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 retrieval from Units 1-3. (Note 1) Fuel assemblies having melted through in the accident.

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, etc. Through these measures, the generation of contaminated water was reduced from approx. 540 m³/day (in May 2014) to approx. 130 m³/day (in FY2021). Measures continue to further suppress the generation of contaminated water to 100 m³/day or less within 2025.

(2) Efforts to complete stagnant water treatment

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

(3) Efforts to stably operate contaminated water management

- Various measures are underway to prepare for tsunamis. For heavy rain, sandbags are being installed to suppress direct inflow into buildings while work to close openings in buildings and install sea walls to enhance drainage channels and other measures is being implemented as planned.
Progress Status and Future Challenges of the Mid-and-Long-Term Roadmap toward Decommissioning of TEPCO Holdings Fukushima Daiichi Nuclear Power Station (Outline)

**Progress status**

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

**Unit 1 Status of the Primary Containment Vessel (PCV) internal investigation (the latter half)**

During the period March 4-7, 2023, an investigation was conducted at 34 points to create a deposit 3D-mapping by ROV-B.

From March 28, an investigation inside the pedestal by ROV-A2 started, in which exposure of a portion of bar arrangement was confirmed at the foundation inside the pedestal. Regarding the soundness of the pedestal, based on a past earthquake-resistant evaluation conducted by the International Research Institute for Nuclear Decommissioning (IRID), it is evaluated that serious risk will not occur, even if a portion of the pedestal is lost. However, as the present information is limited, the investigation will continue to acquire as much information as possible.

**Status of transfer of HIC slurry**

Waste (slurry) generated with the contaminated water treatment in ALPS has been contained and stored in the High Integrity Container (HIC). Among HIC affected by irradiation of beta rays from slurry, after implementing measures to reduce exposure, work for the target to transfer 45 units in FY2022 started and completed on March 23.

Measures to reduce the risk of decommissioning continue.

**Circulation and stirring operation of the ALPS treated Water Dilution/Discharge Facility**

Among the ALPS treated Water Dilution/Discharge Facility, for the measurement and confirmation facilities, a pre-service inspection certificate was granted by the Nuclear Regulation Authority (NRA) on March 15 and to homogenize the concentration of radioactive nuclides, circulation and stirring operation started for the measurement and confirmation tank area B on March 17.

On March 19, as water-level decline was detected in the tank area A (A10) in which circulation and stirring operation was not conducted, the outlet valve of that area was closed immediately. As no further decline was noticed, it was considered attributable to the seat pass of the isolation valve. No leakage to the outside of the system or external influence was identified.

After the time required for homogenization had elapsed from March 19 when the containment function was secured, sampling was conducted on March 27 in the presence of the national government and local municipalities. During the next phase, analysis will be conducted to verify compliance with the discharge criteria.

An investigation of the cause of the seat pass of the isolation valve is underway and efforts to prevent recurrence will be made.

**Milestone for contaminated water treatment in buildings in the Mid-and-Long-Term Roadmap was achieved**

To reduce the risk of contaminated water in the Reactor Buildings leaking outside of the system, treatment of contaminated water has been conducted.

While checking the influence of dust, measures have been implemented to reduce the water level. In March 2023, the water level in each building reached the target.

**Immediate response concerning establishment of the analysis system toward decommissioning of Fukushima Daiichi Nuclear Power Station**

In accordance with the government’s Comprehensive Monitoring Plan, Fukushima Prefecture, the Nuclear Regulation Authority, the Ministry of the Environment and TEPCO have strengthened sea area monitoring by increasing the number of measurement locations and the frequency of measurements.

The monitoring results had been published by each organization. This time the Overarching Radiation-monitoring data Browsing System is opened.

In the Overarching Radiation-monitoring data Browsing System in the coastal ocean of Japan (ORBS) is opened on March 13, which is a website that gathers sea-area monitoring measurements disclosed by each organization and displays them on a map format for easy viewing thereby providing objective and comprehensive data on sea conditions.

TEPCO will continue to provide easy-to-understand information.

