



Fukushima Daiichi Nuclear Power Station Update on Efforts to Decommissioning and the Handling of ALPS Treated Water (Tokyo Electric Power Company Holdings, Inc.)

October 24, 2022

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※October 26, 2022 Correction of error

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Correction details

Error

Page 9

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Correction

Page 9

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- I. The status of Fuel removal from spent fuel pools and Fuel debris retrieval at Unit 1/2**

- II. Initiatives for the handling of ALPS treated water and activities to foster understanding**

Progress Status of the Mid-and-Long-Term Roadmap toward Decommissioning of Fukushima Daiichi NPS

Main decommissioning work and steps

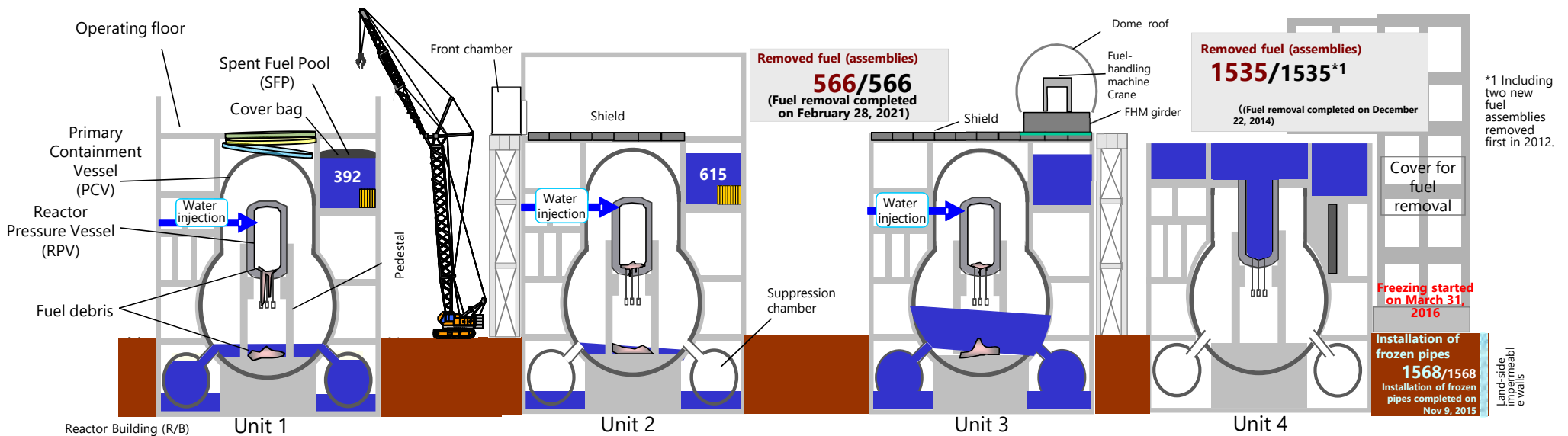
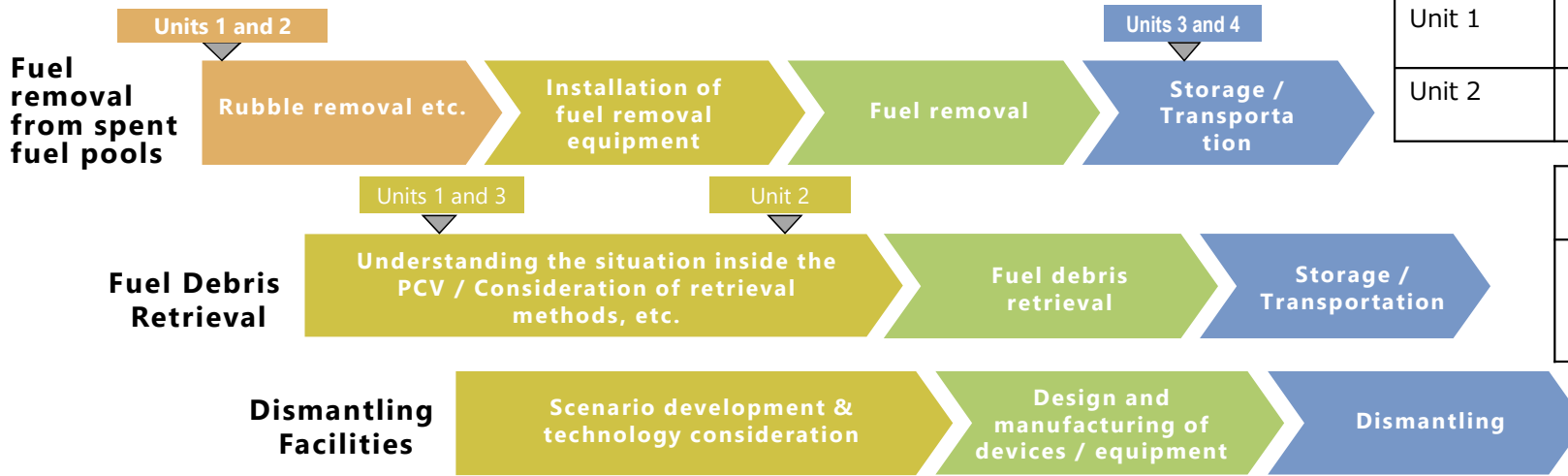
Fuel removal from the spent fuel pool was **completed on December 22, 2014 at Unit 4 and on February 28, 2021 at Unit 3**.
 Work continues sequentially toward the start of fuel removal from Units 1 and 2 and debris (Note 1) retrieval from Units 1-3

Note 1) Fuel assemblies having melted through in the accident.

<Milestone 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

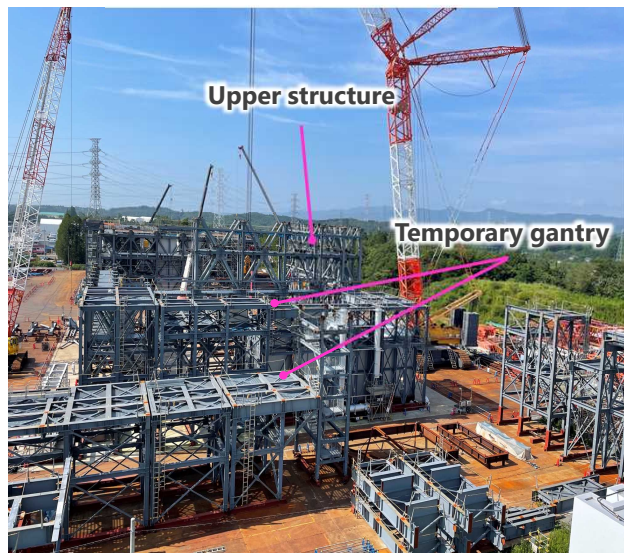
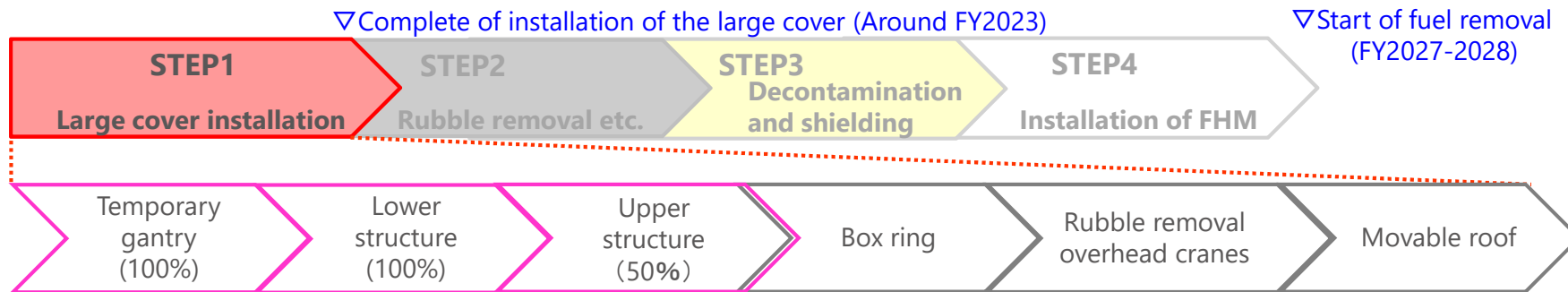
First unit	Start of fuel debris retrieval
Unit 2	Within 2021 *To increase the safety and reliability of the work, the process was revised to start in the latter half of FY2023.



Status of Work (Spent Fuel Removal ①)

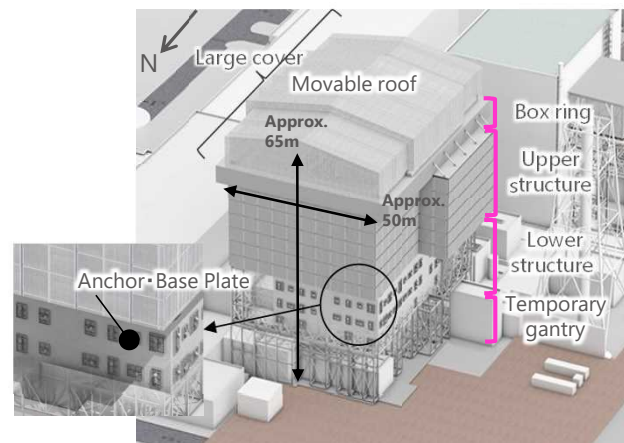
Fuel removal from spent fuel pool [Unit 1]

- In preparation for the start of fuel removal between FY2027 and FY2028, a large cover is being installed over the reactor building to suppress dust dispersion during rubble removal, build a working environment, and suppress the inflow of rainwater.
- **Temporary gantry and lower structure were installed, and the groundwork for the upper structure is approx. 50% complete.**



<Work outside the site (August 8, 2022)>

【Large cover to be installed】



< Schematic diagram of the entire large cover >

*The illustration is for illustrative purposes only and may differ from the actual.

