Status of Progress of the installation of ALPS treated water dilution/discharge facility and related facilities

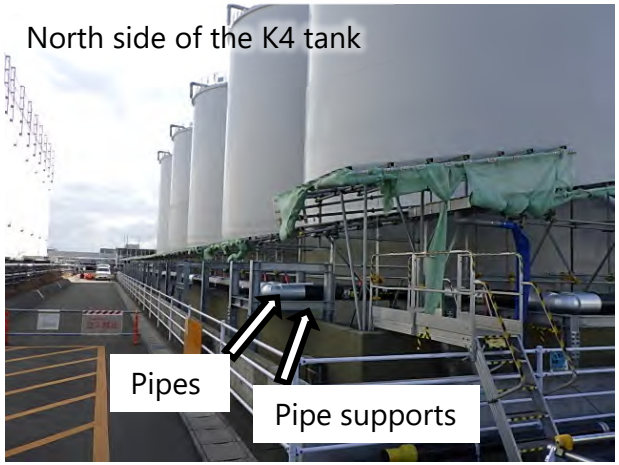
April 27, 2023

Tokyo Electric Power Company Holdings, Inc.

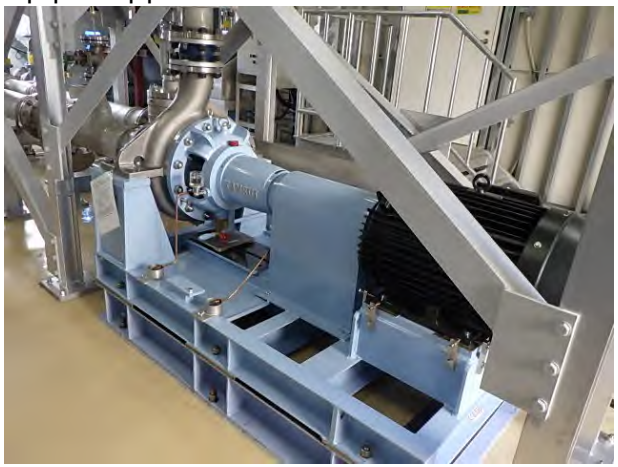
1. Status of construction

■ Measurement/confirmation facility and transfer facility

The installation of pipe supports and pipes for the measurement/confirmation facility and the transfer facility began on August 4 from the area around K4 tank area.
Pre-service inspection was started on January 16.



Installing circulation pipes and pipe supports



Circulation pump

Installing the piping supports/pipes

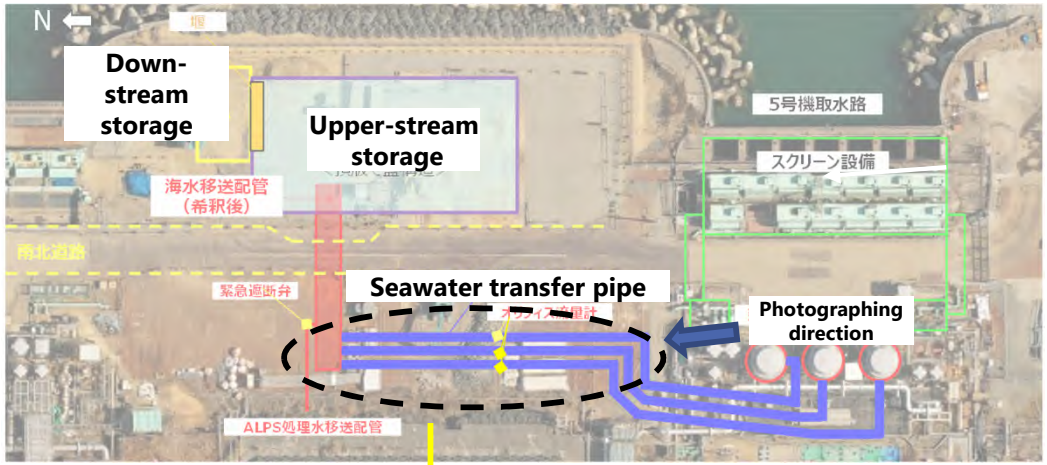
【 Measurement/confirmation facility 】
・Supports
Approx. 540 out of approx. 540m
・Pipes
Approx. 1,000 out of approx. 1,000m

【Transfer facility】
・Supports
Approx. 1,495 out of approx. 1,500m ※1
・Pipes
Approx. 1,463 out of approx. 1,500m ※1
※1 Descriptions have been revised
<As of April 24>

【Measurement/confirmation facility】
March 15
・Received the use inspection completion certificate
March 17～27
・Started circulation/agitation operation
March 27
・Took samples from the B tank group

■ Dilution facilities

The driving of piles for the foundation and construction of the foundation frame for the seawater transfer pipes have been completed. Installation of pipes and other equipment are currently underway.

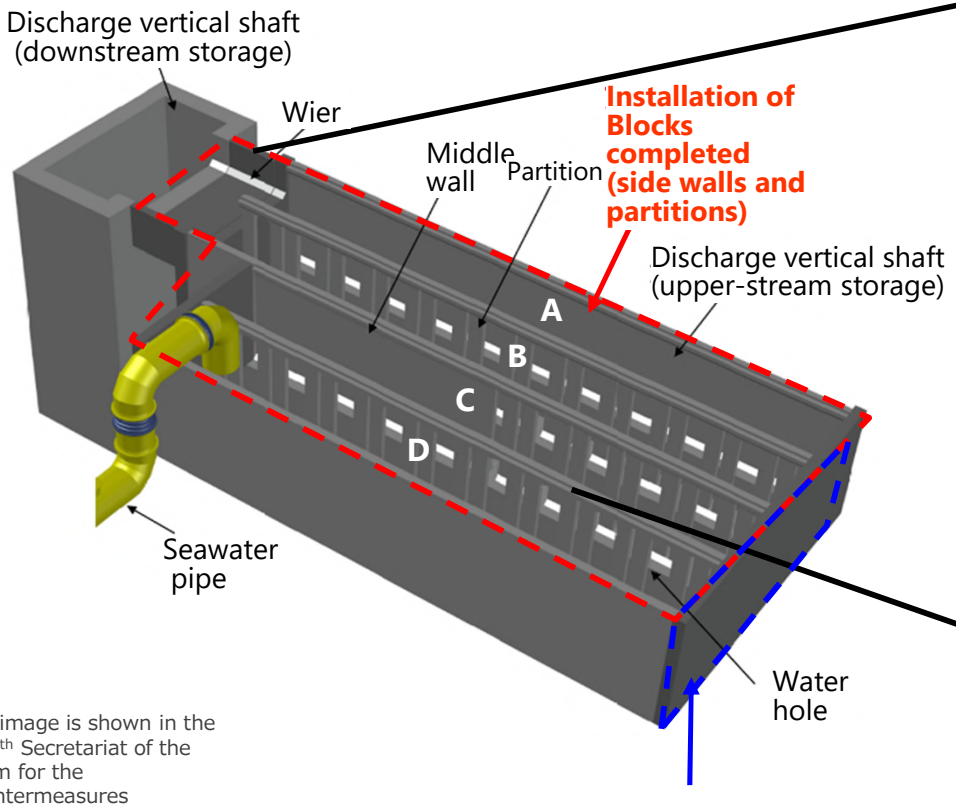


【Dilution facilities】
・Constructing the foundation of pipe foundation
11 out of 11 complete
・Support facility
0 out of 320 m complete
・Pipe facility
0 out of 320 m complete
<as of April 24>

Building the seawater transfer pipes foundation and installing the seawater pipe header

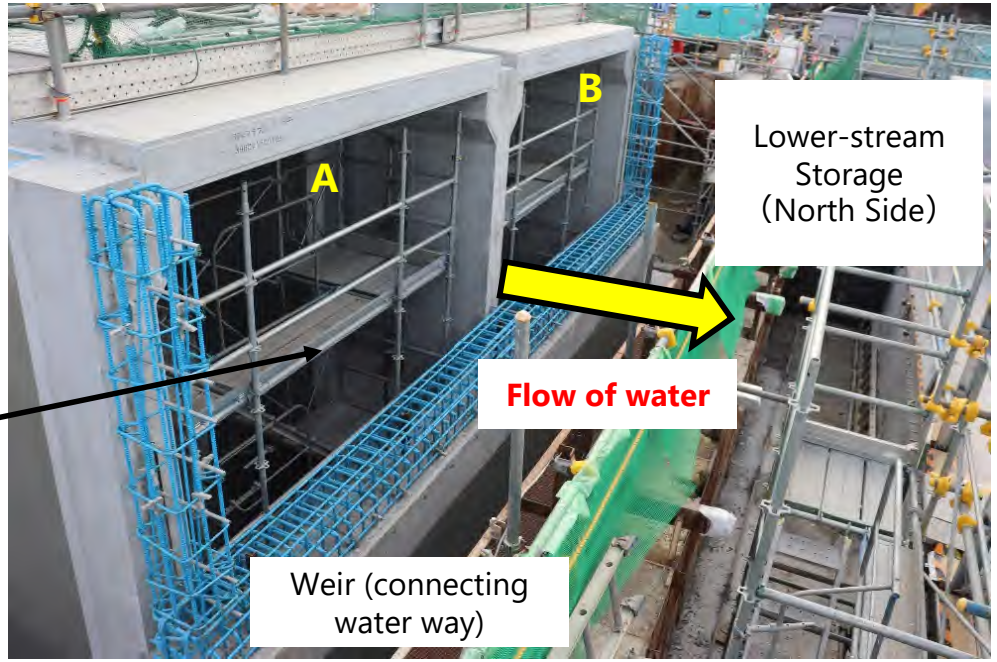
1. Progress in construction (cont.)

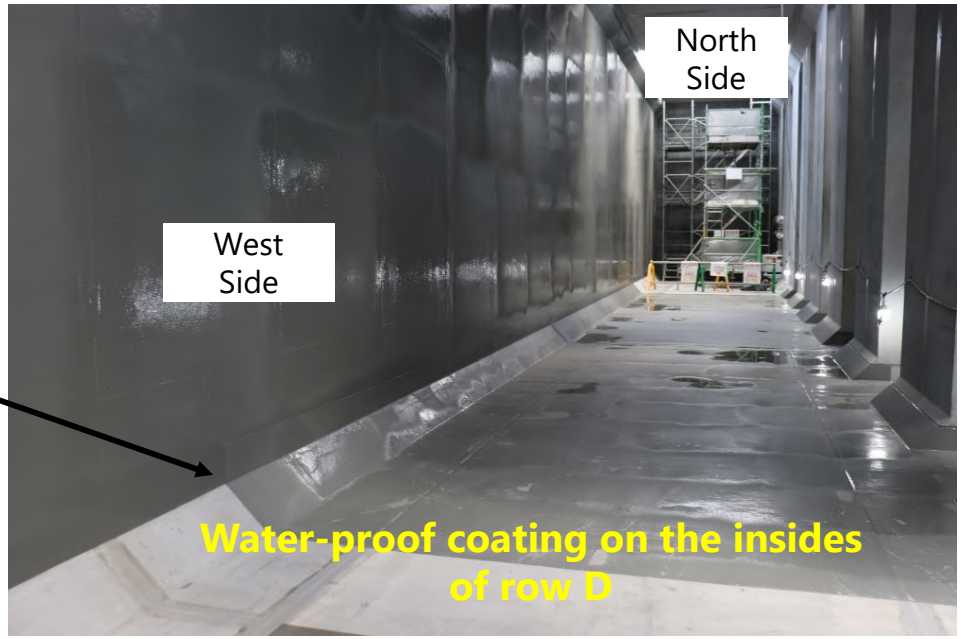
- Dilution facility: Discharge vertical shaft (upper-stream storage)
  The installation and assembly of the blocks (manufactured outside of the premises) started on January 12 and the concrete pouring for the deck slab (base) started on February 9 were completed. It will now be painted with a waterproof coating.