*At present, measurements of cesium and tritium in seawater are displayed.*
Major initiatives – Locations on site

Overarching Radiation-monitoring data Browsing System (ORBS) is opened

Milestone for contaminated water treatment in buildings in the Mid-and-Long-Term Roadmap was achieved

Immediate response concerning establishment of the analysis system toward decommissioning of Fukushima Daiichi Nuclear Power Station

Circulation and stirring operation of the ALPS treated Water Dilution/Discharge Facility

Status of transfer of HIC slurry

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

**Temperatures inside the reactors**

Through continuous reactor cooling by water injection, the temperatures of the Reactor Pressure Vessel (RPV) bottom and the Primary Containment Vessel (PCV) gas phase were maintained within the range of approx. 10 to 25°C for the past month, though it varied depending on the unit and location of the thermometer.

**Other indices**

There was no significant change in indices, including the pressure in the PCV and the PCV radioactivity density (Xe-135) for monitoring critically, nor was any anomaly in the cold shutdown condition or critically 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**
  - Multi-layered measures, including pumping up by sub-drains and land-side impermeable walls, which were implemented to control the continued generation of contaminated water, suppressed the groundwater inflow into buildings.
  - After implementing "redirecting" measures (groundwater bypass, sub-drains, land-side impermeable walls and others) and rainwater prevention measures, including repairing damaged portions of building roofs, the amount of contaminated water generated within FY2021 declined to approx. 130 m³/day.
  - Measures will continue to further reduce the amount of contaminated water generated.

**Release of radioactive materials from the Reactor Buildings**

As of February 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. $1.8 \times 10^{-12}$ Bq/cm³ and $1.8 \times 10^{-12}$ Bq/cm³ for Cs-134 and Cs-137 respectively, while the radiation exposure dose due to the release of radioactive materials there was less than 0.00004 mSv/year.

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

*Note: The concentration limit of radioactive materials in the air outside the surrounding monitoring area: [Cs-134]: $2 \times 10^{-12}$ Bq/cm³, [Cs-137]: $3 \times 10^{-12}$ Bq/cm³*
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 March 16, 2023, 2,112 release operations had been conducted. The water quality of all temporary storage tanks satisfied the operational target.

Implementation status of facing
- Facing is a measure that involves asphalt-ing 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 February 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 February 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
- 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. The (additional) multi-nuclide removal equipment went into full-scale operation from October 16, 2017. Regarding the (high-performance) multi-nuclide removal equipment, 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.
- As of March 23, 2023, the volumes treated by existing, additional and high-performance multi-nuclide removal equipment were approx. 494,000, 753,000 and 104,000 m³, respectively (including approx. 9,500 m³ stored in the J1(D) tank, which contained water with highly concentrated radioactive materials at the System B outlet of the existing multi-nuclide removal equipment).
- Treatment measures comprising the removal of strontium by cesium-adsorption apparatus (KURION), the secondary cesium-adsorption apparatus (SARRY) and the third cesium-adsorption apparatus (SARRY II) continued. Up until March 23, 2023, approx. 708,000 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 March 23, 2023, approx. 876,000 m³ had been treated.
- As of March 23, 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 February 2023, 40% of the planned area (60,000 m²) had been completed.

Status of freshwater storage
- With the progress of contaminated water management, contaminated water generated in this fiscal year has been significantly suppressed. (This may also be attributable to less frequent intensive rainfall such as typhoon)
- On the other hand, with the reduction in the amount of contaminated water generated, the amount of purifed freshwater to be used for reactor water injection has been reduced. The amount of the freshwater storage tank in the area of 33.5 m above sea level has declined compared with past years.
- As countermeasures, from February 13, 2023, a portion of “treated water to be re-purified” stored in the ALPS treated water tank has been temporarily transferred (150 m³/day) to the waste liquid supply tank and subject to RO treatment to secure the amount of the freshwater storage tank.
- It was confirmed that the amount of freshwater storage was being recovered. If the status remains constant, storage of approx. 4,500 m³ will be secured by around the end of March 2023.
- By this procedure, a portion of transferred “treated water to be re-purified” began to be transferred to ALPS, which will subsequently help reduce “treated water to be re-purified” subject to secondary treatment.

