

Progress of Landside Impermeable Wall freezing: Phase 2 of the first stage

October 27, 2016

TEPCO

Tokyo Electric Power Company Holdings, Inc.

- The purpose of the Landside Impermeable Wall construction lies not in freezing soil to form an underground wall but in keeping groundwater from flowing into the reactor/turbine buildings and preventing new contaminated water from being generated.
- By closing less than 95 percent of the mountain side of the Landside Impermeable Wall in Phase 2 of the first stage, it is expected that the amount of groundwater flowing into the areas around the reactor/turbine buildings will be reduced. This will help keep groundwater from being contaminated during the first stage.
- Throughout the first stage, how freezing of the Landside Impermeable Wall has progressed will be checked by monitoring the difference in groundwater levels inside and outside of the wall and the amount of groundwater pumped up by the subdrain and groundwater drain systems and the well point system.

[Reference] Distribution map of soil temperatures (north side of Unit 1) **TEPCO**

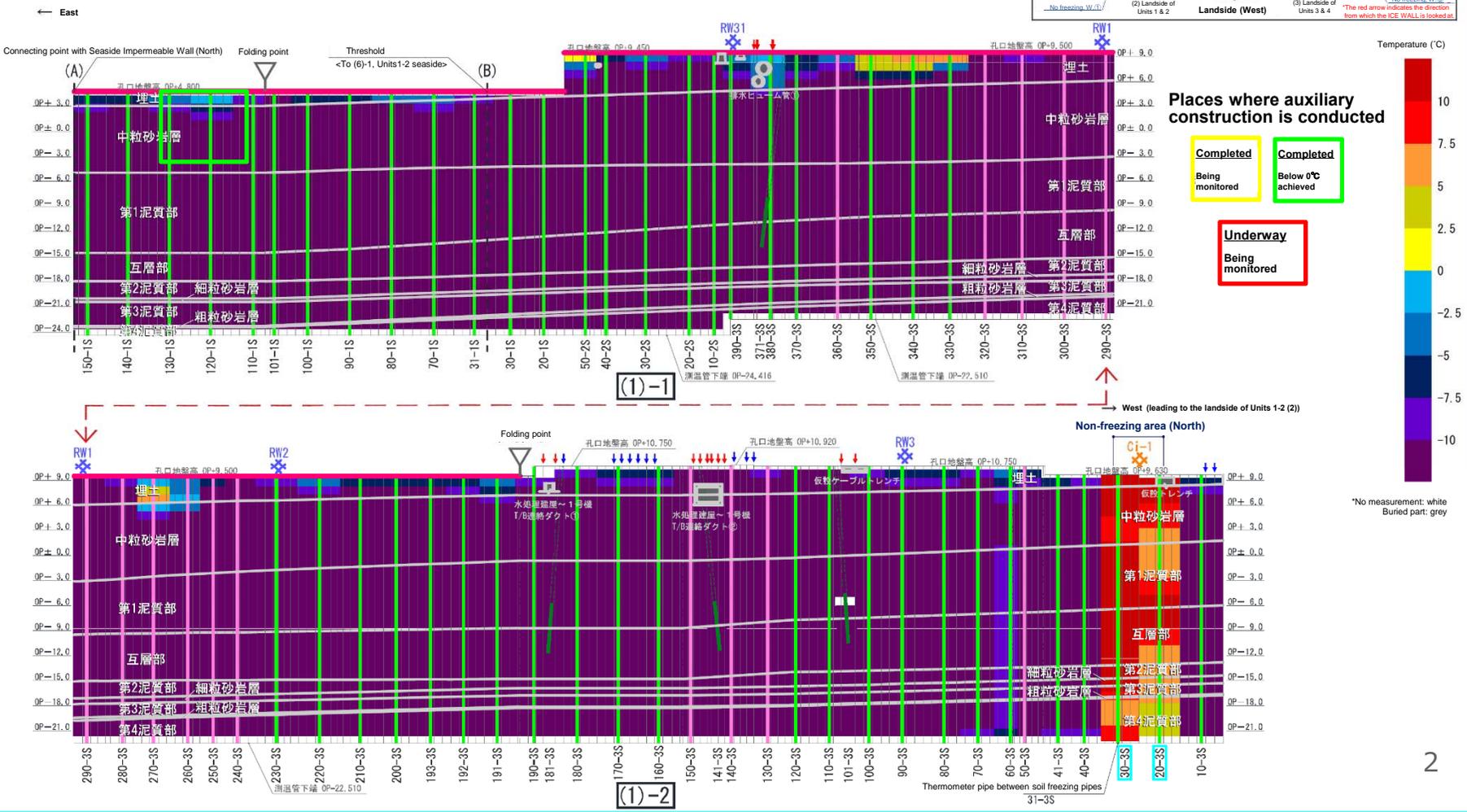
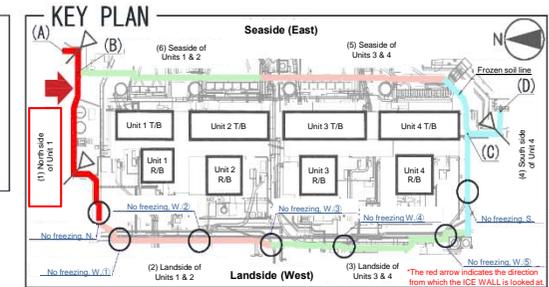
■ Distribution map of soil temperatures

(1) North side of Unit 1 (a view from the north side)

(The temperature data as of 7 a.m. on October 25)

[Legend]

- Thermometer pipe for the outside of frozen soil line
- Thermometer pipe for the inside of frozen soil line
- Diagonally installed thermometer pipe for the soil freezing pipes installed on multiple line
- Thermometer pipe for no freezing areas
- Corner of frozen soil line
- RE (recharge well)
- CI (medium-grained sandstone layer in the inside of frozen soil line)
- Soil freezing pipes installed on single line (advanced freezing)
- Soil freezing pipes installed on multiple lines (advanced freezing)
- Freezing areas for the seaside and a part of the north side



[Reference] Distribution map of soil temperatures (west side of Units 1-2)



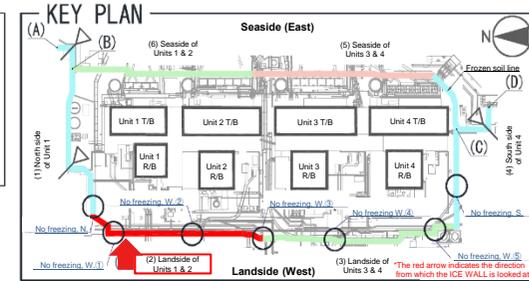
■ Distribution map of soil temperatures

(2) Landside of Units 1-2 (a view from the west side)

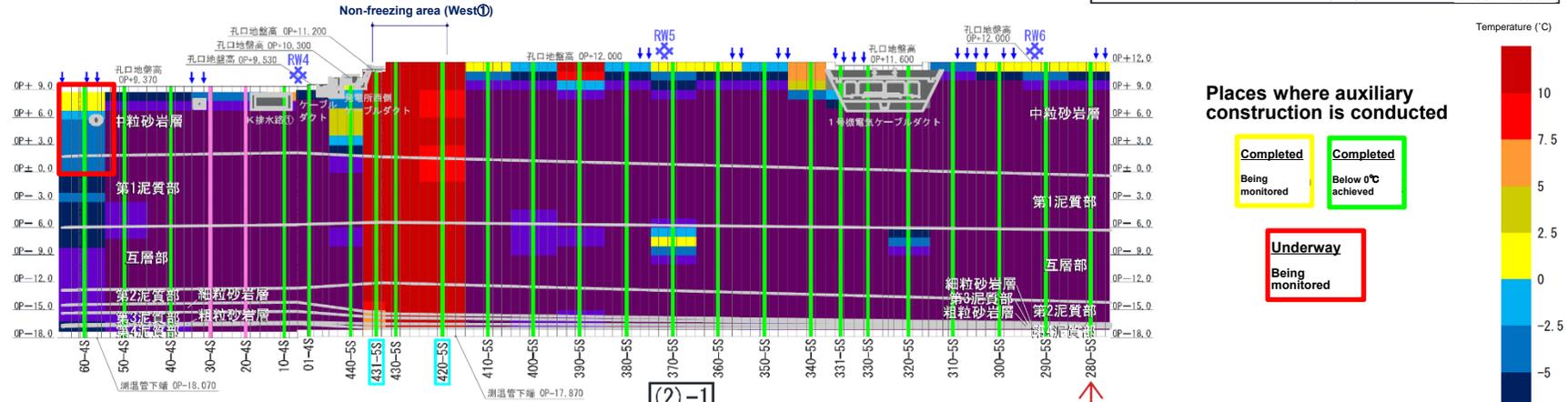
(The temperature data as of 7 a.m. on October 25)

[Legend]

- Thermometer pipe for the outside of frozen soil line
- Thermometer pipe for the inside of frozen soil line
- Diagonally installed thermometer pipe for the soil freezing pipes installed on multiple line (advanced freezing)
- Thermometer pipe for no freezing areas
- Corner of frozen soil line
- RE (recharge well)
- Ci (medium-grained sandstone layer in the inside of frozen soil line)
- Soil freezing pipes installed on single line (advanced freezing)
- Soil freezing pipes installed on multiple line (advanced freezing)
- Freezing areas for the seaside and a part of the north side



← North (to the north side of Unit 1 (1))

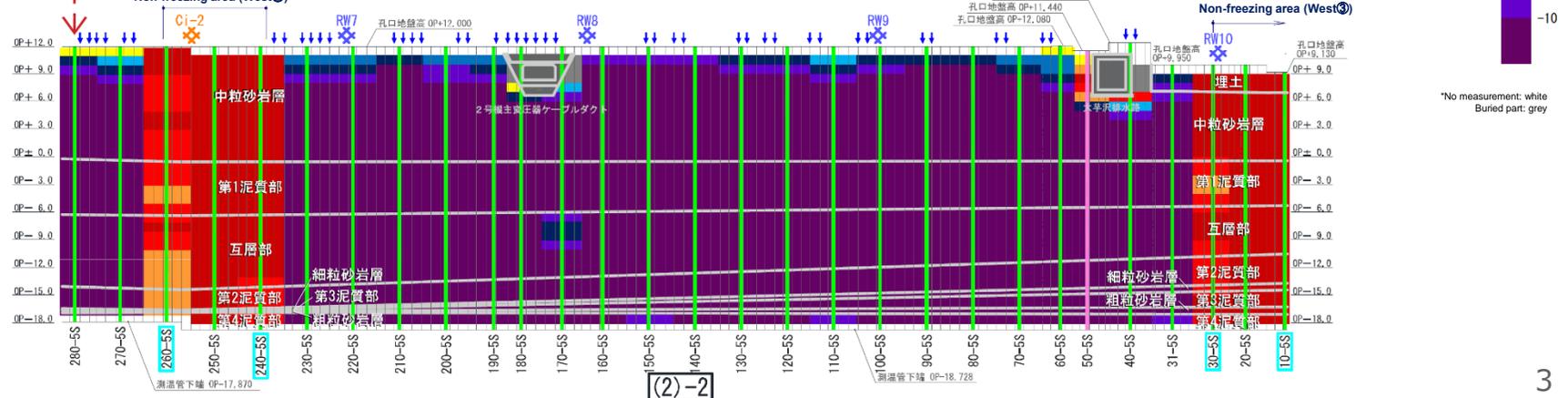


Places where auxiliary construction is conducted

- Completed Being monitored
- Completed Below 0°C achieved
- Underway Being monitored

