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

TEPCO

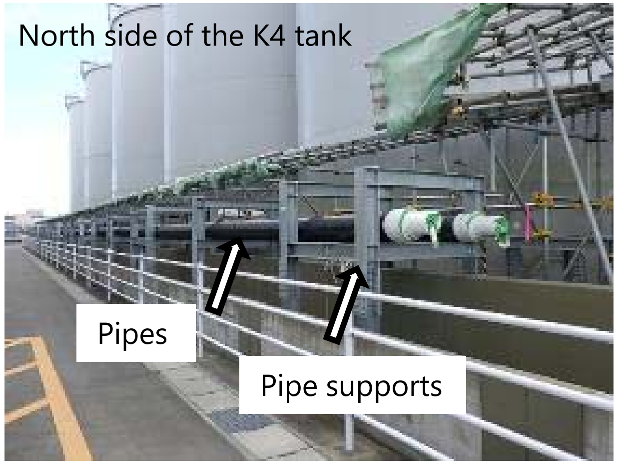
December 22, 2022

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.

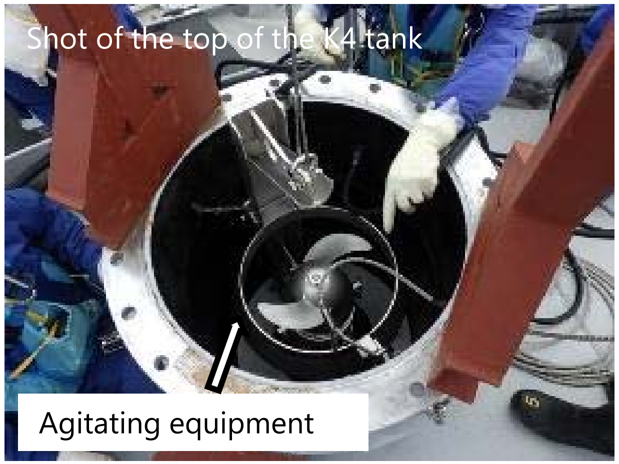


Installing circulation pipes and pipe supports

Installing the piping supports/pipes

【Measurement/confirmation facility】
・Supports
Approx. 478 out of approx. 540m
・Pipes
Approx. 848 out of approx. 1,000m

【Transfer facility】
・Supports
Approx. 695 out of approx. 1,820m
・Pipes
Approx. 457 out of approx. 1,820m
<As of December 15>



Installing agitating equipment

Installing agitating equipment

20 out of 30 units
(hung inside the tank)
<As of December 15 >

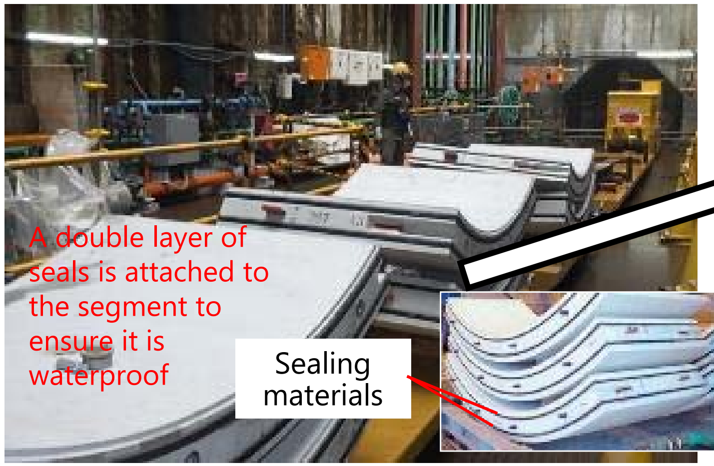
■ Discharge facility

On August 4, the shield machine began tunneling through the bedrock layer as construction of the discharge tunnel commenced. Construction of down-stream storage was started as well.

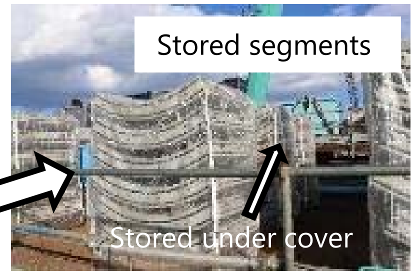
Tunnel driving was halted on December 7 to start construction of the down-stream storage first on December 18.
Approx. 827m out of Approx. 1,030m
<As of December 7>

※1 Initial digging was completed and the main digging work was started on October 9

Safety equipment inside the tunnel



Segments carried in



The surface contamination density of the segments is measured. The segments are stored covered in the yard outside of the premises.

1. Status of construction (cont.)

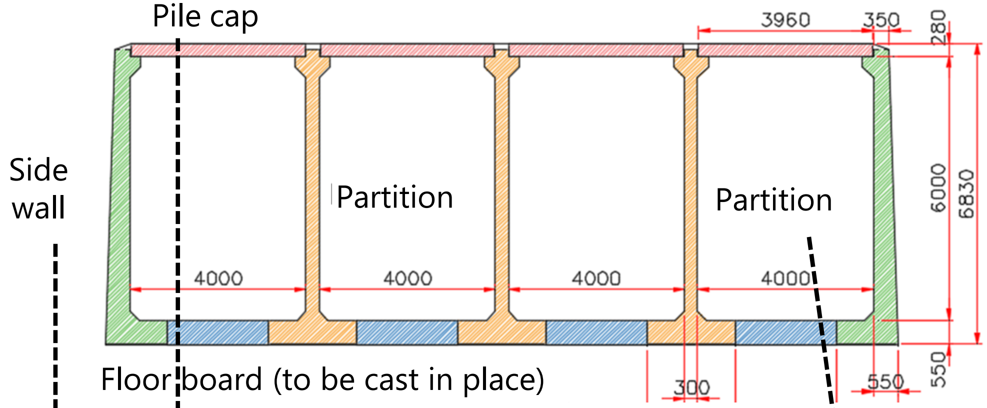
- Dilution facility
  Ground improvement work as part of seismic countermeasures for the discharge vertical shaft (upper-stream storage) was completed. Construction on the upper-stream storage itself was subsequently started on October 7.

Ground improvement work

Placing leveling concrete

Building of the upper-stream storage was started on December 14. Assembly of the pre-cast block is scheduled to start in January.

- Dilution facility
  Manufacturing of the discharge vertical shaft (upper-stream storage) precast block was started on September 14 at a factory in Fukushima Prefecture.



Cross-sectional diagram of the upper-stream storage

Pile cap of the upper-stream storage

Side wall of the upper-stream storage

Partition of the upper-stream storage

1. Status of construction (cont.)

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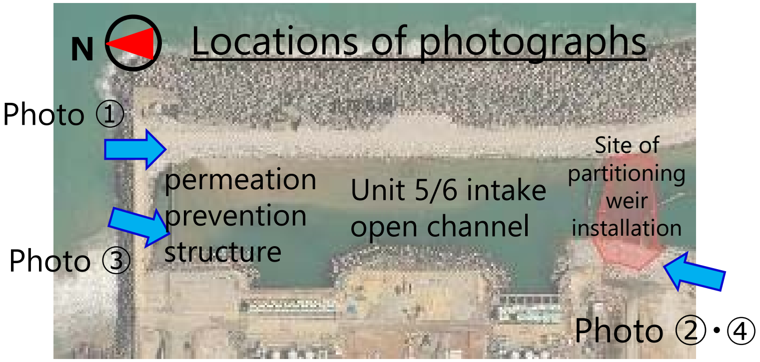
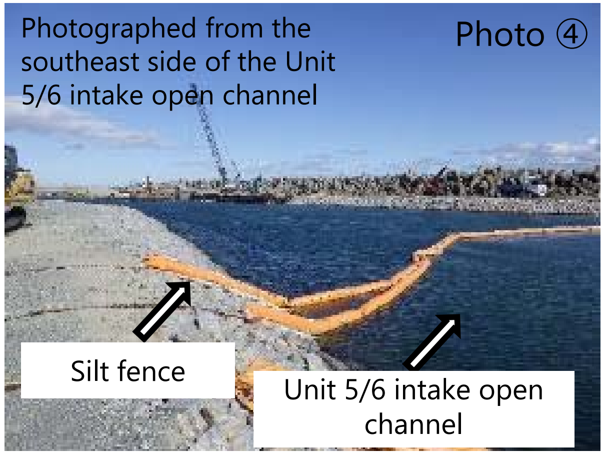
- Other construction (building partitioning weir, etc.)
  Preparatory construction for developing roads for heavy machinery started on August 4 as part of efforts to build a partitioning weir. In the Units 5 and 6 sea-side construction area, silt deposits inside the open intake channel are being removed (dredging) and the grounds for heavy machinery are being developed simultaneously. After construction of the partitioning weir, the permeation prevention structure will be removed.