Sum of concentration ratios required by law after transfer and storage to reused tanks in the Category (3) (previously reported) and source tanks
- From tanks storing strontium-reduced water and others to tanks storing ALPS treated water and others, the reuse of welded-joint tanks is underway.
- To minimize the sum of concentration ratios required by law, based on the condition inside the tanks after treating residual water and the storage record, reused tank areas are classified into three categories (1)-(3), with measures...
being implemented and examination underway in each category.

- Regarding tanks in the Category (3), “treated water to be re-purified” with which the sum of concentration ratios required by law is 1 or higher” and subject to secondary treatment will be transferred and source tanks will receive ALPS treated water to minimize the sum of concentration ratios required by law.
- After completing the reception of “treated water to be re-purified” to tanks in the Category (3) and “ALPS treated water” to source tanks, analysis was conducted. The analytical results showed that, as initially planned, the sum of concentration ratios required by law was less than 1 for the source tanks.

- Status of sea-area monitoring related to the handling of ALPS treated water
  - The concentration of tritium in seawater within 2km of the port has remained constant over the past year and was also low at new measurement points within the fluctuation range of seawater in Japan*. The concentration of Cesium-137 increased temporarily, which was considered due to rainfall, as applied to the past fluctuation in seawater around the Fukushima Daiichi Nuclear Power Station. However, it remained constant relative to measurement benchmarks for the past year and at new measurement points, also low within the fluctuation range of seawater in Japan*. For tritium, monitoring with a lower detection limit has been conducted since April 18, 2022.
  - Both concentrations of tritium and Cesium-137 in seawater within 20km of the coast had remained constant for the past year and low within the fluctuation range of seawater in Japan*.
  - The concentration of tritium in seawater further than 20km from the coast remained low, including at new measurement points, within the fluctuation range of seawater in Japan*. The concentration of Cesium-137 remained constant over the past year within the fluctuation range of seawater in Japan*.

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

<table>
<thead>
<tr>
<th>Area</th>
<th>Tritium Concentration</th>
<th>Cesium-137 Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Japan (including off the coast of Fukushima Prefecture)</td>
<td>0.043 - 0.2 Bq/L</td>
<td>0.0010 - 0.45 Bq/L</td>
</tr>
<tr>
<td>Off the coast of Fukushima Prefecture</td>
<td>0.043 – 2.2 Bq/L</td>
<td>0.0010 - 0.45 Bq/L</td>
</tr>
</tbody>
</table>

Source: Environmental Radioactivity and Radiation in Japan, Environmental Radiation Database

https://www.kankyosho.sho.go.jp/data/database/

- The concentration of tritium in fish sampled at the sampling point T-S8 had remained constant for the past year. The concentration of tritium in fish sampled at new sampling points, including those for which the analytical value was verified, remained low within a similar fluctuation range for seawater in Japan*. Other measurement data of fish is being verified.

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

<table>
<thead>
<tr>
<th>Area</th>
<th>Tritium Concentration (tissue free water type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Japan (including off the coast of Fukushima Prefecture)</td>
<td>0.064 – 0.12 Bq/L</td>
</tr>
<tr>
<td>In Japan</td>
<td></td>
</tr>
</tbody>
</table>
  - The concentration of iodine 129 in seaweed sampled since July 2022 had been below the lower detection limit (< 0.1 Bq/kg (raw)). The concentration of tritium had not been analyzed due to a lack of sufficient sample population for reanalysis via the improved method following a review of the analytical procedures based on the verification results of fish tritium analysis data. The fluctuation range of iodine 129 in seaweed in Japan had been within the range of minimum – maximum values detected during April 2019 – March 2021 in the database below.

- Progress of the rearing test of marine organisms in the Fukushima Daiichi Nuclear Power Station
  - To eliminate concerns and reassure those in society, a rearing test of marine organisms (flounder and abalone) in seawater with ALPS treated water added and normal seawater for comparison is underway.

