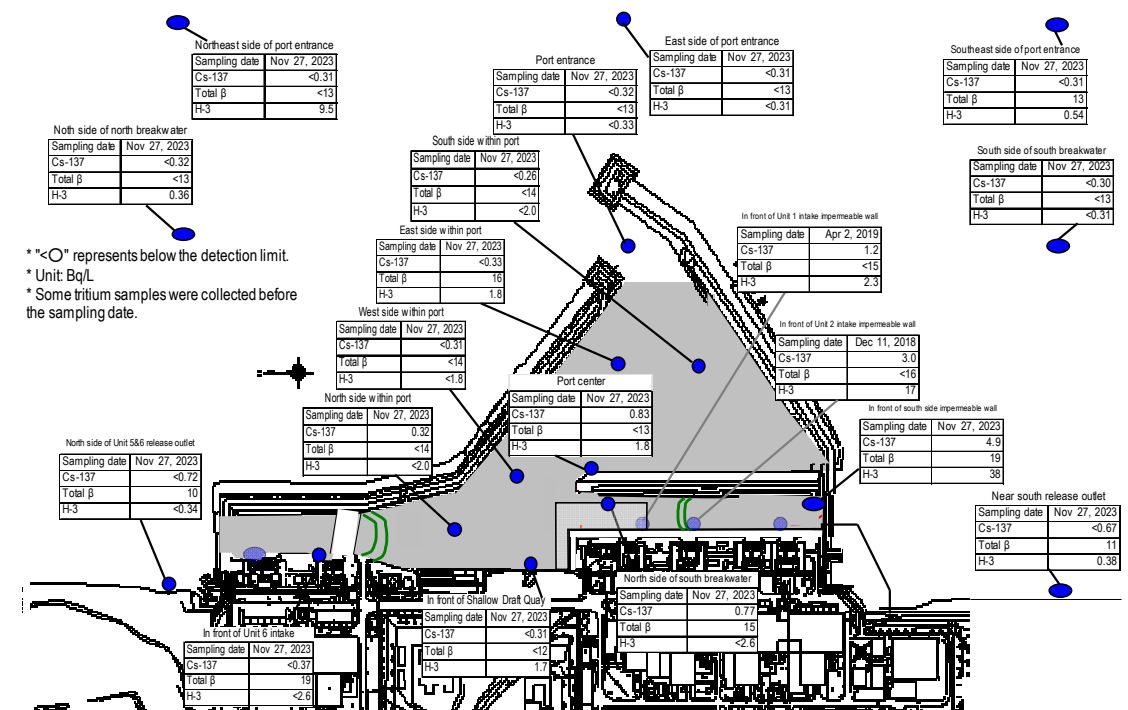


Figure 5: Seawater concentration around the port



- 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.

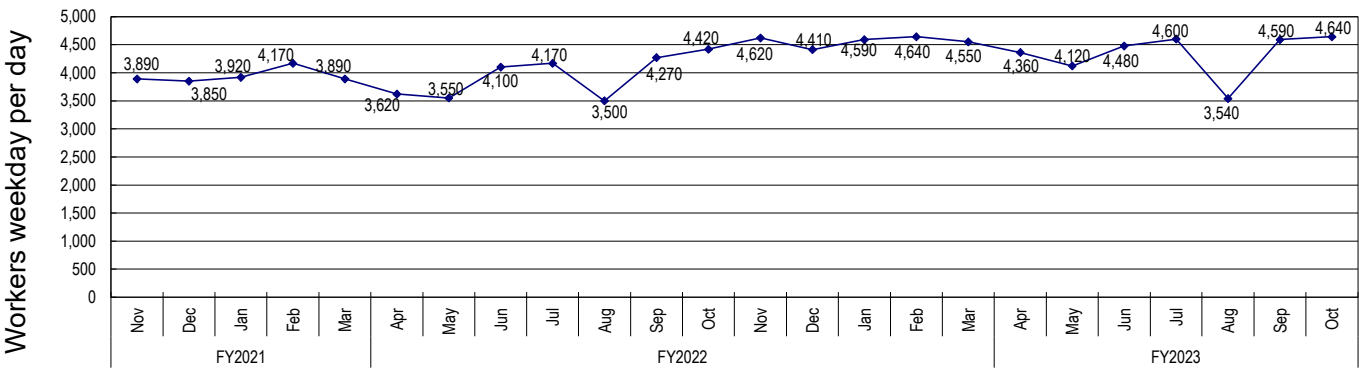


Figure 6: Changes in the average number of workers weekday per day for each month of the most