Work area on the sea side of Units 5/6

1. Status of construction (cont.)

TEPCO

1. Status of construction (cont.)

Backfilling the area around the caisson （December 8, 2022）

Concrete plant ship
Placing mortar off the shores of Fukushima Daiichi NPS


Concrete plant ship
No turbidity on the sea surface
Placing pipe
Discharge outlet caisson
Concrete plant ship
Placing mortar off the shores of Fukushima Daiichi NPS
Backfilling the area around the caisson (December 8, 2022)

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

TEPCO

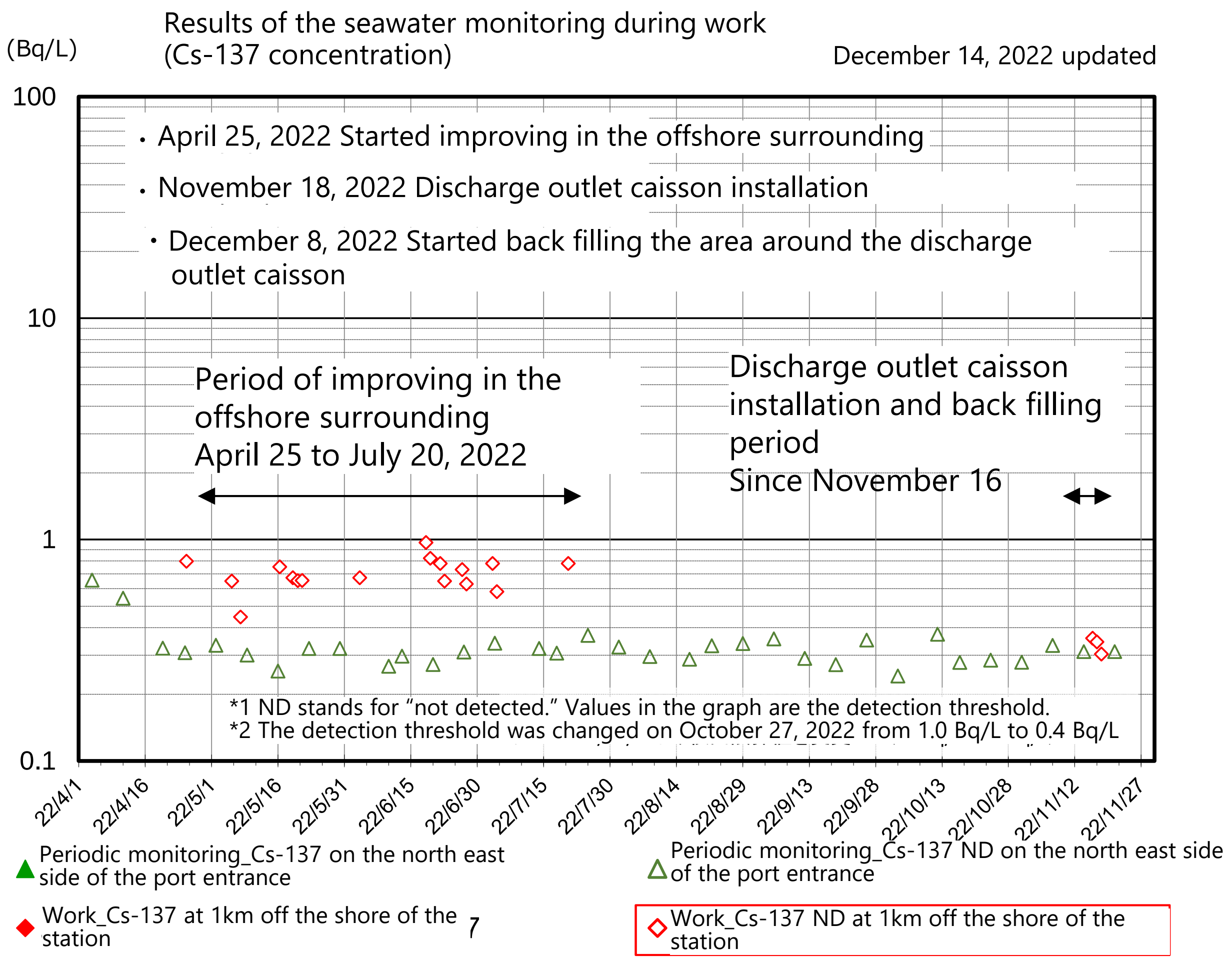
- Overview

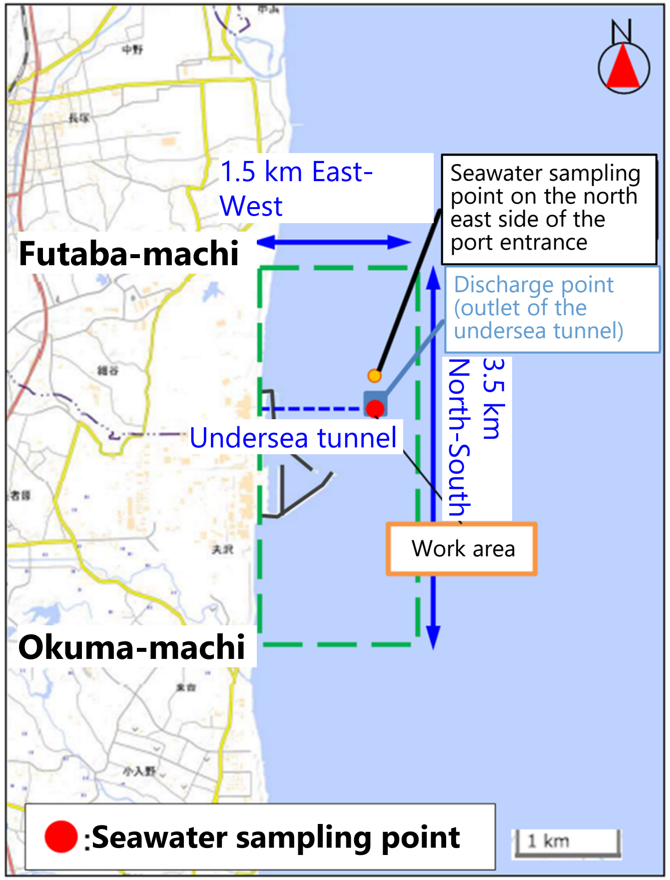
  Seawater was sampled during the discharge outlet caisson installation, etc. *1 conducted offshore, and results confirmed that cesium concentration had not risen due to the work.

- Results

  *1　Discharge outlet caisson installation, work to remove the seabed sediment before installation

  Cesium up to the most recent samples taken December 10, 2022 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.





Area* where fishing is not routinely conducted
1.5 km East-West　3.5 km North-South
*Area where common fishery rights are not set

(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, work to remove the seabed sediment before installation

➢ Results

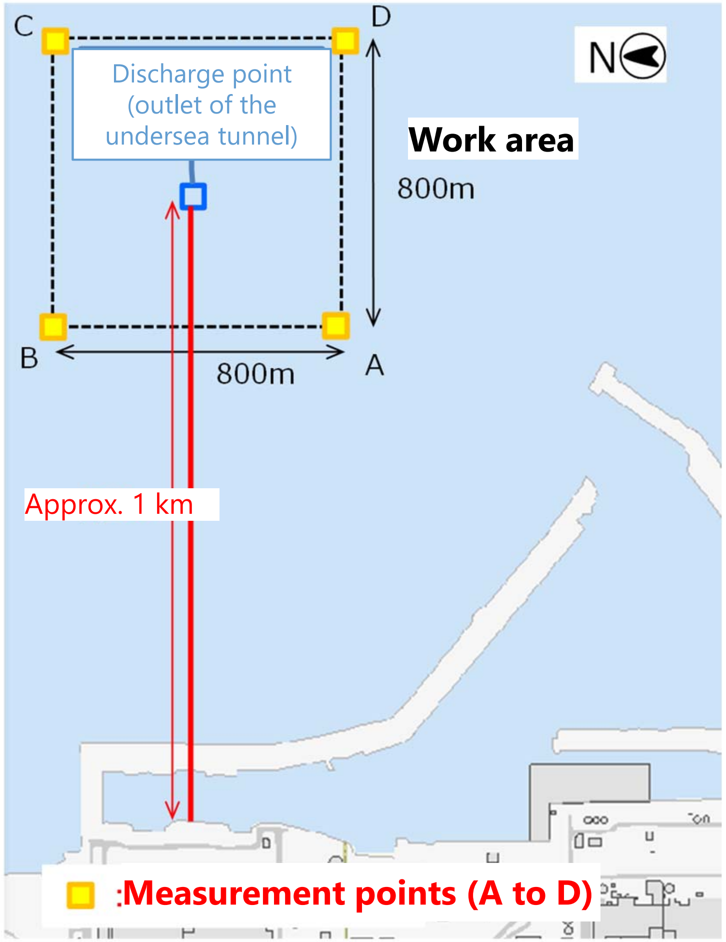
The turbidity measurements taken until December 10, 2022 were all below the control value*2. Visual inspection of turbidity has found that turbidity had not increased due to the work outside of the work area. We will continue to measure turbidity during the plant offshore work appropriately.