- Regarding the test of flounder, since February 11, 2023, no death or abnormality was detected (as of March 22).
- Regarding the test of abalones, since the test started on October 25, 2022, 37 deaths were detected in “normal seawater” and 58 deaths, in “ALPS treated water diluted by seawater” (as of March 22).
- The timing for starting the rearing test of seaweed will be announced as soon as it has been decided.
- Subsequently, the tritium concentration will be measured for abalones having been reared in diluted ALPS treated water (less than 1,500 Bq/L) in October - November 2022 and flounder, (approx. 30 Bq/L) in November - December 2022.

- Progress status of work to install the ALPS treated Water Dilution/Discharge Facility and related facilities
  - For the measurement and confirmation/transfer facilities, work to install a pipe support, piping and others for these facilities started from August 4, 2022 from around the K4 area tanks. The pre-service test started from January 16, 2023. On March 15, 2023, a pre-service inspection certificate was granted for the measurement and confirmation facilities. During the period March 17-27, circulation and stirring operation was conducted and on March 27, tank area B sampling.
  - For the discharge facility, test operation of the shield tunnel started from April 1, 2023 and if there is no further problem after that, tunnel excavation will be resumed. As the tunnel excavation includes work to connect to the outlet caisson and requires careful drilling, the period required until completion of the drilling will continue to be refined. Construction of the main frame of the downstream pool started from December 18, 2022 and was completed on March 23, 2023.
  - For the dilution facility, placing of the foundation pile for seawater transfer pipes was completed and work to construct the foundation frame and install the pipe support, piping and others started.
  - In the seaside area for Units 5 and 6, scaffolding for heavy-duty machines was completed on December 29, 2022 and the scaffold has been utilized, mainly to construct the upper stream pool from April 1, 2023. Sedimentation inside the intake open channels is being removed simultaneously and after installing the partition weir, anti-permeation work will be removed.
  - At sea, the temporary surveying tower, which is equipped with the outlet caisson, is being removed.

Fuel removal from the spent fuel pools

Work to help remove spent fuel from the pool is progressing steadily while ensuring seismic capacity and safety.

- Main work to help spent fuel removal at Unit 1
  - From April 2021, work to assemble a temporary gantry and others has been underway in a yard outside the site as part of efforts to install a large cover. The ground assembly was completed for the temporary gantry and lower structure and approx. 83%, for the upper structure.
  - A work yard was prepared around the Reactor Building and preliminary work to install a large cover started from August 2021.
  - A temporary gantry is being installed from the portion where anchors and base plates near the top of the temporary gantry are installed.
  - Before the forthcoming drilling of anchors near the operating floor level, removal of rubble which interferes with the drilling will start from March 2023.

- Main work to help spent fuel removal at Unit 2
  - Work to remove the control room of the fuel-handling machine (hereinafter FHM control room), which started from August 2022, was completed in November 2022. (Work to transport dismantled rubble was completed on January 31)
  - From February 6, 2023, work to dismantle the existing facility on the south side commenced and was completed in March 20. Work to collect and transfer of dismantled rubble continues.
  - Outside the building, the erection of a steel structure commenced from January 23, 2023.
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 February 2023, the total storage volume for concrete and metal rubble was approx. 327,000m³ (-700 m³ compared to the end of January with an area-occupation rate of 87%). The total storage volume of trimmed trees was approx. 118,900m³ (-1,900 m³ with an area-occupation rate of 68%). The total storage volume of used protective clothing was approx. 14,800m³ (+800m³, with an area-occupation rate of 28%). The decrease in rubble was attributable for transfer to area arrangement. As of the end of February 2023, there were five temporary deposits with storage capacity exceeding 1,000m³, storage 62,900m³.

- Management status of secondary waste from water treatment
  - As of March 2, 2023, the total storage volume of waste sludge was 468 m³ (area-occupation rate: 67%), while that of concentrated waste fluid was 9,386 m³ (area-occupation rate: 91%). The total number of stored spent vessels, High-Integrity Containers (HICs) for multi-nuclide removal equipment and other vessels, was 5,523 (area-occupation rate: 88%).

- Status of trouble shooting of the Radioactive Waste Incinerator
  - On February 10 and 11, during the annual inspection, deposit of a rust-like powder was detected in the lower part of the exhaust gas filter casing and corrosion and thinning were also detected in the casing base material under the hatch. After perforation, it was confirmed that the hydrogen concentration inside the pipe was 0%.