The image is shown in the 110th Secretariat of the Team for the Countermeasures for Decommissioning and Contaminated Water Treatment

Concrete pouring for the end walls is complete





1. Progress in construction (cont.)

■ Discharge facility: discharge tunnel

Date	Item (progress)
April 1	Started digging the remaining 200m of the tunnel
April 22	Main tunneling (tunneling of the bedrock) is completed. Started tunneling the arrival areas (connection to the discharge port caisson)*
April 25	Arrived at the tip of the fluidized soil inside the arrival tube. Started fixing the shield machine in place.
April 26	Tunneling complete

【Discharge facilities】
・Discharge tunnel: Tunneling complete (tunnel length: 1031 m)
<As of April 26>

*See slides 5 and 6 for details of the work performed after tunneling was complete

1. Progress in construction (cont.)

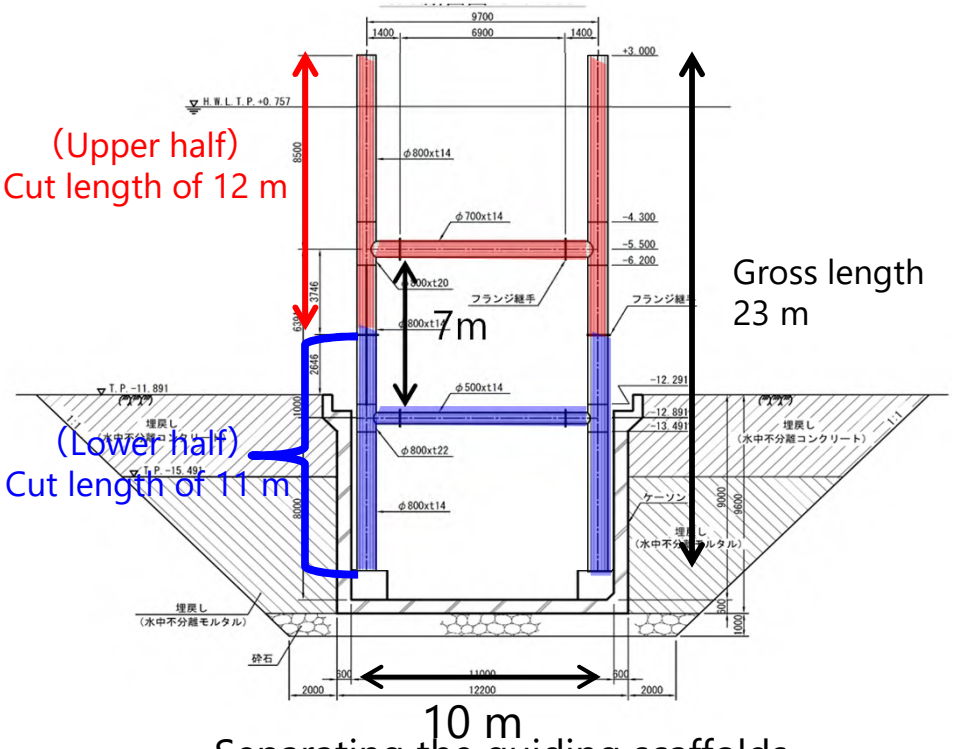
■ Discharge facilities: discharge port caisson

The temporary guiding scaffolds* that were attached to the caisson were removed. It was separated into the upper and lower halves, and the upper half was removed on April 9 and the lower half on April 13.

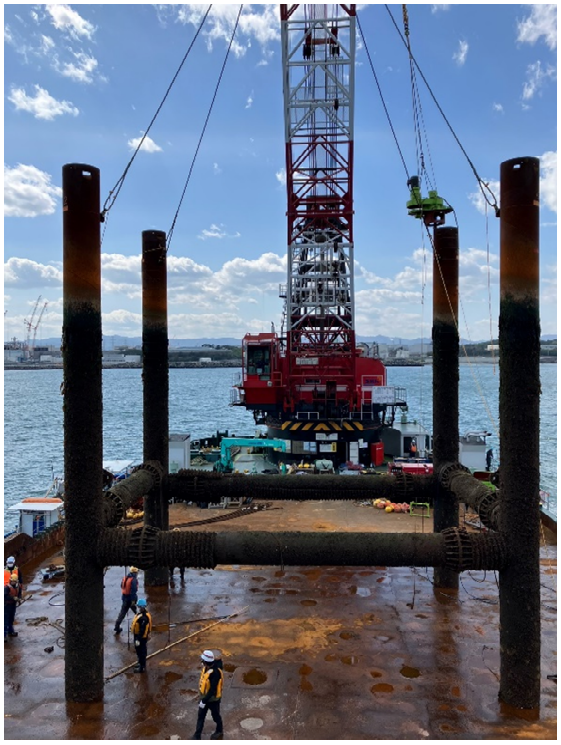
*The guiding scaffolds were used to mark the location of the caisson to ensure the tunnel arrived at the right location. Measuring instruments were loaded onto the top of the scaffolds to obtain location information.

【Discharge facilities】

・Discharge outlet caisson: Guiding scaffolds were removed
＜As of April 13＞



Separating the guiding scaffolds
(upper and lower halves)

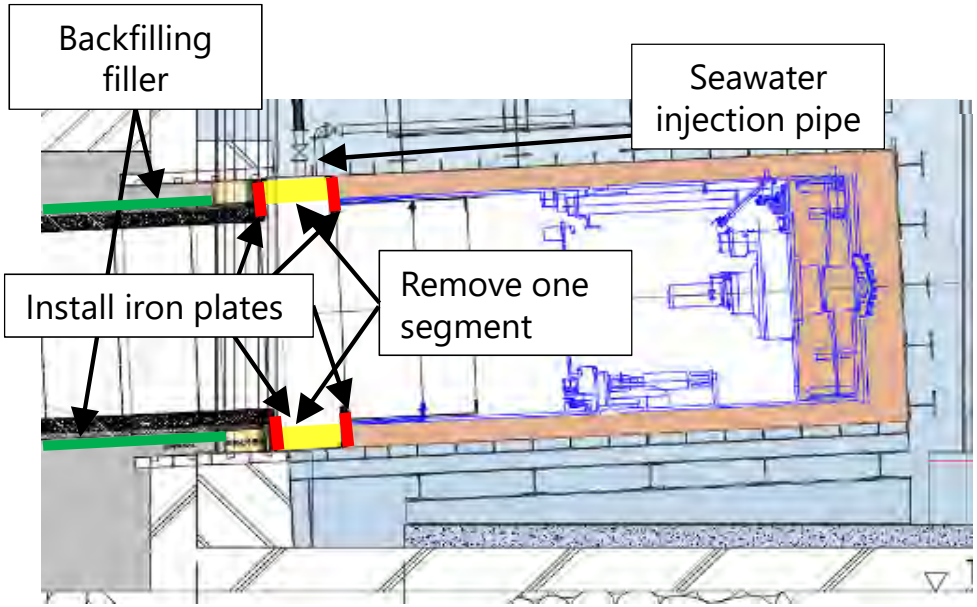


Guiding scaffolds
(upper half) being removed

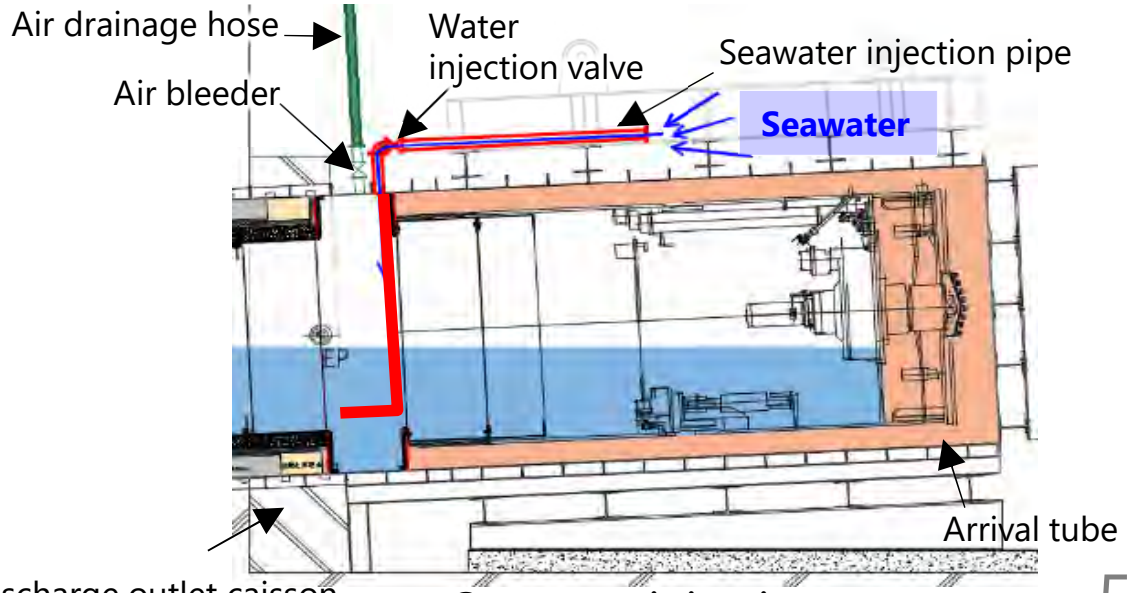
Guiding scaffolds
(lower half) being removed

(Reference) Preparations to remove the arrival tube (shield machine)

■ Equipment removal	• Connecting wagons that were used with the shield machine, the overhead crane with the hoist and the sludge transportation pipes will be removed.
■ Waterproofing works	• To prevent the groundwater within the bedrock and from the joint between the discharge port caisson and the backfilling (projected water routes) from sprouting out, those areas will be waterproofed with backfilling fillers and other chemicals (areas in green in the diagram below). • One segment (at the 1,030m mark of the tunnel) near the seawater injection tube will be removed (area in yellow in the diagram below). • Iron plates will be installed on both ends of the area where the segment was removed to stop water from seeping in (area in red in the diagram below).
■ Cleaning up the inside of the tunnel and the lower-stream storage	• Light fixtures, water feeding and discharge tubes, rails within the tunnel and the stairs within the down-stream storage will be removed.
■ Seawater injection	• Once cleanup inside the tunnel is complete, a diver will install an air removal hose and open the air bleeder. • Once the air bleeder is confirmed to be open, a diver will open the water injection valve to inject water into the tunnel.