*No measurement: white
Buried part: grey

← Non-freezing area (West②)



[Reference] Distribution map of soil temperatures (west side of Units 3-4)



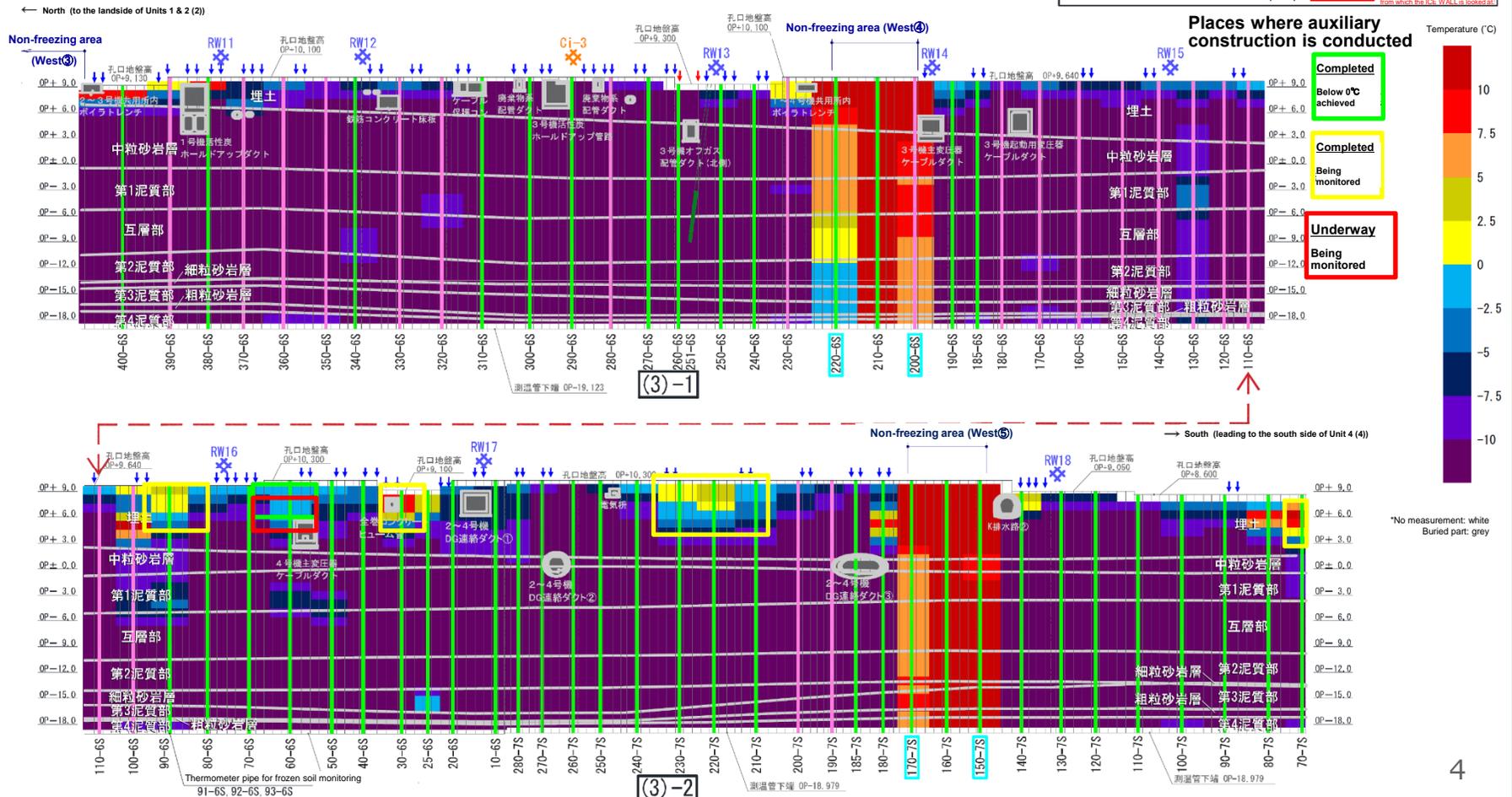
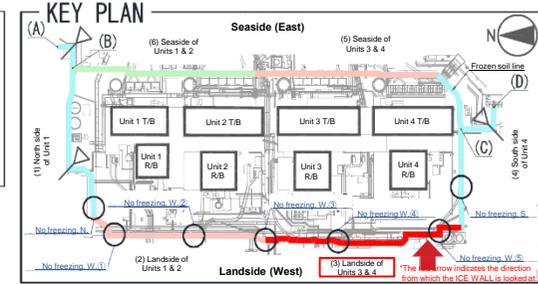
■ Distribution map of soil temperatures

(3) Landside of Units 3-4 (a view from the west side)

(The temperature data as of 7 a.m. on October 25)

[Legend]

- Thermometer pipe for the outside of frozen soil line
- Thermometer pipe for the inside of frozen soil line
- Diagonally installed thermometer pipe for the soil freezing pipes installed on multiple line
- Thermometer pipe for no freezing areas
- Corner of frozen soil line
- RE (recharge well)
- Cl (medium-grained sandstone layer in the inside of frozen soil line)
- Soil freezing pipes installed on single line (advanced freezing)
- Soil freezing pipes installed on multiple lines (advanced freezing)
- Freezing areas for the seaside and a part of the north side



[Reference] Distribution map of soil temperatures (south side of Unit 4)



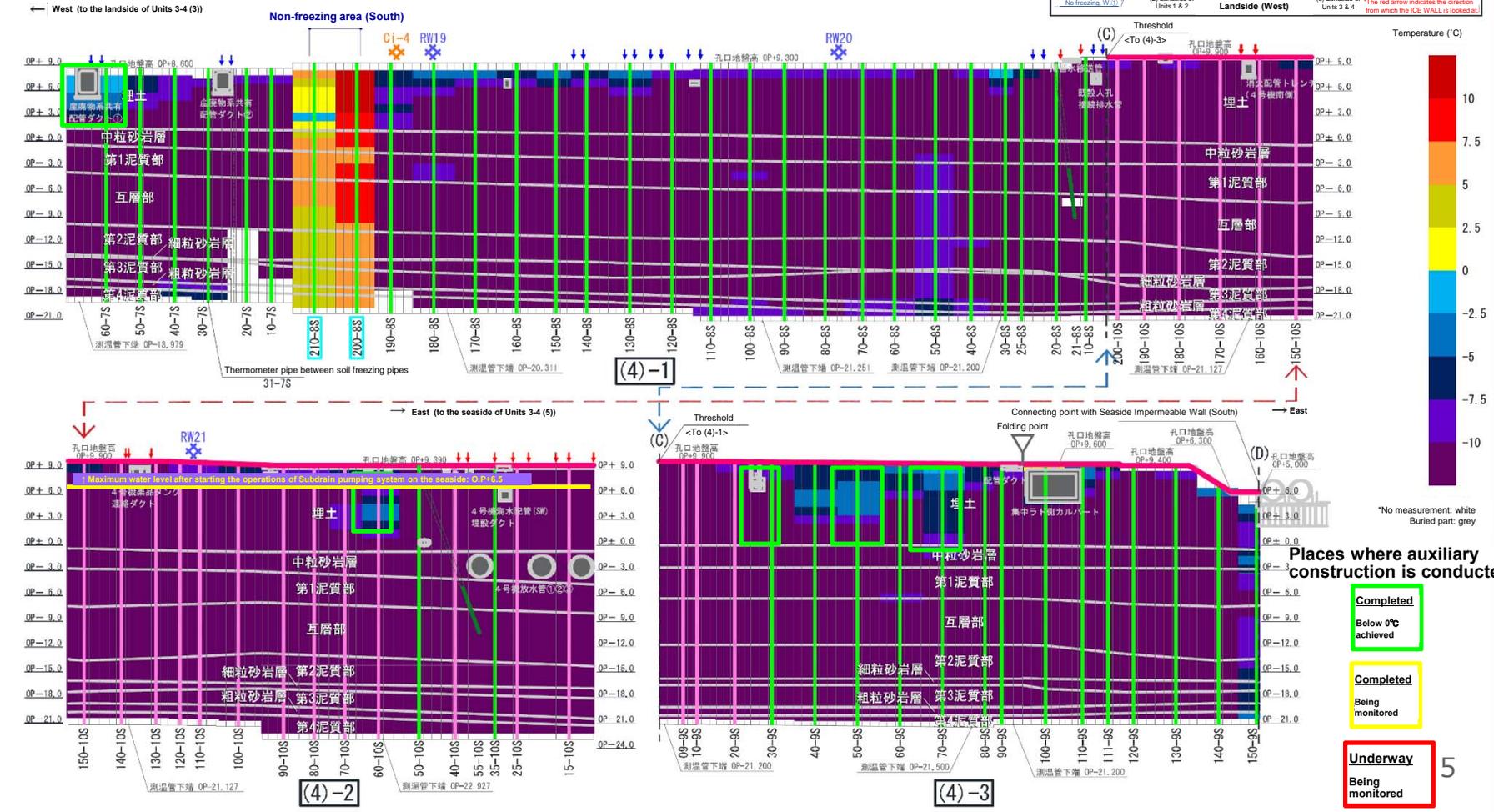
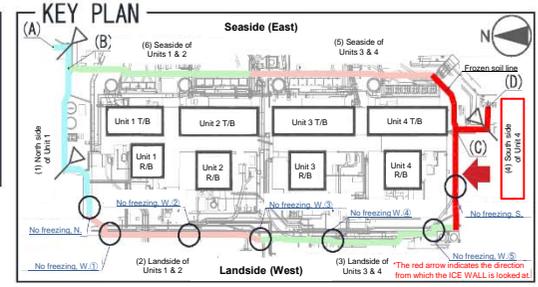
Distribution map of soil temperatures

(4) South side of Unit 4 (a view from the south side)

(The temperature data as of 7 a.m. on October 25)

[Legend]

- Thermometer pipe for the outside of frozen soil line
- Thermometer pipe for the inside of frozen soil line
- Diagonally installed thermometer pipe for the soil freezing pipes installed on multiple line
- Thermometer pipe for no freezing areas
- Corner of frozen soil line
- RE (recharge well)
- CI (medium-grained sandstone layer in the inside of frozen soil line)
- Soil freezing pipes installed on single line (advanced freezing)
- Soil freezing pipes installed on multiple lines (advanced freezing)
- Freezing areas for the seaside and a part of the north side



[Reference] Distribution map of soil temperatures (east side of Units 3-4)



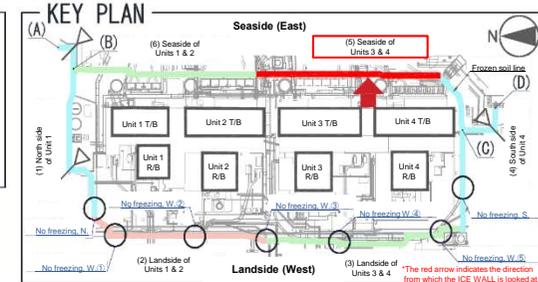
■ Distribution map of soil temperatures

(5) Seaside of Units 3-4 (west side: a view from the inside of frozen soil)

