<Reference>

Results of Groundwater Quality Survey at the East Side of the Turbine Building at Fukushima Daiichi NPS

June 19, 2013

Tokyo Electric Power Company

TEPCO 東京電力

1. Overview

■Situation

- Since radioactive material (cesium) density detected in seawater in the port has not decreased, we have had expert review meetings to investigate the cause.
- The observation holes were drilled and groundwater was obtained/analyzed at the east side of Unit 1-4 Turbine Buildings. Cesium density detected in groundwater is lower than those detected in seawater, and it is declining recently. Therefore, the cause is not estimated to be affected by the groundwater.
- Tritium density detected in groundwater obtained at the sampling point between Unit 1 and Unit 2 in May 2013 was high (500,000Bq/L).

■Evaluation as of now

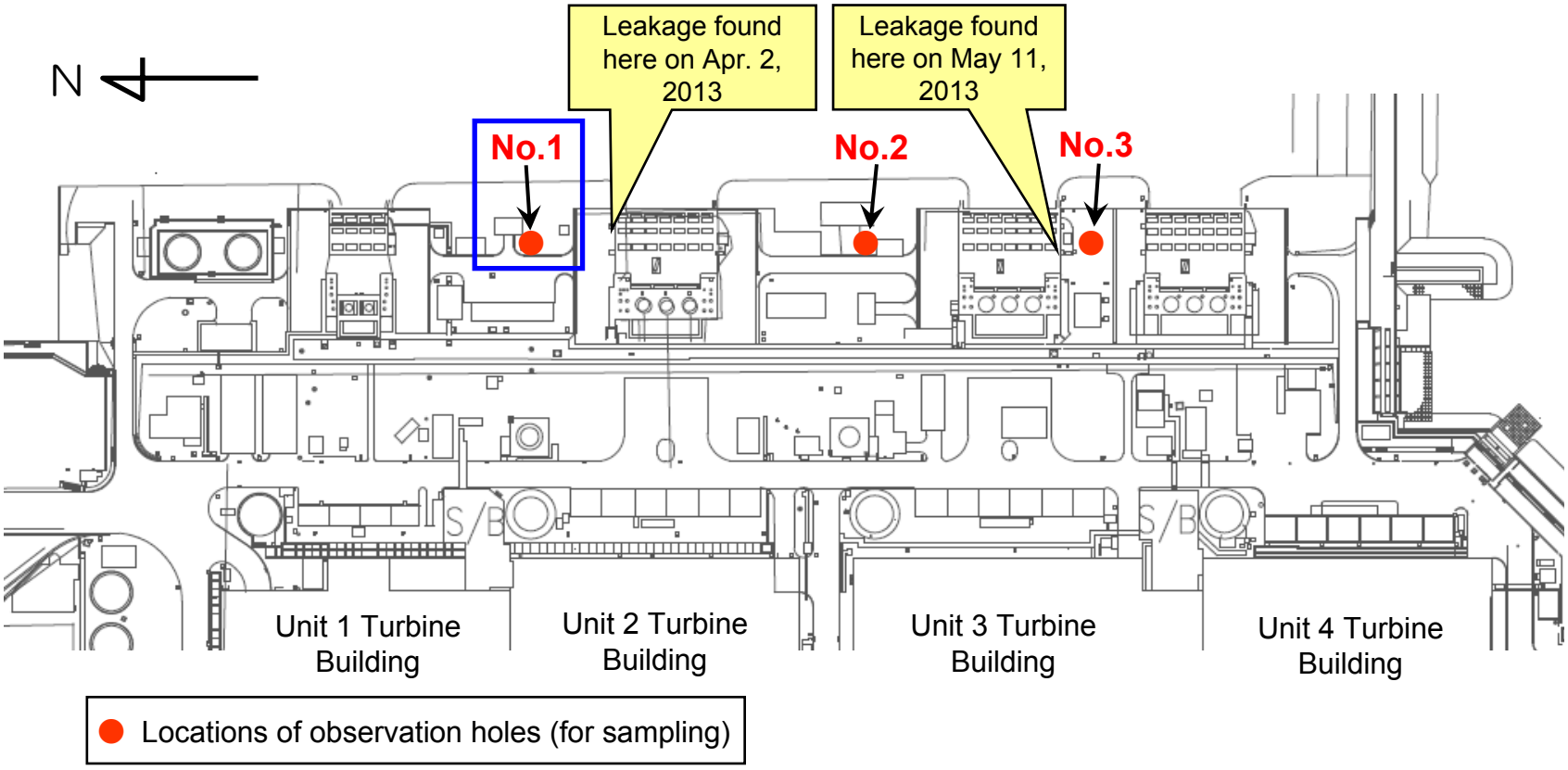
- There is a high possibility that tritium has been remained in soil and has transferred to the groundwater when the contaminated water leaked out to the screen pump room at Unit 2 in the past.
- Since tritium density detected in the groundwater obtained at the east side of the Turbine Building increased more than one digit compared to those detected in December 2012, it is less likely that the groundwater was affected by fallouts observed in the past.