The large cover is a steel structure consisting of a lower structure, upper structure, box ring, and movable roof, which is anchored to the reactor building at the location of the lower structure.

Status of Work (Spent Fuel Removal ②)

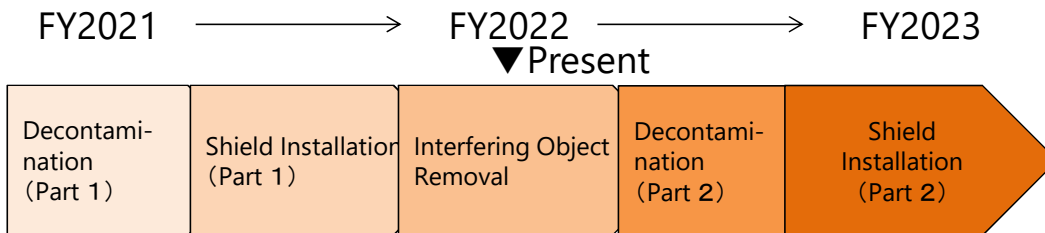
Fuel Removal from Spent Fuel Pool [Unit 2]

In preparation for the start between FY2024 - FY2026, removal of FHM control room in the building and the gantry foundation installation work are underway.

<In the building>

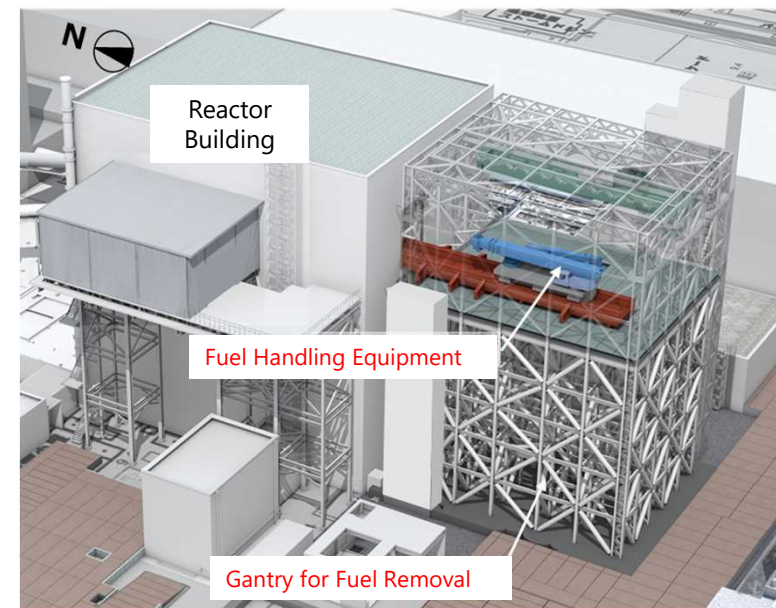
From May 2022, the FHM that parked above the spent fuel pool has been moved to the north side of the operating floor ※1. In August, removal of FHM control room was started.

※1 Top floor of the reactor building



[Gantry for Fuel Removal to be installed]

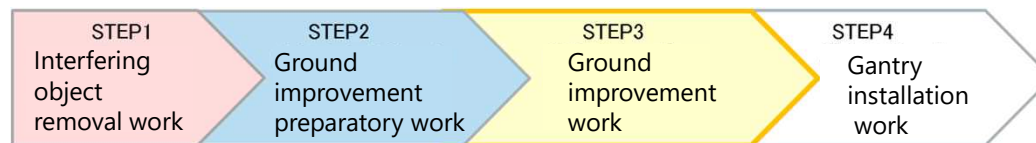
We plan to carry out fuel removal work by moving the fuel handling equipment in and out from the fuel removal gantry to be installed on the south side of the reactor building.



<Outside the building>

Excavation work was completed in June 2022. From June 16, the gantry foundation installation work is underway.

▼Present



- Interfering object removal
- Removal of OF cables

- Placing MMS
- Roadbed preparation

- Ground improvement

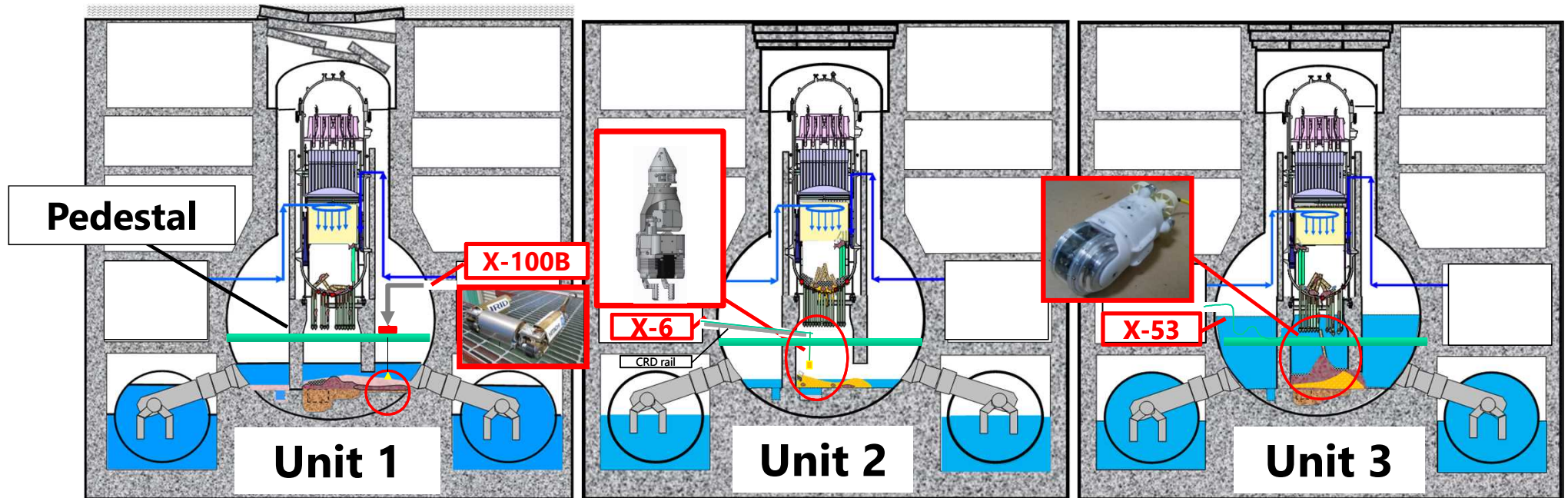
- Foundation Installation
- Steel frame erection

<Conceptual drawing of Gantry>

Status of Work (Fuel Debris Retrieval ①)

Estimated Distribution of Fuel Debris

- In order to prepare for the fuel debris retrieval, distribution of fuel debris in the primary containment vessels (PCV) was estimated after conducting robot investigation, accident progression analysis, muon investigation, etc. Considering the results of these investigations, **Unit 2 has been selected as the first unit from which fuel debris will be retrieved.**



It is estimated that almost all of the fuel debris has fallen to the bottom of the PCV.

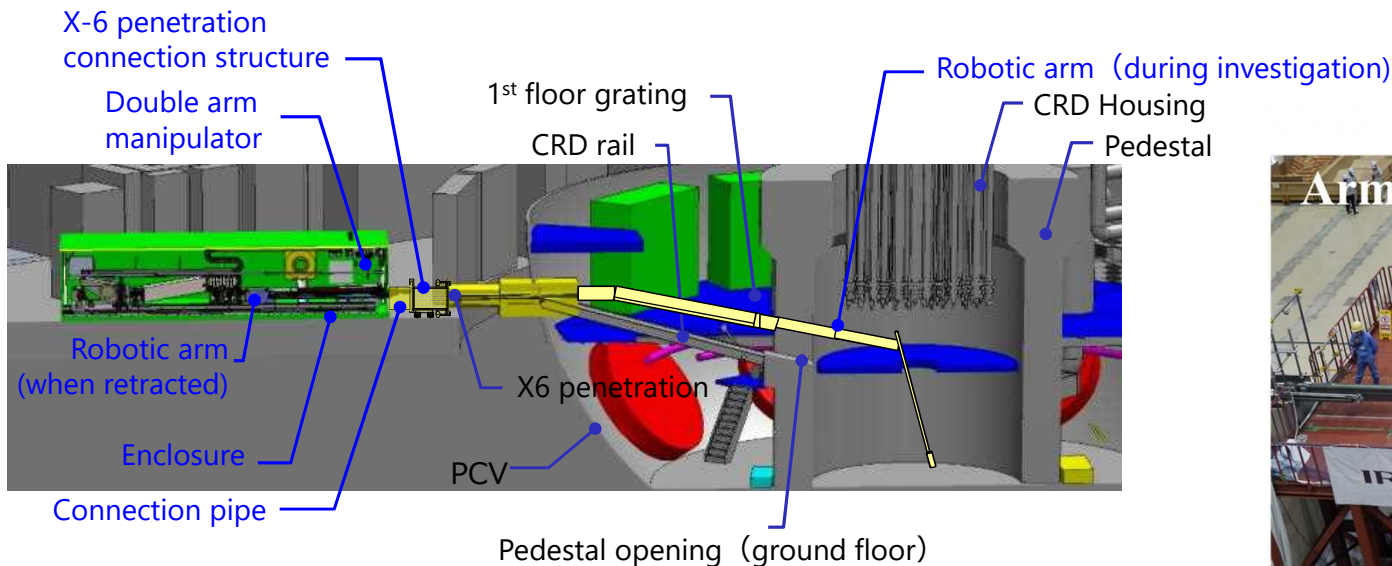
It is estimated that a part of melted fuel has fallen to the lower areas of RPV and PCV, and a part of it is still remaining in the reactor core.