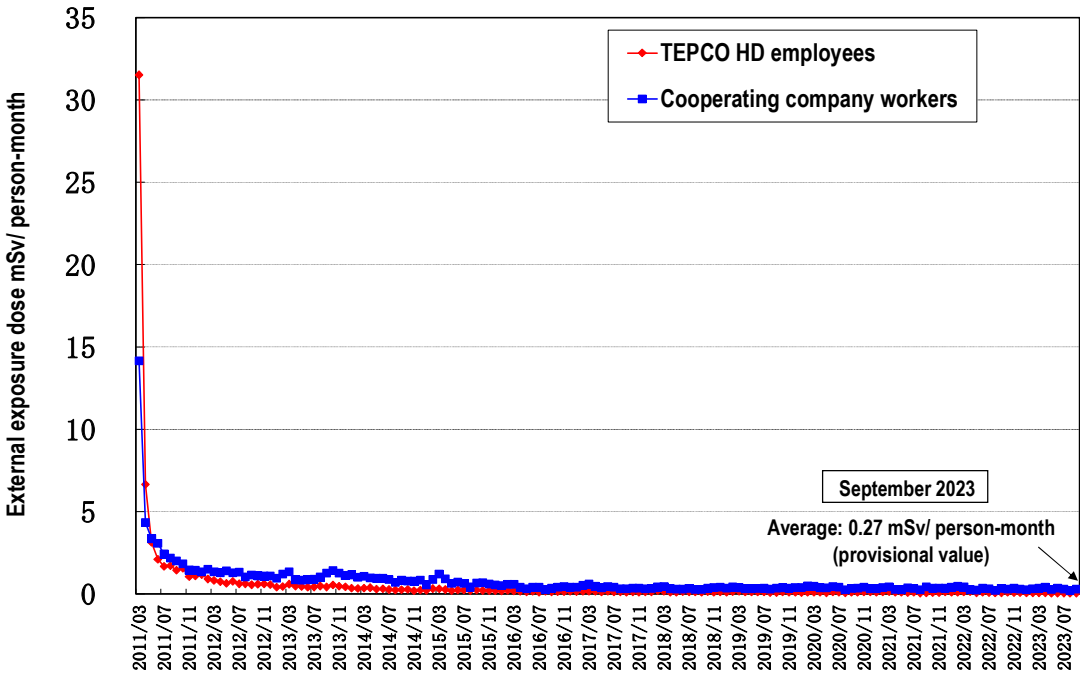


Figure 7: Changes in monthly average exposure dose of individual worker (monthly exposure dose since March 2011)

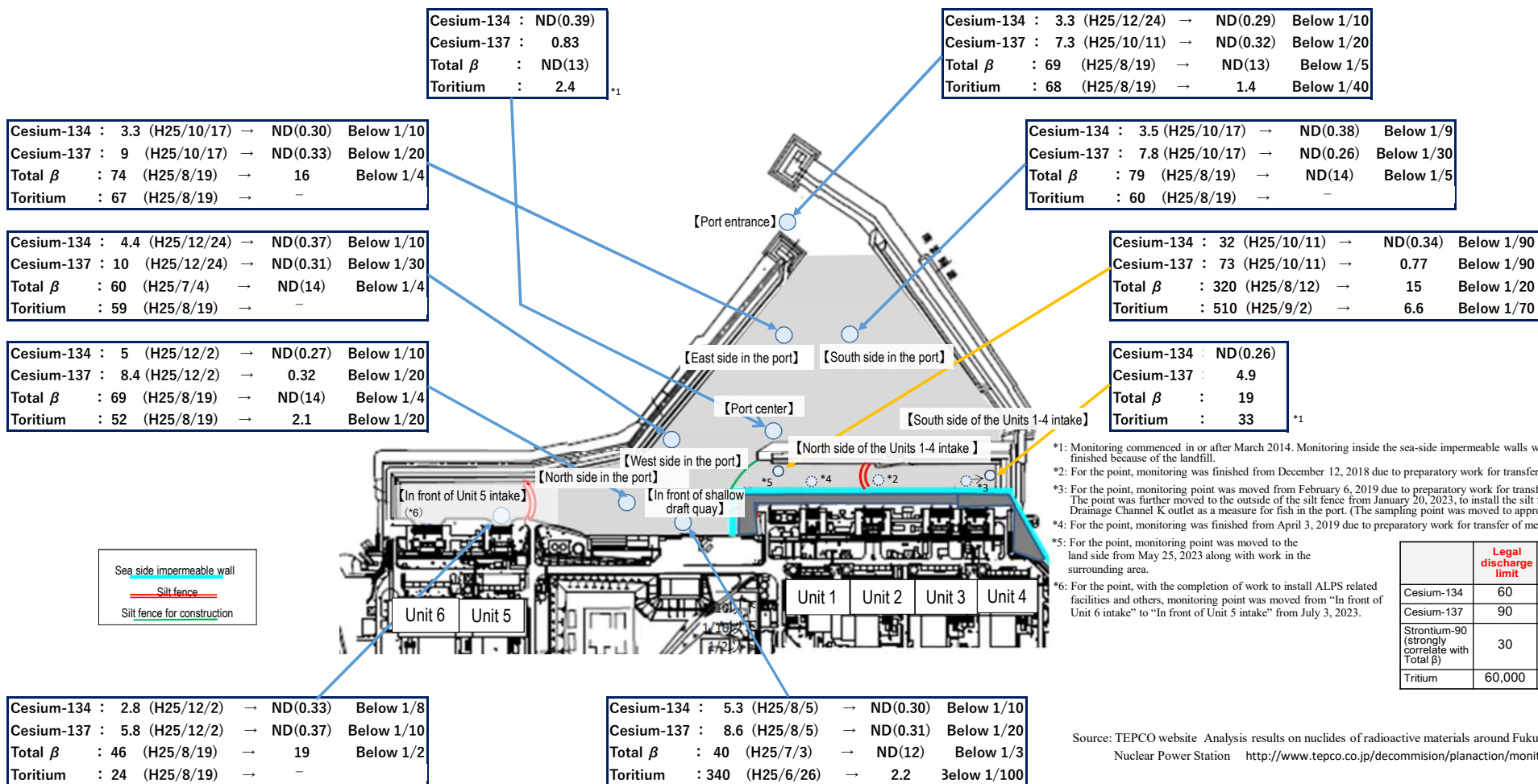
- Status of heat stroke cases
  - In FY2023, measures to further prevent heat stroke commenced from April to October to cope with the hottest season.
  - FY2023, seven workers suffered heat stroke due to work up until November 27 (in FY2022, ten workers up until the end of November). Continued measures 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  $\beta$  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