- Reduction in radiation dose and mitigation of contamination
  - Status of the groundwater and seawater on the east side of Turbine Building Units 1-4
    - In the Unit 1 intake north side area, the H-3 concentration was below the legal discharge limit of 60,000 Bq/L at all observation holes and remained constant or has been declining overall. The concentration of total β radioactive materials has remained constant overall but increased temporarily from April 2020 and is even increasing or declining at many observation holes at present, including Nos. 0-1-2, 0-3-1, 0-3-2 and 0-4. The trend continues to be monitored carefully.
    - In the area between the Unit 1 and 2 intakes, the H-3 concentration has remained below the legal discharge limit of 60,000 Bq/L at all observation holes. It has been increasing or declining at Nos. 1-1-2, 1-1-3, 1-1-6, 1-1-7, 1-1-8 and 1-1-17. The trend continues to be monitored carefully.
    - In the area between the Unit 2 and 3 intakes, the H-3 concentration has been below the legal discharge limit of 60,000 Bq/L at all observation holes. It has been increasing and declining at Nos. 2-3, 2-5, 2-6 and 2-7 but has remained constant overall. The concentration of total β radioactive materials has remained constant overall but been increasing or declining at No. 2-5. The trend continues to be monitored carefully.
    - In the area between the Unit 3 and 4 intakes, the H-3 concentration has been below the legal discharge limit of 60,000...
Bq/L at all observation holes and remained constant or been declining overall. The concentration of total β radioactive materials has remained constant overall but has been increasing or declining at many observation holes, including Nos. 3-4 and 3-5. The trend continues to be monitored carefully.

- In the groundwater on the east side of the Turbine Buildings, as with the total β radioactive materials, the concentration of cesium has also remained constant as the overall area but been increasing or declining and exceeded the previous highest record at some observation holes. Investigations into the fluctuation are underway for Nos. 0-3-2, 1, 1-6, 2-5, 2-6 and 3-3.
- The concentration of radioactive materials in drainage channels has remained constant overall, despite increasing during rainfall. In Drainage Channel D, drainage of the low-dose area on the west side of the site started to pass from August 30, 2022 and the concentration has remained low. From November 29, 2022, continuous monitors were installed and drainage around the Units 1 and 2 switch yard started to pass.
- The concentration of radioactive materials in seawater intake for Units 1 to 4, the concentration of radioactive materials in seawater has remained below the legal discharge limit and been declining long term, despite temporary increases in Cs-137 and Sr-90 noted during rainfall. They have also been declining following the completed installation and the connection of steel pipe sheet piles for the sea-side impermeable walls. The concentration of Cs-137 has remained slightly higher in front of the south-side impermeable walls and slightly lower on the north side of the east breakwater since March 20, 2019, when the silt fence was transferred to the center of the open channel due to mega float-related construction.
- In the port area, the concentration of radioactive materials in seawater has remained below the legal discharge limit and been declining long term, despite temporary increases in Cs-137 and Sr-90 observed during rainfall. They have remained below the level of those in the Units 1-4 intake open channel area and been declining following the completed installation and connection of steel pipe sheet piles for the sea-side impermeable walls.
- In the area outside the port, regarding the concentration of radioactive materials in seawater, those of Cs-137 and Sr-90 declined and remained low after steel pipe sheet piles for the sea-side impermeable walls were installed and connected. Regarding the concentration of Cs-137, a temporary increase was sometimes observed on the north side of the Unit 5 and 6 outlets and near the south outlet due to the influence of weather, marine meteorology and other factors. Regarding the concentration of Sr-90, variation 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.