Although there is a high possibility that the groundwater was affected by contaminated water leakage observed in the past, we will investigate the other possibilities.
As for the location where it is likely to have contaminated, we will prevent the contaminated groundwater from spreading to the sea and identify the contaminated area.

2. Water quality of groundwater sampled east of the turbine buildings

- In order to confirm whether contaminated water currently still remains under the ground due to the leakage of accumulated water, observation holes (drilled to about −16m G.L.) were installed at 3 locations near the bank protection between the Unit 1-4 water intakes, and groundwater was sampled through the holes for measurement.

Groundwater sampling locations east of the turbine buildings



Results of water quality measurements on groundwater sampled east of the turbine buildings (1/2)

Sampling date	Dec. 8, 2012*2		Dec. 12, 2012*2	May 24, 2013			May 31, 2013		
Analysis item	No.1	No.2	No.3	No.1	No.2	No.3	No.1	No.2	No.3
Cs-134 (Bq/L)	ND (0.59)	ND (0.61)	ND (0.60)	ND (0.45)	ND (0.37)	0.87	0.53	ND (0.41)	1.6
Cs-137 (Bq/L)	ND (0.72)	ND (0.81)	ND (0.79)	ND (0.45)	ND (0.41)	1.4	0.57	0.95	2.7
I-131 (Bq/L)	ND (0.26)	ND (0.25)	ND (0.24)	ND (3.0)	ND (2.1)	ND (2.4)	ND (0.80)	ND (0.64)	ND (0.66)
Co-60 (Bq/L)	0.26	ND (0.14)	ND (0.10)	ND (0.65)	ND (0.25)	ND (0.32)	ND (0.65)	ND (0.38)	ND (0.41)
Ru-106 (Bq/L)	ND	ND	ND	26	ND	ND	19	ND	ND
Sr-90 (Bq/L)	8.6	8.2	8.3	1,000	28	ND (1.0)	Measurements underway		
H-3 (Bq/L)	29,000	410	3,200	500,000	380	2,200	460,000	340	1,800
All-α (Bq/L)	ND (5.0)	ND (5.0)	ND (6.1)	ND (11)	ND (11)	ND (11)	ND (8.3)	ND (8.3)	ND (8.3)
All-β (Bq/L)	150	55	41	1,900	53	18	1,300	76	ND (17)
Chloride concentration (PPM)	4,000	4,300	1,950	1,700	3,300	1,200	1,500	3,450	900

*1: “ND” indicates a case where the result is below the detection limit value.

*2: In measurements for the γ nuclide, the results are smaller than the actual values because of the use of BG having a high density.

Results of water quality measurements on groundwater at the east side of the turbine buildings (2/2)

Sampling date	June 7, 2013						June 14, 2013	
Analysis item	No.1①	No.2①	No.3①	No.1②	No.2②	No.3②	No.1①	No.1②
Cs-134 (Bq/L)	ND (0.42)	0.47	0.90	ND (0.40)	ND (0.37)	0.52	ND (0.37)	ND (0.37)
Cs-137 (Bq/L)	ND (0.53)	0.73	2.0	0.49	ND (0.48)	1.6	ND (0.43)	0.51
I-131 (Bq/L)	ND (0.52)	ND (0.48)	ND (0.49)	ND (0.85)	ND (0.49)	ND (0.47)	ND (0.44)	ND (0.49)
Co-60 (Bq/L)	ND (0.34)	ND (0.33)	ND (0.48)	ND (0.42)	ND (0.33)	ND (0.56)	ND (0.62)	ND (0.46)
Ru-106 (Bq/L)	19	ND	ND	21	ND	ND	18	19
Sr-90 (Bq/L)	Measurements underway			Measurements underway			Measurements underway	
H-3 (Bq/L)	500,000	390	1,800	470,000	340	1,800	Measurements underway	
All-α (Bq/L)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	Measurements underway	
All-β (Bq/L)	1,700	ND (18)	ND (18)	1,600	ND (18)	ND (18)	Measurements underway	
Chloride concentration (PPM)	1,700	3,700	1,000	1,700	3,700	1,000	1,800	1,800

*1: “ND” indicates a case where the result is below the detection limit value.

Cs-137:

All of samples of No.1 to No.3 were assessed as not being at levels affecting the densities in seawater