## 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)
Tritium	: 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)
Tritium	: 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
Tritium	: 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)
Tritium	: 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
Tritium	: 68 (H25/8/19)	→	1.4 Below 1/40

【Port entrance】

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

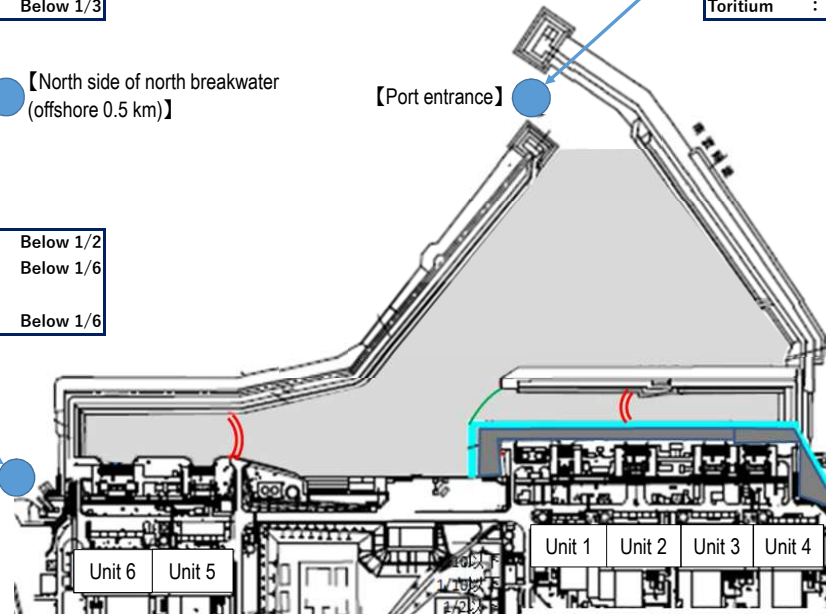
Cesium-134	: ND (H25)	→	ND(0.30)
Cesium-137	: ND (H25)	→	ND(0.30)
Total β	: ND (H25)	→	ND(13)
Tritium	: ND (H25)	→	1.0

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
Tritium	: 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
Tritium	: 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.