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

- **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 November 2022 to January 2023 was approx. 9,700 (cooperating company workers and TEPCO HD employees), which exceeded the monthly average workforce (approx. 7,700). Accordingly, sufficient personnel were registered to work on site.
  - It was confirmed with the prime contractors that the estimated manpower necessary for the work in April 2023 (approx. 4,000 workers per day: cooperating company workers and TEPCO HD employees) would be secured at present. The average numbers of workers per day for each month (actual values) for the most recent 2 years were maintained, with approx. 3,000 to 4,600.
  - The number of workers from both within and outside Fukushima Prefecture remained constant. The local employment ratio (cooperating company workers and TEPCO HD employees) as of February 2023 remained constant at around 70%.
The average exposure doses of workers were approx. 2.54 and 2.60 and 2.51 mSv/person-year during FY2019, 2020 and 2021, respectively (The legal exposure dose limits are 100 mSv/person and 50 mSv/person-year over five years, the TEPCO HD management target is 20 mSv/person-year).

For most workers, the exposure dose was sufficiently within the limit and allowed them to continue engaging in radiation work.

As of March 29, 2023, 1,751 workers (including 280 TEPCO HD employees, 1,466 cooperating company workers, 3 business partner company employees and 2 temporary workers) of the Fukushima Daiichi Nuclear Power Station had been infected by COVID-19, an increase in 8 workers (including 2 TEPCO HD employees and 6 cooperating company workers) from the figures in the previous published material (as of February 21, 2023).

No significant influence on decommissioning work, such as a corresponding delay to work processes due to this infection, had been identified.

Mid- and Long-Term Decommissioning Action Plan 2023

The “Mid-and-Long-Term Decommissioning Action Plan” was created by TEPCO for indicating the main work processes involved in decommissioning as a whole, to achieve the goals laid out in the Mid-and-Long-Term Roadmap and the Risk Map of the Nuclear Regulation Authority (NRA). Based on the FY2022 progress, the plan was revised.

The points revised in the Mid-and-Long-Term Decommissioning Action Plan 2023 include for the contaminated water management, revising a target of “reducing contaminated water generation to about 50-70 m³/day (by the end of FY2028), for the spent fuel removal from pools, specifying processes to remove highly radioactive equipment, for the fuel debris retrieval, accelerating the study to further expand the scale of retrieval and for the waste management, adding the installation plan of the melting facility.

Based on the Mid-and-Long-Term Decommissioning Action Plan 2023, a procurement plan will be formulated to expand the entry of and procurement from local companies.
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 March 13-27)”; unit (Bq/L); ND represents a value below the detection limit

Summary of TEPCO data as of March 28, 2023

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.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Latest Value</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesium-134</td>
<td>ND(0.36) Below 1/9</td>
<td>Cesium-134 : 3.3 (H25/12/24) → ND(0.31) Below 1/10</td>
</tr>
<tr>
<td>Cesium-137</td>
<td>ND(0.35) Below 1/20</td>
<td>Cesium-137 : 7.3 (H25/10/11) → ND(0.28) Below 1/20</td>
</tr>
<tr>
<td>Torium</td>
<td>ND(1.8) Below 1/30</td>
<td>Torium : 67 (H25/8/19) → ND(1.7) Below 1/30</td>
</tr>
<tr>
<td>Cesium-134</td>
<td>ND(0.32) Below 1/7</td>
<td>Cesium-134 : 3.3 (H25/10/17) → ND(0.36) Below 1/9</td>
</tr>
<tr>
<td>Cesium-137</td>
<td>ND(0.36) Below 1/20</td>
<td>Cesium-137 : 9 (H25/10/17) → ND(0.35) Below 1/20</td>
</tr>
<tr>
<td>Torium</td>
<td>ND(1.8) Below 1/30</td>
<td>Torium : 59 (H25/8/19) → ND(1.8) Below 1/30</td>
</tr>
<tr>
<td>Cesium-134</td>
<td>ND(0.29) Below 1/10</td>
<td>Cesium-134 : 4.4 (H25/12/24) → ND(0.32) Below 1/10</td>
</tr>
<tr>
<td>Cesium-137</td>
<td>ND(0.36) Below 1/20</td>
<td>Cesium-137 : 10 (H25/12/24) → ND(0.31) Below 1/20</td>
</tr>
<tr>
<td>Torium</td>
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<td>Torium : 59 (H25/8/19) → ND(1.8) Below 1/30</td>
</tr>
<tr>
<td>Cesium-134</td>
<td>ND(0.29) Below 1/10</td>
<td>Cesium-134 : 5 (H25/12/2) → ND(0.29) Below 1/10</td>
</tr>
<tr>
<td>Cesium-137</td>
<td>ND(0.36) Below 1/20</td>
<td>Cesium-137 : 8.4 (H25/12/2) → ND(0.36) Below 1/20</td>
</tr>
<tr>
<td>Torium</td>
<td>ND(1.7) Below 1/30</td>
<td>Torium : 52 (H25/8/19) → ND(1.7) Below 1/30</td>
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<tr>
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<td>ND(0.29) Below 1/10</td>
<td>Cesium-134 : 2.8 (H25/12/2) → ND(0.36) Below 1/7</td>
</tr>
<tr>
<td>Cesium-137</td>
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<td>Cesium-137 : 5.8 (H25/12/2) → ND(0.37) Below 1/10</td>
</tr>
<tr>
<td>Torium</td>
<td>1.9 Below 1/10</td>
<td>Torium : 24 (H25/8/19) → ND(0.36) Below 1/7</td>
</tr>
</tbody>
</table>