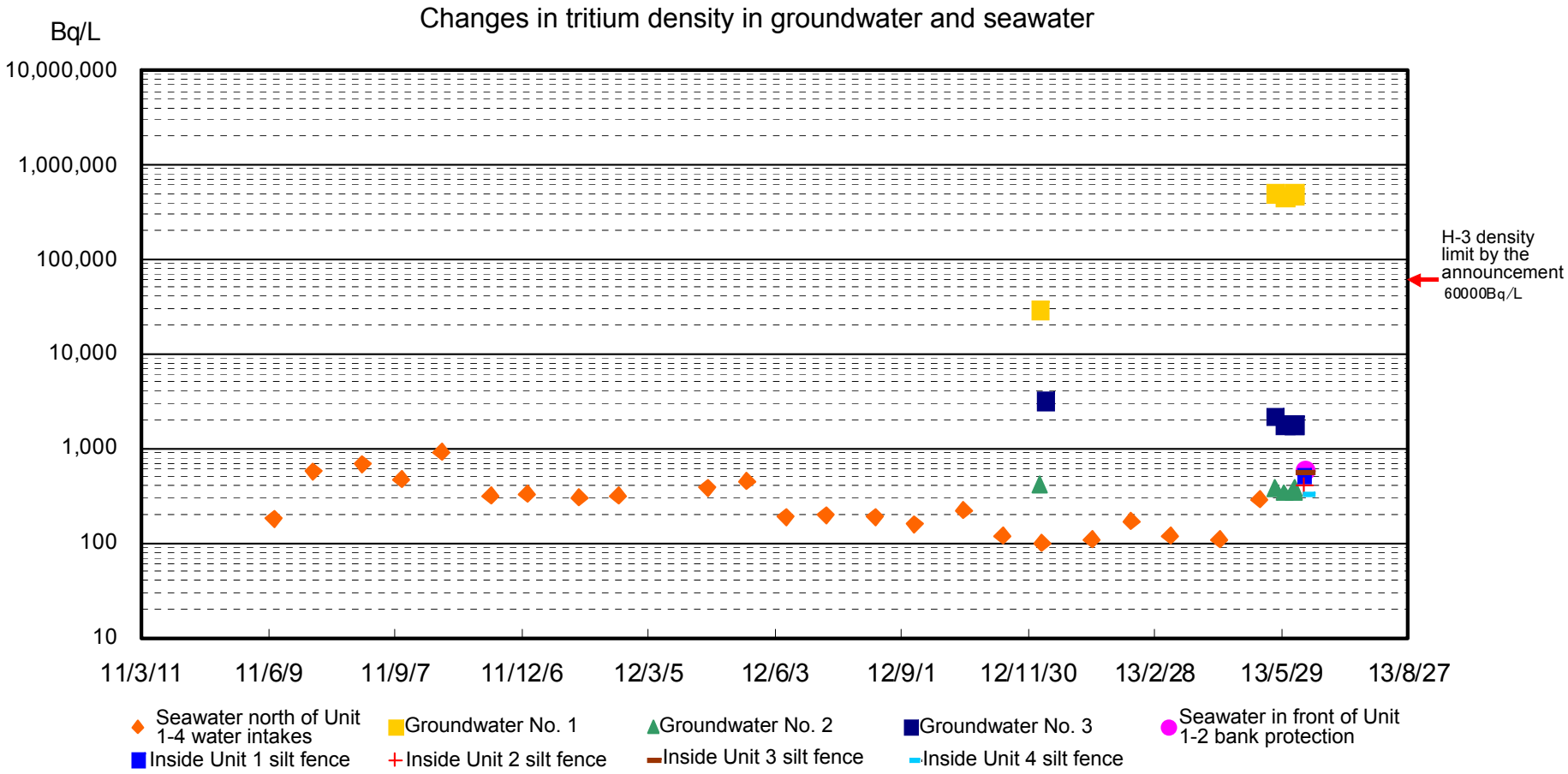
Sr-90：

An increase was found in No.1, and further assessment will be conducted using results of samples taken on the other days.