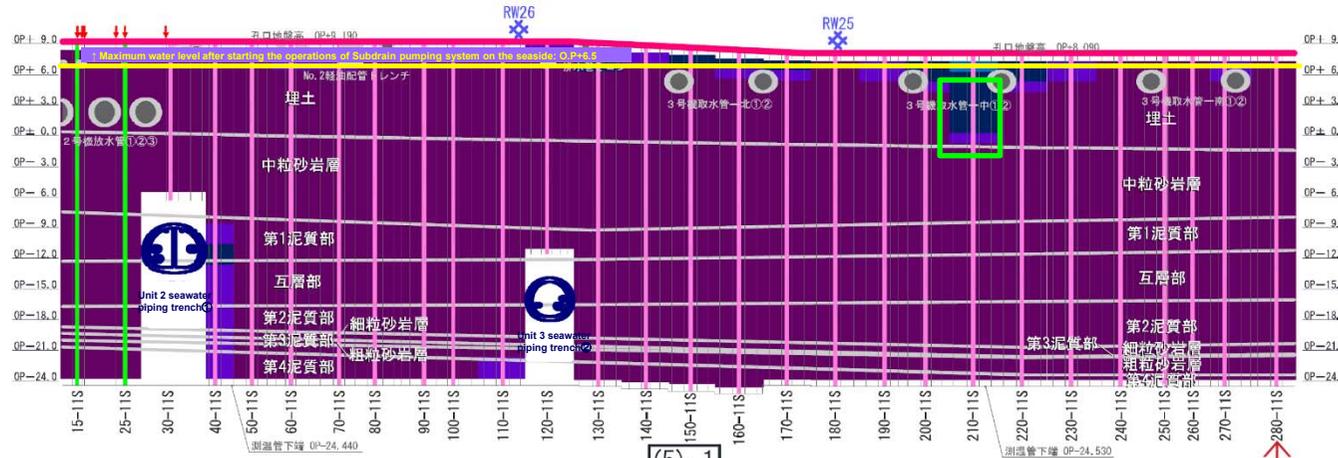
(The temperature data as of 7 a.m. on October 25)

[Legend]

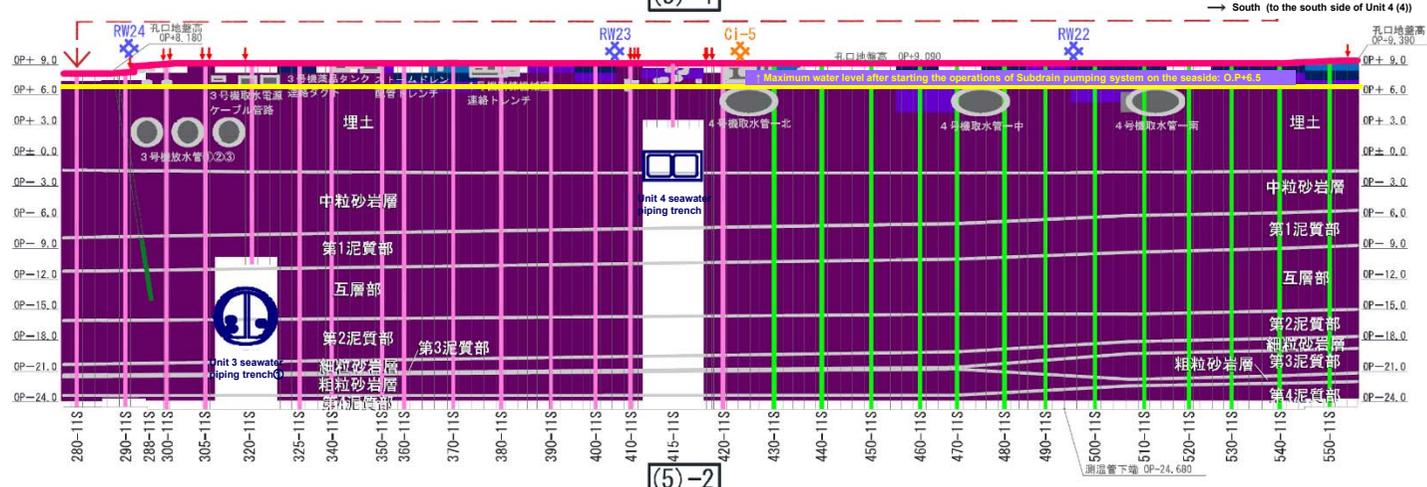
- Thermometer pipe for the outside of frozen soil line
- Thermometer pipe for the inside of frozen soil line
- Diagonally installed thermometer pipe for the soil freezing pipes installed on multiple line
- Thermometer pipe for no freezing areas
- Corner of frozen soil line
- RE (recharge well)
- CI (medium-grained sandstone layer in the inside of frozen soil line)
- Soil freezing pipes installed on single line (advanced freezing)
- Soil freezing pipes installed on multiple lines (advanced freezing)
- Freezing areas for the seaside and a part of the north side



← North (to the seaside of Units 1-2 (6))



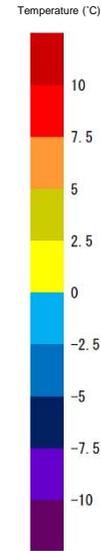
(5)-1



(5)-2

Places where auxiliary construction is conducted

- Completed Being monitored
- Completed Below 0°C achieved
- Underway Being monitored



*No measurement: white
Buried part: grey

[Reference] Distribution map of soil temperature (east side of Units 1-2) **TEPCO**

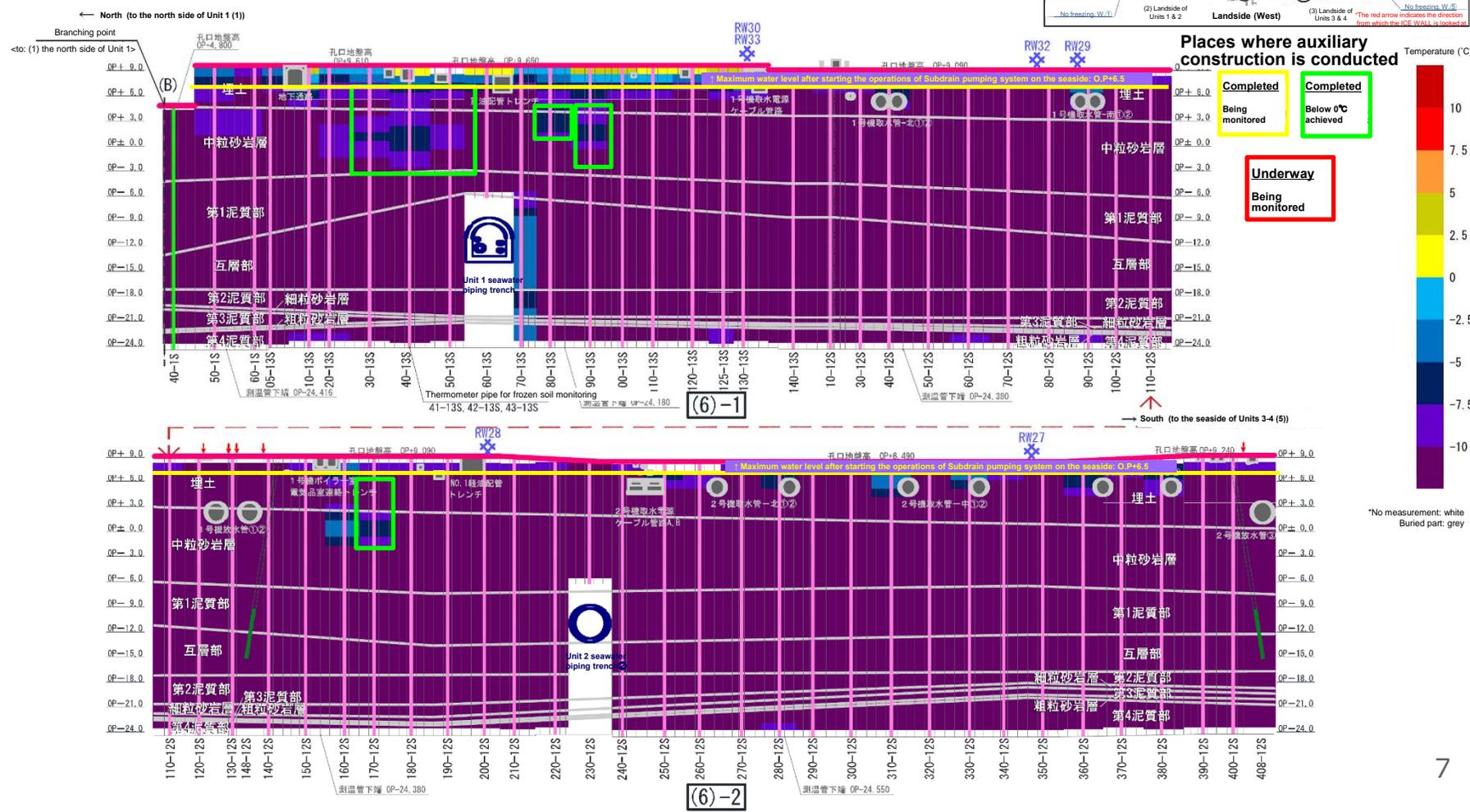
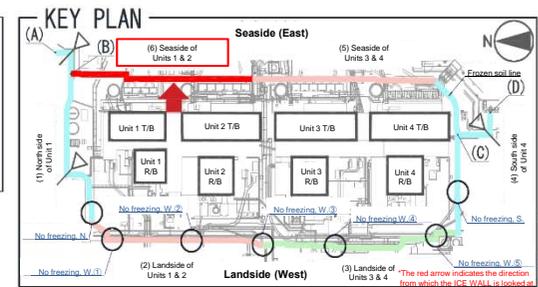
■ Distribution map of soil temperatures

(6) Seaside of Units 1-2
(west side: a view from the inside of frozen soil)

(The temperature data as of 7 a.m. on October 25)

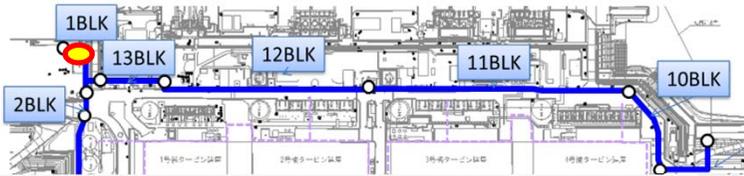
[Legend]

- Thermometer pipe for the outside of frozen soil line
- Thermometer pipe for the inside of frozen soil line
- Diagonally installed thermometer pipe for the soil freezing pipes installed on multiple lines (advanced freezing)
- Thermometer pipe for no freezing areas
- Corner of frozen soil line
- RE (recharge well)
- CI (medium-grained sandstone layer in the inside of frozen soil line)
- Soil freezing pipes installed on single line (advanced freezing)
- Soil freezing pipes installed on multiple lines (advanced freezing)
- Freezing areas for the seaside and a part of the north side