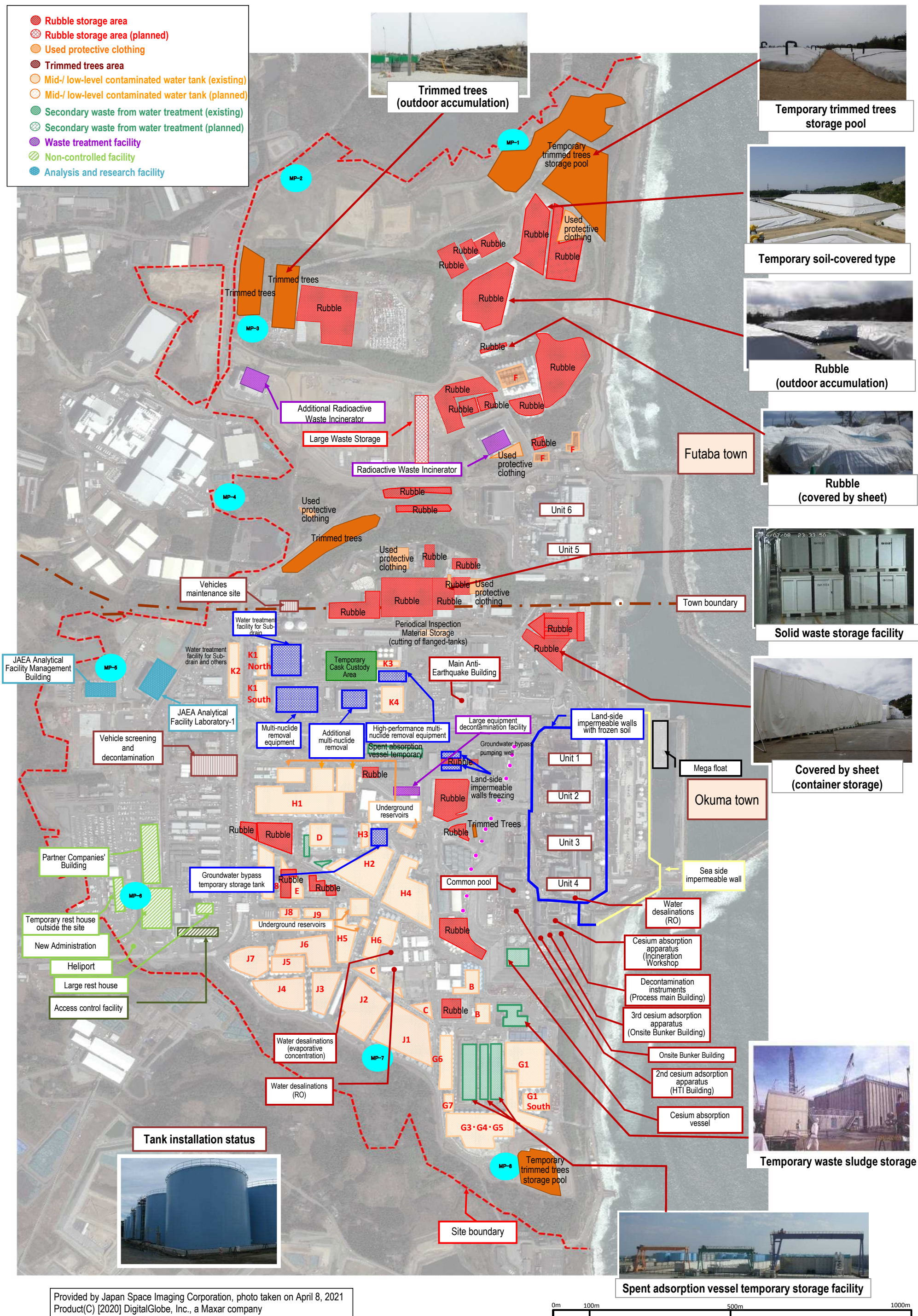
\*: Because safety of the sampling points was unassured due to the influence of Typhoon No. 10 in 2016, samples were taken from approx. 330 m south of the Unit 1-4 release outlet. Samples were also taken from a point approx. 280m south from the same release outlet from January 27, 2017 and approx. 320m 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/decommission/planaction/monitoring/index-j.html>



# TEPCO Holdings Fukushima Daiichi Nuclear Power Station Site Layout

Appendix 2  
November 30, 2023



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



## 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 m<sup>3</sup>/day or less (within 2020)
- Suppressing the amount of contaminated water generated to 100 m<sup>3</sup>/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)

Reference 1 / 6

November 30, 2023

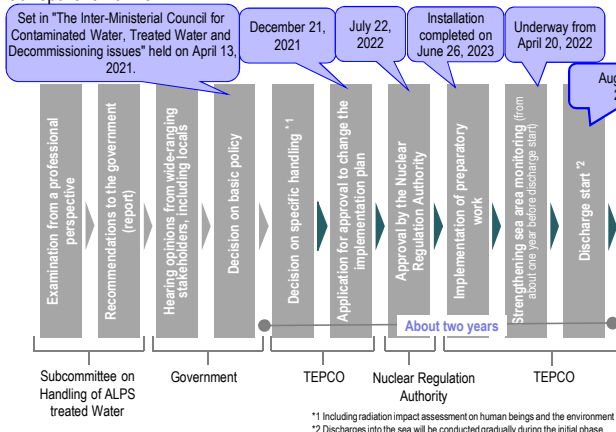
Secretariat of the Team for  
Countermeasures for Decommissioning,  
Contaminated Water and Treated Water