*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	
Nov 16, 2022	○	(6.9)	○	(9.6)	○	(5.4)	○	(5.7)
Nov 17, 2022	○	(7.0)	○	(7.4)	○	(8.3)	○	(6.7)
Nov 18, 2022	○	(3.1)	○	(4.1)	○	(4.8)	○	(7.9)
Dec 8, 2022	○	(12.8)	○	(14.4)	○	(4.4)	○	(3.9)
Dec 9, 2022	○	(5.4)	○	(12.1)	○	(2.5)	○	(3.1)
Dec 10, 2022	○	(5.3)	○	(6.1)	○	(3.6)	○	(5.2)

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



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

TEPCO

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. 10,000m^3 × 3 groups)

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)

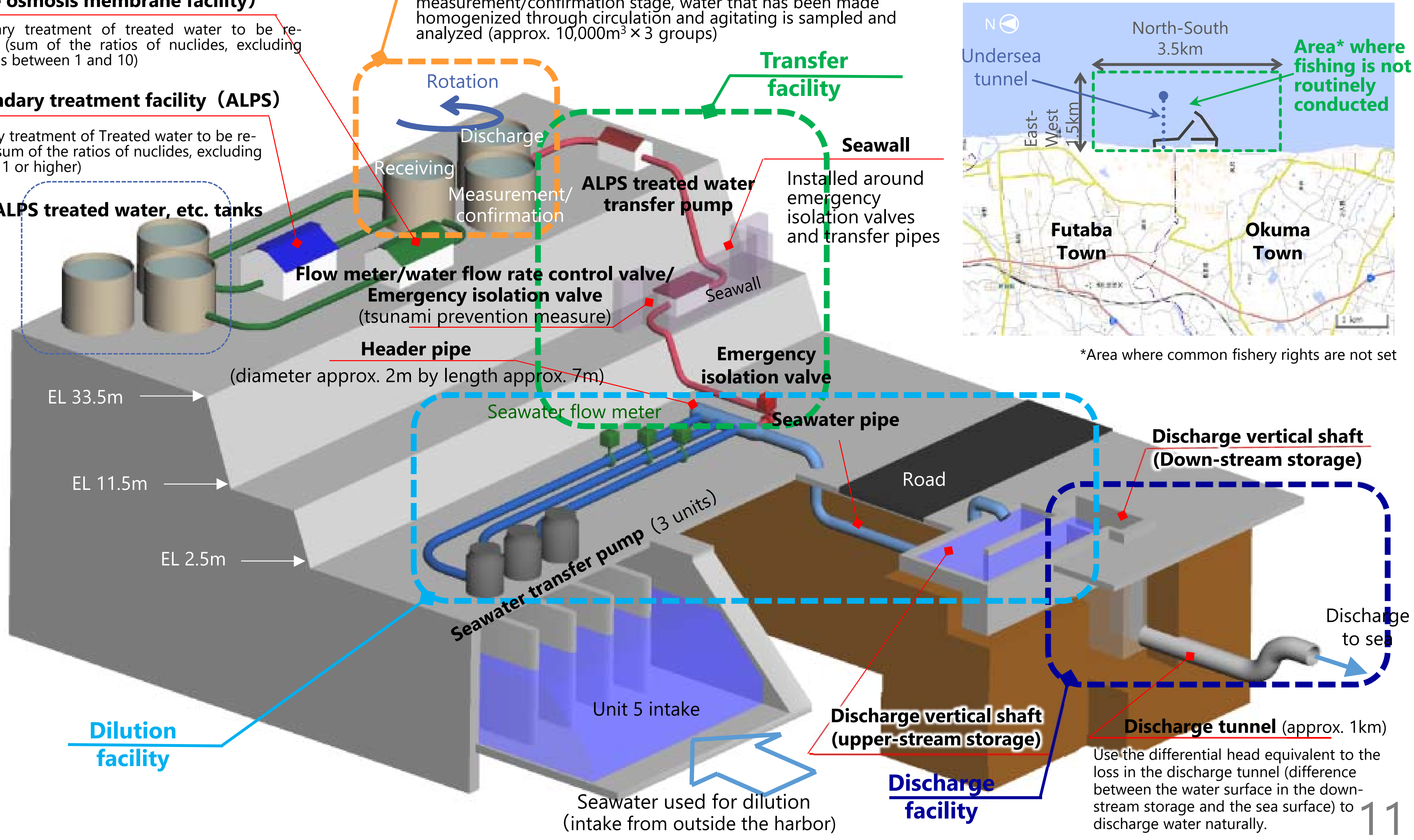
Secondary treatment facility（ALPS）

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

Seawall

Installed around emergency isolation valves and transfer pipes

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

Discharge tunnel (approx. 1km)

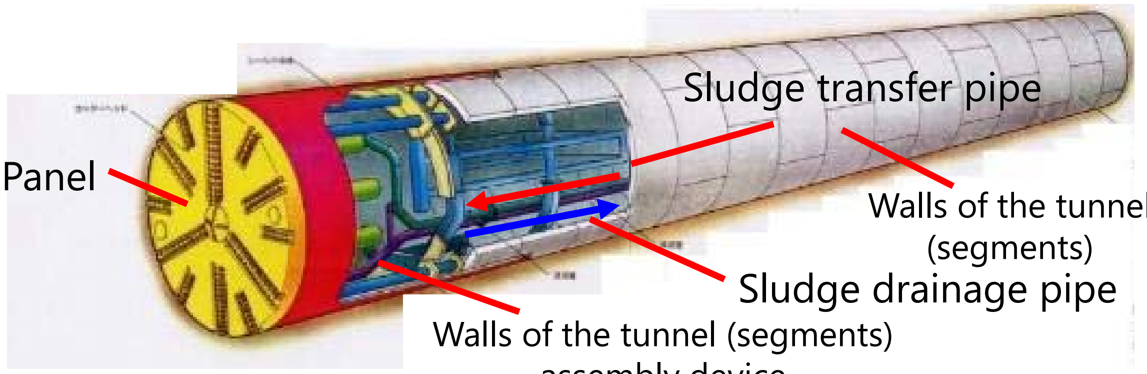
Use the differential head equivalent to the loss in the discharge tunnel (difference between the water surface in the down-stream storage and the sea surface) to discharge water naturally.

(Reference) Discharge Tunnel

TEPCO

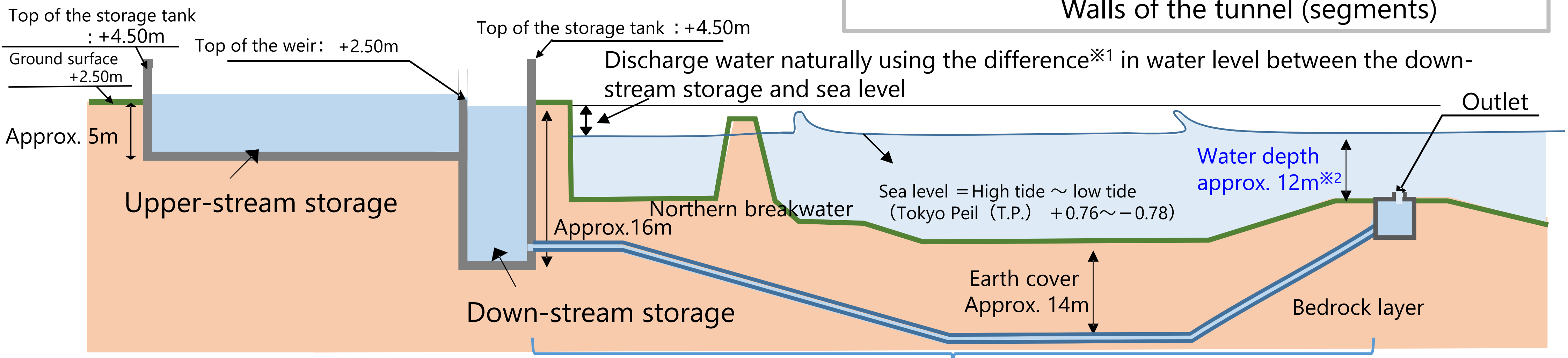
- The discharge tunnel has low leakage risk and is earthquake resistant※ because it goes through the bedrock layer. The design of the tunnel takes into account typhoons (high waves) and storm tides (increased sea levels). Furthermore, the tunnel is designed to use the differential head equivalent to the loss in the discharge tunnel (difference between the water surface in the down-stream storage and the sea surface) to discharge water naturally (taking into account the adhesion of shellfishes).
- A slurry shield tunneling method will be used, and the walls of the tunnel (segments) will be made of reinforced concrete combined with two layers of sealing material to prevent water from coming in.

※ Designed based on the quake-resistant design concept suggested by NRA.



Overview of shield machine

Walls of the tunnel (segments)



Discharge facility conceptual diagram

※ Heights are expressed in Tokyo Peil (T.P.)
※1 Seawater transfer pump (3 units) : 1.6m, Seawater transfer pump (2 units) : 0.7m
※2 Based on the standard time tide level in Tokyo Peil (T.P.)