It is estimated that the situation is intermediate between Units 1 and 2.

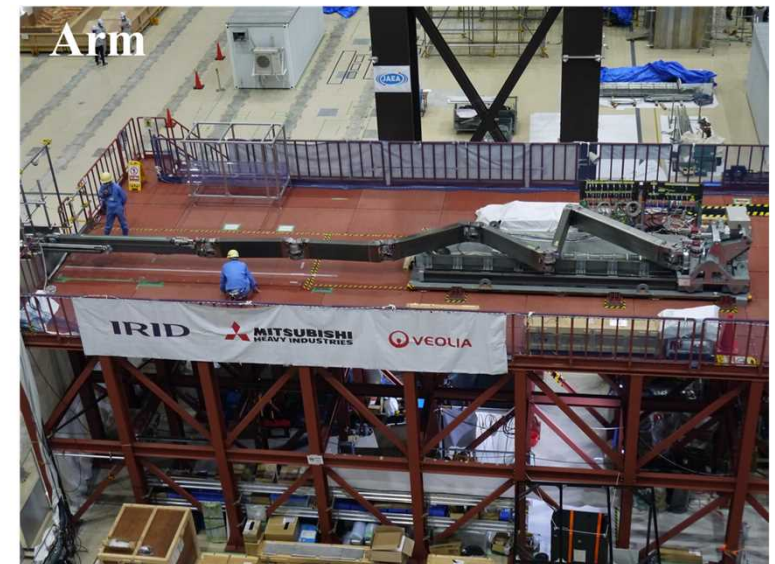
Status of Work (Fuel Debris Retrieval ②)

Work in Preparation for Fuel Debris Retrieval [Unit 2]

- Work related to fuel debris retrieval from Unit 2 is to be started in the form of a trial retrieval.
- We plan to insert a British-made robot arm through a penetration hole of the containment vessel as an access route to retrieve granular fuel debris on a very small scale. Currently, through mock-up tests, we are working on improvements such as modifying the control program.
- In order to increase the safety and certainty of the trial retrieval work, we added a preparation period of one to one and a half years, and revised the process to start the trial retrieval work around the second half of FY2023.



Conceptual drawing of a robotic arm working through a pedestal opening

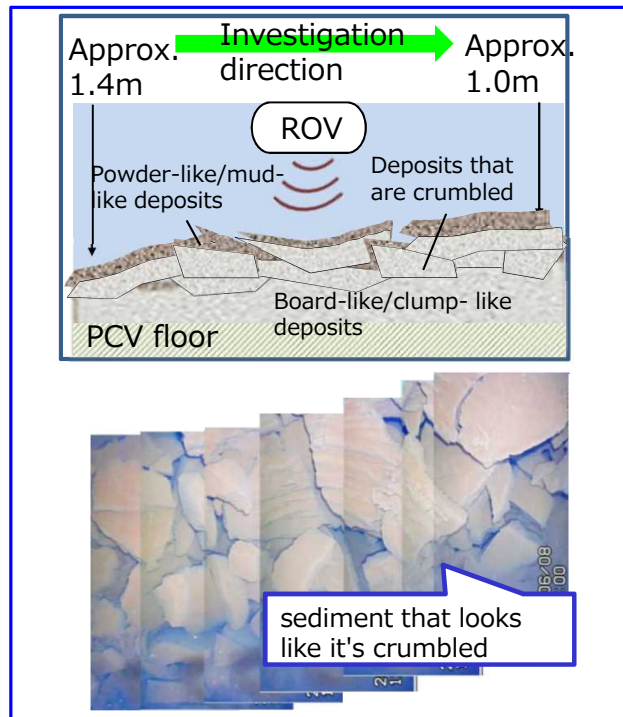


A robot arm being adjusted at a mockup facility
Source : IRID

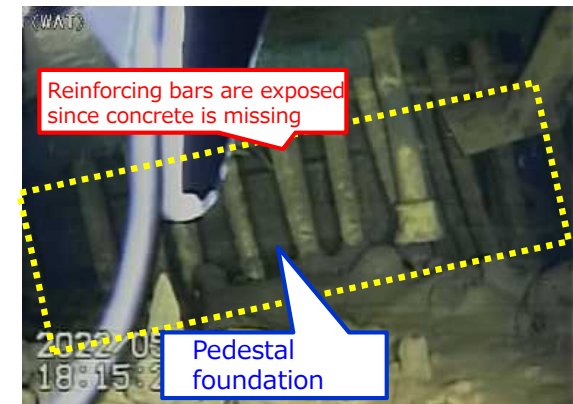
Status of Work (Fuel Debris Retrieval ③)

Work in preparation for Fuel Debris Retrieval [Unit 1]

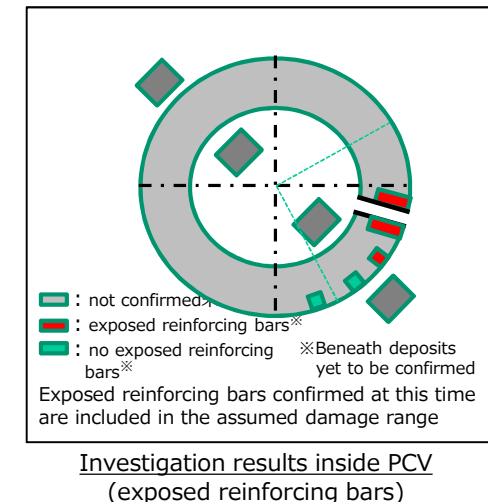
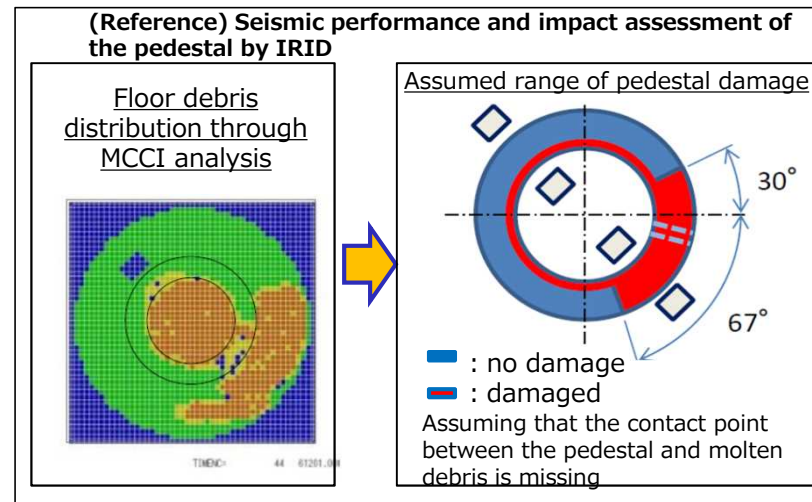
- In preparation for fuel debris retrieval, we conduct internal investigations using remote-controlled robots (ROVs) that are suitable for use.
- As a result of the investigation inside the nuclear reactor containment vessel (PCV), large areas of clump-like and shelf-like deposits are confirmed. In addition, it was confirmed that there was no concrete on the wall of the pedestal opening, and reinforcing bars, etc., were exposed.
- Based on current information etc., we have considered the impact of pedestal damage on the plant, and believe that **the possibility of large-scale damage due to an earthquake is low.**