		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 ▽ Reduction of strontium by Cesium Adsorption Apparatus (KURION) (from 2015.1.6) ▽ Reduction of strontium by 2nd Cesium Adsorption Apparatus (SARRY) (from 2014.12.26)				▽ Purification of strontium-reduced water in flanged tanks complete ▽ Purification of strontium-reduced water complete					
	Removal of contaminated water from seawater pipe trench	 Landing of the second Cesium Adsorption Apparatus (SARRY)		 Multi-nuclide removal equipment (ALPS)		▽ 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) ▽ Multi-nuclide Removal Equipment (high performance ALPS) (from 2014.10.18, hot tests conducted)		▽ Treatment start of strontium-reduced water (ALPS: from 2015.12.4, additional: from 2015.5.27, high-performance: from 2015.4.15) ▽ Start of full-scale operation (from 2017.10.16)			▽ Reduction of strontium by 3rd Cesium Adsorption Apparatus (SARRY II) (from 2019.7.12) ▽ Pre-service inspection started (2023.3.2)				
Contaminated water management (Redirect)	Groundwater bypass	 Installation start of groundwater bypass			▽ Operation start of groundwater bypass (drainage started from 2014.5.21)										
	Sub-drain	 Pumping well		▽ 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 m <sup>3</sup> /day)			▽ Enhancement of treatment capacity (2000 m <sup>3</sup> /day)						
	Land-side impermeable wall	 Land-side impermeable wall brine (refrigerant) circulation pipe		▽ Start of land-side impermeable walls		▽ Freezing start		▽ Start of maintenance operation on north and south sides ▽ Freezing completion ▽ Start of maintenance operation on east side		▽ Start of maintenance operation in all sections ▽ Freezing completion (except for some parts)		▽ In some temperature measurement tubes near the K drainage channel cross, temperature exceeded 0°C 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			
	Facing	 Sub-drain purification system				▽ Completion of waterproof pavement (icing) (except for areas of 2.5 and 6.5m above sea level and around Unit 1-4) ▽ Completion			 Placement of seaside impermeable walls complete		▽ Completion of waterproof pavement (icing) (except for around Unit 1-4)				
Contaminated water management (Retain)	Bank groundwater measures	High concentration of radioactive materials detected from observation well of bank ▽ Installation start of seaside impermeable walls		▽ Area 2.5m above sea level – Start of ground improvement by water glass ▽ Start of pumping of water from contaminated areas (well point)		▽ Installation of seaside impermeable walls complete ▽ Operation start of groundwater drain (pumping-up started on 2015.11.5)									
	Storage facility	▽ Storage in steel square tanks ▽ Storage in flanged cylindrical tanks ▽ Water leakage (10L) from flanged tank		▽ Water leakage (300L) from flanged tank ▽ Water leakage (100L) from flanged tank ▽ Completion of fence to prevent leakage expanding ▽ Work to raise fence height complete ▽ 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 ▽ Sprinkling start of rainwater within tank fences by rainwater treatment facility (from 2014.5.21)		▽ Completion of purification treatment of RO concentrated salt water ▽ Completion of replacement of steel square tanks Construction of welded-joint tanks		▽ Purification of strontium-reduced water in flanged tanks complete ▽ Transfer and storage of all treated water in welded-joint tanks ▽ Removal of steel horizontal tanks complete (except for condensed waste liquid)		 Flanged and welded-joint tanks		▽ Purification of strontium-reduced water complete			
Treatment of stagnant water		▽ Installation of stagnant water transfer equipment/transfer start		▽ Completion of work to improve reliability of transfer line (replacement with PE pipes)		▽ Start to maintain water-level difference with sub-drain water level ▽ Transfer start from each building to Central Rn Building		▽ Floor exposure of Unit 1 TB ▽ Separation of stagnant water between Units 3 and 4		▽ Separation of stagnant water between Units 1 and 2 ▽ Floor exposure of Unit 1 RB ▽ Floor exposure of Unit 2 TB, RB ▽ Floor exposure of Unit 3 TB, RB ▽ Floor exposure of Unit 4 RB, TB, RB		▽ Treatment of stagnant water in buildings complete ▽ Completed lowering to target water level of Unit 2 RB		▽ Reduction of contaminated water in the Reactor Buildings to approx. half of the level at the end of 2020 achieved ▽ Completed lowering to target water level of Unit 1, 3 RB	
				▽ Examination start of measures to close building openings ▽ Work for common pool complete ▽ Work for HTI building complete				 Work for Process Main Building complete Work for Unit 3 TB complete		Work for Unit 1-3 RB complete Work for Units 1-4 RB was completed					
Measures to tsunami	Closure of openings														
	Seawall	▽ Installation of outer-rise tsunami seawall complete								▽ Construction start of Chishima Trench Tsunami Seawall ▽ Completion of installation		Japan Trench tsunami seawall ▽ On-site start			
	Mega float								▽ Start of marine construction Temporary grounding of mega float		▽ Internal filling complete (reduction of tsunami risks)				
					 Chishima Trench Tsunami Seawall complete			 Construction of Japan Trench Tsunami Seawall							

## 2 Handling of ALPS treated water

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

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



### 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

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)

2023.6.26 Completion of installation  
2023.7.7 Receipt of Certificate of Completion for Pre-service Inspections

2023.7.7 Receipt of Certificate of Completion for Pre-service Inspections

### 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 m<sup>3</sup>) was diluted with seawater (approx. 1,200 m<sup>3</sup>), 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 <sup>3</sup>	7,810 m <sup>3</sup>
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 organisms 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.