Waterproofing work

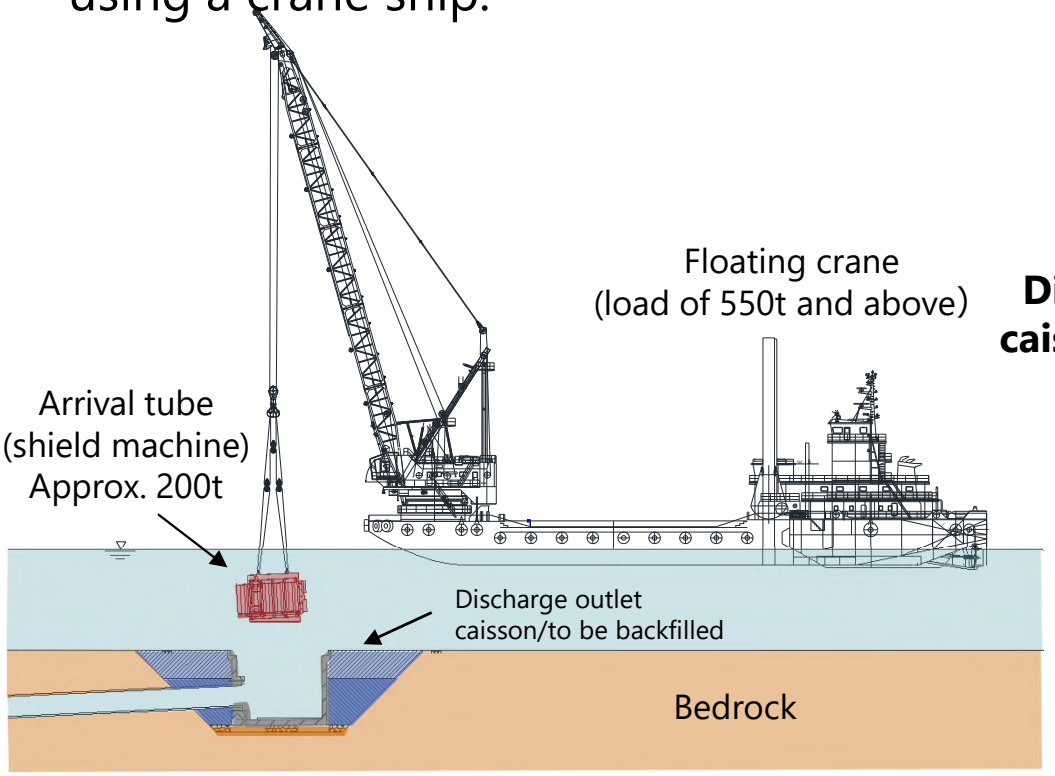


Seawater injection

(Reference) Removal of the arrival tube (shield machine)

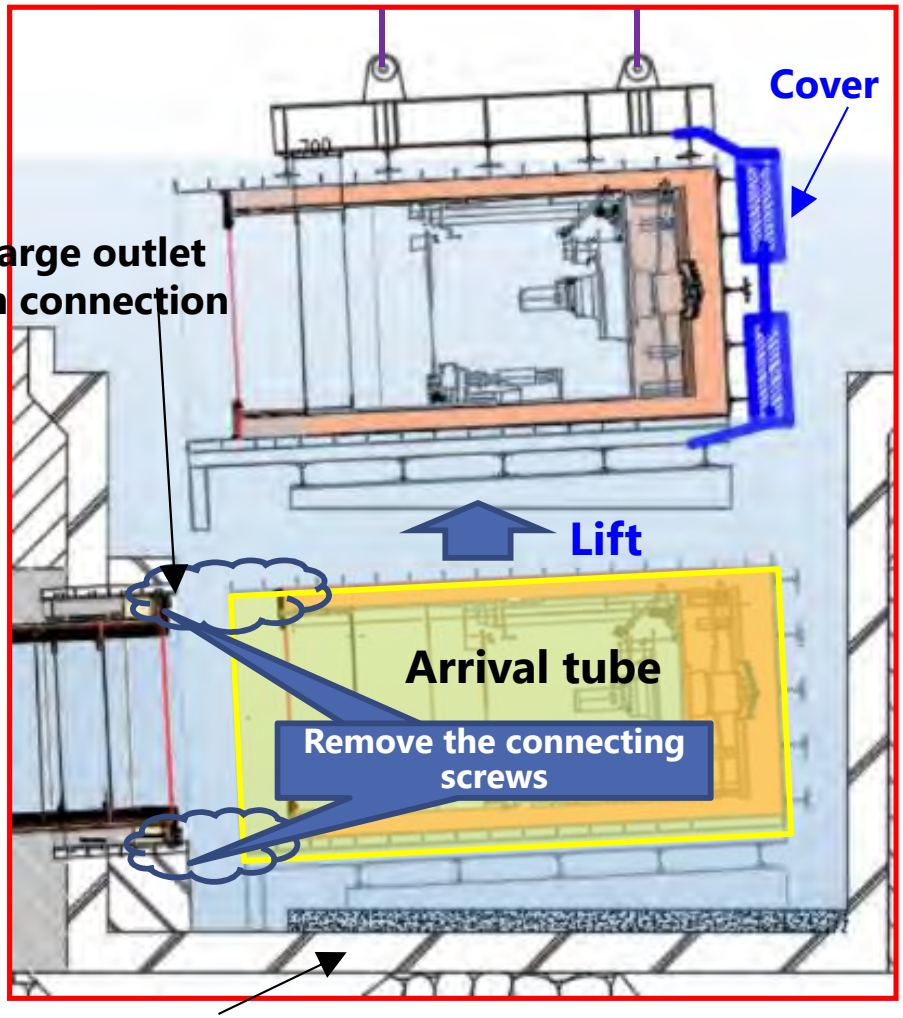
[Removal of the arrival tube (shield machine)]

- Once the tunnel is full of seawater, a diver will separate the arrival tube from the connection for the discharge outlet caisson. The arrival tube will then be removed using a crane ship.



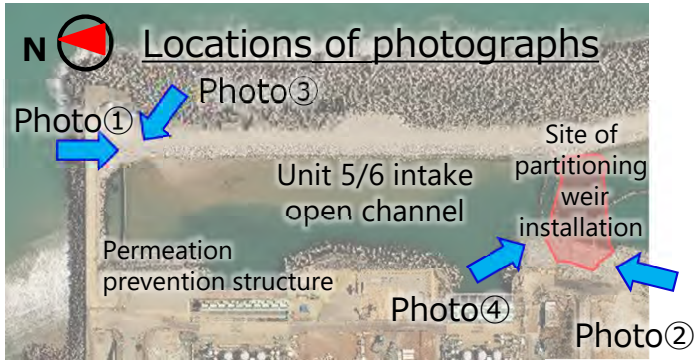
Arrival tube (shield machine) removal

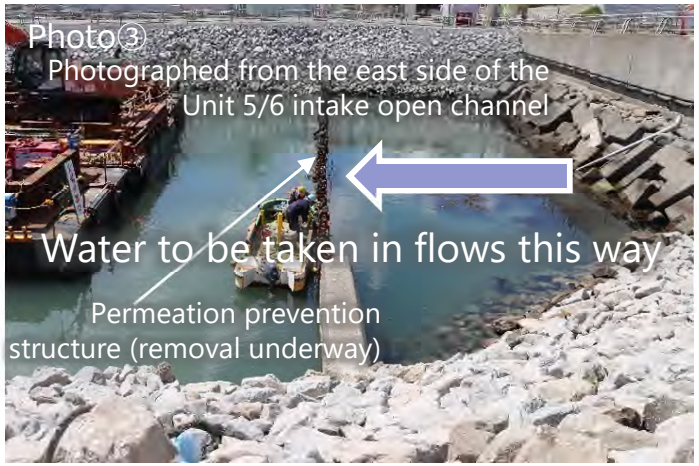
Enlarged

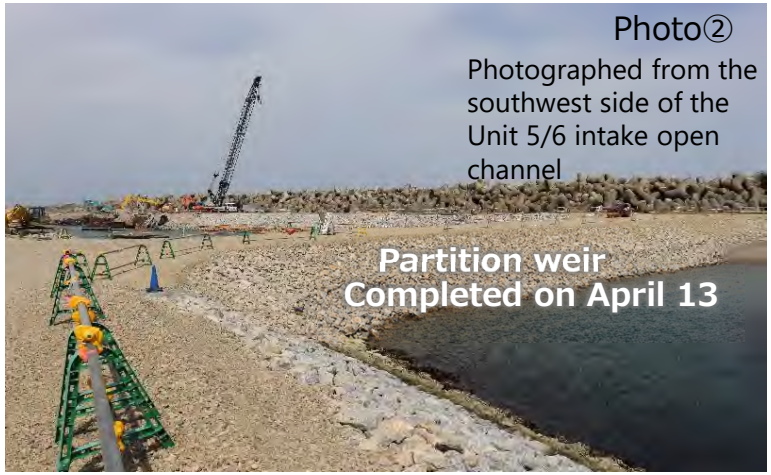


1. Status of construction (cont.)

- Other (building a partition weir, etc.)
  In the Units 5 and 6 sea-side construction area, the heavy machinery scaffolding was completed on December 29. The scaffolding has been in use for building the upper-stream storage since January 5. The removal of silt from the open intake channel (dredging) and the building of the partition weir (completed on April 13) are being done simultaneously. Partial removal of permeation prevention wall was started on April 18.





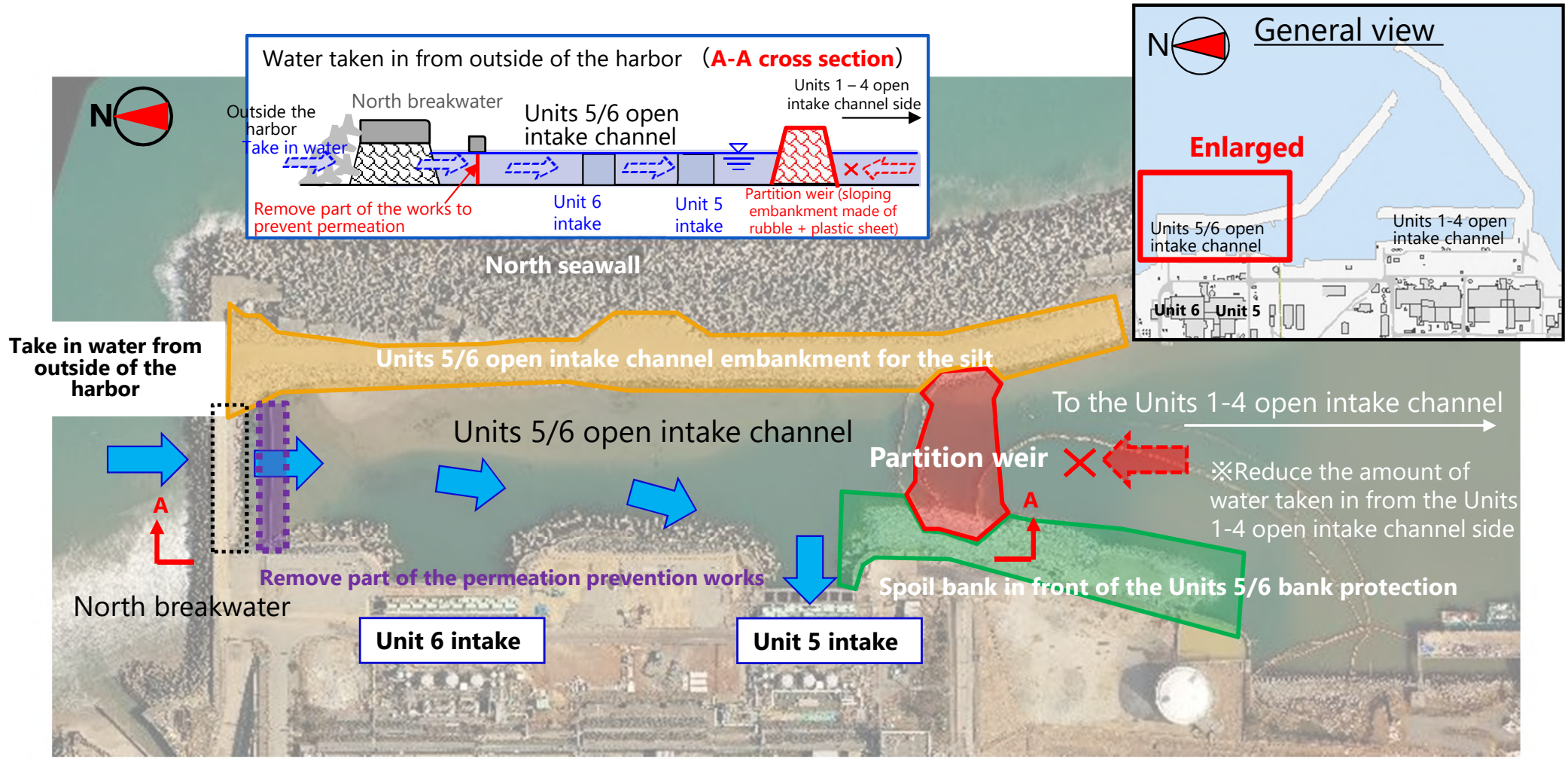


Work area on the sea side of Unites 5/6

(Reference) Overview of the intake method

- The partition weir (sloping embankment made of rubble + plastic sheet*) will separate the Units 5/6 open intake channel from the harbor on the Units 1 through 4 side. Part of the permeation prevention works near the north seawall will be modified to allow seawater for dilution to be taken in from outside of the harbor.
- By cutting off the open intake channel from the harbor on the Units 1 through 4 side and taking in water from outside of the harbor, seawater within the harbor with relatively high radioactive concentrations will be less likely to be used in dilution.