Deposits photographed by ROV



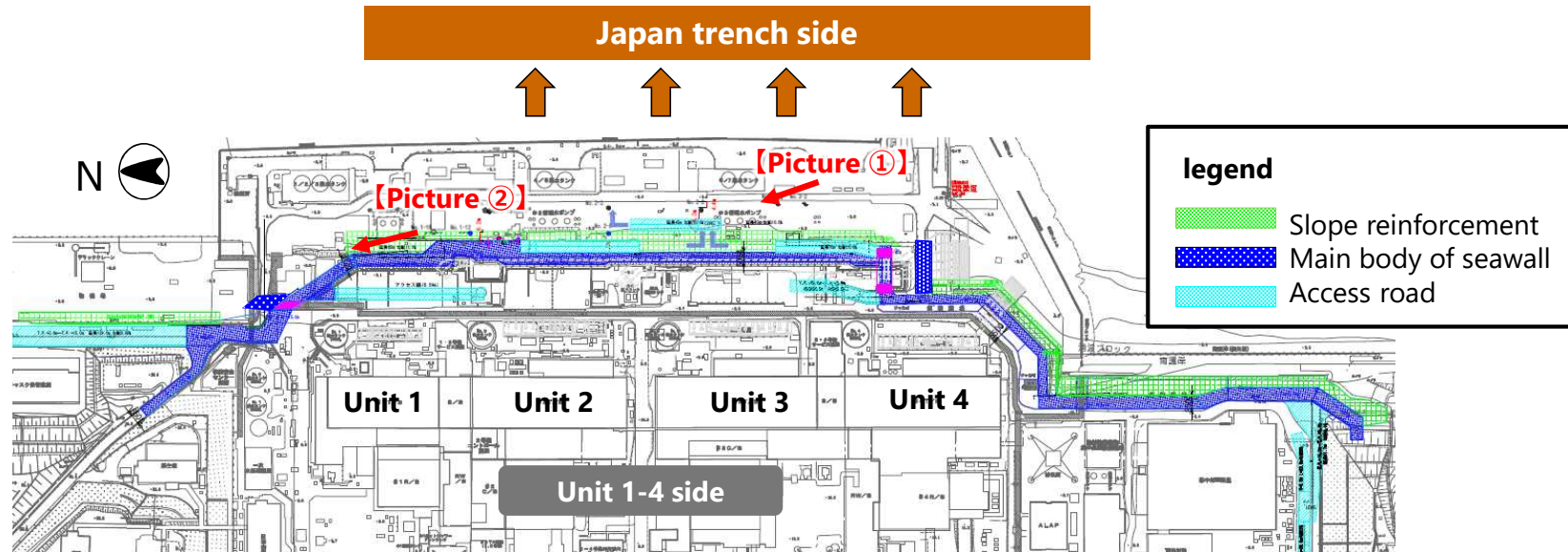
Pedestal opening wall photographed by ROV



Status of Work (countermeasures against Tsunami)

Installation of Japan Trench Tsunami Seawall

- It is necessary to respond to the imminent tsunami emergency. Countermeasures against Outer Rise Tsunami and Chishima Trench Tsunami were implemented to prevent any increase in stagnant water due to inflow into the buildings and alleviate damage to important facilities for decommissioning by suppressing flooding by tsunami. **(Completed in FY 2020)**
- In addition, a new seawall is being installed as a facility against the Japan Trench tsunami. Work is underway for completion in FY2023, and **installation of the seawall is approximately 30% complete.** (As of September 2022)



【Picture ①】
Main body of seawall
under construction
(2022.9)



【Picture ②】
North side seawall
under construction
(2022.8)



Initiatives for the handling of ALPS treated water

- Regarding the discharge of the ALPS treated water into the sea, we will **ensure the safety** of the public, surrounding environment as well as agricultural, forestry and fishery products through compliance with safety standards based on relevant laws and legislations. We will take further measures based on international standards and practices to confirm the safety of the water to be discharged.
- We have further expanded and strengthened our sea area monitoring efforts to **minimize the adverse impacts on reputation**. Measurements and assessments by third parties will also be disclosed. We continue to work on safety review by the IAEA, and disseminate accurate information in a highly transparent manner.

The status of approval, etc.

- At the fifth Inter-Ministerial Council for Contaminated Water, Treated Water and Decommissioning Issues held on April 13, 2021, a decision was announced about the government's basic policy on the handling of ALPS treated water at Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station.
- On April 16, 2021, we published "TEPCO Holdings' Action in Response to the Government's Policy on the Handling of ALPS Treated Water from the Fukushima Daiichi Nuclear Power Station."
- In December, 2021, TEPCO submitted the "Application Documents for Approval to Amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station Specified Nuclear Facility" regarding the design of ALPS Treated Water Dilution/Discharge Facilities, etc. to the Nuclear Regulation Authority (NRA), and on July 22, 2022, these application documents were approved by the NRA.
- On August 2, 2022, Fukushima Prefecture, Okuma Town, and Futaba Town granted us the prior consent after confirming the state of the necessary safety measures based on the "Agreement to Ensure Safety in Surrounding Areas Related the Decommissioning of Fukushima Daiichi Nuclear Power Station.

Preparation status of ALPS treated water dilution/discharge facility, etc.

- Based on the prior consent (see above), construction of the discharge tunnel began on August 4, using a shield machine to excavate the bedrock layer.
- Preparation work for the installation of partitioning weir in the Unit 5/6 intake open channel is also underway.



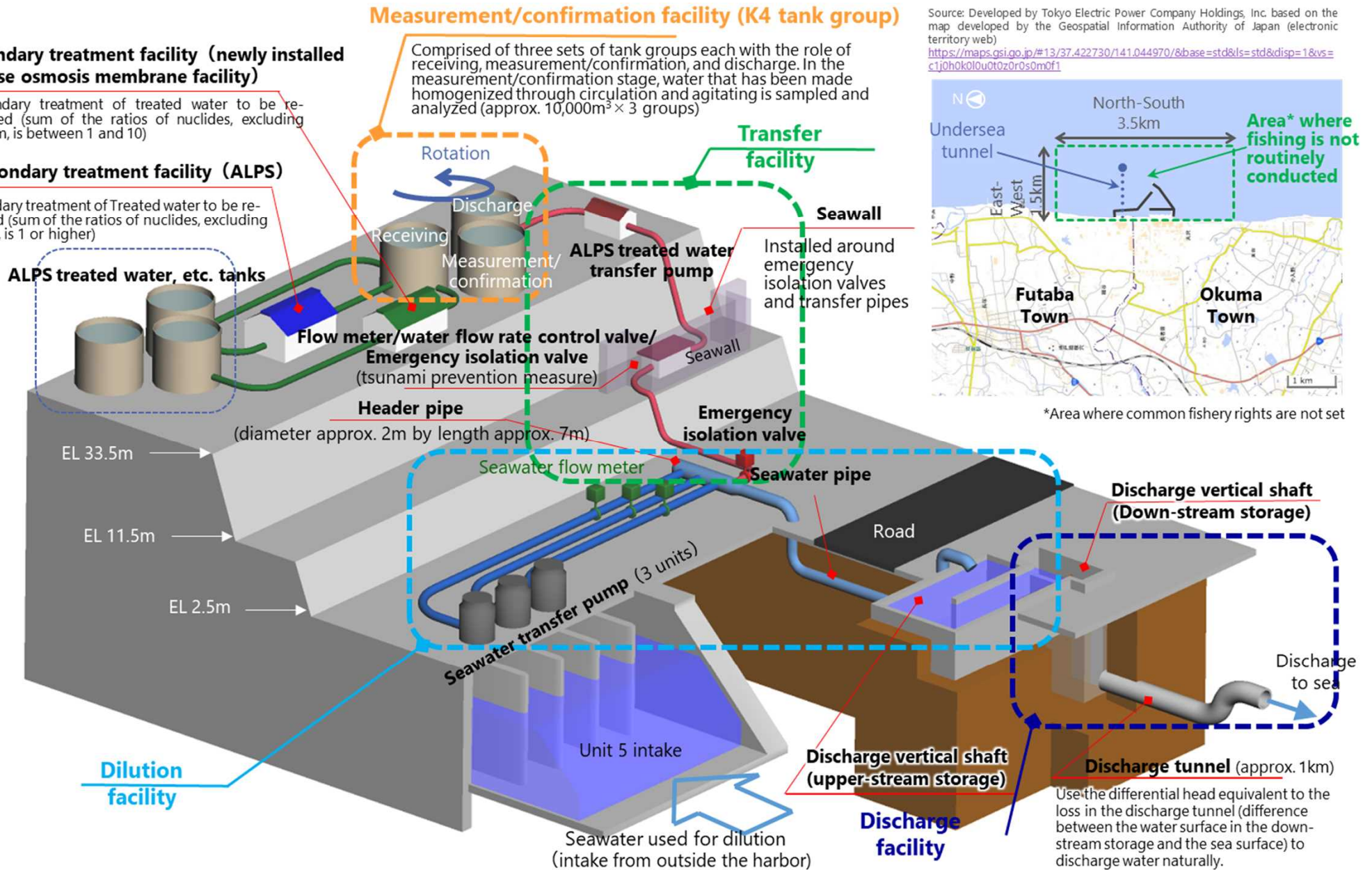
Key Points for the Handling of ALPS Treated Water ①

Secondary treatment facility (newly installed reverse osmosis membrane facility)

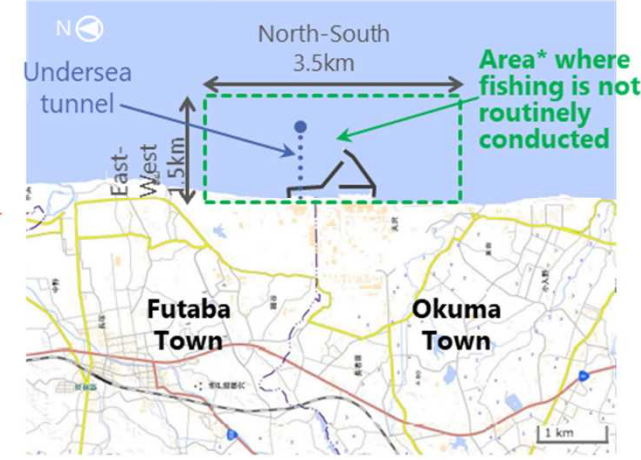
Secondary treatment of treated water to be re-purified (sum of the ratios of nuclides, excluding tritium, is between 1 and 10)