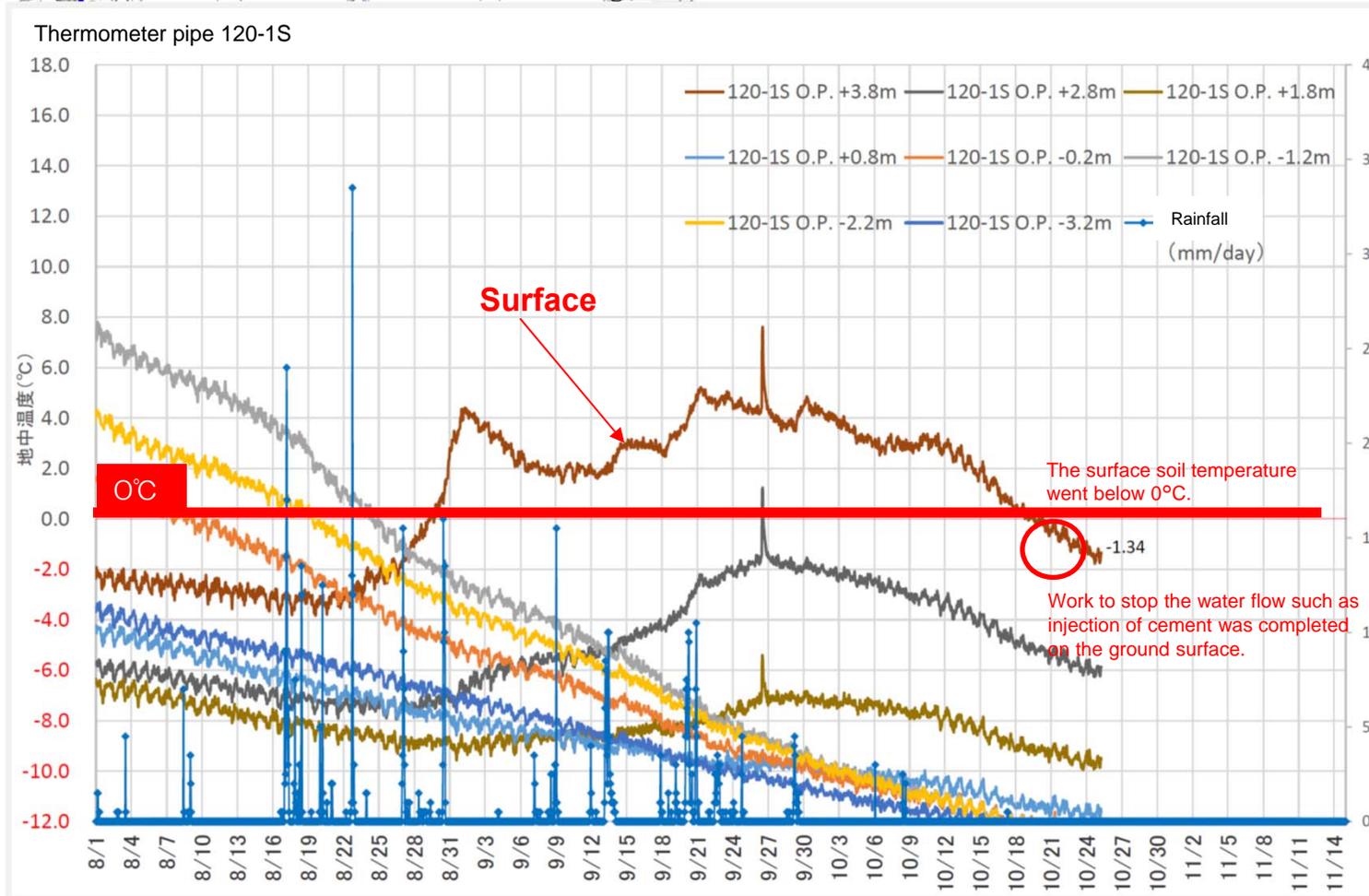
*No measurement: white
Buried part: grey

Auxiliary construction to assist freezing of the seaside (Surface of 1BLK)



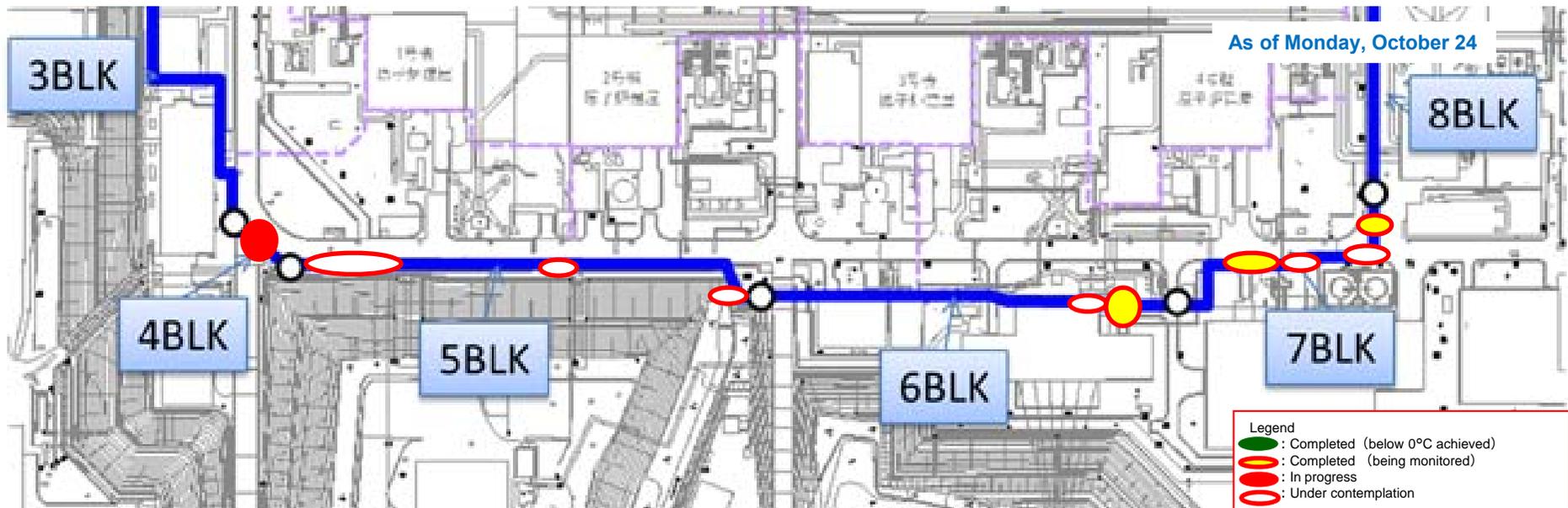
【120-1S】

Soil temperatures including the ground surface went below 0°C.



Soil temperatures went below 0° C at all monitoring points on the seaside.

Auxiliary construction to assist freezing of the landside



Construction in progress (pictures of 6 BLK)



Process of auxiliary construction to assist freezing of the mountainside



Process 1. In the data of soil temperatures obtained from all the thermometer pipes that are buried deeper than 2m from the ground, the depth at which auxiliary construction is supposed to take place, find measurement points where the current soil temperatures and the expected soil temperatures*¹ are both above 0°C.

Process 2. Among the measurement points, find the ones with 3 or more consecutive “Shindo”s*² where the current soil temperatures and the expected soil temperatures are both above 5°C. Auxiliary construction will take place at these points as a “Highest Priority.”

Process 3. Among the measurement points found in Process 1 but excluded in Process 2, auxiliary construction will take place as the “2nd highest priority” at the points which are located in the layers shallower than the medium-grained sandstone layers.

Process 4. Among the measurement points found in Process 1 but excluded in Process 2, auxiliary construction will take place as the “3rd highest priority” at the points which are located in the layers deeper than the alternating strata layers.

Process 5. In principle, auxiliary construction will take place in the order of “Highest Priority,” “2nd highest priority” and “3rd highest priority.”

Process 6. Processes 1-4 will continue to be reviewed at least once in two weeks. At each time, the points where auxiliary construction will take place will be added or deleted and then reflected to the schedule. This process will be applied to the not frozen areas when they will be frozen in the future.

*1 Expected soil temperatures: Soil temperatures measured 30 days after making the assumption that the temperature measured during a week will maintain.

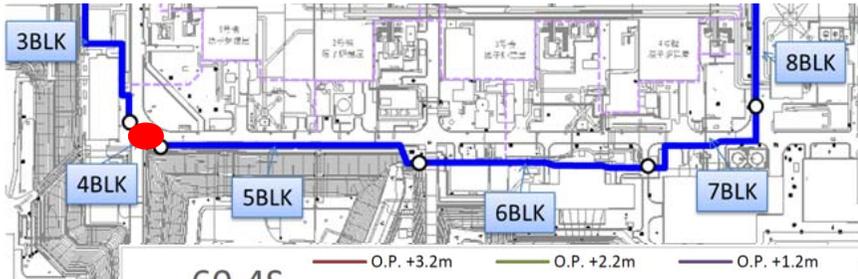
*2 “Shindo”: 1 “Shindo” is about 1m deep and a measurement point indicates an average temperature of the 1m deep interval.

Schedule for auxiliary construction to assist freezing of the landside (based on the changes of soil temperatures from October 6 to October 13) and its progress (as of October 24)