H-3：

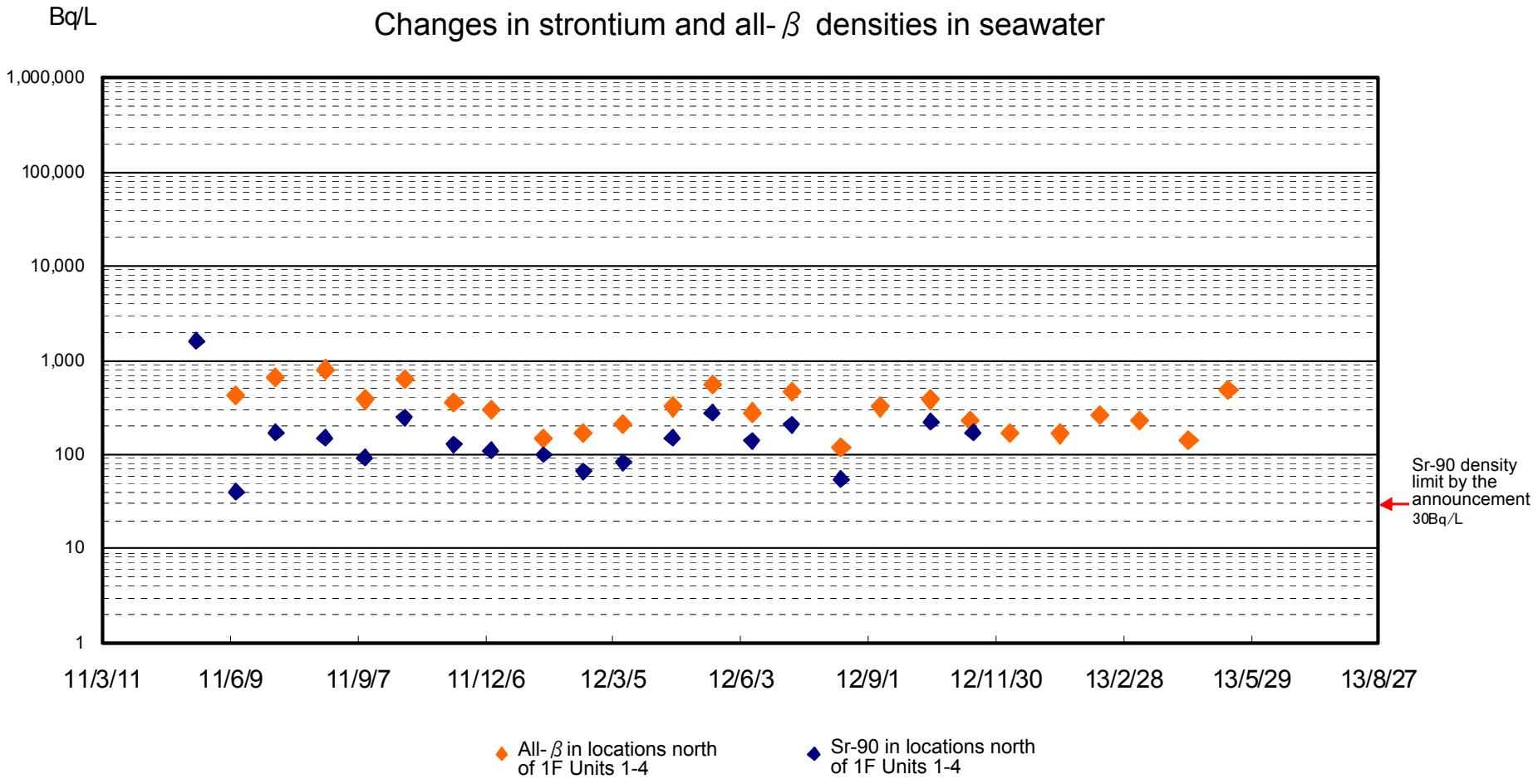
An increase was found in No.1.

Assessment through Comparison with Water Quality of Seawater in the Port (1/2)



○ No location showed a particularly high value as the tritium density in seawater in the port. We will continue monitoring seawater as well as groundwater.

Assessment through Comparison with Water Quality of Seawater in the Port (2/2)



○ No location showed a particularly high all-β density. We will continue monitoring.

3. Contamination Sources and Transition Routes Currently Suspected

- Our considerations on the current situations are as follows:

- Considering that water leaked in the past to the Unit 2 screen pump room has passed through the crushed-rock layer under the power cable conduit, there is a high possibility of contaminated water remaining under the ground.
- With respect to trenches where contaminated water has been accumulated, the main pits of the trenches have been closed after past leakages.
- Since tritium density detected in the groundwater obtained at the east side of the Turbine Building increased more than one digit compared to those detected in December 2012, it is less likely that the groundwater was affected by fallouts observed in the past.