2/6  
November 30, 2023  
Secretariat of the Team for Countermeasures for Decommissioning, Contaminated Water and Treated Water



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/breed/index/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



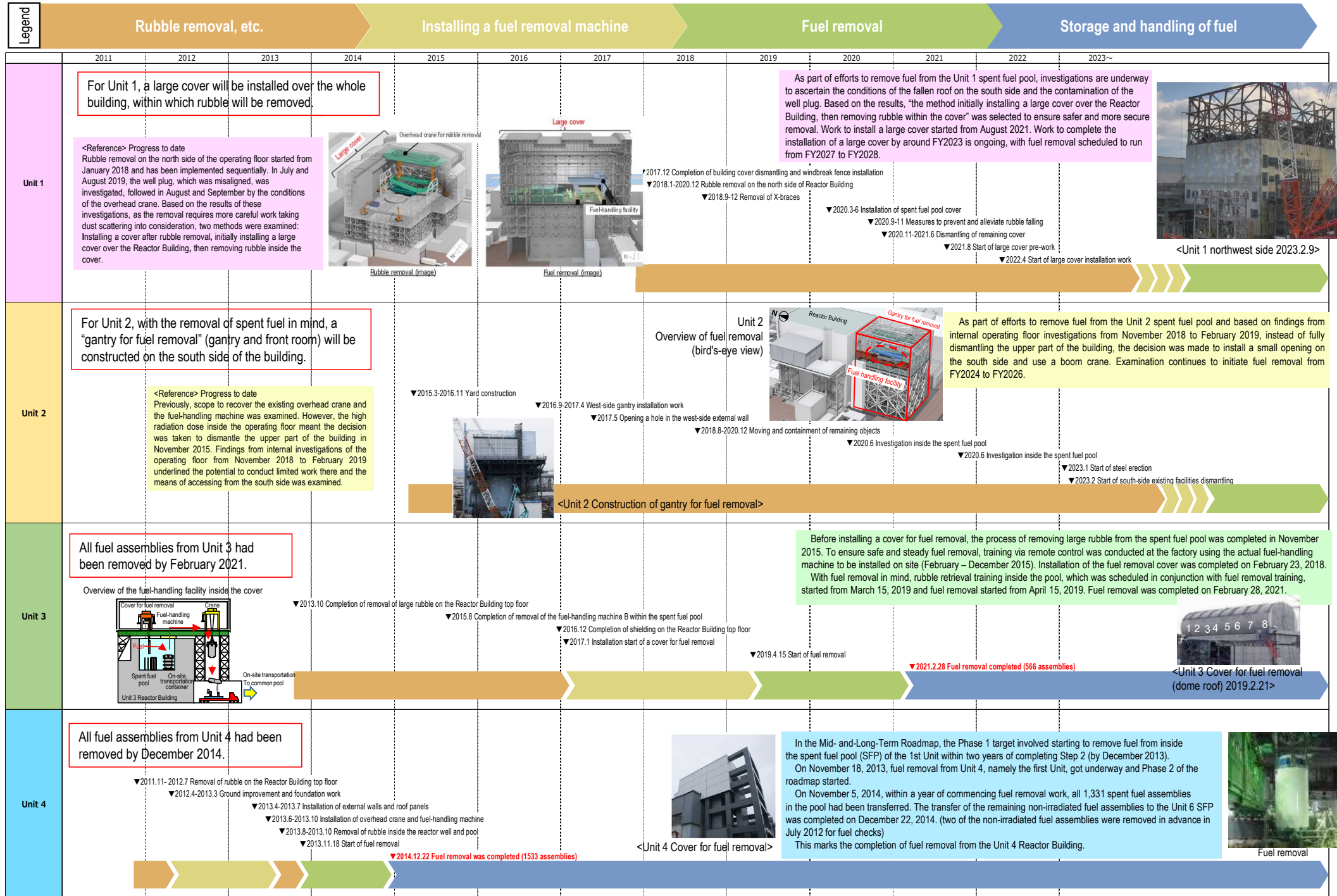


### 3 Removal of fuel from spent pool

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)

Reference 3/6  
November 30, 2023  
Secretariat of the Team for  
Countermeasures for Decommissioning,  
Contaminated Water and Treated Water



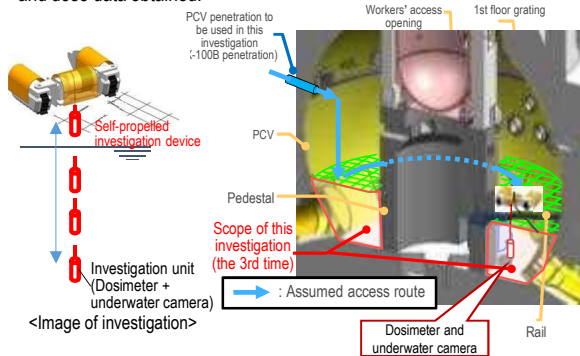
## Milestones of the Mid- and Long-Term Roadmap (major target processes)

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

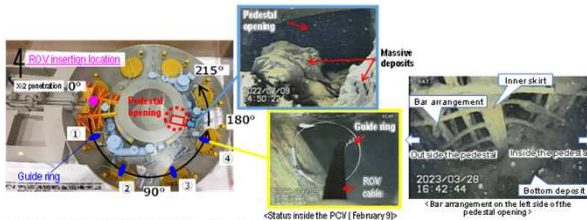
Before removing fuel debris, investigations inside the Primary Containment Vessel (PCV) are conducted to inspect the conditions there, including locations of fuel debris.