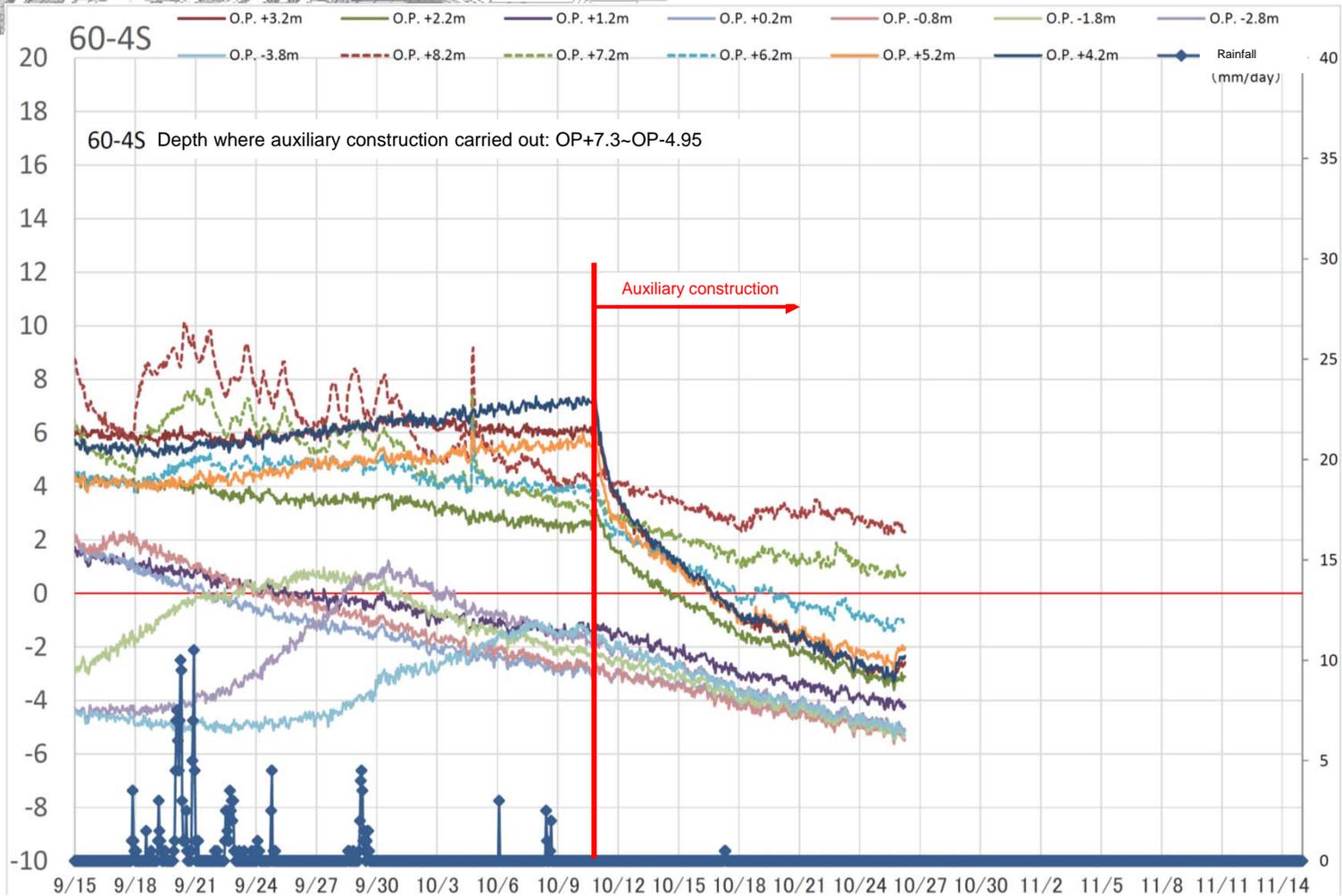


BLK	Thermometer pipe	Progress status	September	October	November	December	
4	60-4S	In progress					
6	90-6S	Completed					
	60-6S	Completed					
7	230-7S	Completed	[Highest priority]				
	220-7S						
	210-7S						
	60-7S	Completed					
5	440-5S	Completed		Schedule for auxiliary construction is being discussed because the thermometer pipe is located close to the non freezing area.			
	331-5S	Yet to begin					
	340-5S					320-5S → Went below 0°C	
	180-5S	Yet to begin					
	50-5S	Yet to begin		[2nd highest priority]		[3rd highest priority]	
	40-5S						
6	100-6S	Yet to begin					
	30-6S	Completed					
7	80-7S	Yet to begin (new)		Auxiliary construction will be carried out based on the process of auxiliary construction to assist freezing of the landside.			
	180-7S	Yet to begin		Schedule for auxiliary construction is being discussed because the thermometer pipe is located close to the non freezing area.			
	70-7S	Completed					
3	270-3S	Yet to begin					

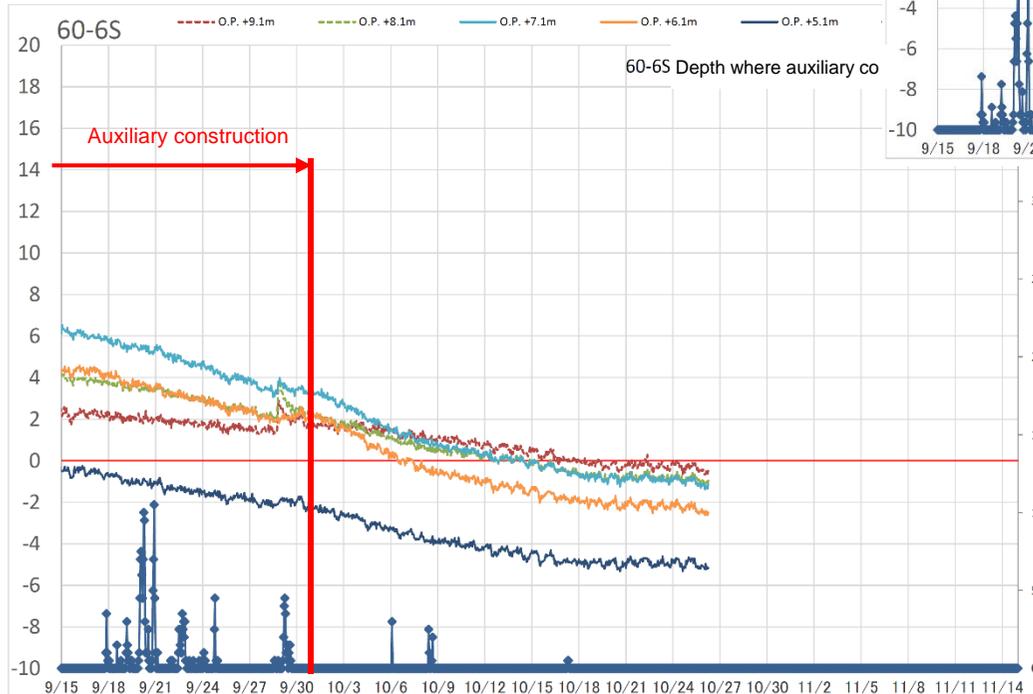
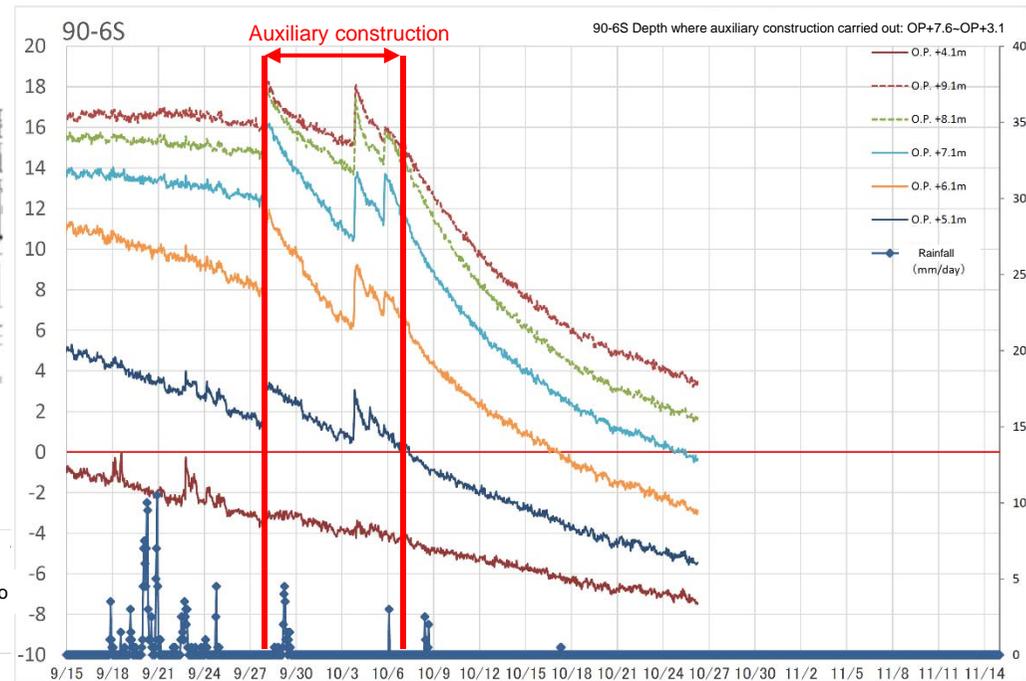
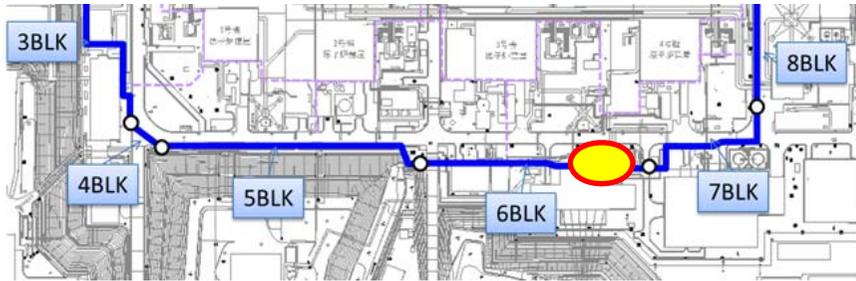
Auxiliary construction to assist freezing of the landside; fall in soil temperatures (4BLK)



【60-4S】
Auxiliary construction is underway. Soil temperatures are falling relatively steadily. The progress is being monitored.



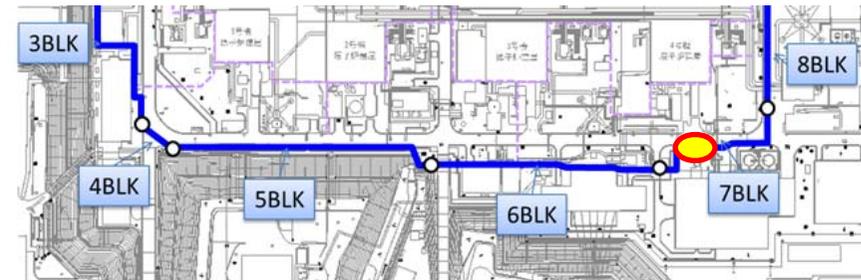
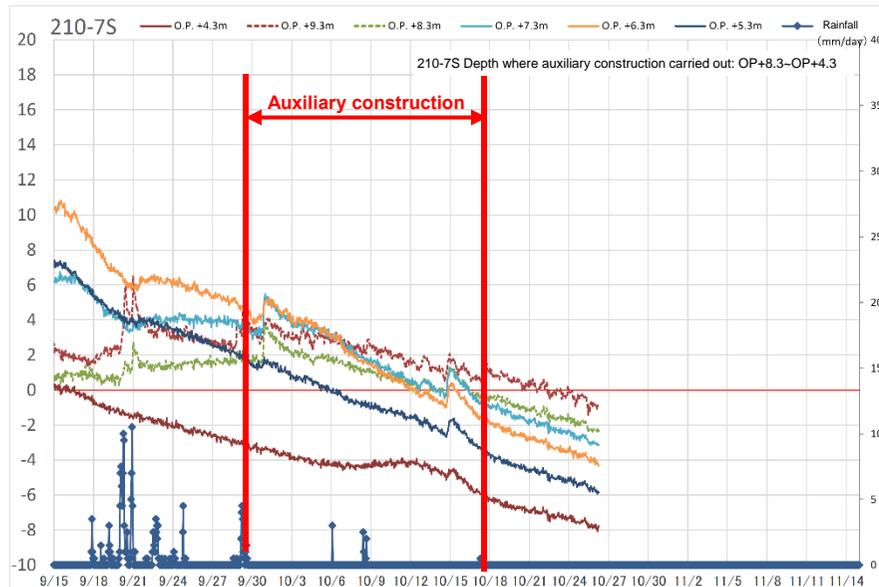
Auxiliary construction to assist freezing of the landside; fall in soil temperatures (6BLK)