*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. 1m east side)
*4: For the point, monitoring was finished from April 3, 2019 due to preparatory work for transfer of mega float.

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.html
Summary of TEPCO data as of March 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 March 13-27)

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<td>Total β</td>
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<td>ND (14)</td>
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<td>ND (H25)</td>
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<td>ND (H25)</td>
<td>#VALUE!</td>
<td>ND (H25)</td>
<td>#VALUE!</td>
</tr>
</tbody>
</table>

Sea side impermeable wall
Silt fence
Silt fence for construction

Note: Because safety of the sampling points was unassured due to the influence of Typhoon No. 10 in 2016, samples were taken from approx. 330 m south of the Unit 1-4 release outlet. Samples were also taken from a point approx. 280m south from the same release outlet from January 27, 2017 and approx. 320m from March 23, 2018.

Source: TEPCO website, Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station http://www.tepco.co.jp/decommission/planaction/monitoring/index-j.html
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 related-standards to ensure the safety of the public, surrounding environment and agriculture, 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 transparent manner.

- To alleviate concerns and lead to relief of local residents, the response of TEPCO was announced on April 16.
- Based on this, the response of TEPCO was announced on April 16.
- Measures for decomposition, contaminated water and treated water of the Fukushima Daiichi Nuclear Power Station need efforts to reduce risks over a long term. Regarding handling of ALPS treated water as a part of decommissioning, to local residents, those in the fishing industry and related parties, we will thoroughly explain about the policies and responses concerning the facility design, operation, and management to ensure safety, monitoring of radioactive materials and others, and proceed with efforts to sincerely face their concerns and interests and respond to each of them.

Moreover, to further deepen the understanding of everyone in Japan and overseas, efforts to coherently disseminate measurement results of ALPS treated water and information concerning facility operation, radiation impact assessment and others will continue to be enhanced.

- For overseas, the sea was renewed. "Treated Water portal site in English, Chinese and Korean"
  - "Sea Area Monitoring page in English, Chinese and Korean was published
  - "The 1st IAEA Review" explanation booklet was published in English, Chinese and Korean
- When inaccurate or misleading overseas information was conducted, for maximum suppression of reputation, recall call or other actions will be taken.
- A condition to deliver science-based information to overseas media and embassies in Japan will be created.
- Approach to major media and embassies is being enhanced.
- For accurate media coverage, regular press conferences will continue to be held.

- For overseas, the sea was renewed. "Treated Water portal site in English, Chinese and Korean"
  - "Sea Area Monitoring page in English, Chinese and Korean was published
  - "The 1st IAEA Review" explanation booklet was published in English, Chinese and Korean

Safety review of International Atomic Energy Agency (IAEA) in November 2022, IAEA review team visited Japan to conduct the second review concerning safety of ALPS treated water (the first visit was conducted in February 2022 and the report was published in April).

- The article of the IAEA Review concerning handling of ALPS treated water and overview of the report are published timely on the TEPCO website.
- Instructions from IAEA were reflected in the revision of the implementation plan and the radiation assessment report.
- The report of the second review will be published around early 2023.