* 5mm-thick flexible PVC mat



Overview of the water intake method

Source: Japan Space Imaging (Photo taken on April 8, 2021) Product(C)[2021] DigitalGlobe, Inc., a Maxar company.

(Reference) Improving the environment inside of the Units 5/6 open intake channel for taking in water

- Since October 2022, dredging work has been performed to improve the environment inside of the Units 5/6 open intake channel for taking in water.

- The inside of the Units 5/6 open intake channel has been monitored since August 2022, before the dredging started. While the dredging is being performed, radioactive material concentration analysis will be performed on the seawater (every day that there is work being done) and seabed soil (silt; monthly basis).

- The seabed soil (silt) monitoring has found that the radioactive material concentration in front of the Unit 5 intake was 12,290Bq to 144,000Bq (Cs-137; 2 to 22 times previously taken measurements) since January 2023. There was no significant fluctuations in the radioactive material concentration in seawater during the same period.

- Silt removal from the area in front of the Unit 5 intake was completed in November to December 2022, and our evaluations seem to shown that no seabed soil (silt) was moved when taking in water for dilution. However, to further improve the environment inside of the Units 5/6 open intake channel for taking in water, we have decided to carefully remove the silt from the area outside of the Unit 5 intake that is within our premises to be completed before discharge starts.

- Seabed soil monitoring will be continued even once discharge starts and if high cesium concentrations is observed in the silt in the seabed soil and there is significant fluctuations in the cesium concentration in seawater, we will remove the silt to maintain a good environment within the Units 5/6 open intake channel for taking in water.

(Reference) Results of the seawater monitoring of the Units 5/6 open intake channel while in construction

TEPCO

- Overview

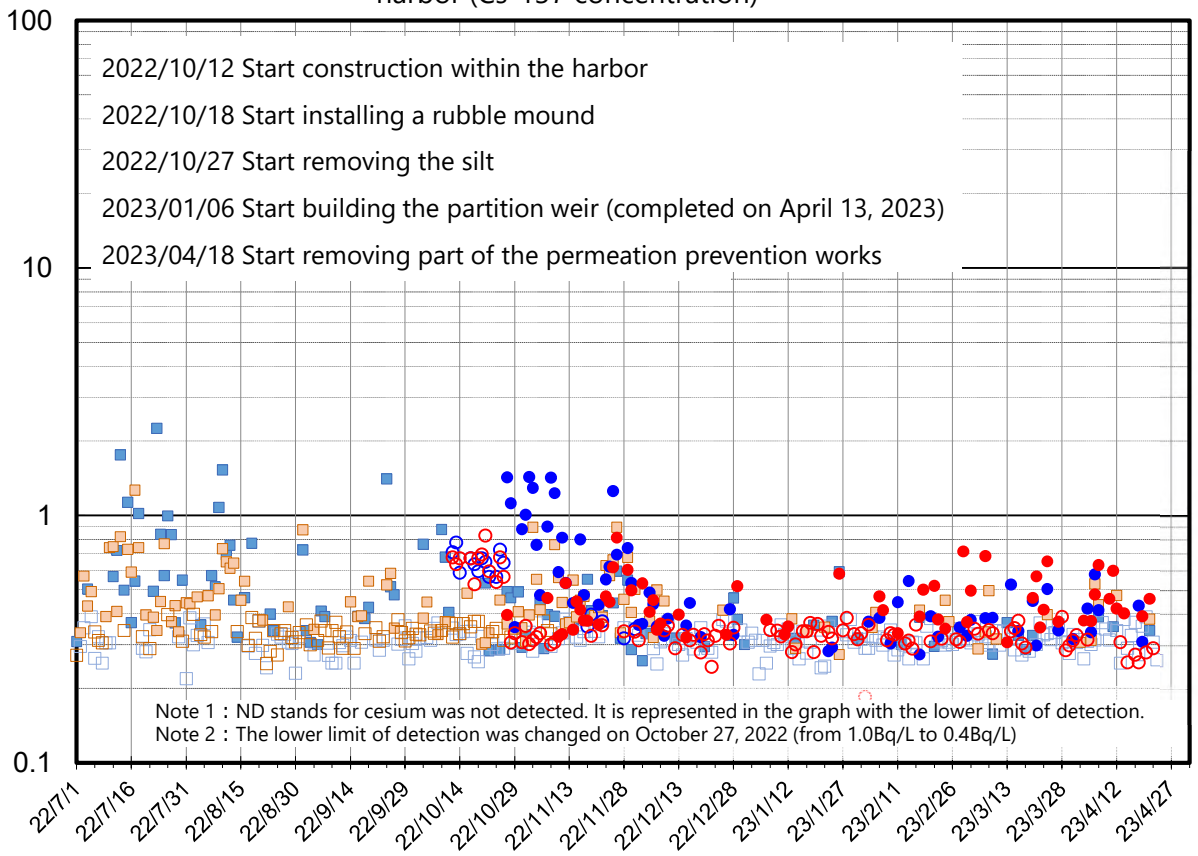
While construction was being performed inside the Units 5/6 open intake channel, a pollution prevention fence was installed in front of the intake to reduce the amount of radioactive materials in the water taken into Units 5/6. Seawater sampling found that the concentration of cesium within the seawater does not rise due to the construction.

- Results

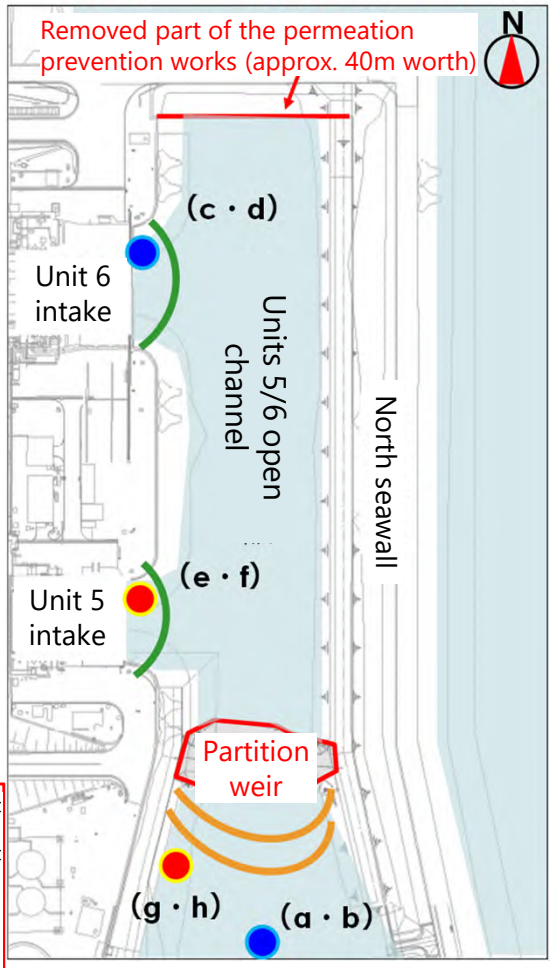
As of April 23, 2023, no significant fluctuation in cesium concentration in seawater has been identified. We will continue to perform appropriate seawater monitoring while working in the Units 5/6 open intake channel.

Results of seawater monitoring during construction in the harbor (Cs-137 concentration)