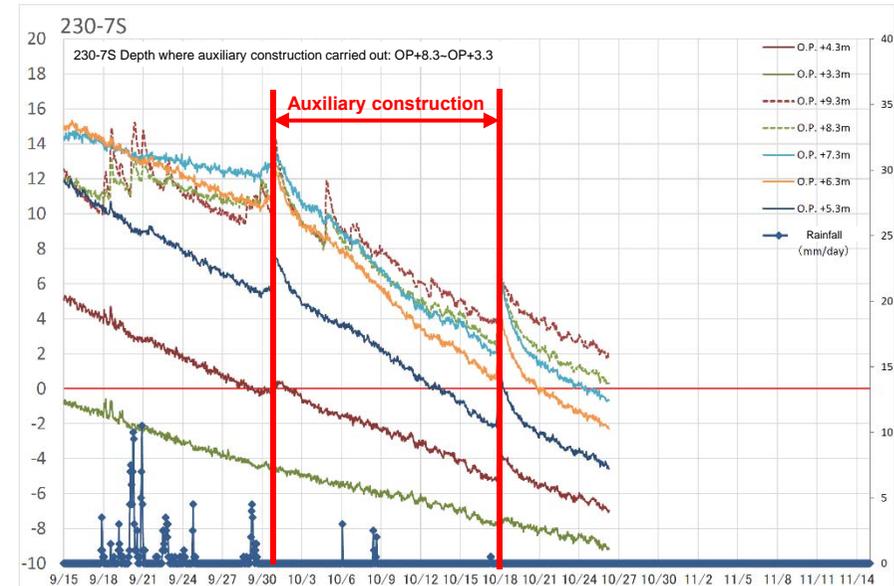
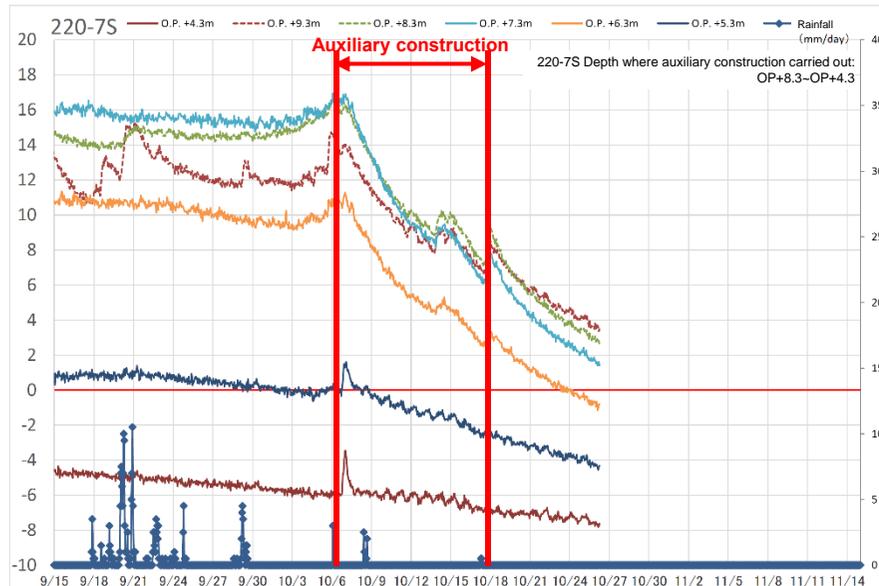
[60-6S]
 Auxiliary work was completed. Soil temperatures went below 0°C.

[90-6S]
 Auxiliary work was completed. Soil temperatures have been falling relatively steadily. The progress is being monitored.

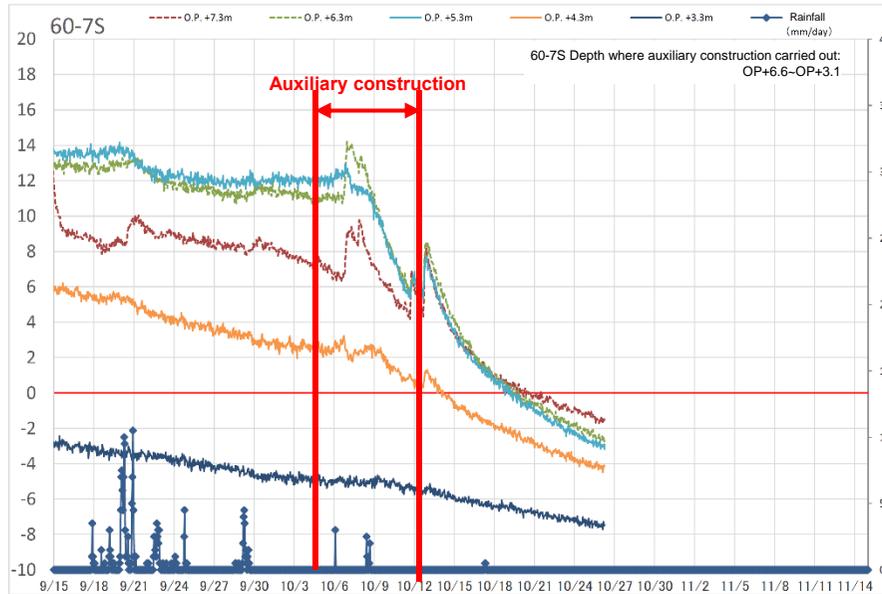
Auxiliary construction to assist freezing of the landside; fall in soil temperatures (7BLK 1/2)



【210-, 220- and 230-7S】
Auxiliary construction was completed. Soil temperatures at 210-7S went below 0°C. Soil temperatures at 220-7S and 230-7S have also been falling relatively steadily. The progress is being monitored.



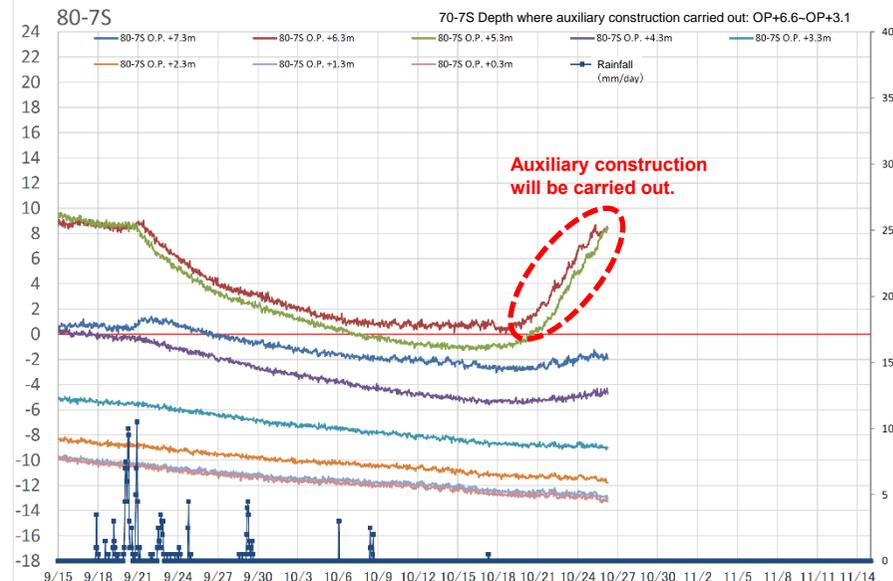
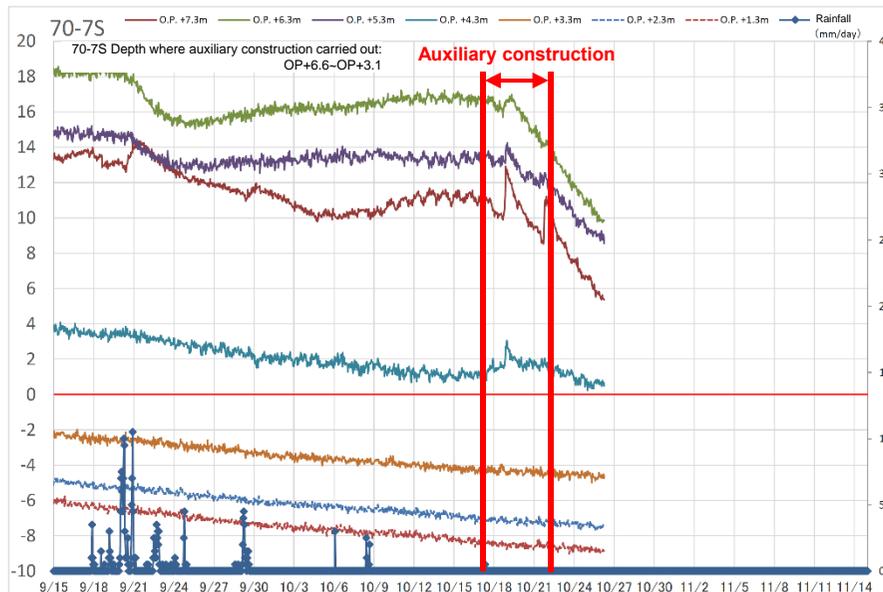
Auxiliary construction to assist freezing of the landside; fall in soil temperatures (7BLK 2/2)



【60-7S】
 Auxiliary construction was completed. Soil temperatures went below 0°C.

【70-7S】
 Auxiliary construction was completed. Soil temperatures have been falling relatively steadily. The progress is being monitored.

【80-7S】
 The progress is being monitored. Auxiliary construction will be conducted based on the process of auxiliary construction to assist freezing.

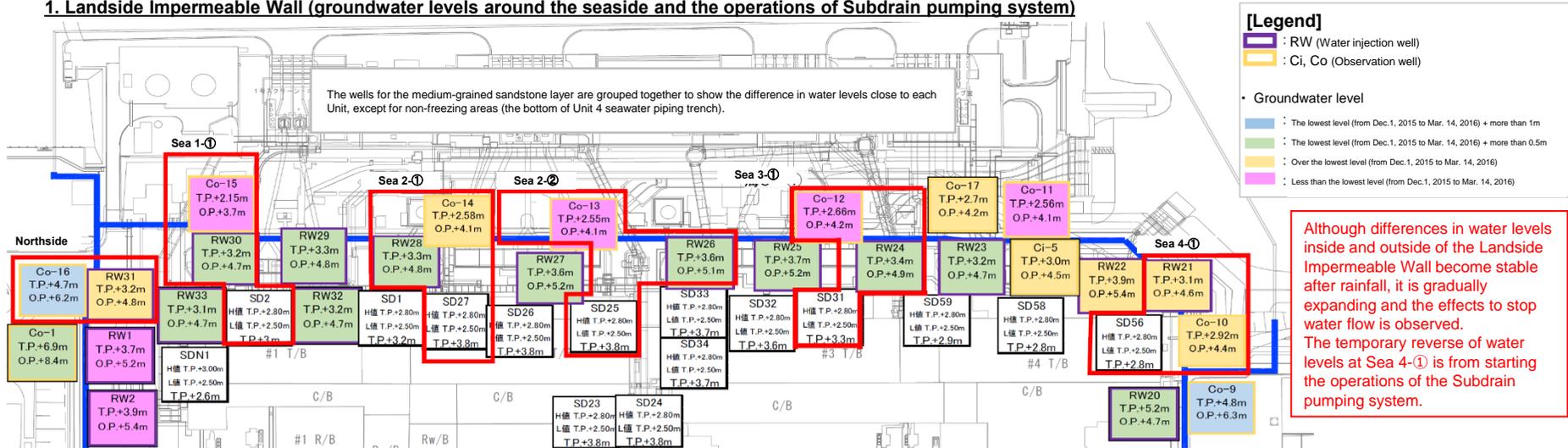


Groundwater levels and hydraulic heads (in the medium-grained sandstone layer 1 on the seaside)