Secondary treatment facility (ALPS)

Secondary treatment of Treated water to be re-purified (sum of the ratios of nuclides, excluding tritium, is 1 or higher)



Source: Developed by Tokyo Electric Power Company Holdings, Inc. based on the map developed by the Geospatial Information Authority of Japan (electronic territory web) <https://maps.gsi.go.jp/#13/37.422730/141.044970/&base=std&ls=std&disp=1&vs=c1j0h0k0l0u0t0z0r0s0m0f1>



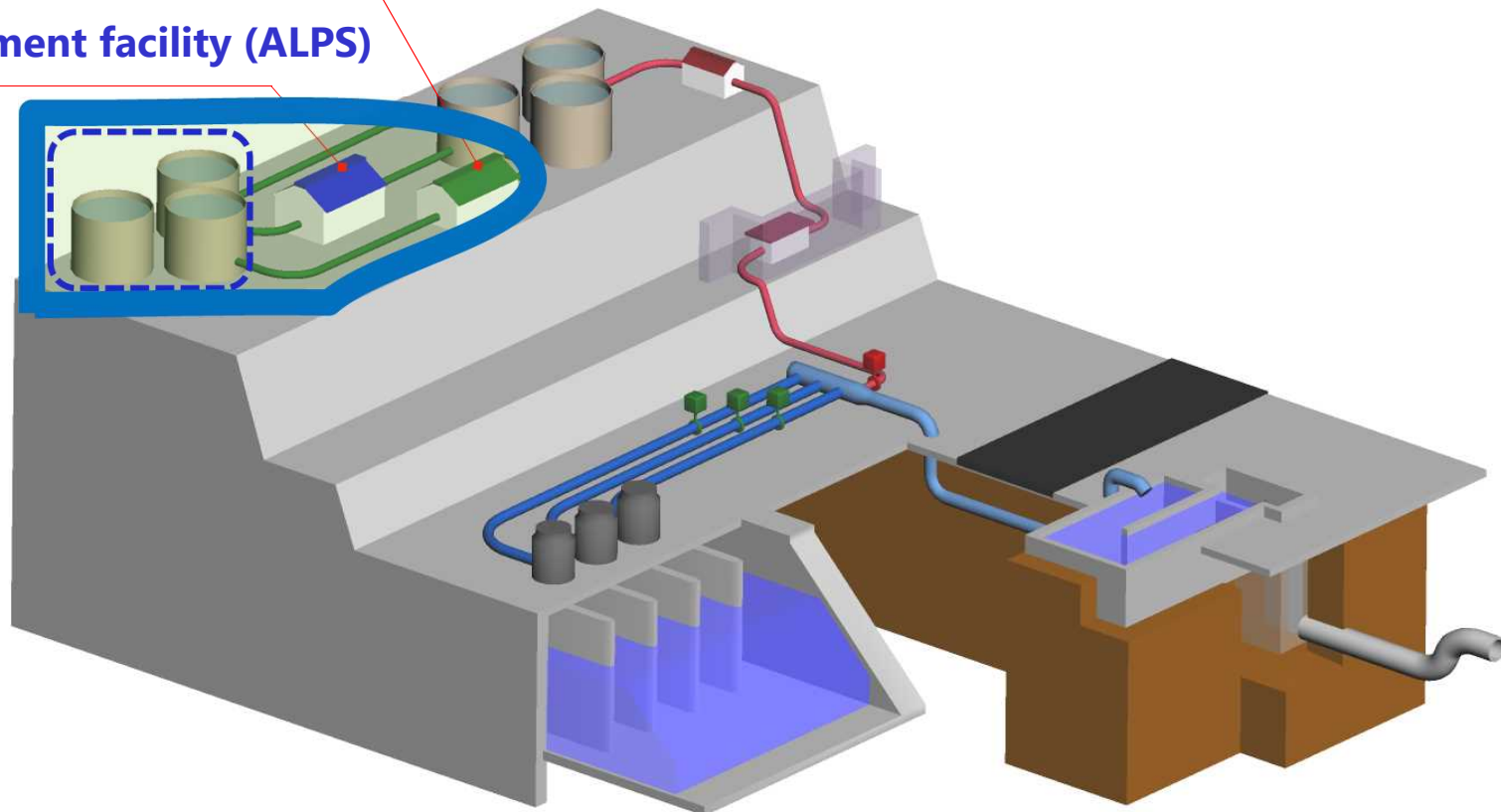
*Area where common fishery rights are not set

Key Points for the Handling of ALPS Treated Water ②

Secondary treatment facility (newly installed reverse osmosis membrane facility)

Secondary treatment facility (ALPS)

ALPS treated water, etc. tanks



① Secondary treatment facility

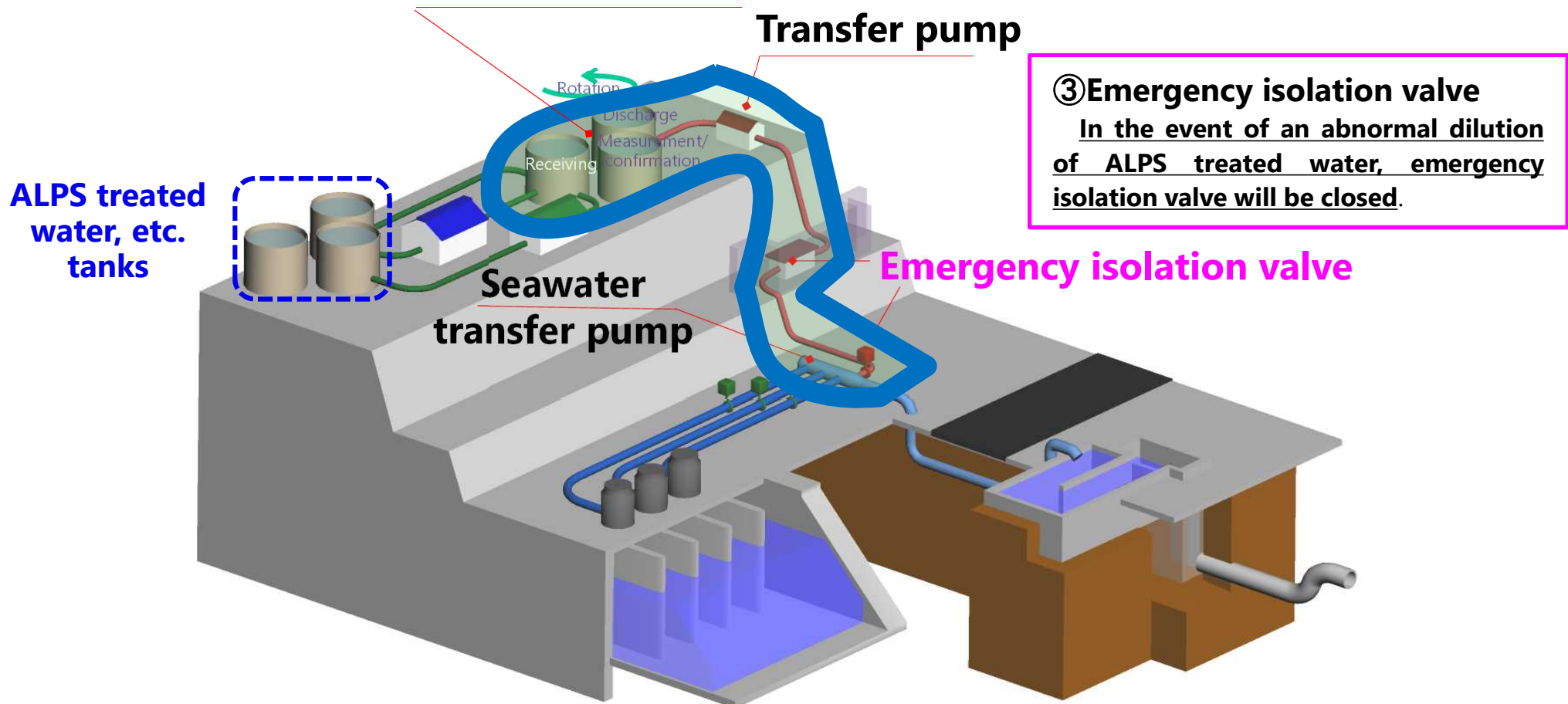
Radioactive materials other than tritium in the water stored in the tanks will **be purified as many times as necessary until they are certainly below the regulatory standard value for safety at the pre-discharge stage.**