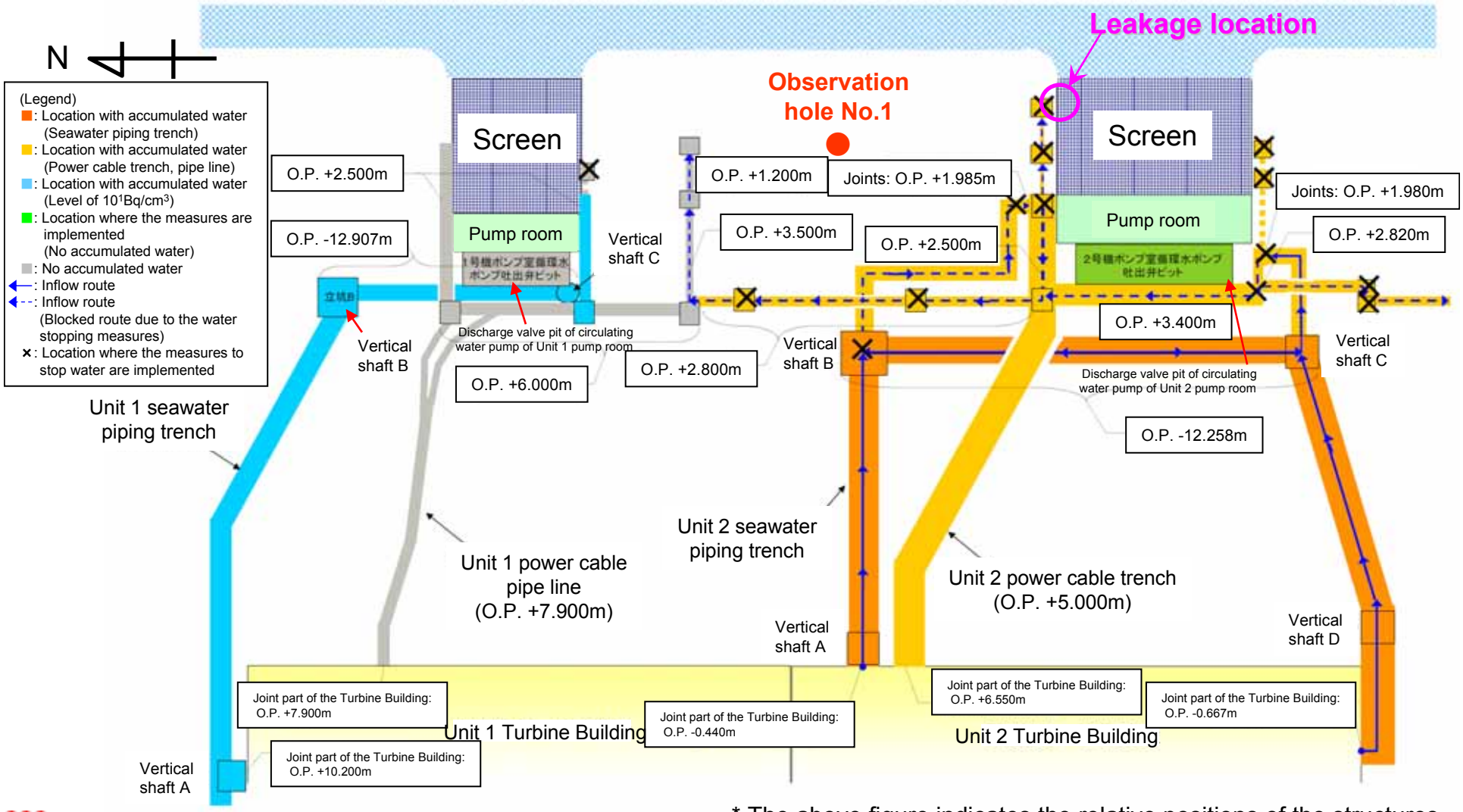
- Based on the above considerations, highly possible contamination sources and transition routes are thought as follows:

- When leakage from the Unit 2 water intake section occurred in April 2011, a part of leaked water permeated and spread into the north-side ground through the Unit 2 power cable conduit, and remains under the ground.
- While cesium has been absorbed onto the soil, tritium has moved by groundwater.

- We will implement measures to prevent leakage to the sea and additional measures for locations where leakages occurred in the past. In parallel, we will conduct monitoring to identify the affected areas.

Blocking of the Pit at the East Side of the Turbine Building (Units 1 and 2)

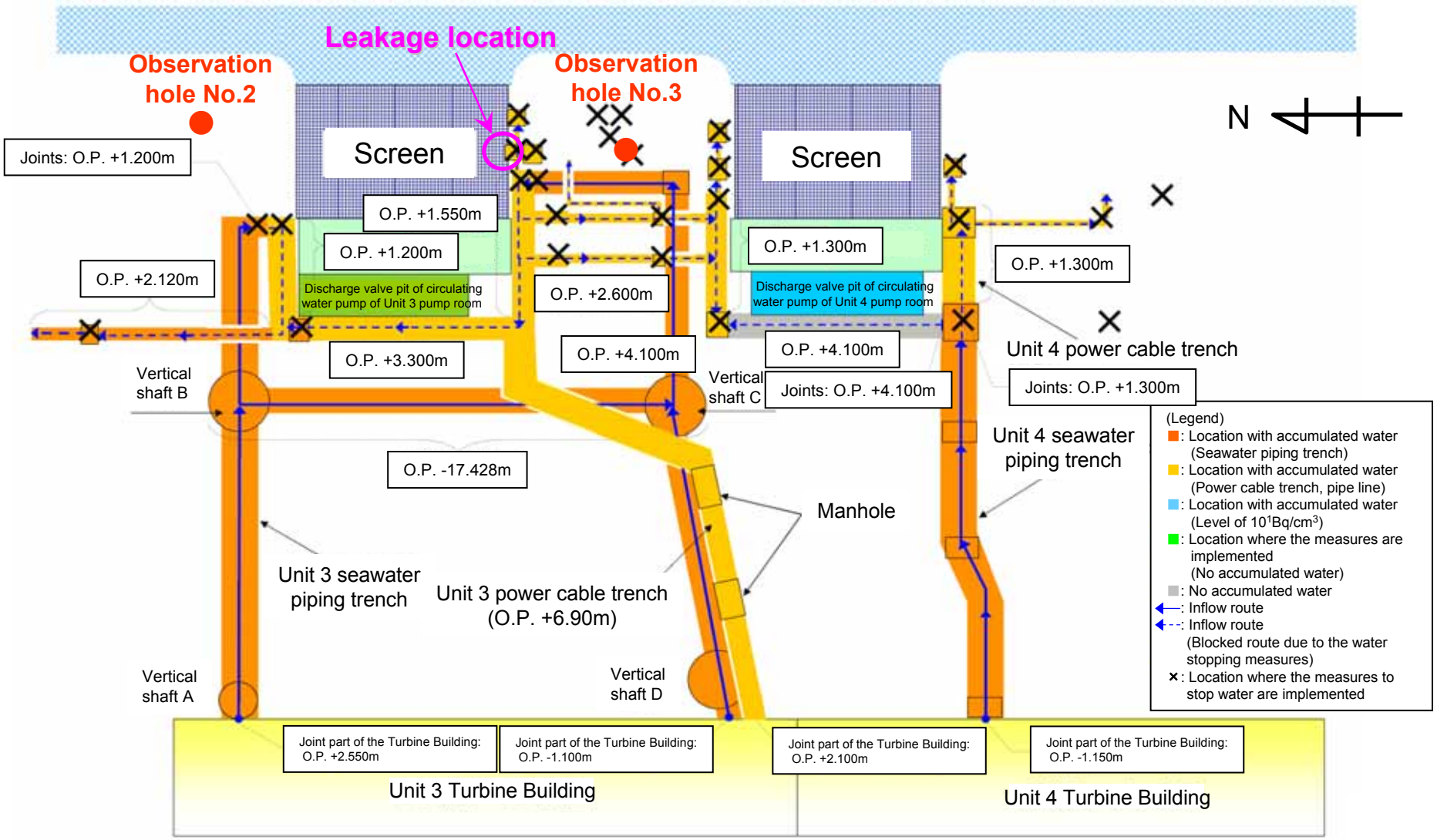
- The pit was basically blocked, so there is a possibility that contaminated water remains in the trench.