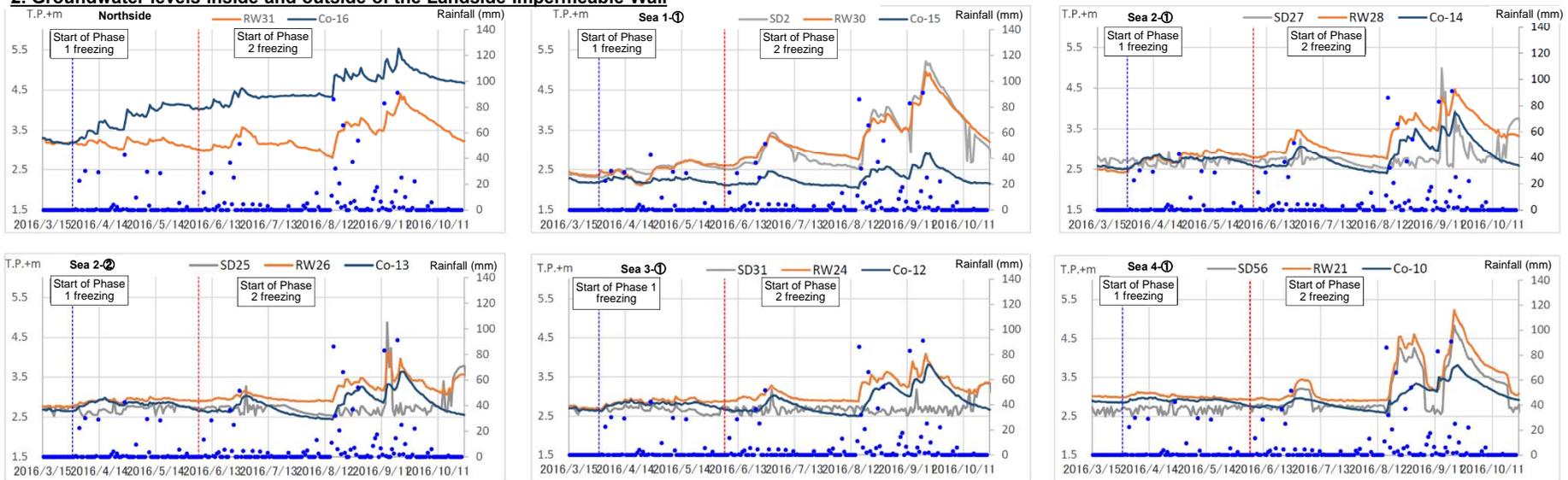


What to be monitored in an early stage of the ice wall freezing (Phase 1 Stage 1, seaside, water levels in the middle-grained sandstone layer)

1. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)



2. Groundwater levels inside and outside of the Landside Impermeable Wall



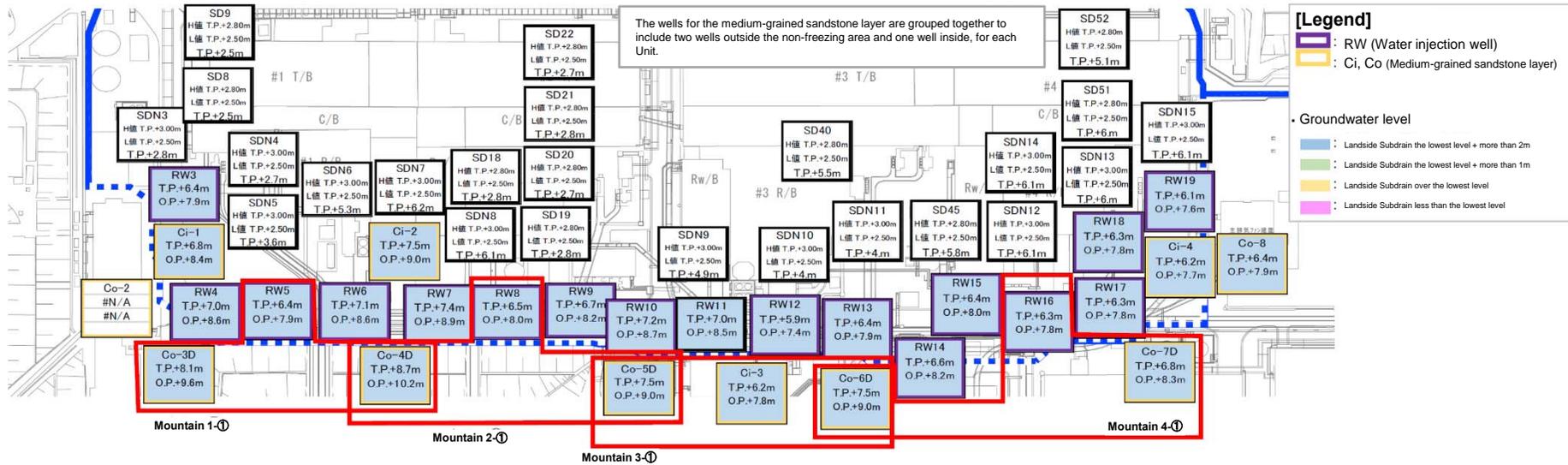
The data of groundwater levels as of 12 p.m. on October 25.

Groundwater levels and hydraulic heads (in the medium-grained sandstone layer 2 on the landside)

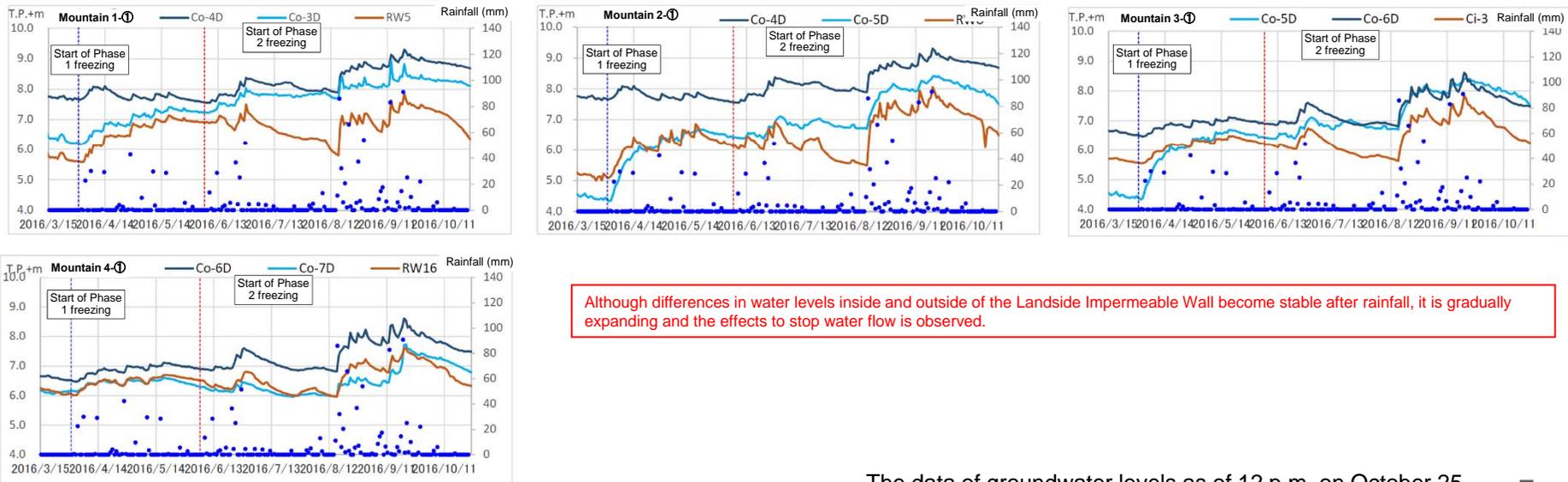


What to be monitored in an early stage of the ice wall freezing (Phase 1 Stage 1, seaside, water levels in the middle-grained sandstone layer)

3. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)