Key Points for the Handling of ALPS Treated Water ③

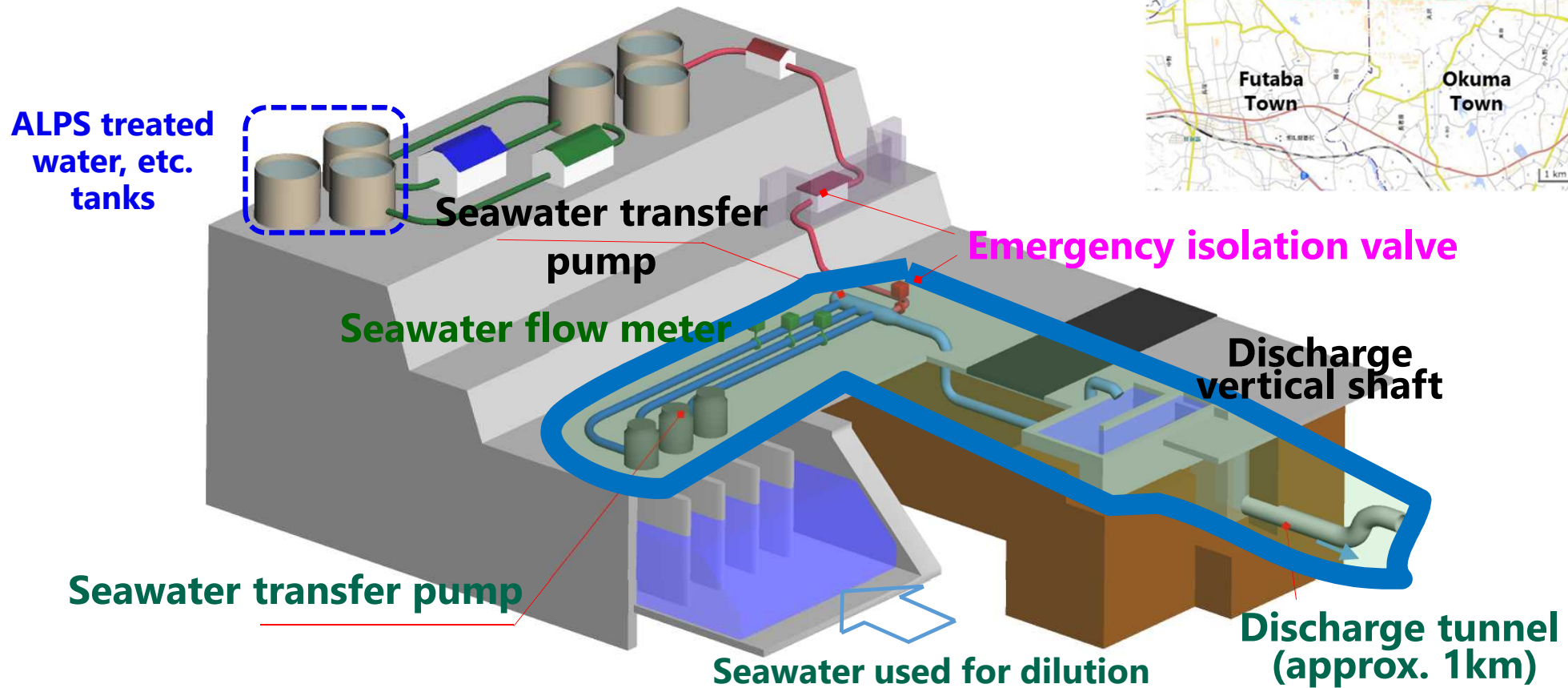
② Measurement/confirmation facility

After homogenizing ALPS treated water, we will discharge only the water which be below the regulatory standard value for safety confirmed through the measurement and assessment by not only TEPCO but also the external agencies.

Measurement/confirmation facility



Key Points for the Handling of ALPS Treated Water ④



④ Amount of ALPS treated water to be discharged

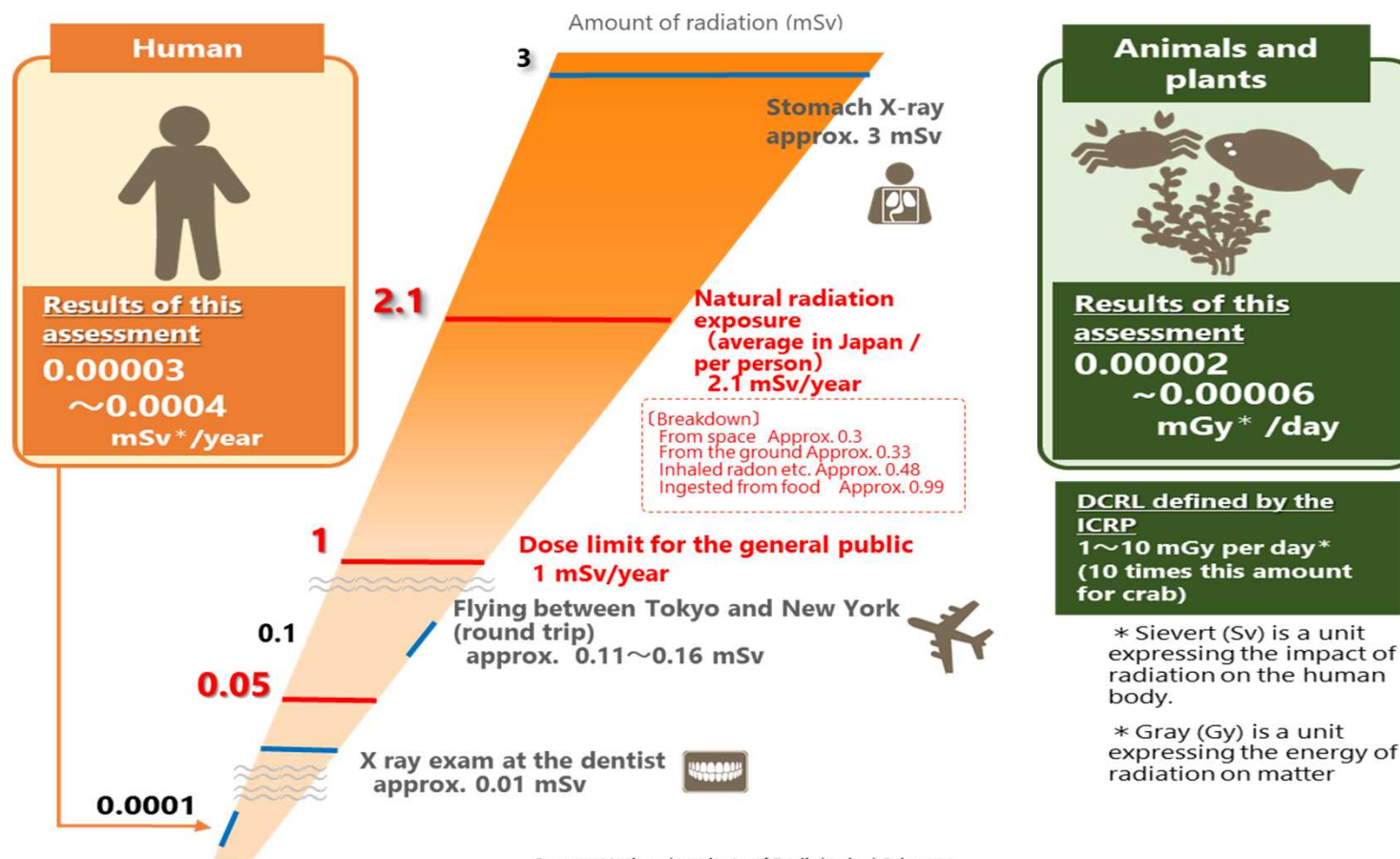
Three pumps with a capacity of approx. 170,000 m³/day each will be prepared so that the tritium concentration after dilution with seawater will be even greater below 1,500 Bq per liter.

We will discharge ALPS treated water while ensuring that the tritium concentration will be less than 1,500 Bq/L and the total amount of tritium to be discharged for a year will be less than 22 trillion Bq. It will be as small as possible to the extent that it does not interfere with decommissioning.

Initiatives for the handling of ALPS treated water ①

Results of the Radiological Impact Assessment

- We have conducted a radiological impact assessment on the public and the environment regarding the discharge of ALPS treated water into the sea using the assessment methodology developed in accordance with internationally recognized methods. The assessment found that **effects of the discharge of ALPS treated water into the sea on the public and the environment is minimal.**
- Results of the assessment on the public found that the exposure dose was **approx. 1/30,000 to approx. 1/3,000** of dose limit for the general public (1 mSv/year), **0.00003 ~ 0.0004 mSv/year.** (X ray exam at the dentist : approx. 0.01 mSv)