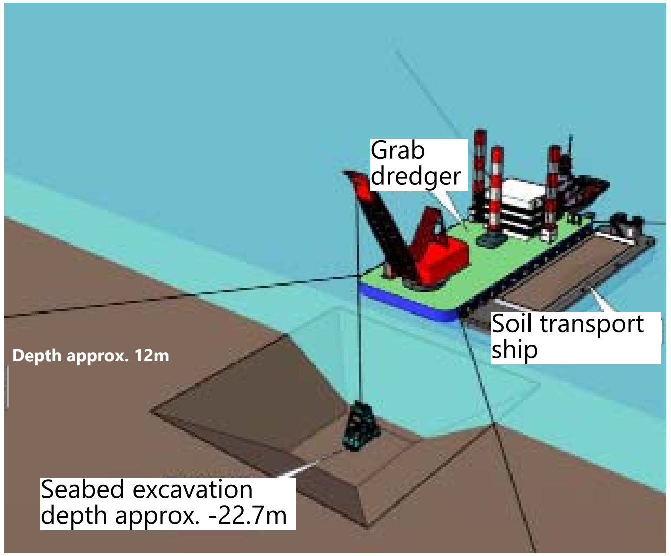
(Reference) Discharge Outlet Caisson (General Project Overview)

TEPCO

- Seafloor excavation and depositing/covering of rubble work at the discharge outlet of the discharge tunnel and its confirmation have been completed on July 22th. The caisson (a large concrete box) made of reinforced concrete will be installed on the seafloor using large crane ship while watching the weather and sea conditions. The area around the caisson will then be back filled with concrete.
- After the shield machine drilling the discharge tunnel reaches the caisson, a crane ship will be used to extract the shield arrival tube (containing the shield machine) from the outlet caisson.

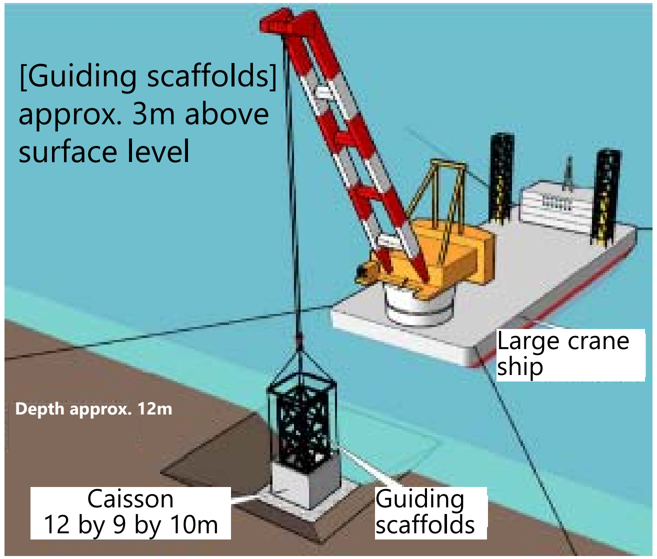
― Improvements in the Surroundings (completed) ―

― Project to install discharge outlet caisson ―



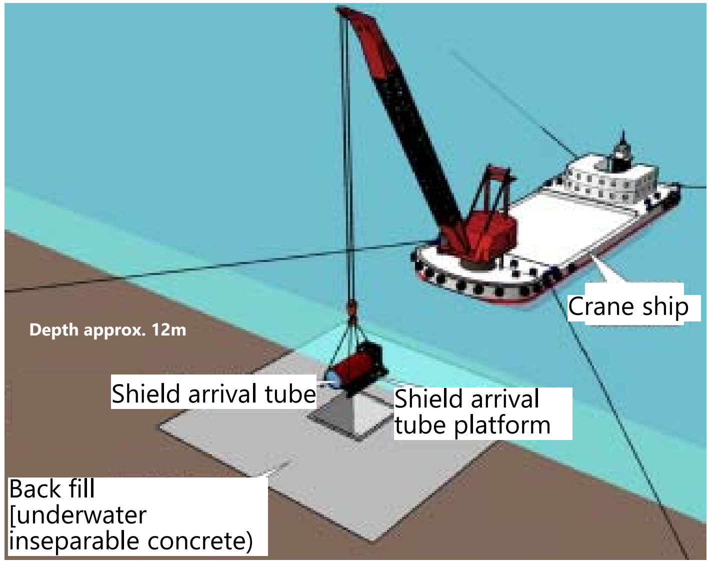
[Bedrock excavation, caisson fabrication]

1. Use grab dredger (seafloor excavation ship) to excavate bedrock
2. Carry excavated soil to power station site
3. Deposit foundation rubble



[Install caisson]

1. The caisson transported by sea from outside the power station is installed using a large crane ship
2. Refill the area around the caisson with concrete
3. In preparation for the arrival of the shield machine, manage locational information of the discharge outlet by using the metal guiding scaffolds connected to the caisson



[Remove excavator, install lid]

1. After the shield machine arrives inside the shield arrival tube in the caisson, fill the tunnel interior with seawater
2. Separate the collector and the tunnel, and collect the shield machine from the vertical shaft using a crane ship
3. Finally, install the caisson lid

(Reference) Discharge Outlet Caisson (Installation of Discharge Outlet Caisson)

TEPCO

- Fix crane ship to the pre-installed sinker blocks (110t) and anchors using mooring wire.
- Guide crane ship to the installation location using GPS installed on the crane ship and surveying the guiding scaffolds installed on the caisson from the ground side (from two locations on the South seawall and North seawall). Fine adjustments for the positioning of the subject crane ship will be performed by winding and releasing the mooring wire using the crane ship's winch. Discharge caisson will be installed after moving the ship to the point of installation.

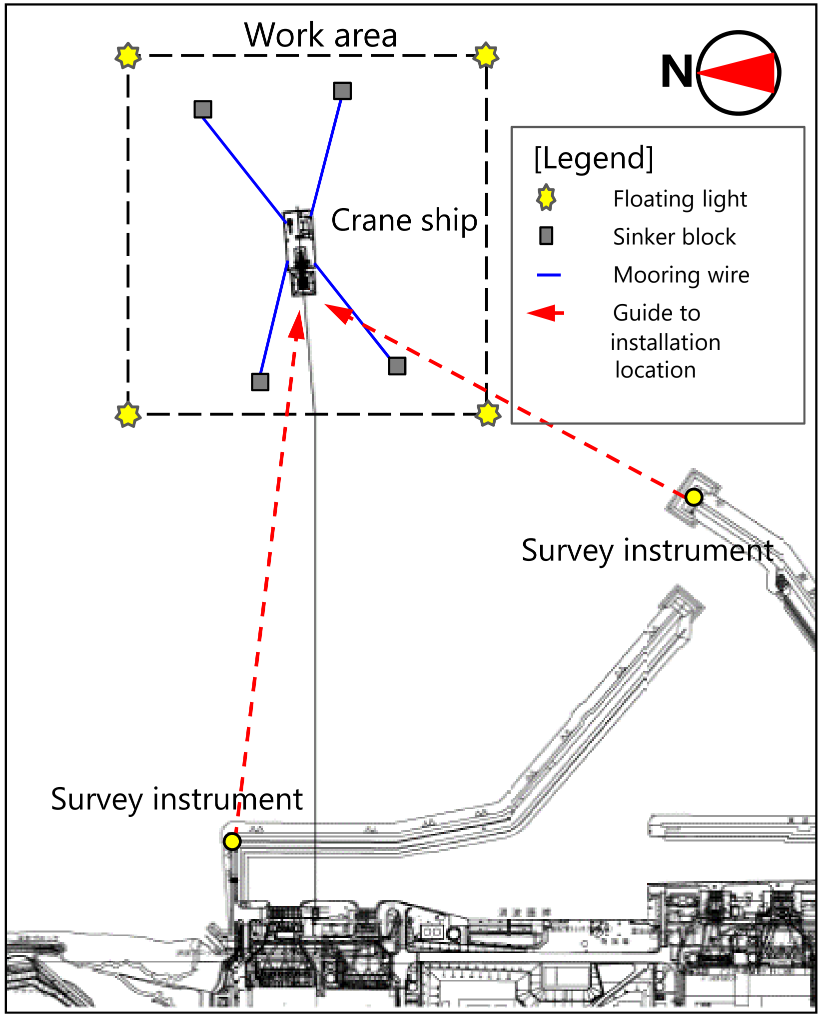


Figure of Work to Install Discharge outlet Caisson (plan view)