* The above figure indicates the relative positions of the structures.

Blocking of the Pit at the East Side of the Turbine Building (Units 3 and 4)

- The pit was basically blocked, so there is a possibility that contaminated water remains in the trench.



* The above figure indicates the relative positions of the structures.

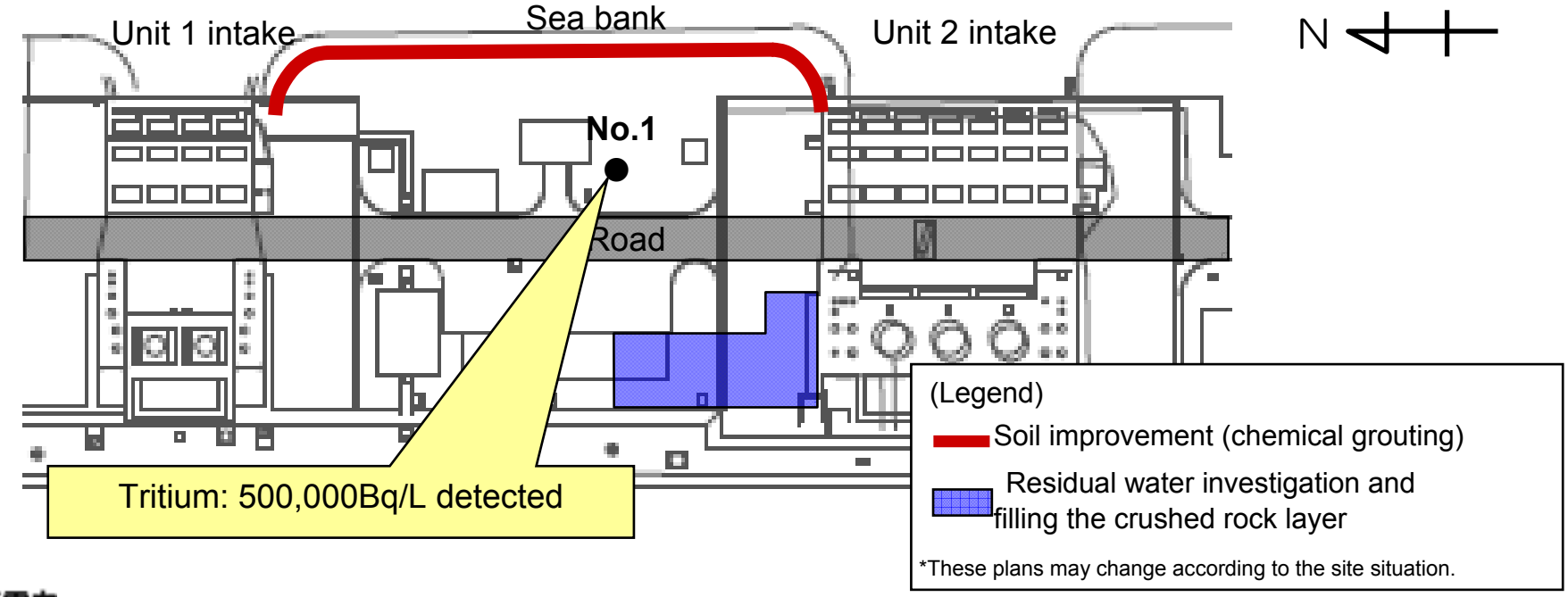
4. Contaminated Water Spread Prevention Measures

1) Ocean Leakage Prevention Measures

- Soil improvement using chemical grouting etc. is planned in the back side area of the sea bank between the water intakes of Unit 1 and 2.
- Following additional measures are planned to be taken around the area where leakage has occurred in the past.