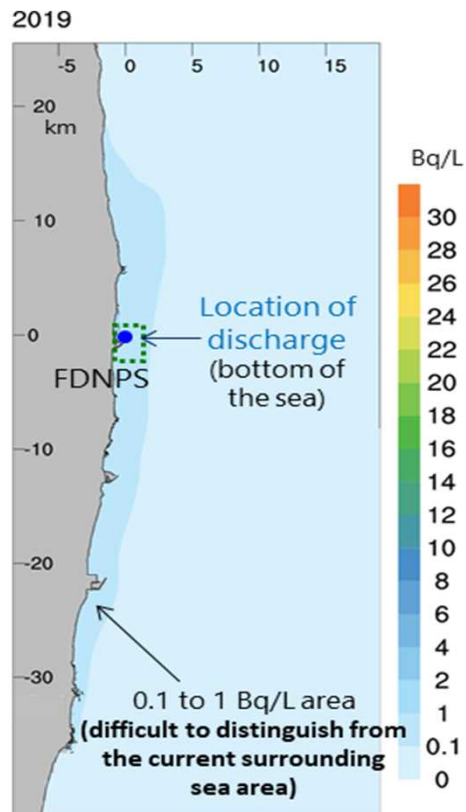


Source: National Institute of Radiological Sciences

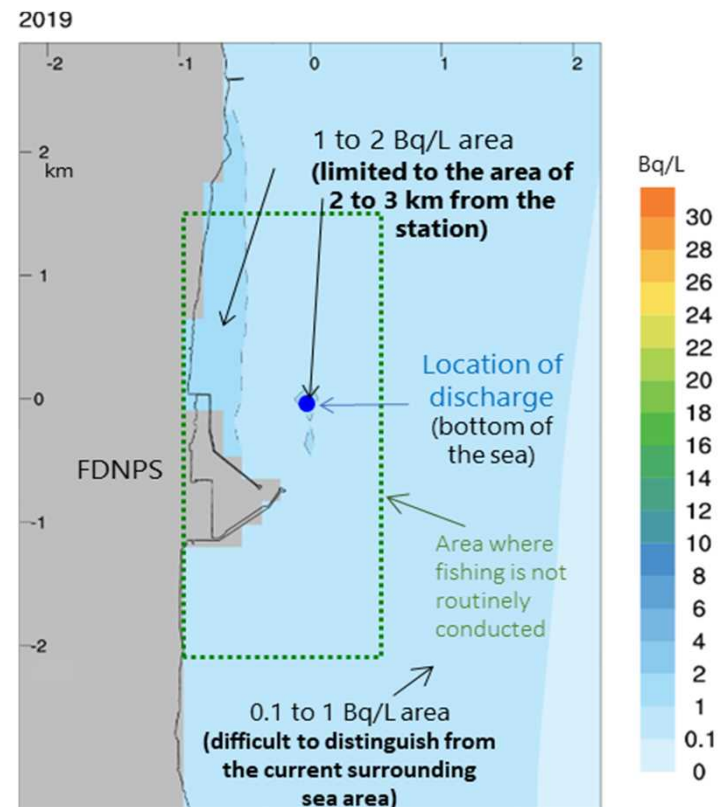
Initiatives for the handling of ALPS treated water ②

Results of dispersion simulation at sea

- If the diluted ALPS treated water is discharged at the undersea tunnel exit approximately 1 km off the coast of TEPCO's Fukushima Daiichi Nuclear Power Station (FDNPS), the simulation (annual average) found that the area assessed to have higher tritium concentration on the surface layer than current levels in the surrounding sea area (0.1 to 1Bq/L) will be **limited to the area of 2 to 3 km from the FDNPS** for the annual average.
- The concentration swiftly falls in areas directly above the undersea tunnel exit and is significantly below the WHO Guidelines for drinking-water quality (10,000 Bq/L).



Enlarged view of the area off the coast of Fukushima (Largest value in scale at 30 Bq/L)



Enlarged view of the area around the FDNPS (Largest value in scale at 30 Bq/L)

Initiatives for the handling of ALPS treated water ③

Securing objectivity and transparency

- TEPCO was reviewed by the International Atomic Energy Agency (IAEA) on the safety aspects of handling of ALPS treated water at the Fukushima Daiichi Nuclear Power Station in February 2022. In April of the same year, the IAEA published a report on its review.
- The report states that in regards to the safety of the facilities, the IAEA has found that, “...TEPCO successfully incorporated prevention measures in the design of the facility as well as in the associated operating procedures.” And, in regards to the radiological impact assessment, “...Task Force acknowledged the comprehensive and detailed assessment that was undertaken in the conduct of the REIA,” adding that, “...**the doses to the assumed representative person are expected to be very low and significantly below the dose constraint set by the regulatory body (NRA).**”
- In March, we set the monitoring plan with additional measurement points and measurement targets and increased frequency in order to strengthen the monitoring of the sea area as the main entity implementing the ALPS treated water discharge. In April, sample collection began in order to continuously confirm the diffusion status, mainly of tritium, and the status of marine organisms before the start of the discharge.
- In addition, in order to show the status of the monitoring in an easy-to-understand manner, Treated water portal site was renovated in September, and a page for sea area monitoring was added. (Japanese version only, English version in preparation)



IAEA Review Conference in February

Overview of the IAEA Review (February, 2022)

【Schedule】

Feb. 14, 17, and 18, 2022 (Meeting at Tokyo)
Feb. 15 and 16, 2022 (Inspection at Fukushima Daiichi Nuclear Power Station)

【Members】

IAEA Task Force consisting of 15 members, including Gustavo CARUSO Director and Coordinator, the IAEA secretariat, and international experts*
* Nationality: United States, United Kingdom, Republic of Korea, France, Russia, China, Viet Nam, and Argentina

【Topics】

- | | |
|---|---|
| 1. Crosscutting requirements and recommendations | 5. Regulatory control and authorization of discharges |
| 2. Characterization of discharge/source term | 6. Source and environmental monitoring programs |
| 3. Safety related aspects of systems and processes for controlling discharges | 7. Involvement of interested parties |
| 4. Radiological environmental impact assessment (REIA) | 8. Occupational radiation protection |



The IAEA task force



The review meeting



Observation of the sampling of ALPS treated water



Inspection around the discharge vertical shaft

Part of a leaflet outlining the IAEA review mission

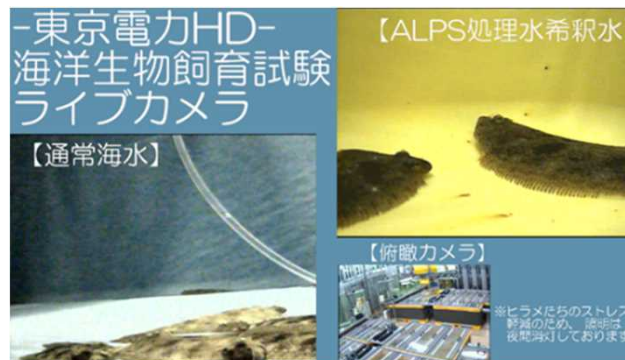
Initiatives for the handling of ALPS treated water ④

Status of the marine organisms rearing test

- After accumulating rearing know-how through the rearing practice that has been conducted since March 2022, in October of the same year, we started rearing tests in both "seawater" and "ALPS treated water diluted with seawater" (currently only for flounder, but abalone and seaweed will also be tested in the future).
- We are **posting the situation daily (weekdays) on Twitter** (in Japanese only) **and on our website**. We also **provide live streaming of rearing tests on YouTube** (in Japanese only).



Marine organism rearing tests ①



Marine organisms rearing tests Live Camera (in Japanese only)



Marine organism rearing tests ②

<Marine Organism Rearing Log>

9 AM, March 17, 2022
 Weather: Sunny
 Water temperature: 15°C

Approximately 100 flounder arrived yesterday and we began rearing at the power station today.
 The flounder are approximately 20cm long and seawater will be used to rear them until around July.
 Since these are living creatures, the handlers tend to be quite careful, and the fish have not yet acclimated to their new environment. This morning they were all very still as if stunned from the earthquake last night.



Marine Organism Rearing Log

Initiatives for the handling of ALPS treated water ⑤

The status of activities to foster understanding

- We provide accurate and easy-to-understand information not only in Japanese, but also in English, Chinese, and Korean, using various contents such as our website "Treated Water Portal Site", videos, and leaflets to deepen the understanding of a wide range of people domestic and abroad. We also make a tour to the site to deepen the understanding of people in Fukushima Prefecture as well as domestic and abroad.

【Treated Water Portal Site】

The website "Treated Water Portal Site" provides comprehensive information on ALPS treated water, including the current status of ALPS treated water, QA, leaflets, etc.

<https://www.tepco.co.jp/decommission/progress/watertreatment/>

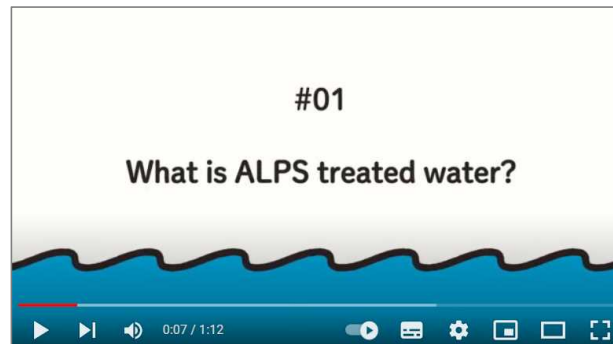


Treated Water Portal Site

【TEPCO Shorts ALPS treated water】

TEPCO Shorts ALPS treated water (one-minute explanatory video) answers various questions about ALPS treated water.

<https://www.tepco.co.jp/en/decommission/progress/watertreatment/link/index-e.html>



TEPCO Shorts ALPS treated water

【INSIDE Fukushima Daiichi】

The Virtual Tour INSIDE FUKUSHIMA allows visitors to experience the decommissioning of the Fukushima Daiichi Nuclear Power Plant on the web.

<https://www.tepco.co.jp/en/insidefukushimadaiichi/index-e.html>



INSIDE Fukushima Daiichi



Overall View of ALPS Treated Water Dilution/Discharge Facility (schematic diagram)

Radiological impact assessment on public and environment

The concentration of tritium contained in ALPS treated water will be below 30 Bq/L near the discharge outlet by diluting with seawater. For the assessment conducted in accordance with internationally recognized methods, results of the assessment on the public found that the exposure dose was approx. 1/3,000 to approx. 1/30,000 of dose limit for the general public (1 mSv/year) and approx. 1/5,000 to approx. 1/70,000 of natural radiation exposure (average in Japan : 2.1 mSv/year).