Updated on April 23, 2023

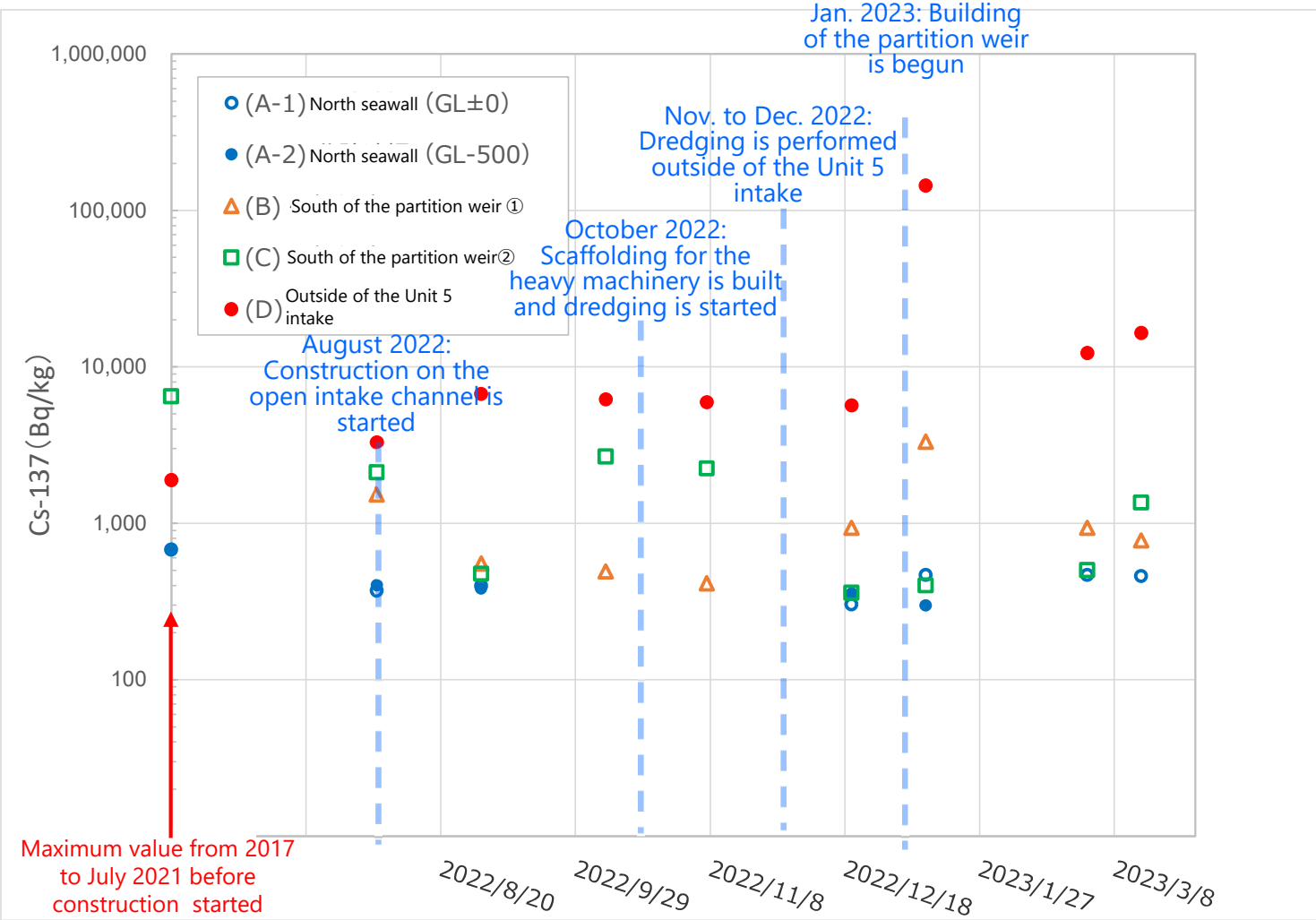


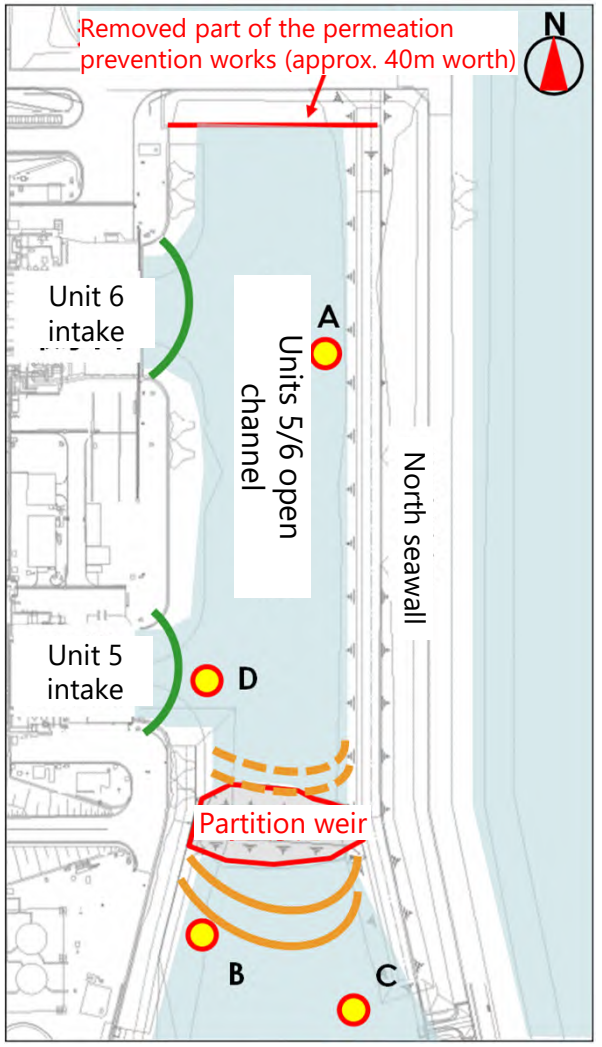
Periodic_North side of the inside of the harbor (a)
Periodic_North side of the inside of the harbor ND (b)
Periodic_in front of the Unit 6 intake (c)
Periodic_in front of the Unit 6 intake ND (d)
During construction_in front of the Unit 5 intake (e)
During construction_in front of the Unit 5 intake ND (f)
During construction_South side of the partition weir (g)
During construction_South side of the partition weir ND (h)



(Reference) Results of the seabed soil monitoring of the Units 5/6 open intake channel while in construction

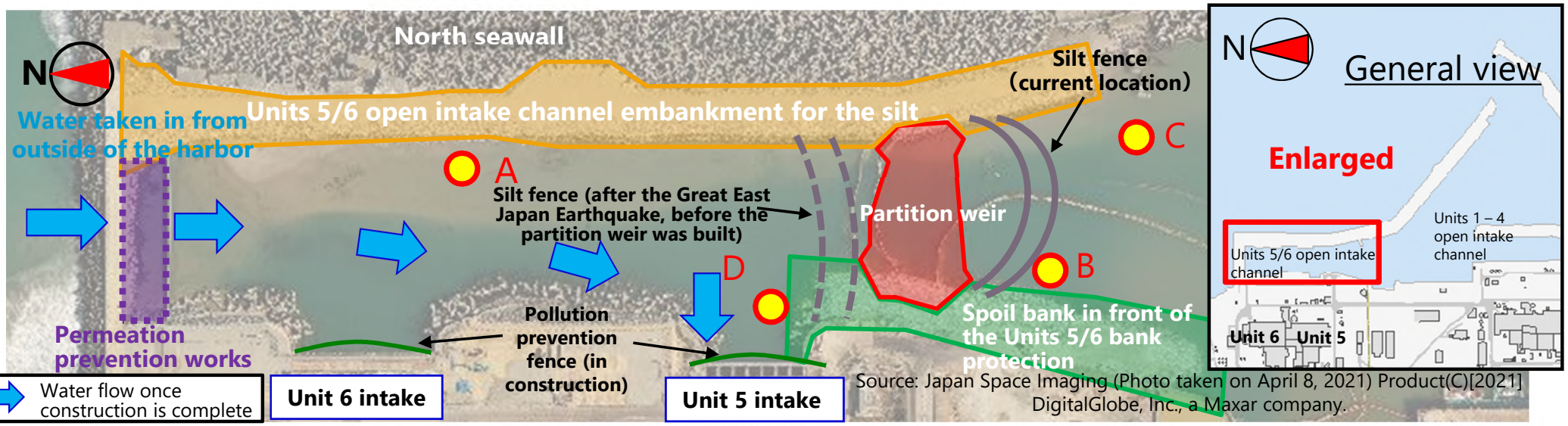
- Results of the seabed soil monitoring performed from before construction was started is shown below.
- While there had been no significant fluctuations in measurements taken near the Unit 5 intake until December 2022 after construction was started, values increased in January 2023 and has been high since. There have been no significant change in the seawater values measured in the same period.
- Prior to 2021, measurements taken near the silt fence (where the partition weir current is) used to show similarly high figures.





(Reference) Results of the seabed soil monitoring of the Units 5/6 open intake channel while in construction

- Point A is where sand with relatively low radioactive material concentration that flowed in from the north seawall side, piled up after the Great East Japan Earthquake.
- Points B and C are where sand with relatively high radioactive material concentration flowed in from the Units 1-4 open intake channel side, piled up.
- Point D is where the silt fence used to be located immediately after the Great East Japan Earthquake. Sand with relatively high radioactive material concentration from the Units 1-4 open intake channel side that was caught in the silt fence, piled up locally.
- There has been no significant fluctuations in seawater measurements during this period.



Source: Japan Space Imaging (Photo taken on April 8, 2021) Product(C)[2021] DigitalGlobe, Inc., a Maxar company.

Sampling points		Before construction	2022					2023		
		2017 to July 2021	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A−1 North side of the Units 5/6 open channel (North side of the silt fence GL±0m)	Cs−134	4.4～52.3	33.2	36.0	−	−	31.5	37.2	39.8	39.8
	Cs−137	163.6～678.6	371.6	398.8	−	−	303.2	468.1	460.2	460.2
A−2 North side of the Units 5/6 open channel (North side of the silt fence GL−0.5m)	Cs−134	14.4～58.5	33.6	32.5	−	−	38.3	33.4	−	−
	Cs−137	310.0～689.8	404.0	383.2	−	−	356.4	299.1	−	−
B South side of the partition weir ① (South side of the silt fence)	Cs−134	723.0	34.5	42.1	65.6	55.4	46.7	73.9	49.1	43.1
	Cs−137	6,475.0	1,528.0	553.9	492.4	412.8	936.0	3,331.0	936.1	777.0
C South side of the partition weir ② (South side of the silt fence)	Cs−134	183.0	51.3	47.2	68.7	59.7	51.8	40.3	30.9	40.3
	Cs−137	1,893.0	2,114.0	476.0	2,671.0	2,242.0	360.8	400.5	503.5	1,356.0
D Unit 5 intake	Cs−134	—	101.6	184.0	213.7	160.4	108.7	3,546.0	167.4	472.0
	Cs−137	—	3,301.0	6,714.0	6,198.0	5,941.0	5,678.0	144,000.0	12,290.0	16,972.0

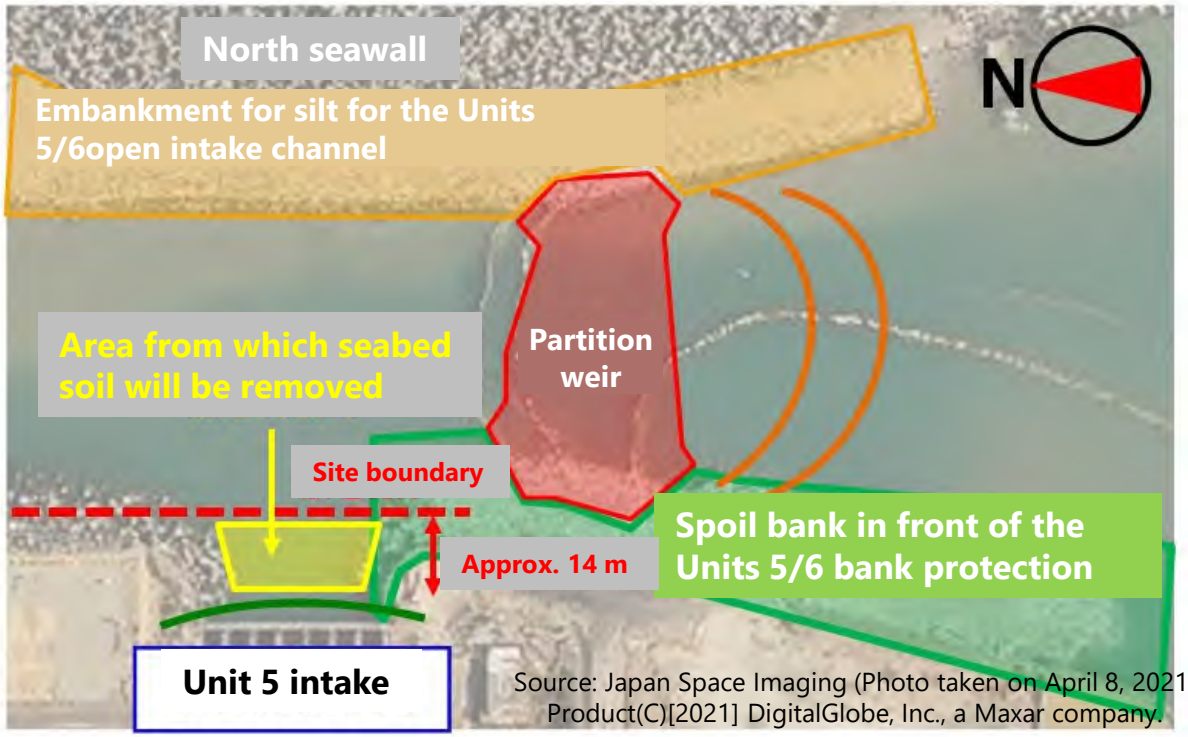
※Greyed out areas were below the detection threshold.

Within the Units 5/6 open intake channel, the area near the partition weir (silt fence) is exhibiting relative high concentrations of radioactive material.