  -Investigation of the existence of residual water inside the power cable duct at the upper stream of Unit 2 power cable conduit

  - Prevention of the contaminated water spread by filling the crushed rock layer of the cable duct foundation and the surrounding airspace.



2) Specifying the Effected Area by Monitoring

Monitoring will be conducted to confirm the hypothesis that a part of the water which leaked out of the Unit 2 water intake occurred in April, 2011, has seeped/spread through the Unit 2 power cable conduit to the northern ground.

(1) Groundwater of the Turbine Building east side

-Observation holes to take groundwater samples will be added around the current observation hole(No.1) to specify the contamination source/spread lines. (Planned drilling depth: approx. G.L.-16m (About the same as the No.1 observation hole)

-For the additional observation holes, samples will be taken and Tritium concentration etc. will be confirmed as soon as possible.

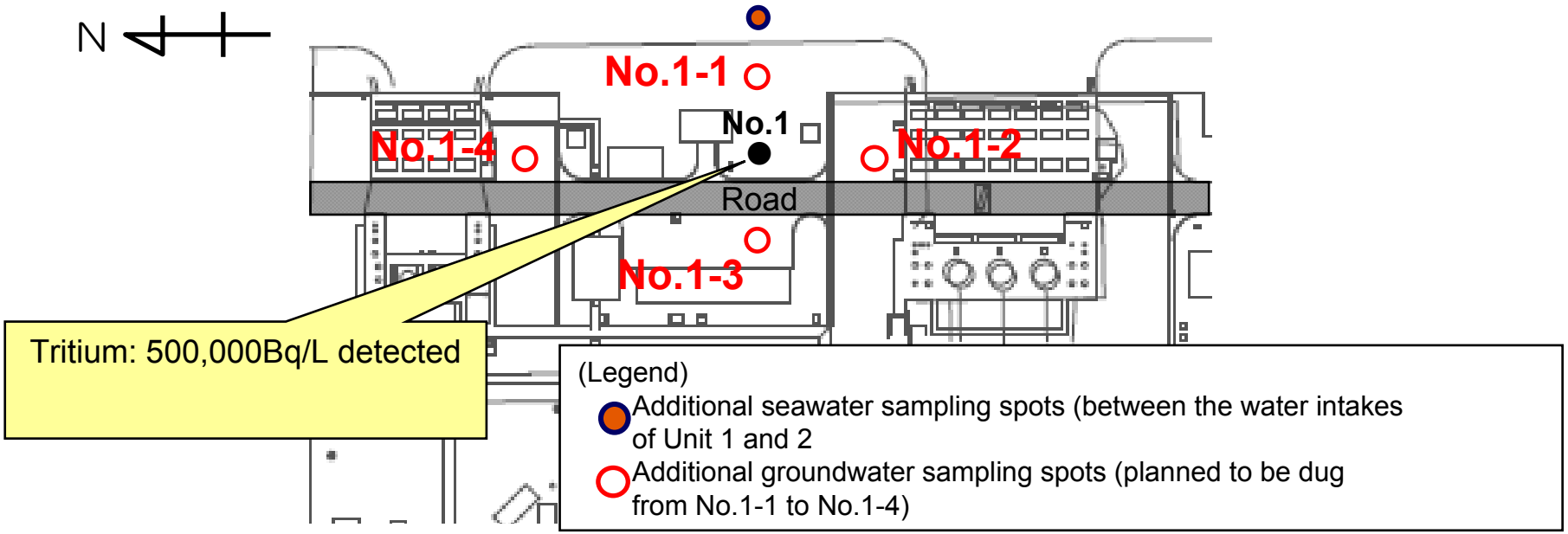
-Monitoring at the No.1 observation hole, which Tritium etc. has been detected this time will also be continued to confirm amount of seep/spread to the ground.

(2) Seawater inside the port

-Monitoring spots will be added at the sea bank area in front of the No.1 observation hole and Tritium concentration etc. will be measured to confirm effects to the seawater inside the port.

-Monitoring in front of each water intakes of Unit 1-4 will be continued in addition to the current Tritium monitoring of the north side of Unit 1-4 water intakes.

Additional Monitoring Spots



○Analyzed nuclides and measurement frequency

-Tritium, Cesium, All Beta: Once/week

-Strontium: Once/month

-In cases when concentration rises, the analyzed nuclides and measurement frequency will be reviewed arbitrarily.