Amount of ALPS treated water to be discharged

We will discharge ALPS treated water while ensuring that the tritium concentration will be less than 1,500 Bq/L and the total amount of tritium to be discharged for a year will be less than 22 trillion Bq, which is same as the target discharge management value before the accident. It will be as small as possible to the extent that it does not interfere with decommissioning.

Emergency isolation valve

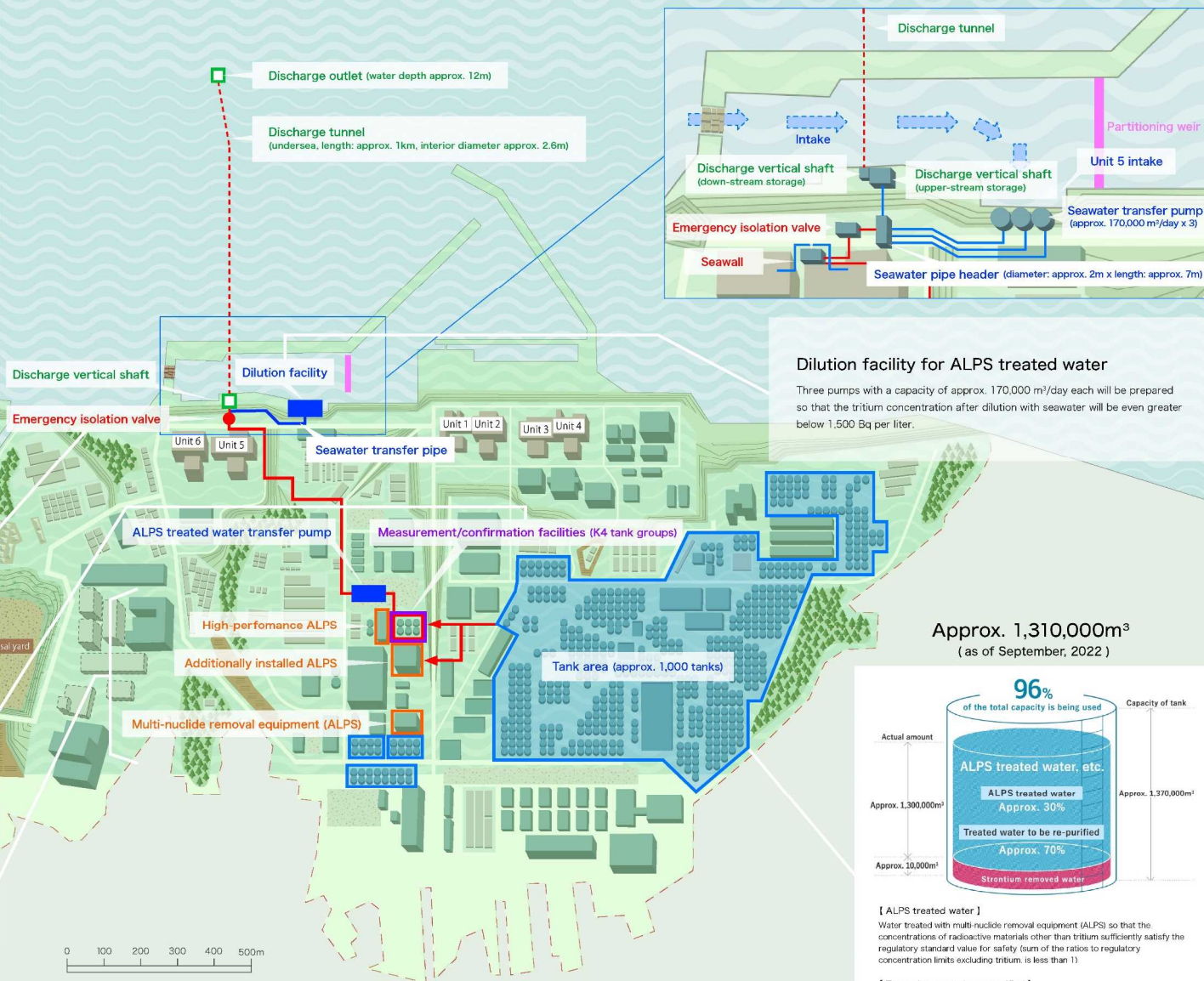
In the event of an abnormal dilution of ALPS treated water, emergency isolation valve will be closed automatically.

Measurement/confirmation facility

Comprised of three sets of tank groups (one group : approx. 10,000m³) each with the role of receiving, measurement/confirmation, and discharge. In measuring/confirmation process, after homogenizing ALPS treated water in the tanks by circulating and agitating, we will discharge only the water only which be below the regulatory standard value for safety confirmed through the measurement and assessment by not only TEPCO but also the external agencies.

Secondary treatment facility

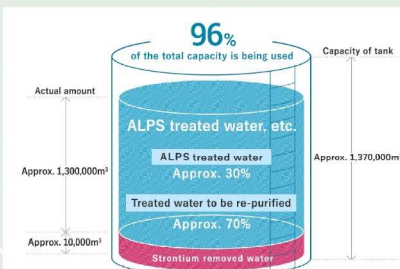
Radioactive materials other than tritium in the water stored in the tanks will be purified as many times as necessary until they are certainly below the regulatory standard value for safety at the pre-discharge stage.



Dilution facility for ALPS treated water

Three pumps with a capacity of approx. 170,000 m³/day each will be prepared so that the tritium concentration after dilution with seawater will be even greater below 1,500 Bq per liter.

Approx. 1,310,000m³
(as of September, 2022)



【ALPS treated water】

Water treated with multi-nuclide removal equipment (ALPS) so that the concentrations of radioactive materials other than tritium sufficiently satisfy the regulatory standard value for safety (sum of the ratios to regulatory concentration limits excluding tritium, is less than 1)

【Treated water to be re-purified】

Water that has been purified with multi-nuclide removal equipment (ALPS), but for which the concentrations of radioactive materials do not meet the regulatory standard value for safety (sum of the ratios to regulatory concentration limits excluding tritium, is 1 or higher)

Before discharging into the sea, it will be re-purified to remove radioactive materials other than tritium until satisfying the regulatory standards

Reference ②

Explanation Using the ALPS Treated Water Sample Bottle Given during Visits to the Fukushima Daiichi Nuclear Power Station

- An article (October 3, 2022) entitled, “‘Manipulating impressions’ not possible to avoid criticism” that refers to the explanation given during visits to the Fukushima Daiichi Nuclear Power Station using a multi-nuclide removal equipment (ALPS) treated water sample bottle appeared in a newspaper. The main purposes of the explanation that TEPCO gives using an ALPS treated water sample bottle are as follows and we explain these in detail using a flip board, etc.

[The main purposes of TEPCO’s explanation during visits]

- The concentrations of 62 gamma nuclides, such as cesium 137, etc., in ALPS treated water have been reduced below the national regulatory standard value by purifying and treating with ALPS, etc.
 - As a result, the amount of gamma radiation that would have an impact on the human body in the form of external exposure has been reduced to at least approximately the same level as background radiation (the air dose rate at the measurement location).
 - Also, water that has been purified and treated with ALPS, etc., still contains concentrations of unremovable tritium with ALPS, etc. (beta rays nuclide) that exceed the regulatory concentration limit, and therefore, we will discharge ALPS treated water only after diluting the water with seawater. (dilution with seawater until the tritium concentration will be below 1/40 of the regulatory standard).
 - The beta radiation emitted by tritium contained in ALPS treated water is so weak that it can be shielded with a single sheet of paper, so the beta rays from the water in the bottle are shielded by the bottle that it is in.
 - Therefore, the dosimeter used to measure gamma rays during the explanation cannot measure beta radiation, and even if attempts were made to measure the beta rays with a dosimeter, it would be impossible to show those radiation measurements in the field.
- Furthermore, the air dose rate at the location in which the explanation is given (on site at the power station) is approximately 0.12 μ Sv per hour, if the concentrations of gamma nuclides such as cesium 137 in the water in the bottle were remained to the level that would result in external exposure (approximately 4,000Bq/L (approximately 44 times the regulatory concentration limit of 90Bq/L) or more, according to our calculation), the needle of the dosimeter used to measure gamma rays would move, however, there are no such levels of radioactive substances in the water purified and treated with ALPS. Also using a flip board to show the concentration of cesium 137 before and after purification and treatment with ALPS, etc., we explain that there are no radioactive substances in ALPS treated water in the bottle that would result in external exposure, additionally in fact, cesium 137 has been successfully purified and treated to below the detection limit (value not detected by detailed analysis performed separately, NOT by measured with the dosimeter at the time of the explanation), which is even lower than the regulatory concentration limit, thereby deepening the understanding of the characteristic of ALPS treated water.
 - Although we deeply regret this news, we will continue to make various efforts to disseminate information on ALPS treated water and decommissioning in an accurate and easy-to-understand manner.



Visit to the Fukushima Daiichi Nuclear Power Plant by IAEA Director-General, H.E. Mr. Rafael Mariano Grossi (May 19, 2022)