（Reference） How the silt in front of the Unit 5 intake

- Seawater monitoring has found no significant fluctuations in cesium concentration. However, because high cesium levels were observed in the seabed soil samples taken outside of the Unit 5 intake, silt will be carefully removed before discharge starts.
- Using a backhoe dredger or an underwater pump, the seabed soil from the Unit 5 intake to the station site boundary (14m area) will be moved up to the concrete bottom of the intake (T.P.-5.0m).
- Dredging will be performed carefully and slowly at a pace of 10 to 20m3/day(*) to reduce the amount of radioactive material that may spread into the water that will be taken into Units 5 and 6. To prevent the Unit 5 intake from sucking in sand, the pollution prevention fence will be kept at the front of the Unit 5 intake. The concentration of radioactive materials within the harbor will continue to be monitored and turbidity will be checked to ensure silt is not spreading.

(*) Last year, silt had been removed from within the Units 5/6 open intake channel at a pace of 200m3/day.



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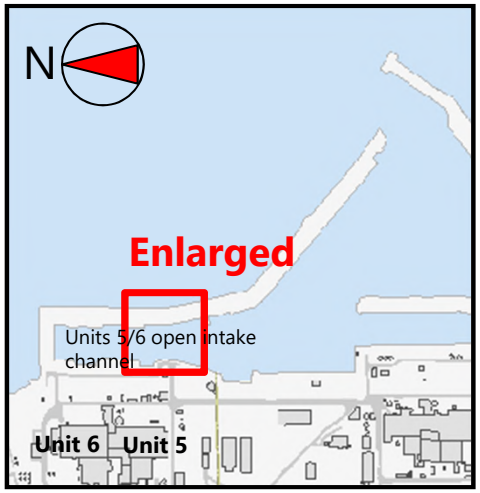


【Legend】
: Silt fence
: Pollution prevention fence

(Reference) Results of seawater monitoring during the discharge outlet caisson installation

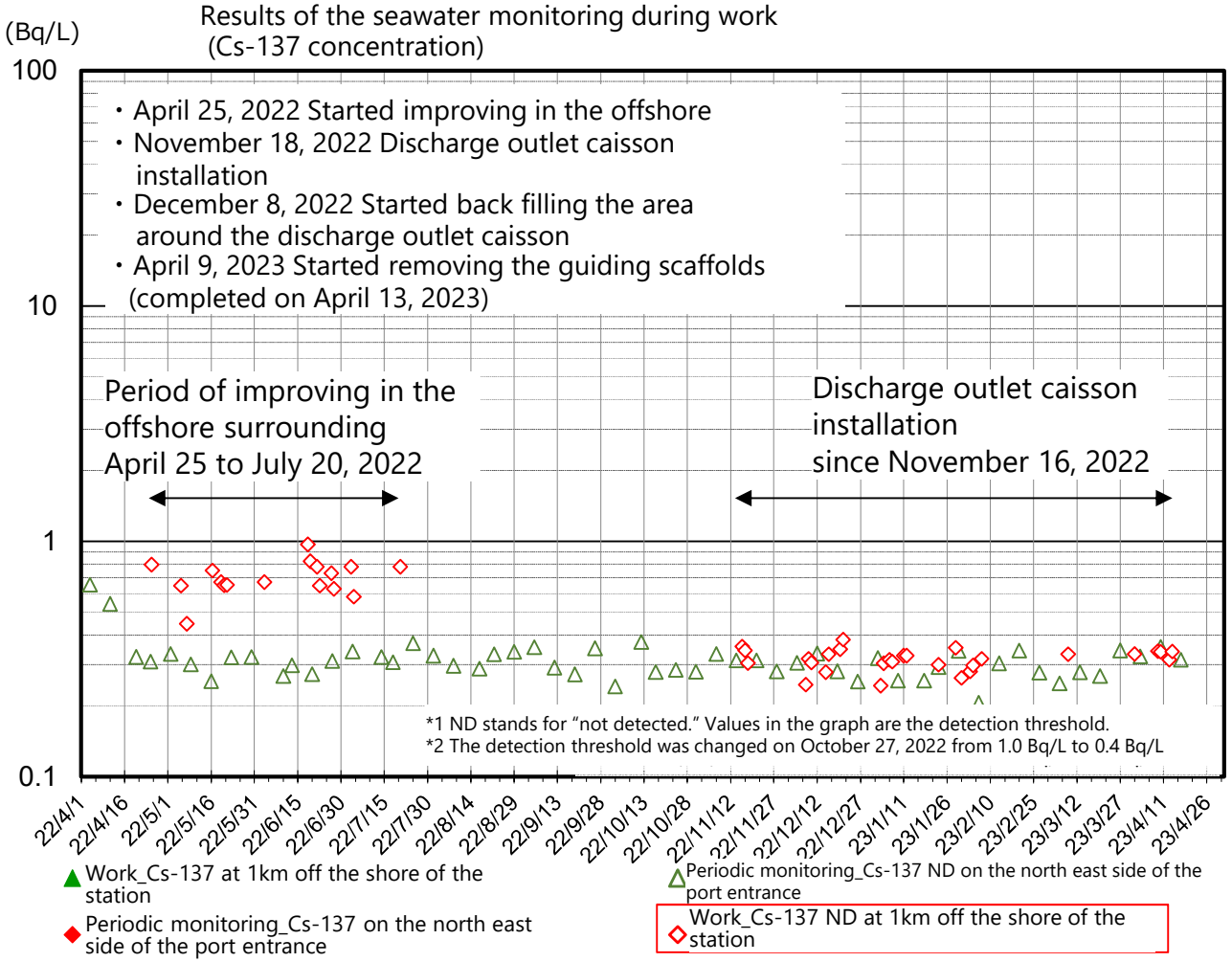
➢ Overview

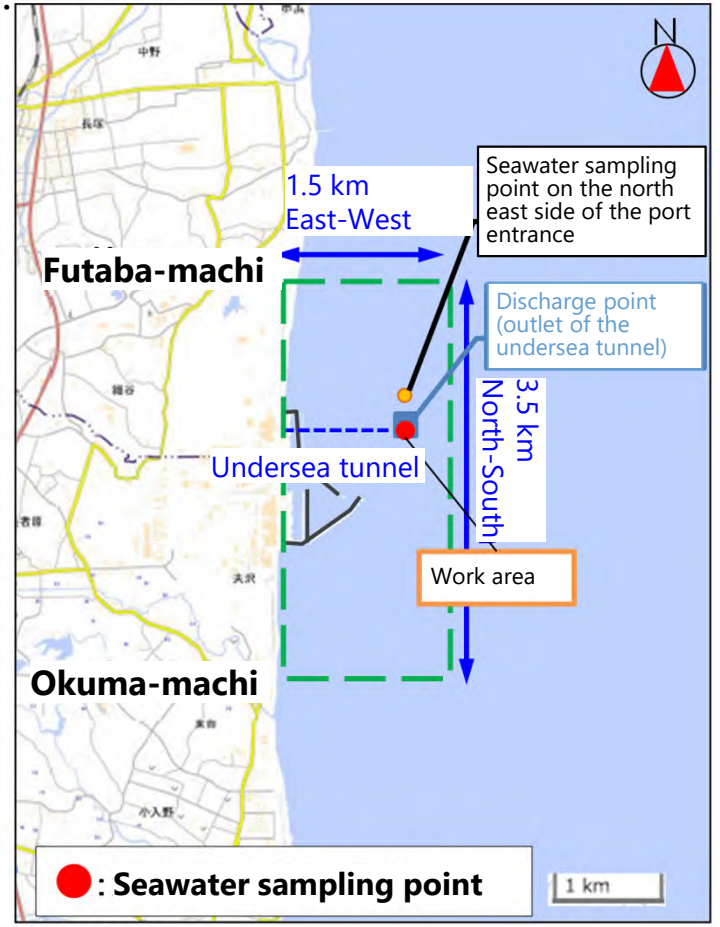
Seawater was sampled during the discharge outlet caisson installation, etc. *1 conducted offshore, and results confirmed that cesium concentration had not risen due to the work.

➢ Results

*1 Discharge outlet caisson installation and backfilling work and associated preparation and cleanup work

Cesium up to the most recent samples taken April 23, 2023 have not been detected (ND) and there have been no significant fluctuations in seawater cesium concentrations. We will continue to appropriately monitor the seawater during the plant offshore work.





(Reference) Results of turbidity measurement during discharge outlet caisson installation

TEPCO

➢ Overview

Turbidity measurements were taken using a turbidity meter at four locations at the work area boundary during the discharge outlet caisson installation, etc. *1 conducted offshore, and results confirmed that turbidity had not increased due to the work outside of the work area.

*1 Discharge outlet caisson installation, backfilling, and related preparation and cleanup work

➢ Results

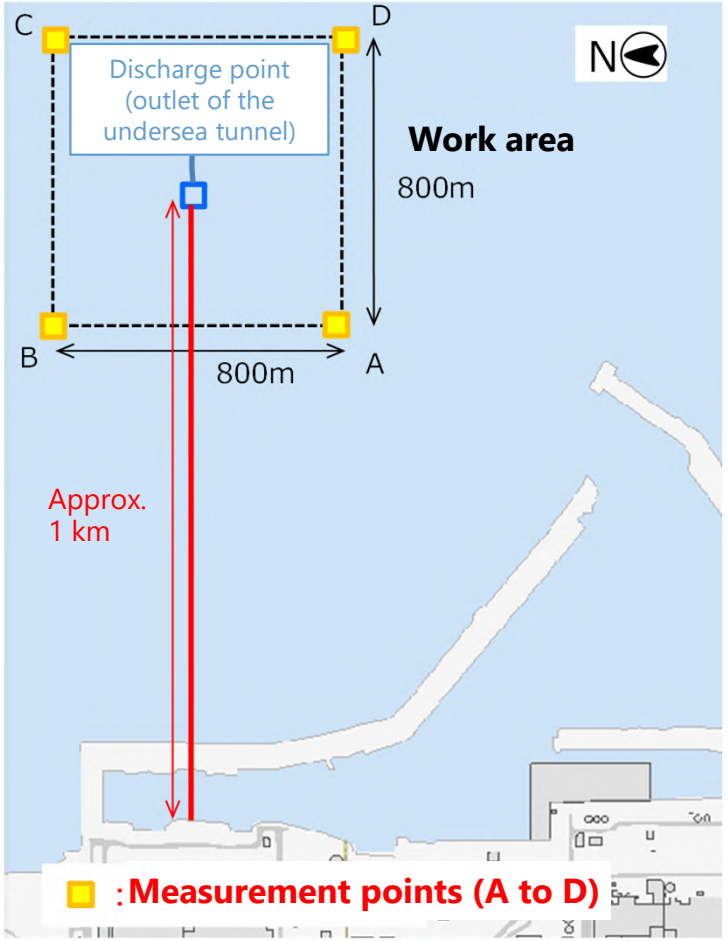
The turbidity measurements taken until April 23, 2023 were all below the control value*2. Visual inspection of turbidity has found that turbidity had not increased due to the work outside of the work area. We will continue to measure turbidity during the plant offshore work appropriately.

*2 Control value
Turbidity is converted to SS (suspended solids; mg/L). It is confirmed that SS does not exceed the threshold of BG value (measurement before work started) + 10mg/L.

Work date (measurement date)	Turbidity measurement results							
	A		B		C		D	
Jan 31, 2023	○	(2.3)	○	(2.1)	○	(1.5)	○	(1.5)
Feb 3, 2023	○	(1.7)	○	(1.5)	○	(1.8)	○	(1.6)
Feb 4, 2023	○	(1.8)	○	(1.6)	○	(1.5)	○	(1.5)
Feb 7, 2023	○	(2.2)	○	(2.1)	○	(1.5)	○	(1.5)
March 9, 2023	○	(6.4)	○	(4.9)	○	(3.4)	○	(3.1)
April 1, 2023	○	(3.9)	○	(4.5)	○	(3.7)	○	(4.8)
April 9, 2023	○	(15.2)	○	(15.6)	○	(8.9)	○	(8.8)
April 10, 2023	○	(8.1)	○	(7.9)	○	(6.2)	○	(7.9)
April 13, 2023	○	(13.6)	○	(9.4)	○	(7.7)	○	(7.2)
April 14, 2023	○	(8.3)	○	(7.6)	○	(6.9)	○	(9.4)

Criteria: Less than control value ○; More than control value ×

*Results for the last ten days. The measurement results were less than the control values going back past the last ten days.