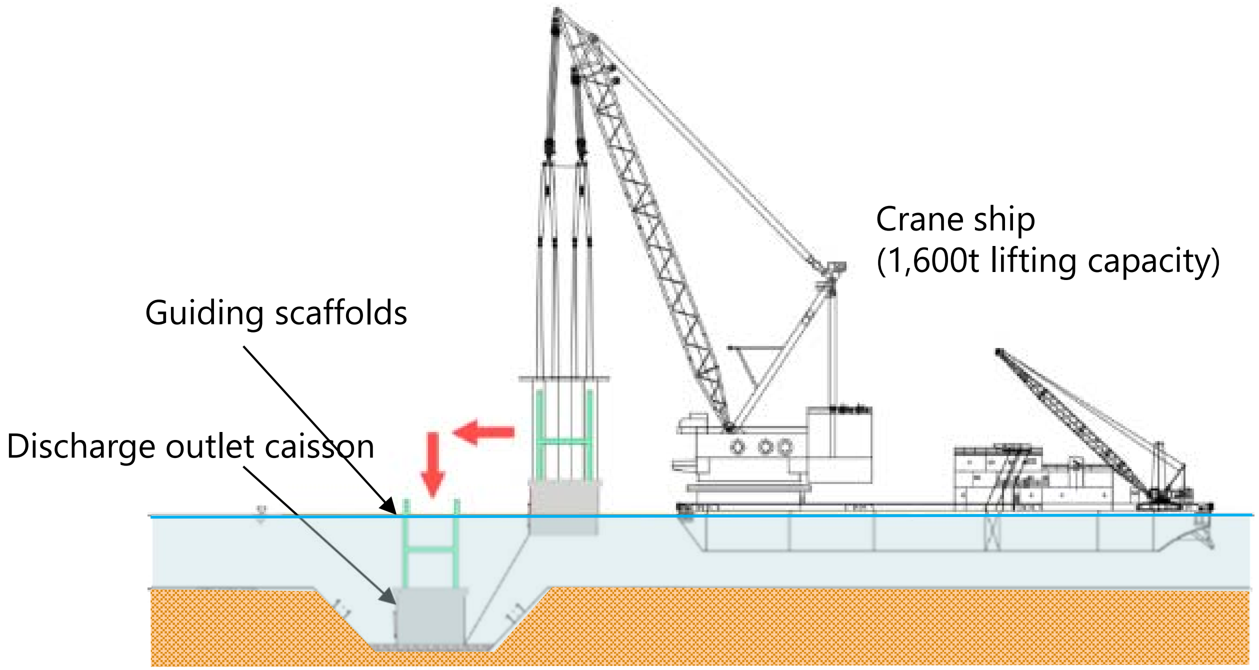
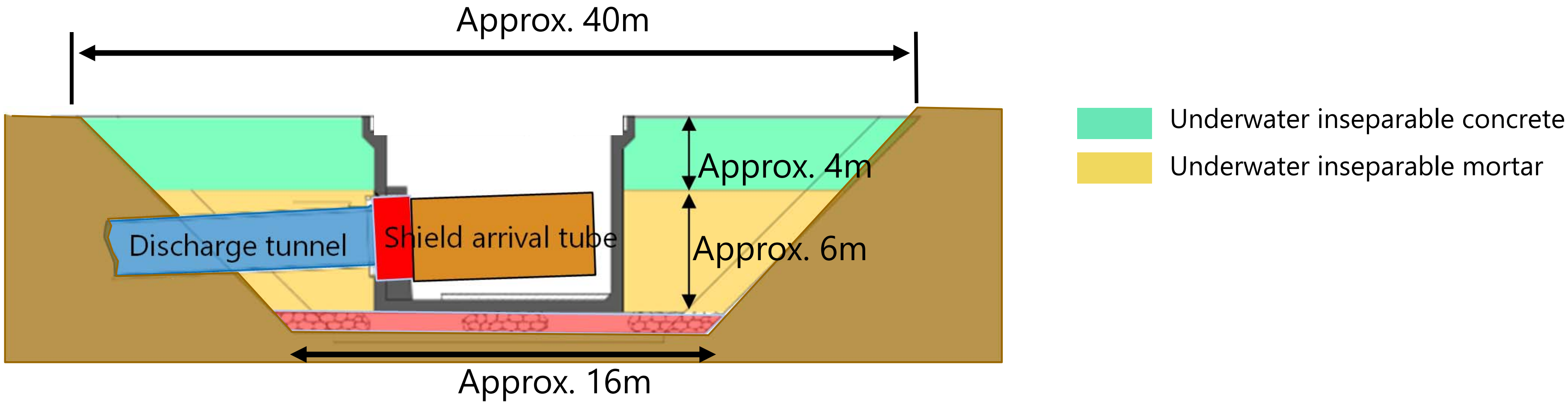


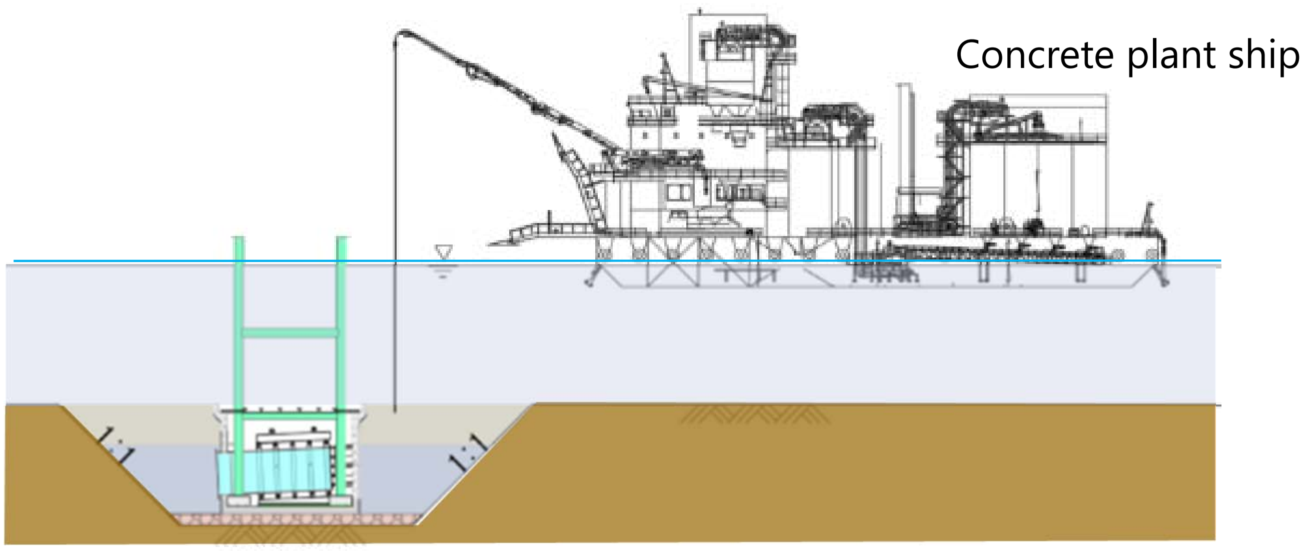
Figure of Work to Install Discharge outlet Caisson (cross section)

(Reference) Discharge Outlet Caisson (Back Fill)

TEPCO

- After installing the discharge outlet caisson, pour underwater inseparable mortar (area where the shield machine passes) and underwater inseparable concrete using a concrete plant ship for back filling.

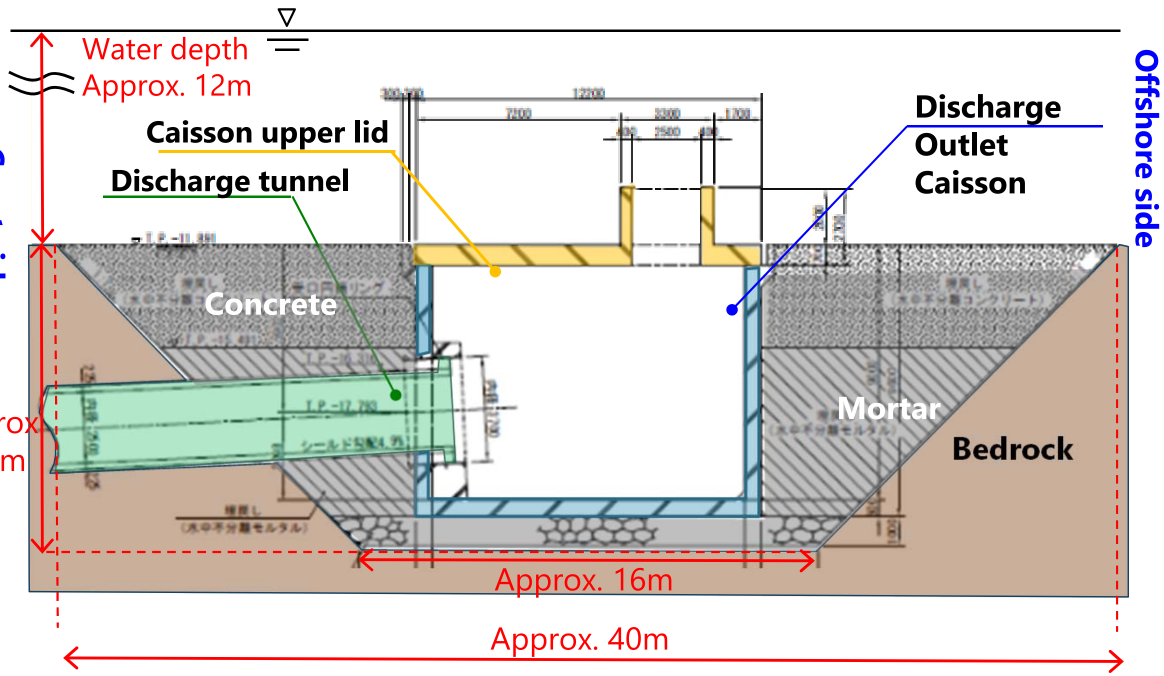




Cross section figure for back filling work

(Reference) Discharge Outlet Caisson (Overview of Discharge Outlet Caisson)

- A guiding scaffold used to manage location information while the tunnel is being excavated, and the shield arrival tube have been installed in advance inside the caisson.