## Unit 1 Investigation overview

- In April 2015, a device having entered the inside of the PCV via a narrow opening (bore:  $\phi 100$  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.



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



## Unit 1 PCV internal investigation

Investigations inside the PCV	1st (2012.10)	<ul style="list-style-type: none"><li>- Acquiring images</li><li>- Measuring the air temperature and dose rate</li><li>- Measuring the water level and temperature</li><li>- Sampling stagnant water</li><li>- Installing permanent monitoring instrumentation</li></ul>
	2nd (2015.4)	<ul style="list-style-type: none"><li>- Confirming the status of the PCV 1st floor</li><li>- Acquiring images</li><li>- Measuring the air temperature and dose rate</li><li>- Replacing permanent monitoring instrumentation</li></ul>
	3rd (2017.3)	<ul style="list-style-type: none"><li>- Confirming the status of the PCV 1st basement floor</li><li>- Acquiring images</li><li>- Measuring the dose rate</li><li>- Sampling deposit</li><li>- Replacing permanent monitoring instrumentation</li></ul>
	4th (From 2022.2)	<ul style="list-style-type: none"><li>- Acquiring information inside PCV (inside/outside of the pedestal)</li><li>- Acquiring images</li><li>- Measuring deposit thickness and sampling deposit</li><li>- Detecting deposit debris, 3D mapping</li></ul>
Leakage points from PCV	<ul style="list-style-type: none"><li>- PCV vent pipe vacuum break line bellows (identified in 2014.5)</li><li>- Sand cushion drain line (identified in 2013.11)</li></ul>	
<u>Evaluation of the location of fuel debris inside the reactor by measurement using muons</u> Confirmed that there was no large fuel in the reactor core. (2015.2-5)		

## 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.



- 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.



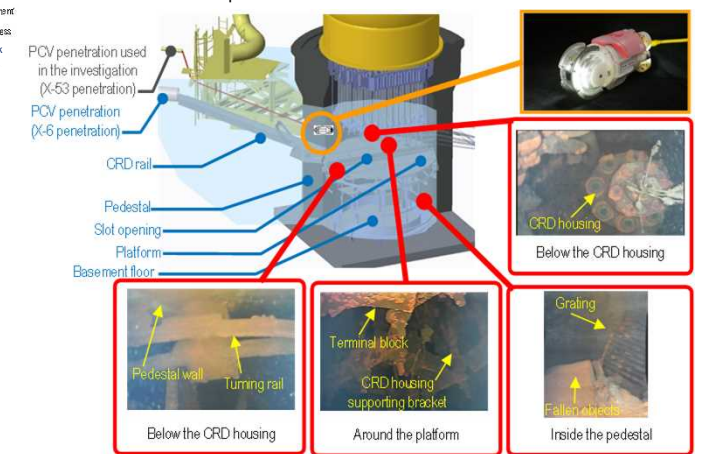
## Unit 2 PCV internal investigation

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	
<u>Evaluation of the location of fuel debris inside the reactor by measurement using muons</u> 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 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.

## &lt;Conditions inside the pedestal&gt;



## Unit 3 PCV internal investigation

Investigations inside the PCV	1st (2015.10-12)	<ul style="list-style-type: none"><li>- Acquiring images</li><li>- Measuring the air temperature and dose rate</li><li>- Measuring the water level and temperature</li><li>- Sampling stagnant water</li><li>- Installing permanent monitoring instrumentation (2015.12)</li></ul>
	2nd (2017.7)	<ul style="list-style-type: none"><li>- Acquiring images</li><li>- Installing permanent monitoring instrumentation (2017.8)</li></ul>
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)		