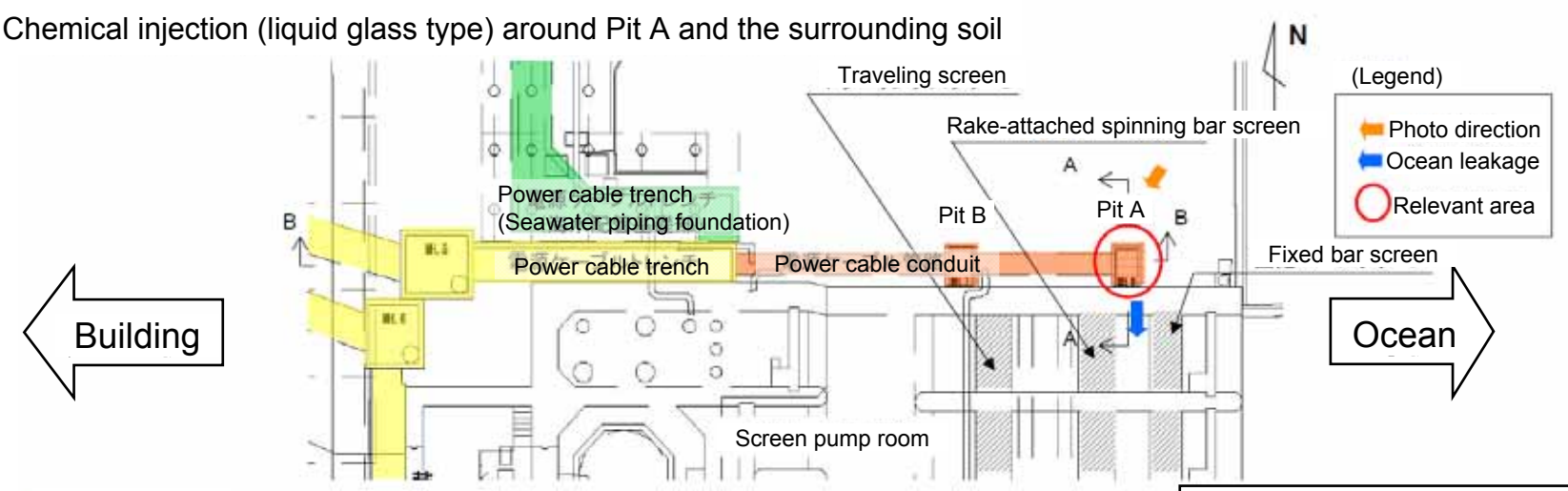
3) Further additional measures

(1) Further additional measures will be taken according to the results to specify the spread area by the additional boring and monitoring.

(2) Regarding the upper stream seawater piping trench, measurements to reduce radiation concentration of the residual contaminated water inside the trench will be reviewed and implemented.

[Reference] Measures to stop water at the Unit 2 Screen Pump Room (April, 2011)

Chemical injection (liquid glass type) around Pit A and the surrounding soil



B-B Section

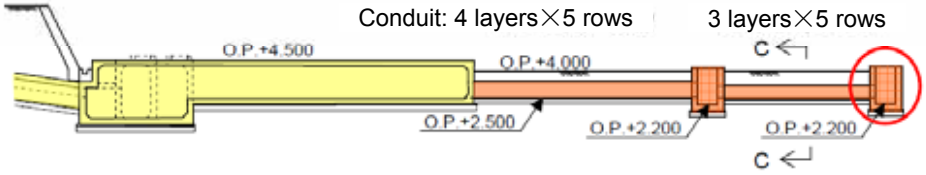
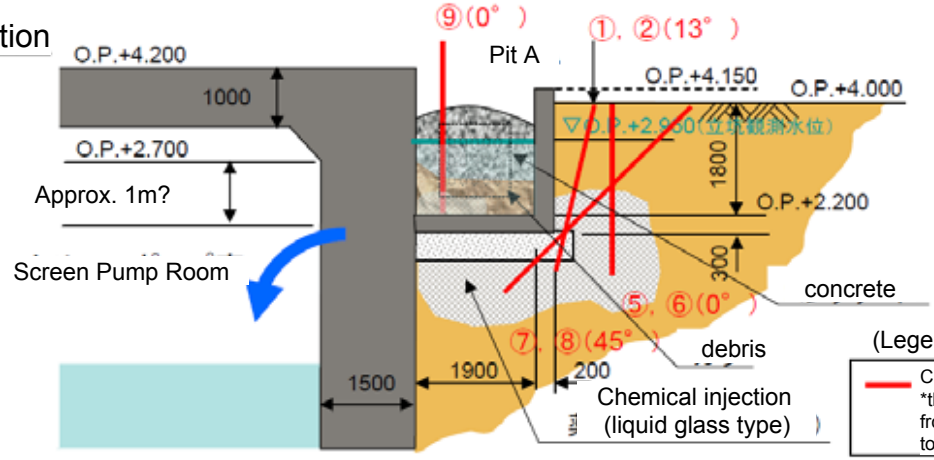
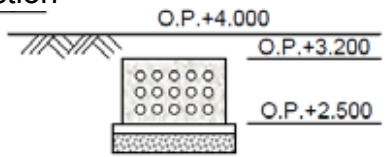


Photo of Unit 2 Pit A chemical injection (taken on April 5, 2011)

A-A Section



C-C Section



(Legend)

Chemical injection (liquid glass type) rod
*the circled numbers show the sequence (()shows the tilt angle from the ground surface vertical) ③ and ④ is the chemical injection to the surrounding areas.