Cross section figure of discharge outlet

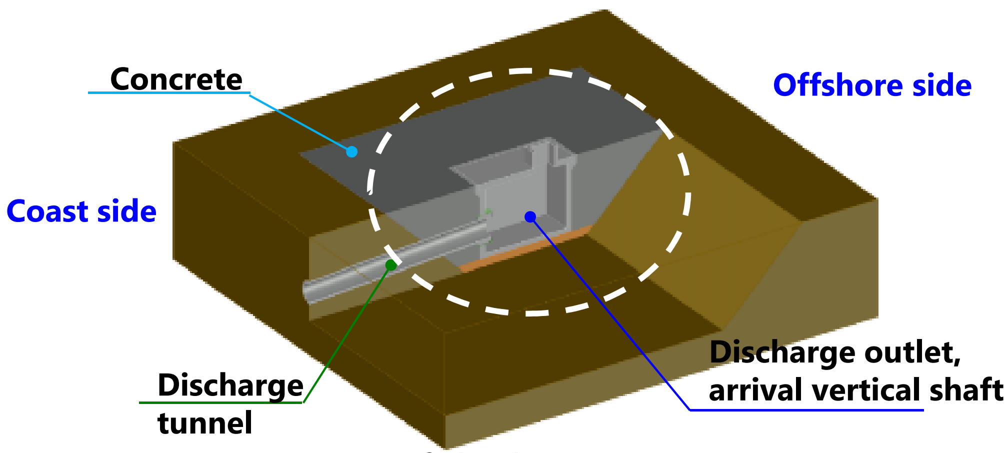


Figure of discharge outlet

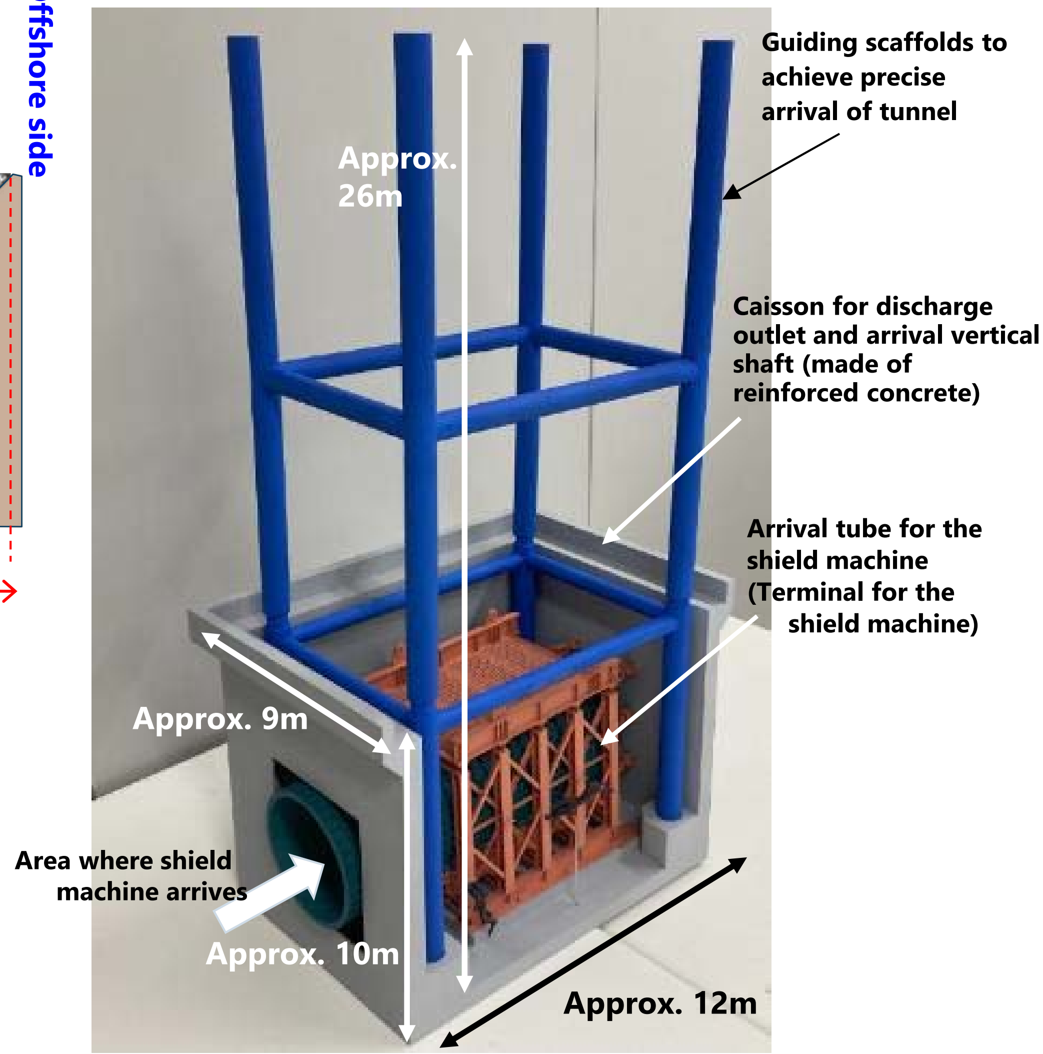


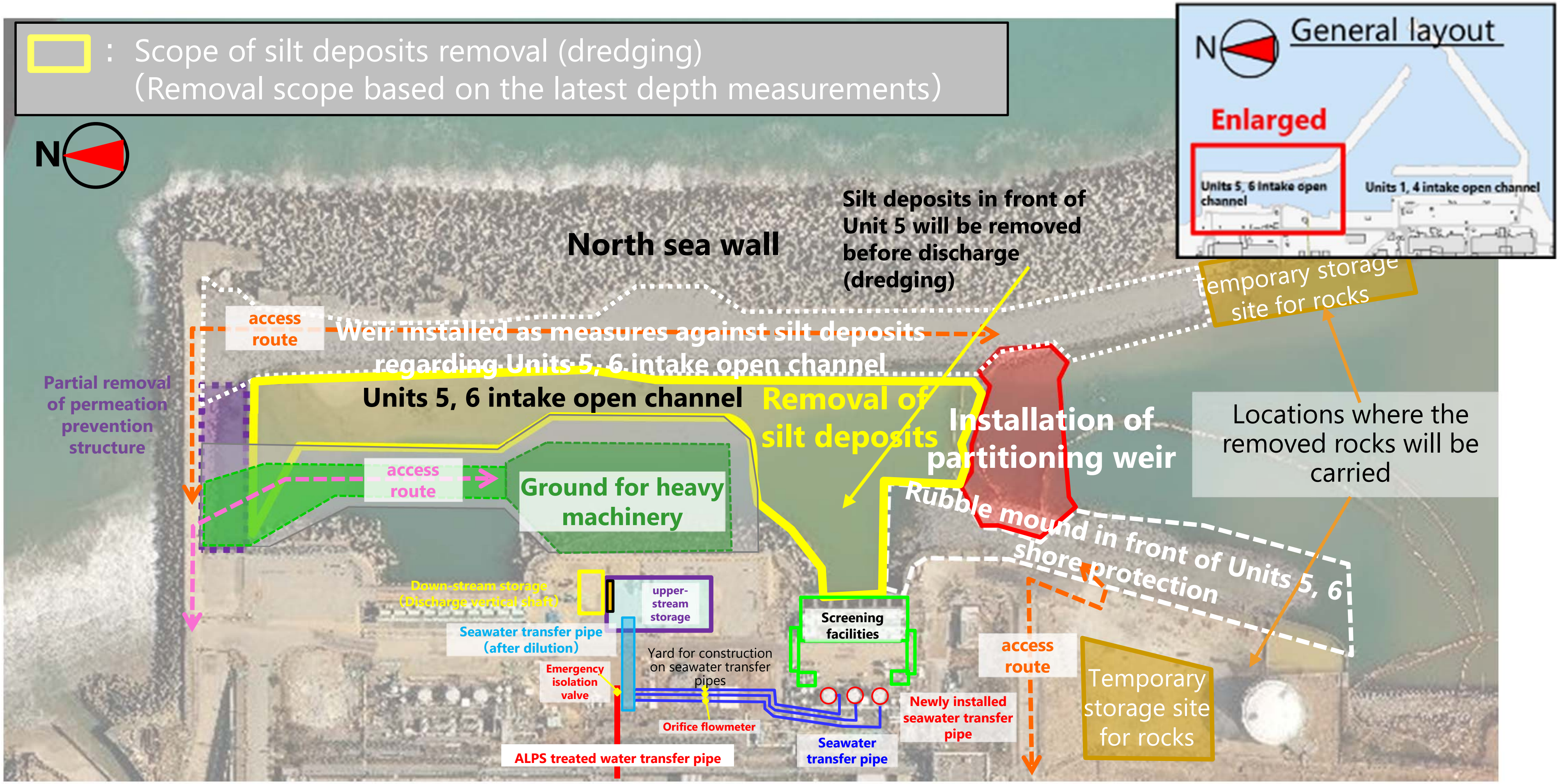
Figure for the fabrication of discharge outlet caisson

(Reference) Construction Projects Within the Harbor for Intake

TEPCO

- As a construction project for the harbor intake, a partitioning weir will be installed in the Units 5, 6 intake open channel (using rubble mound breakwater + sheet*) to divide the harbor from the harbor on the Units 1-4 side with comparatively high concentration of radioactive material.
- Also, to take in seawater for dilution from outside the harbor, work to partially remove permeation prevention structure from the North sea wall shall be initiated from November 2022. Furthermore, silt deposits will be removed (dredged) for the purpose of improving the environment inside the Units 5, 6 intake open channel.