# 5 Management of solid radioactive waste

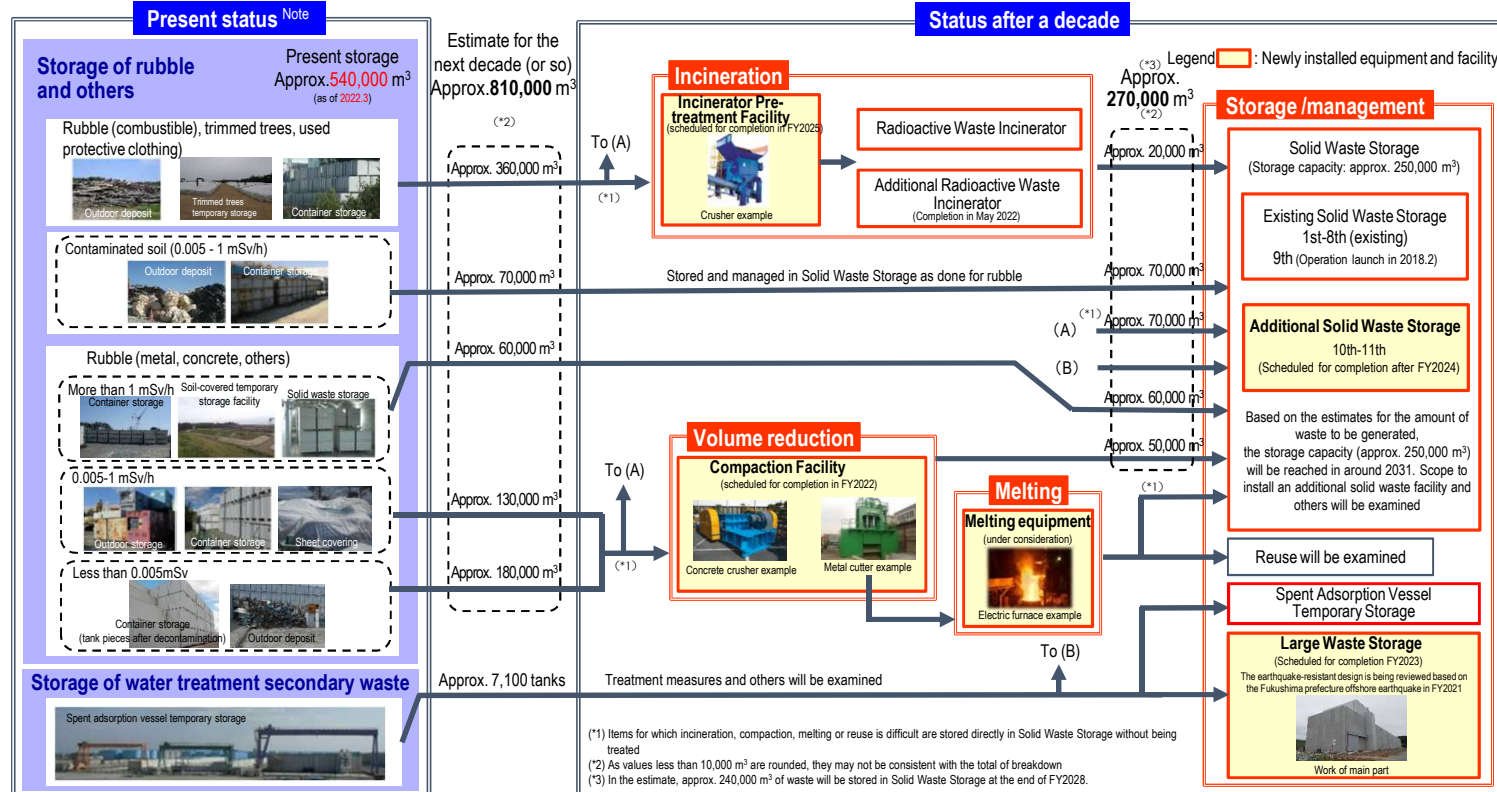
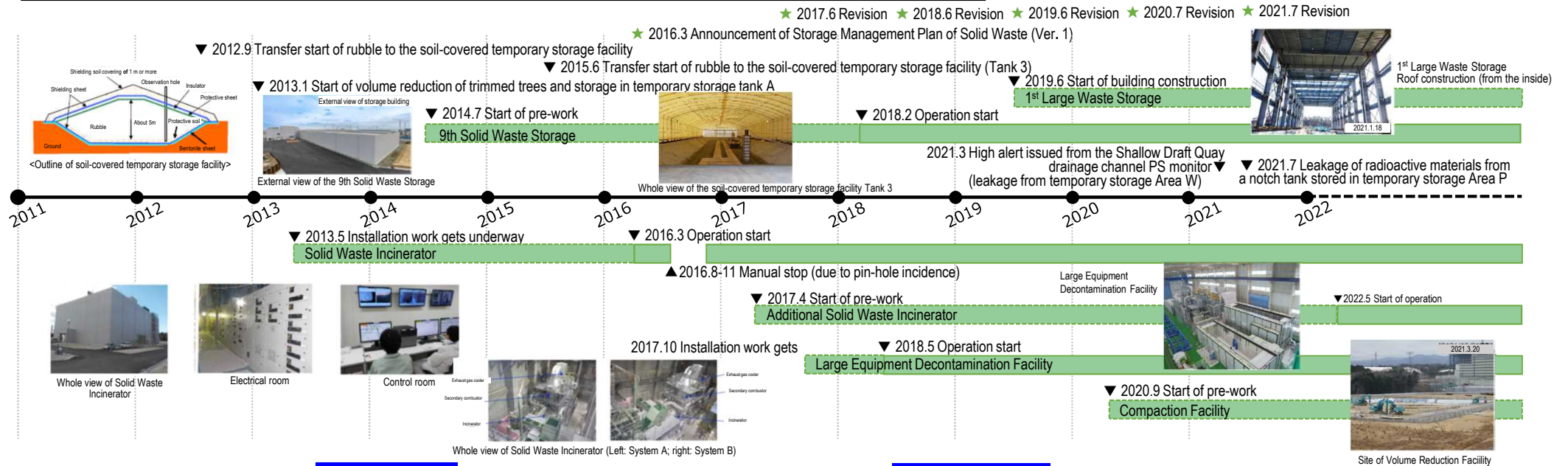
Reference 5/6

November 30, 2023

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

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)



- 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.

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.