(Reference) Overview of the ALPS treated water dilution/discharge facility and related facilities

TEPCO

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)

Measurement/confirmation facility (K4 tank group)

Comprised of three sets of tank groups each with the role of receiving, measurement/confirmation, and discharge. In the measurement/confirmation stage, water that has been made homogenized through circulation and agitating is sampled and analyzed (approx. 10,000m³ × 3 groups)

Transfer facility

Seawall

Installed around emergency isolation valves and transfer pipes

ALPS treated water, etc. tanks

Rotation

Discharge

Receiving

Measurement/ confirmation

ALPS treated water transfer pump

Flow meter/water flow rate control valve/ Emergency isolation valve (tsunami prevention measure)

Seawall

Header pipe (diameter approx. 2m by length approx. 7m)

Emergency isolation valve

Seawater flow meter

Seawater pipe

EL 33.5m

EL 11.5m

EL 2.5m

Seawater transfer pump (3 units)

Road

Discharge vertical shaft (Down-stream storage)

Discharge to sea

Unit 5 intake

Dilution facility

Discharge vertical shaft (upper-stream storage)

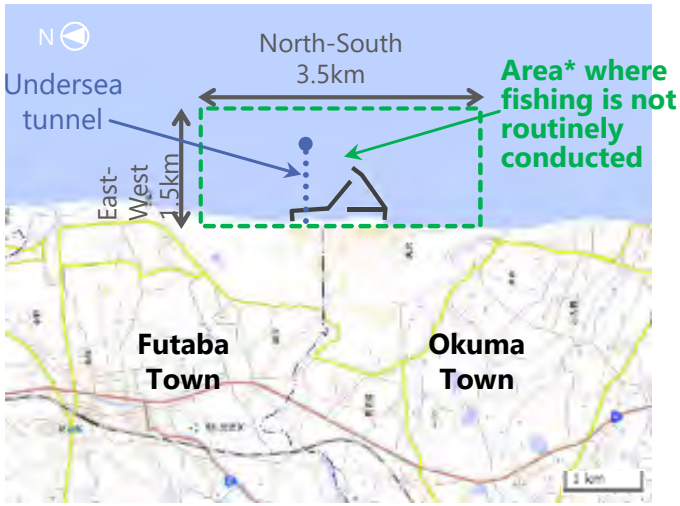
Discharge facility

Discharge tunnel (approx. 1km)

Use the differential head equivalent to the loss in the discharge tunnel (difference between the water surface in the down-stream storage and the sea surface) to discharge water naturally.

Seawater used for dilution (intake from outside the harbor)

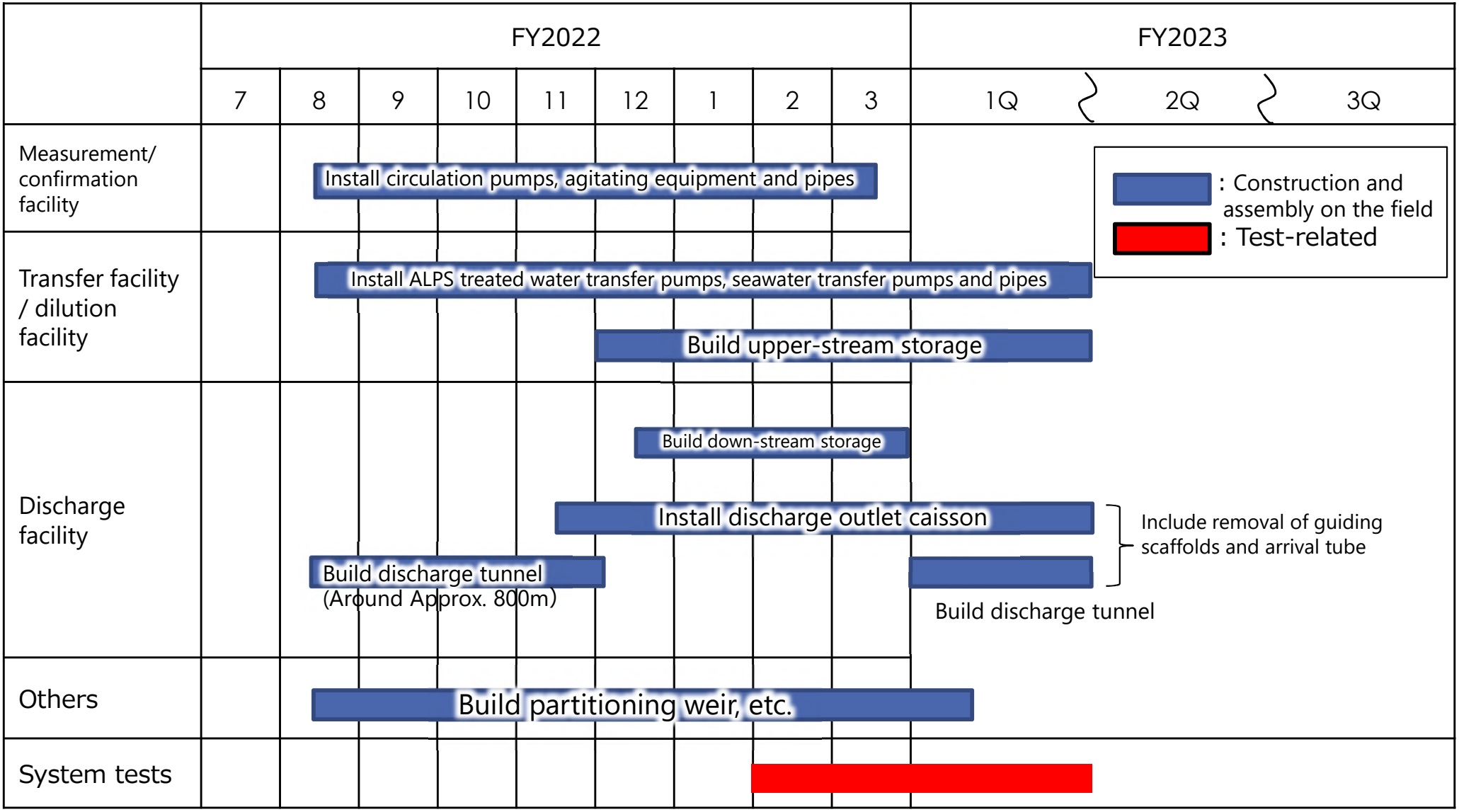
Source: Developed by Tokyo Electric Power Company Holdings, Inc. based on the map developed by the Geospatial Information Authority of Japan (electronic territory web)
https://maps.gsi.go.jp/#13/37.422730/141.044970/&base=std&ls=std&disp=1&vs=c1j0h0k0l0u0t0z0r0s0m0f1



*Area where common fishery rights are not set

The image is shown in the Document 1-1 for the 8th Review Meeting on the Implementation Plan Regarding the Handling of ALPS Treated Water

（Reference）The whole process



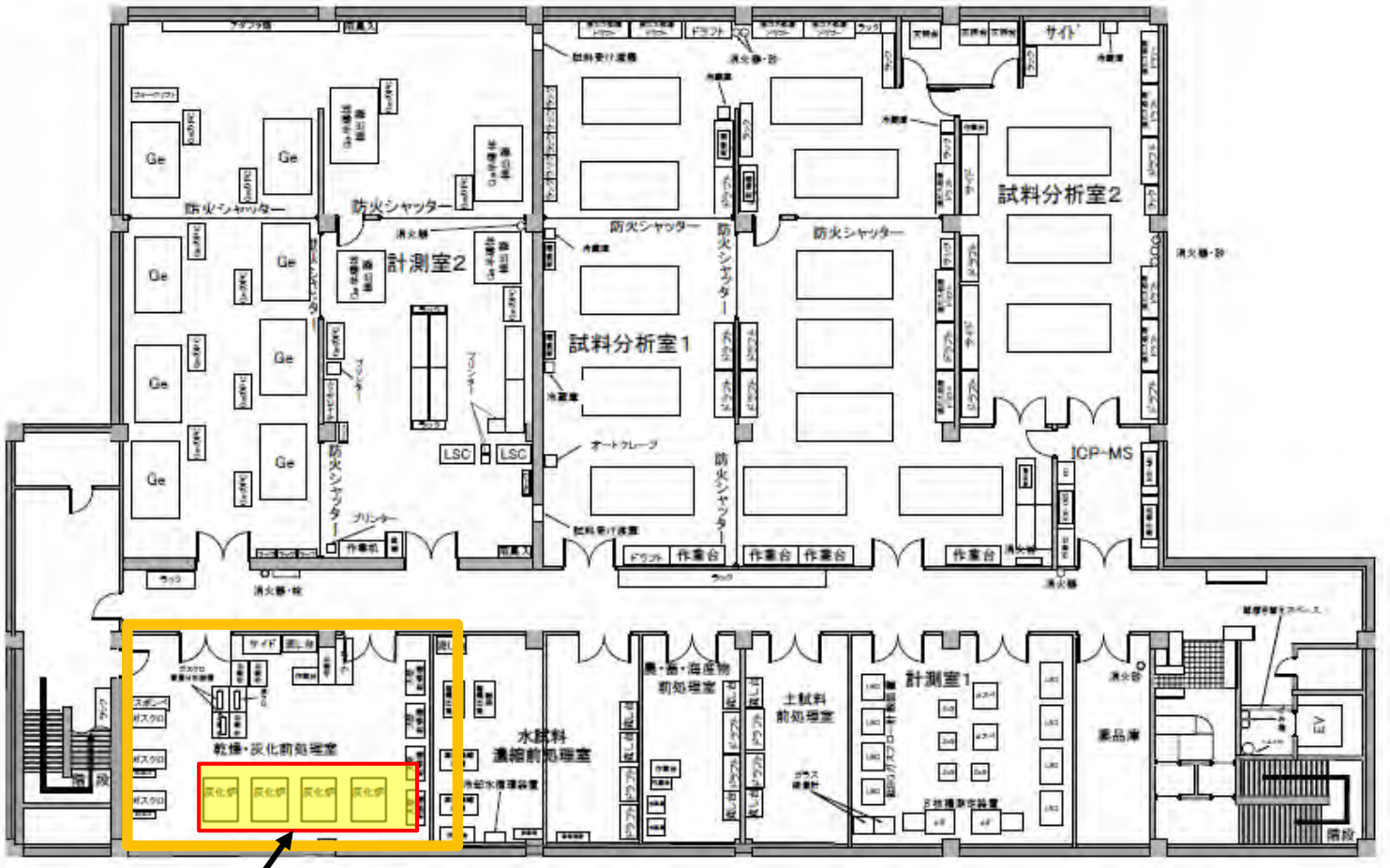
※The schedule may be revised based on progress made and other factors.

2. Installation of electrolytic accumulation devices

The 110th Secretariat of the Team for the Countermeasures for Decommissioning, Contaminated Water and Treated Water
January 26, 2023 (Partially revised)

TEPCO

- The four incinerators in the drying and incineration pre-processing room in the chemical analysis building were removed to install the electrolytic accumulation devices*.
- 8 electrolytic accumulation devices have been delivered to the site as of December 2022 and concentration tests were completed in March 2023. Once comparison tests using actual samples are complete, the devices will be used in analyzing seawater.