- Daily rearing status is published on the TEPCO website and Twitter.
  - TEPCO website: http://www.tepco.co.jp/decommission/information/newsrelease/breedindex.html
  - TEPCO Twitter: https://twitter.com/TEPCOfishkeepers
- Examination concerning handling of ALPS treated water

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

2022.4.28 The report of the second review will be published around early 2023.
3 Removal of fuel from spent pool

Milestones of the Mid- and Long-Term Roadmap (major target processes)
- Completion of Unit 1-6 fuel removal (within 2031)
- Completion of installation of Unit 1 large cover (around FY2023), start of Unit 1 fuel removal (FY2027-2028)
- Start of Unit 2 fuel removal (FY2024-2026)

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

As part of efforts to remove fuel from the Unit 1 spent fuel pool, investigations are underway to ascertain the conditions of the fallen roof on the south side and the contamination of the wellplug. 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.

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.

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 in 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.
**Reference:** 4/6

March 30, 2023

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

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**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:diameter: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.

**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 stripped may exist.

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**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.

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**Summary of Investigations inside the pedestal**

- **PCV internal investigations**
  - **Unit 1 Reactor Building 1st floor**
    - 1st (2012.1) - Acquiring images
    - 2nd (2012.3) - Confirming the status of the PCV 1st floor
    - 3rd (2013.2 - 2014.6)
  - **Unit 2 Reactor Building 2nd floor**
    - 4th (2017.1) - Acquiring images
    - 5th (2017.1) - Acquiring images
    - 6th (2018.1) - Acquiring images

- **Leakage points**
  - **PCV vent pipe vacuum break line (identified in 2014.6)**
  - **Sand cushion line (identified in 2013.1)**

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**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 (2016.3-7).

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

- 2012.9 Transfer start of rubble to the soil-covered temporary storage facility
- 2013.1 Start of volume reduction of trimmed trees and storage in temporary storage tank A
- 2014.7 Start of pre-work
- 2015.6 Transfer start of rubble to the soil-covered temporary storage facility (Tank 3)
- 2016.3 Announcement of Storage Management Plan of Solid Waste (Ver. 1)
- 2016.8-11 Manual stop (due to pin-hole incidence)
- 2017.4 Start of pre-work
- 2018.2 Operation start
- 2019.6 Revision
- 2020.7 Revision
- 2021.7 Leakage of radioactive materials from a notch tank stored in temporary storage Area W
- 2021.3 High alert issued from the Shallow Draft Quay drainage channel PS monitor

Storage of rubble and others

Present storage: Approx. 540,000 m³ (as of 2023)

- Rubble (combustible), trimmed trees, used protective clothing
  - Storage capacity: approx. 250,000 m³
  - Stored and managed in Solid Waste Storage as done for rubble
  - Treatment measures and others will be examined
- Rubble (metal, concrete, others)
  - Storage capacity: approx. 100,000 m³

Storage of water treatment secondary waste

Approx. 7,100 tanks

Present status

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

Status after a decade

- Newly installed equipment and facility
- Incineration
  - Incinerator Pre-treatment Facility
  - Radioactive Waste Incinerator
  - Additional Radioactive Waste Incinerator
  - Counter example
  - Stored and managed in Solid Waste Storage as done for rubble
- Volume reduction
  - Compaction Facility
  - Melting equipment
  - Melting equipment (water-cooled)
- Storage /management
  - Solid Waste Storage (Storage capacity: approx. 250,000 m³)
  - Additional Solid Waste Storage (10th-11th)
  - Large Equipment Decontamination Facility
  - Spent Adsorption Vessel Temporary Storage
  - Large Storage

Legend

- *1 Items for which incineration, compaction, melting or reuse is difficult are stored directly in Solid Waste Storage without being treated.
- *2 In the estimate, approx. 240,000 m³ of waste will be stored in Solid Waste Storage at the end of FY2028.
- *3 For the storage, approx. 1,000 m³ per year are stored, and they may not be consistent with the total of breakdown.

Note: 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.