* Flexible polyvinyl chloride mat, thickness = 5mm

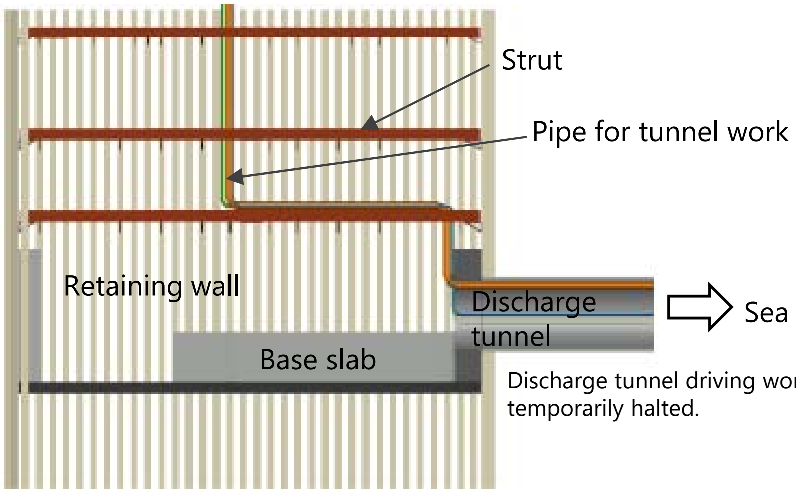


Provided by: JAPAN SPACE IMAGING CORPORATION, Taken April 8, 2021 Product(C)[2021] DigitalGlobe, Inc., a Maxar company.

（Reference） Installing the down-stream storage

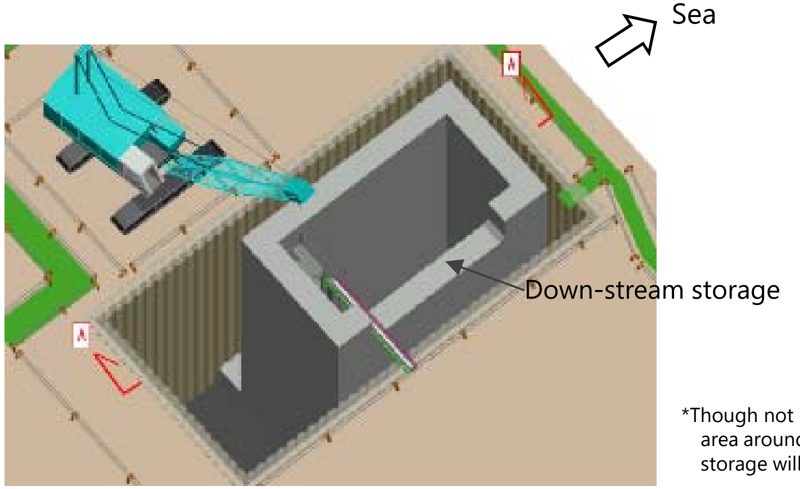
- The down-stream storage will be installed while the discharge tunnel driving work is halted.
- After the down-stream storage is installed, the discharge tunnel installation work will be restarted.

Beginning of construction

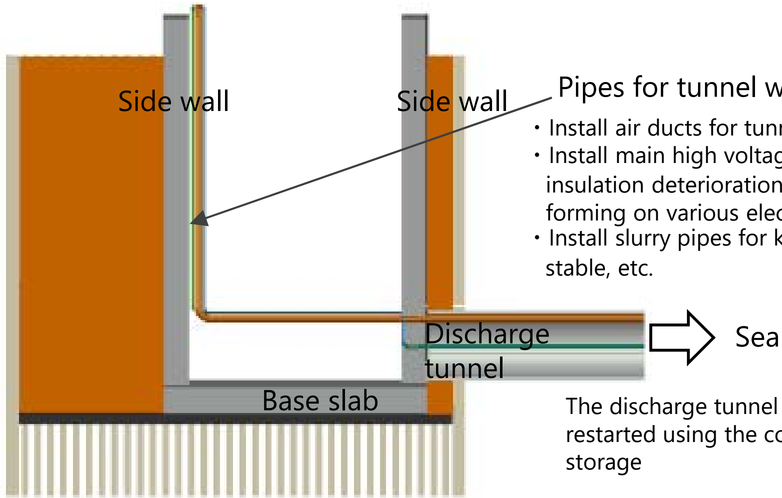


A-A cross section ※Subject to change on the ground

When completed



*Though not shown in the figure, the area around the down-stream storage will be backfilled.



Pipes for tunnel work
- Install air ducts for tunnel ventilation
- Install main high voltage cable for preventing insulation deterioration from condensation forming on various electrical equipment
- Install slurry pipes for keeping the tunnel face stable, etc.

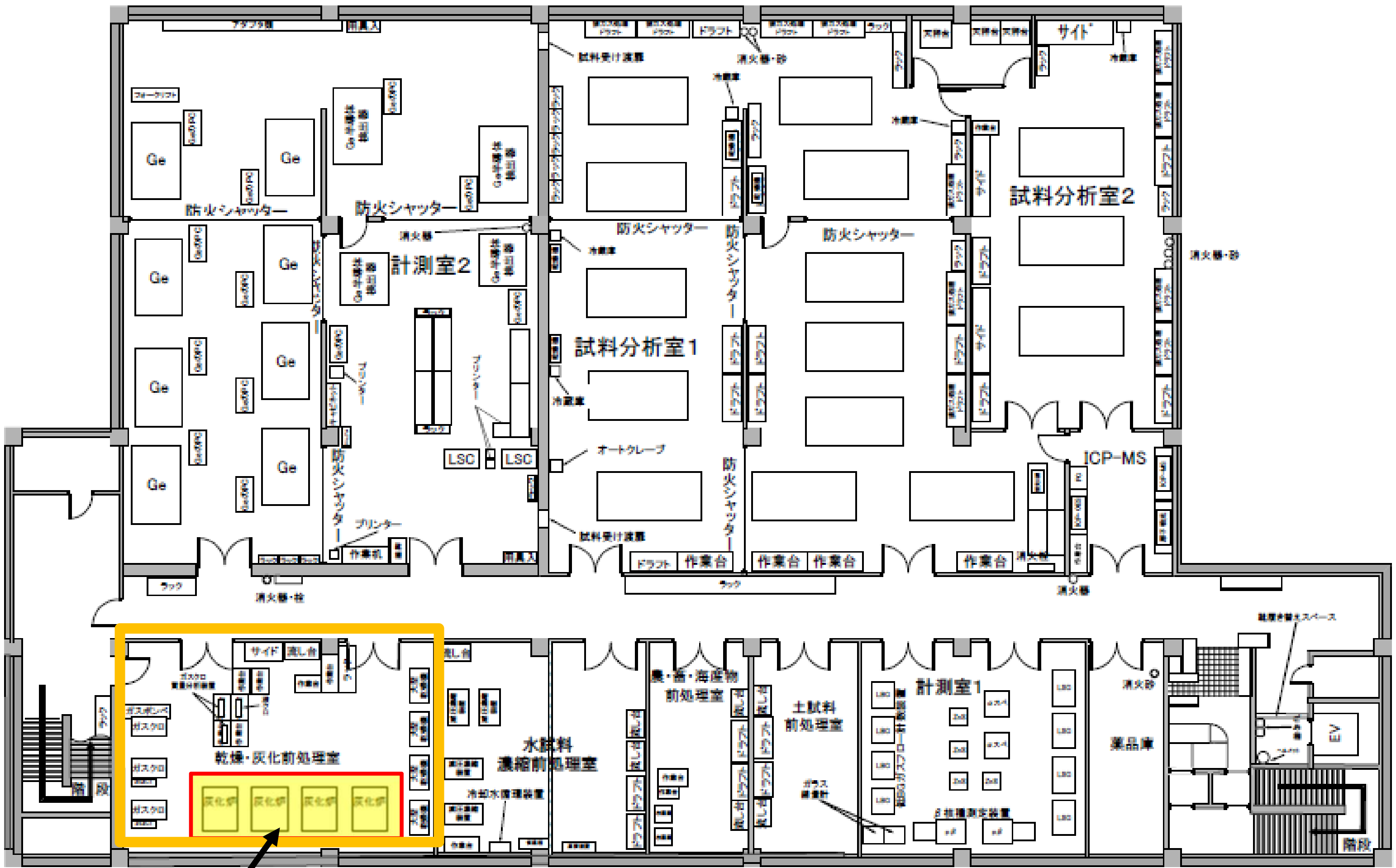
The discharge tunnel driving work will be restarted using the completed down-stream storage

A-A cross section ※Subject to change on the ground

2. Installation of electrolytic accumulation devices

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. Their operation will start by March 2023 after accumulation tests.