Electrolytic accumulation devices were installed here

Chemical analysis building B1F

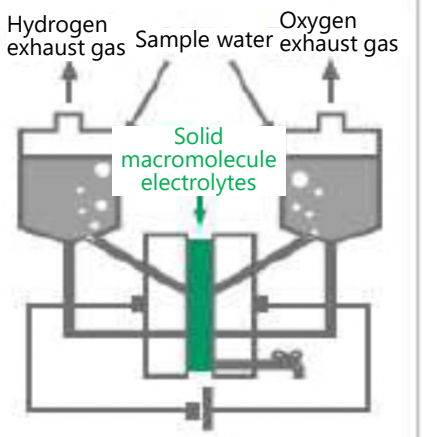
*Pre-processing device to analyze tritium in extremely low concentrations

2. Installation of electrolytic accumulation devices （cont.）

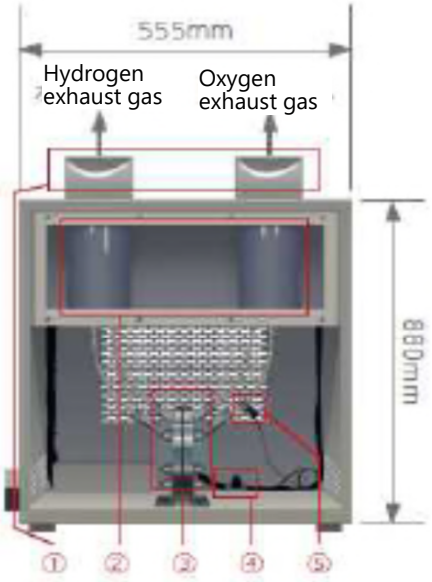
TEPCO

- To detect tritium that may exist in background levels in surface seawater, the tritium needs to be concentrated through electrolysis of the water*.
- The number of days required for analysis takes a month to 45 days more because of the electrolysis but this allows measurement with a lower detection limit.
- This method will be introduced in tritium analysis conducted at Fukushima Daiichi NPS (analysis of free water tritium in marine organisms).

Device schematic



Electrolysis concentration unit



1) Electronic cooler
2) Sample water tank
3) Electrolysis tank
4) Sample water outlet
5) Liquid level sensor

(*) Concentration through electrolysis

Water releases hydrogen and oxygen gas through electrolysis. The reaction rate of becoming hydrogen gas is as follows:

$^{1}H > {}^{2}H > {}^{3}H$ (tritium)

This means that tritium water is less easily electrolyzed. Tritium is concentrated through electrolysis using this characteristic.

【Specifications】

- Enriches 500mL of distilled sample water to 60 mL over 3 days through electrolysis
- Hydrogen and oxygen are released as the electrolysis products.

*Descriptions taken from the De Nora Permelec, Ltd. website

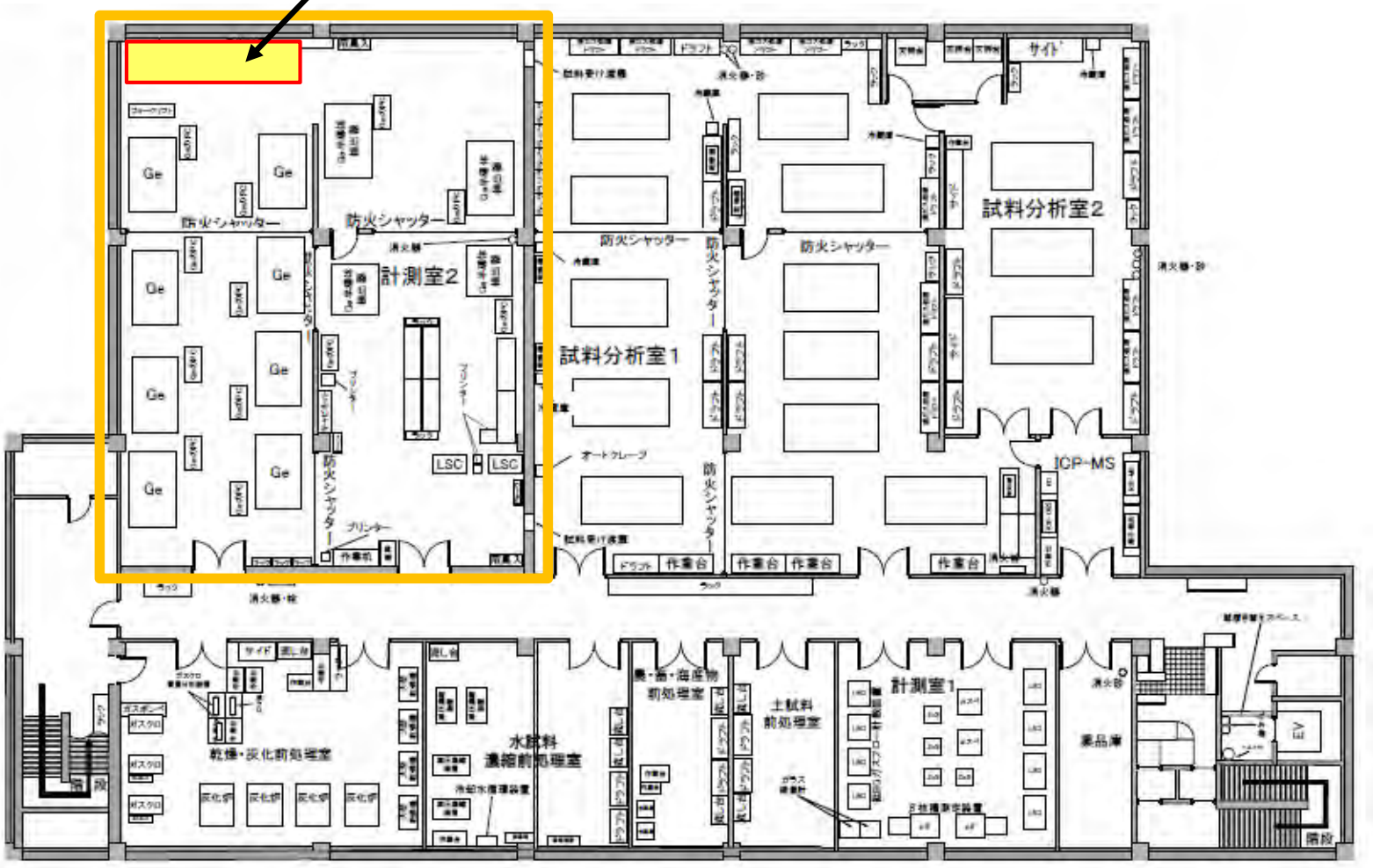
3. Low-energy photon germanium semiconductor detector (LEPS)

The 110th Secretariat of the Team for the Countermeasures for Decommissioning, Contaminated Water and Treated Water
January 26, 2023 (Partially revised)

TEPCO

- Two low-energy photon germanium semiconductor detectors (LEPS) were installed in the measurement room in the chemical analysis building in December 2022. Since verification tests were completed in March 2023, the detectors will be used to measure ALPS treated water.

LEPS were installed here

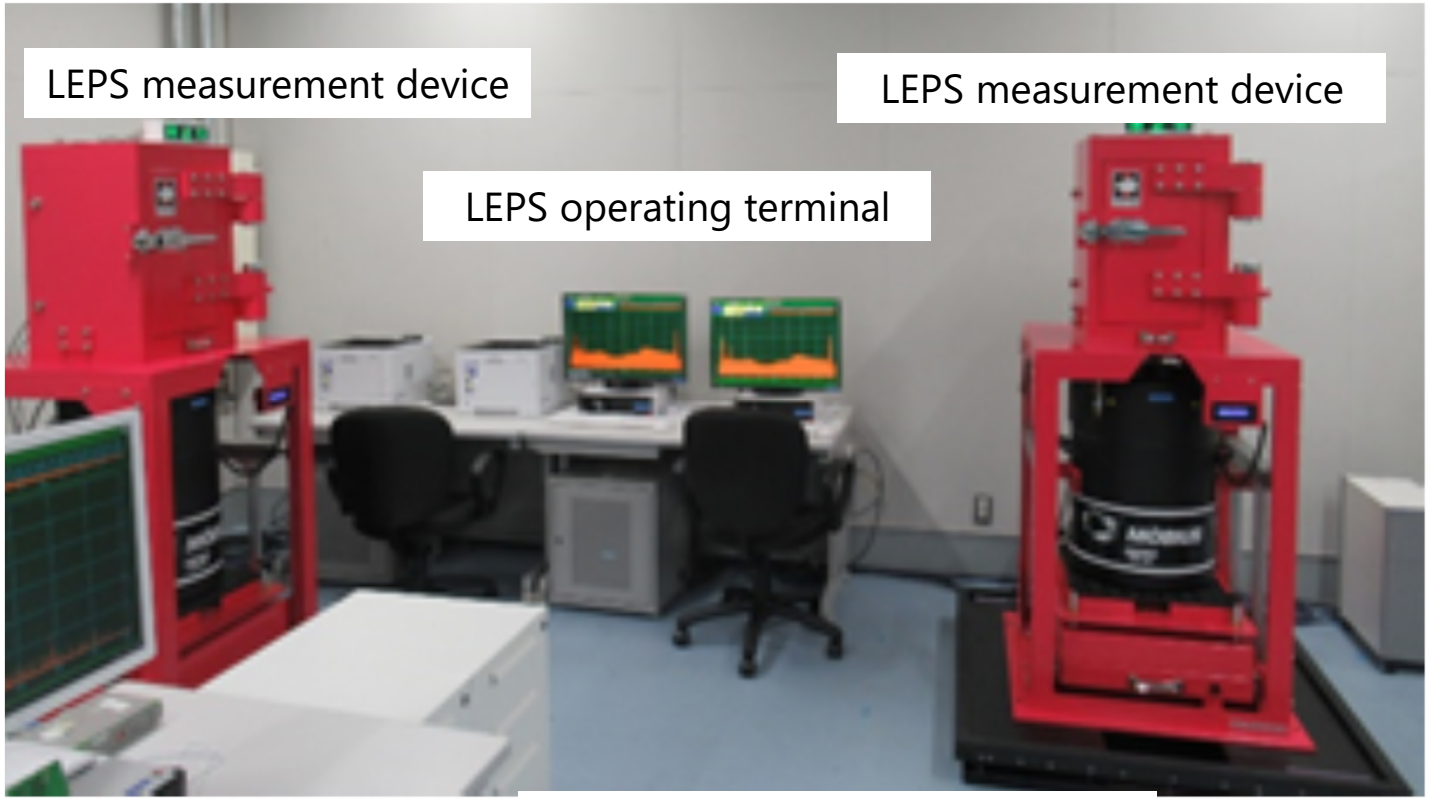


Chemical analysis building B1F

3. Low-energy photon germanium semiconductor detector (LEPS) (cont.)

TEPCO

- Nuclide analysis for those emit low-energy radiation such Fe-55 (nuclides other than the 62 nuclides subject to removal by ALPS) is required in ALPS treated water analysis.
- To conduct the nuclide analysis on Fukushima Daiichi premises, low-energy photon germanium semiconductor detectors (LEPS) were newly installed.



LEPS
(Device in the chemical analysis building measurement room)

Reference: existing germanium semiconductor detector
(Photo of the device in the chemical analysis building measurement room)