Electrolytic accumulation devices to be installed here

Chemical analysis building B1F

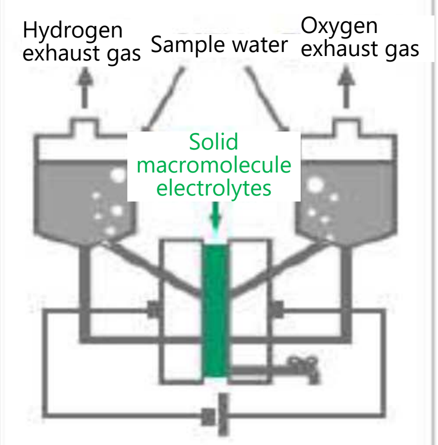
*Pre-processing device to analyze tritium in extremely low concentrations

2． Installation of electrolytic accumulation devices （Cont.）

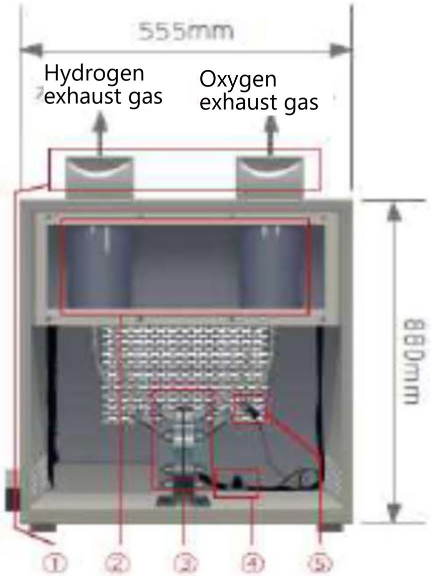
TEPCO

- 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】

- It can concentrate 1,000 mL of distilled sample water to 50 mL with around 60 hours.
- Hydrogen and oxygen are released as the electrolysis products.

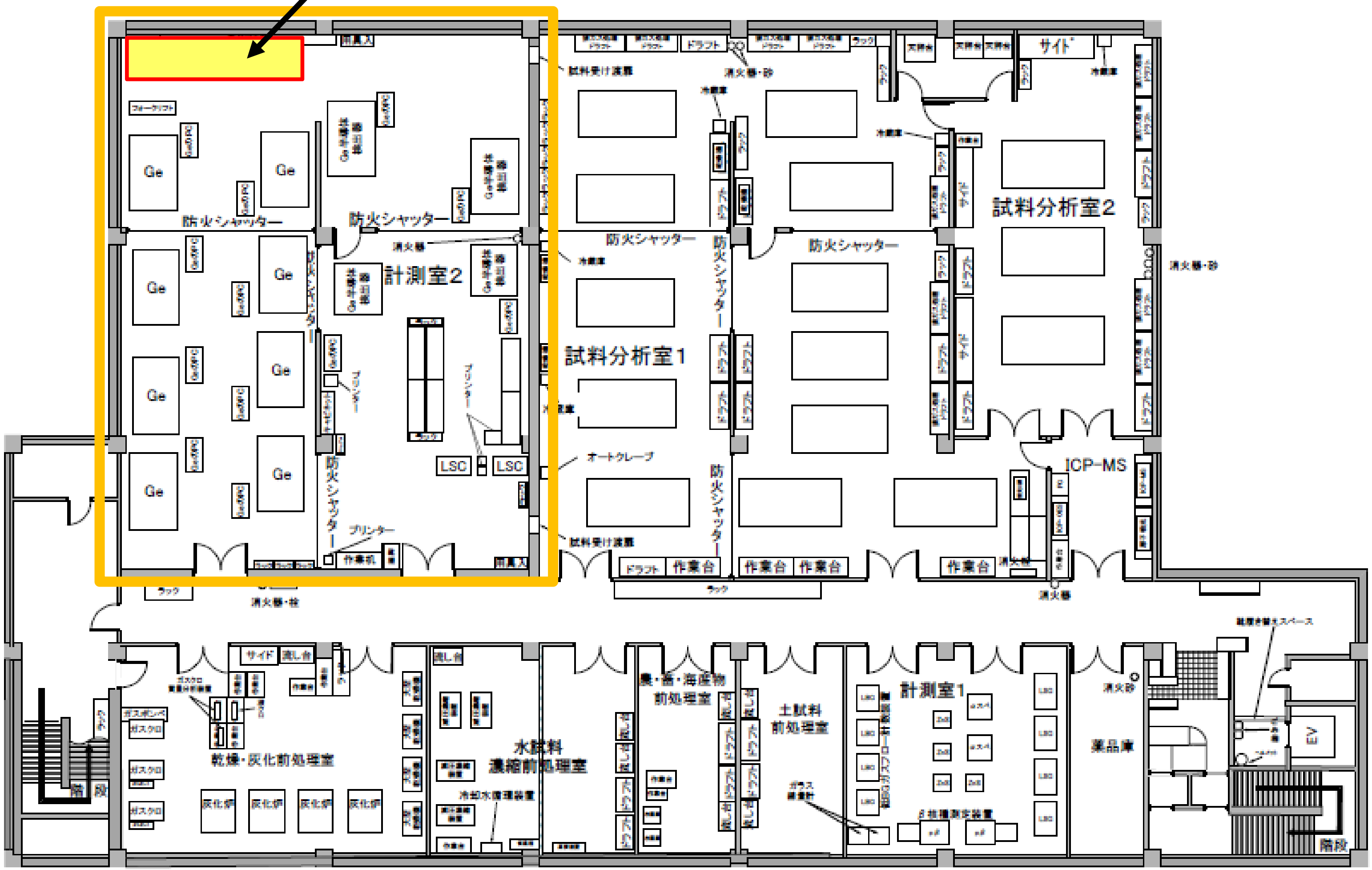
*Descriptions taken from the De Nora Permelec, Ltd. website

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

TEPCO

- A low-energy photon germanium semiconductor detector (LEPS) will be installed in the measurement room in the chemical analysis building. Set up of the LEPS will be completed by the end of December 2022, and the operation will start by March 2023 after verification tests.

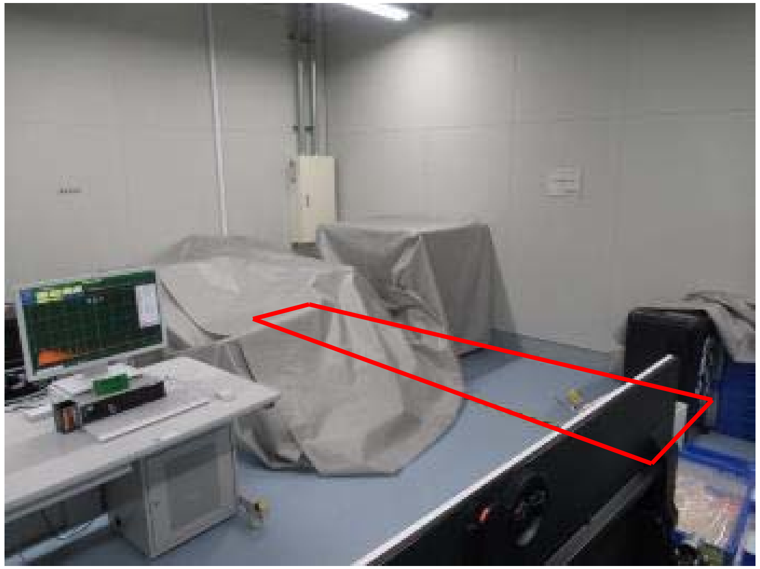
LEPS to be installed here



Chemical analysis building　B1F

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

- In analyzing ALPS treated water, Fe-55, Nb-93m, Mo-93 and other nuclides that emit low energy radiation will need to be analyzed.
- A low-energy photon germanium semiconductor detector (LEPS) will be installed to measure these nuclides which cannot be measured using the germanium semi-conductor detector installed in 1F.



LEPS to be installed here
(Inside the chemical analysis building measurement room)

LEPS
(Photo of the LEPS in Kaken)

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