4. Groundwater levels inside and outside of the Landside Impermeable Wall

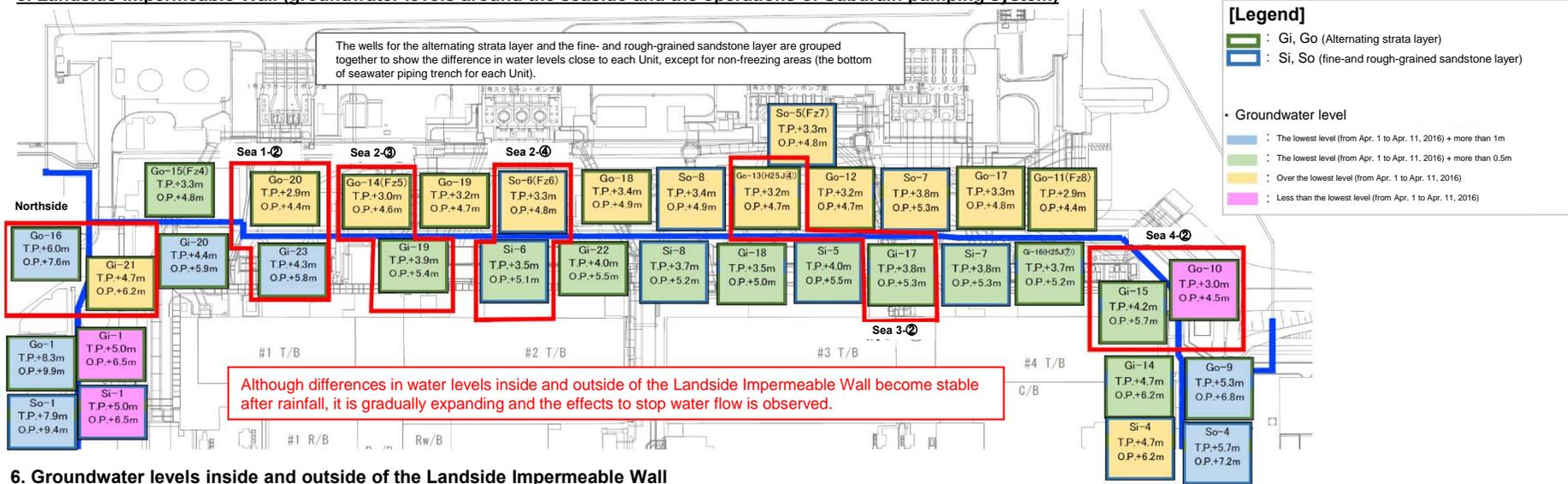


Groundwater levels and hydraulic heads

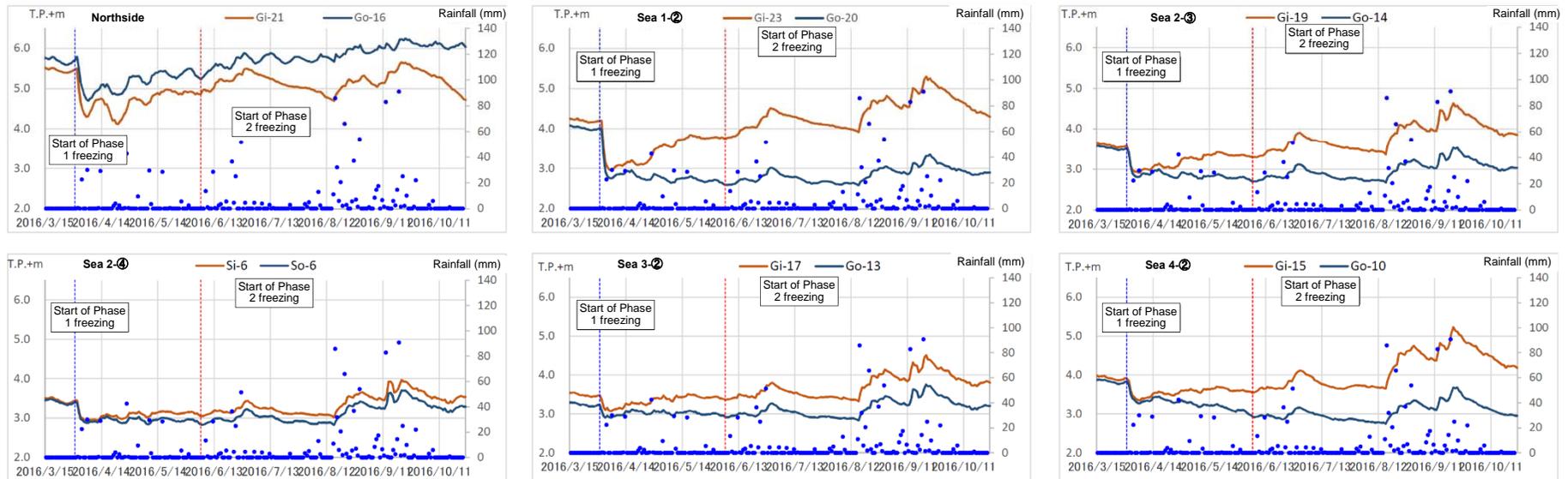
(in the alternating strata layer and the fine- and rough-grained sandstone layer 1 on the seaside) **TEPCO**

What to be monitored in an early stage of the ice wall freezing (Phase 1 Stage 1, seaside, water levels in the middle-grained sandstone layer)

5. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)



6. Groundwater levels inside and outside of the Landside Impermeable Wall



The data of groundwater levels as of 12 p.m. on October 25.

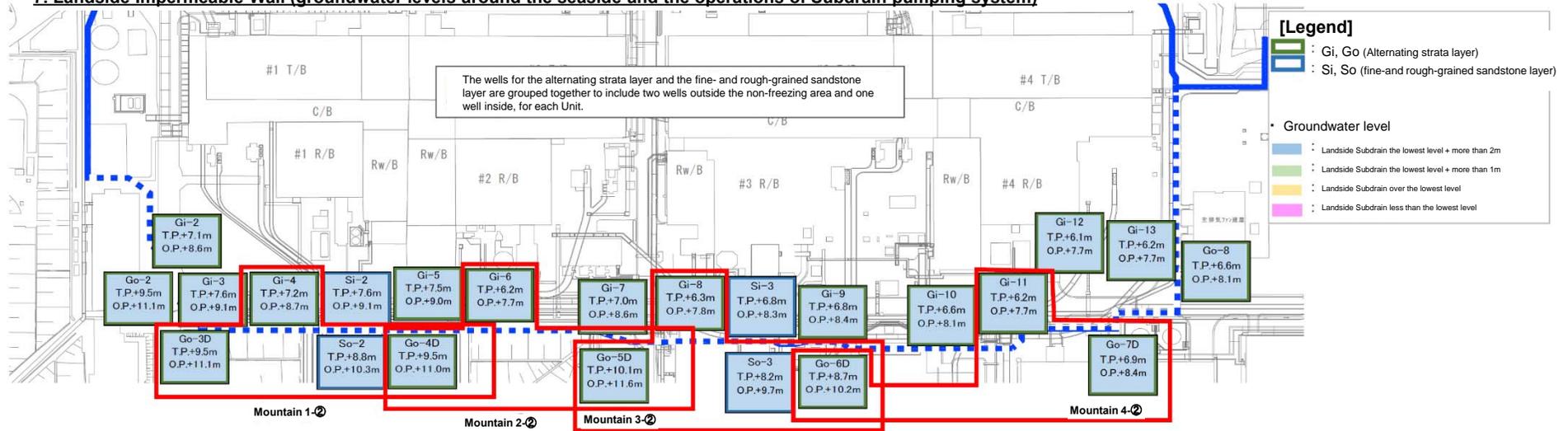
Groundwater levels and hydraulic heads

(in the alternating strata layer and the fine- and rough-grained sandstone layer 2 on the landside)

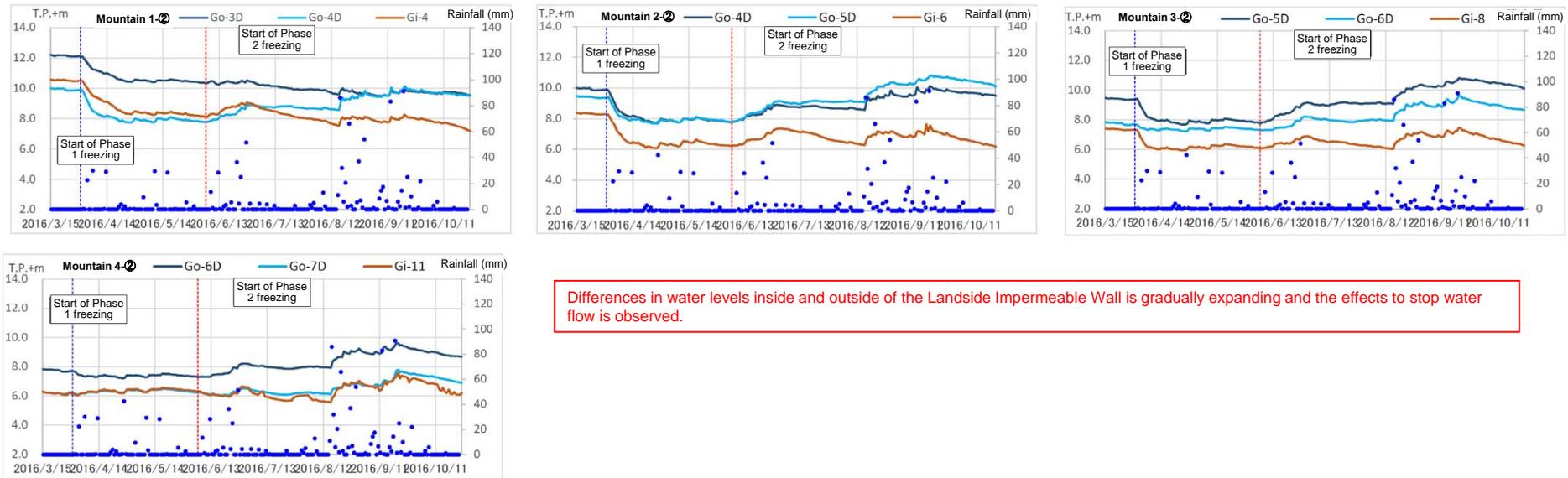


What to be monitored in an early stage of the ice wall freezing (Phase 1 Stage 1, seaside, water levels in the middle-grained sandstone layer)

7. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)



8. Groundwater levels inside and outside of the Landside Impermeable Wall



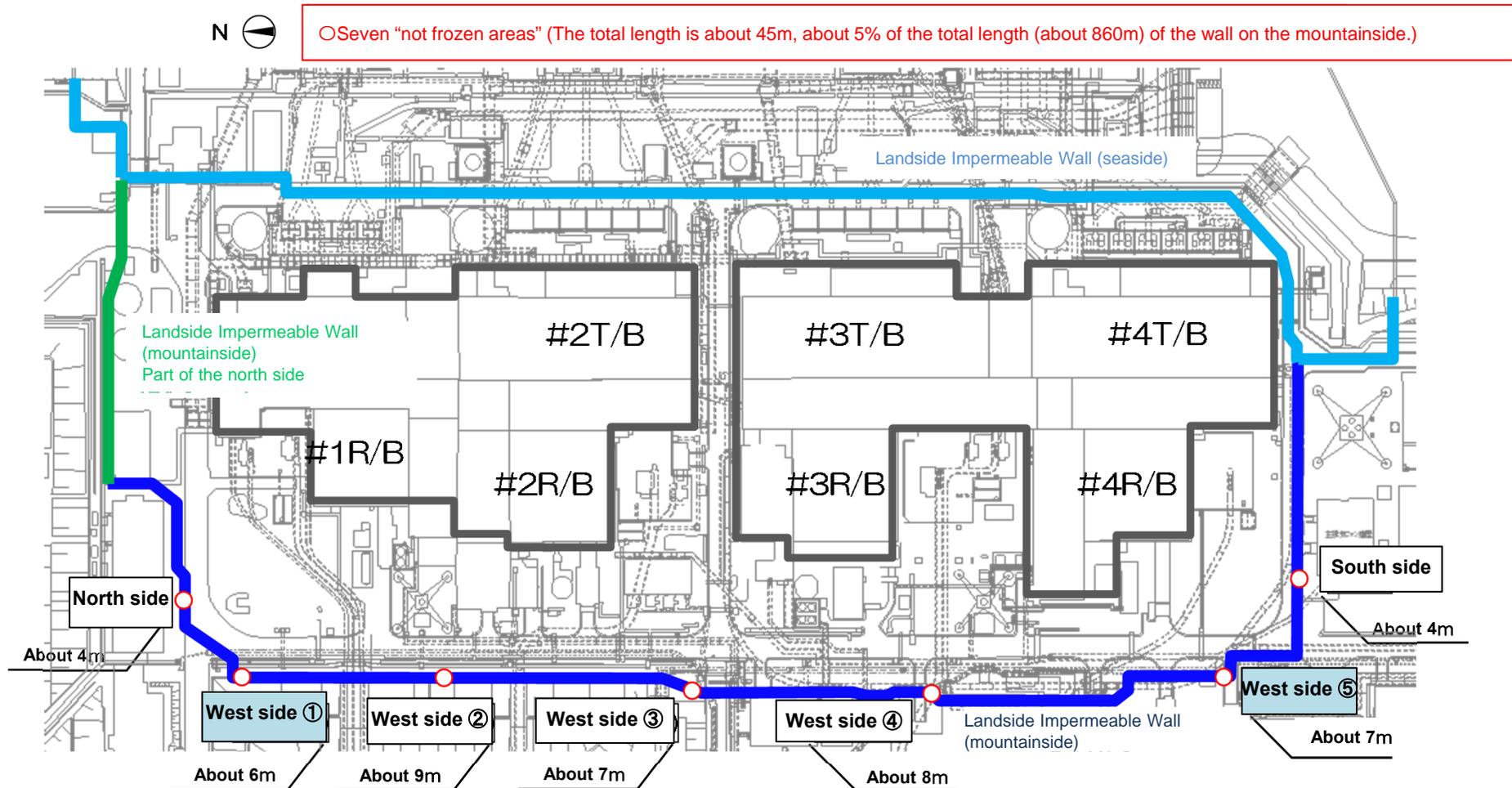
Differences in water levels inside and outside of the Landside Impermeable Wall is gradually expanding and the effects to stop water flow is observed.

The data of groundwater levels as of 12 p.m. on October 25.

Current situation of “not frozen areas” and choice of additional freezing areas

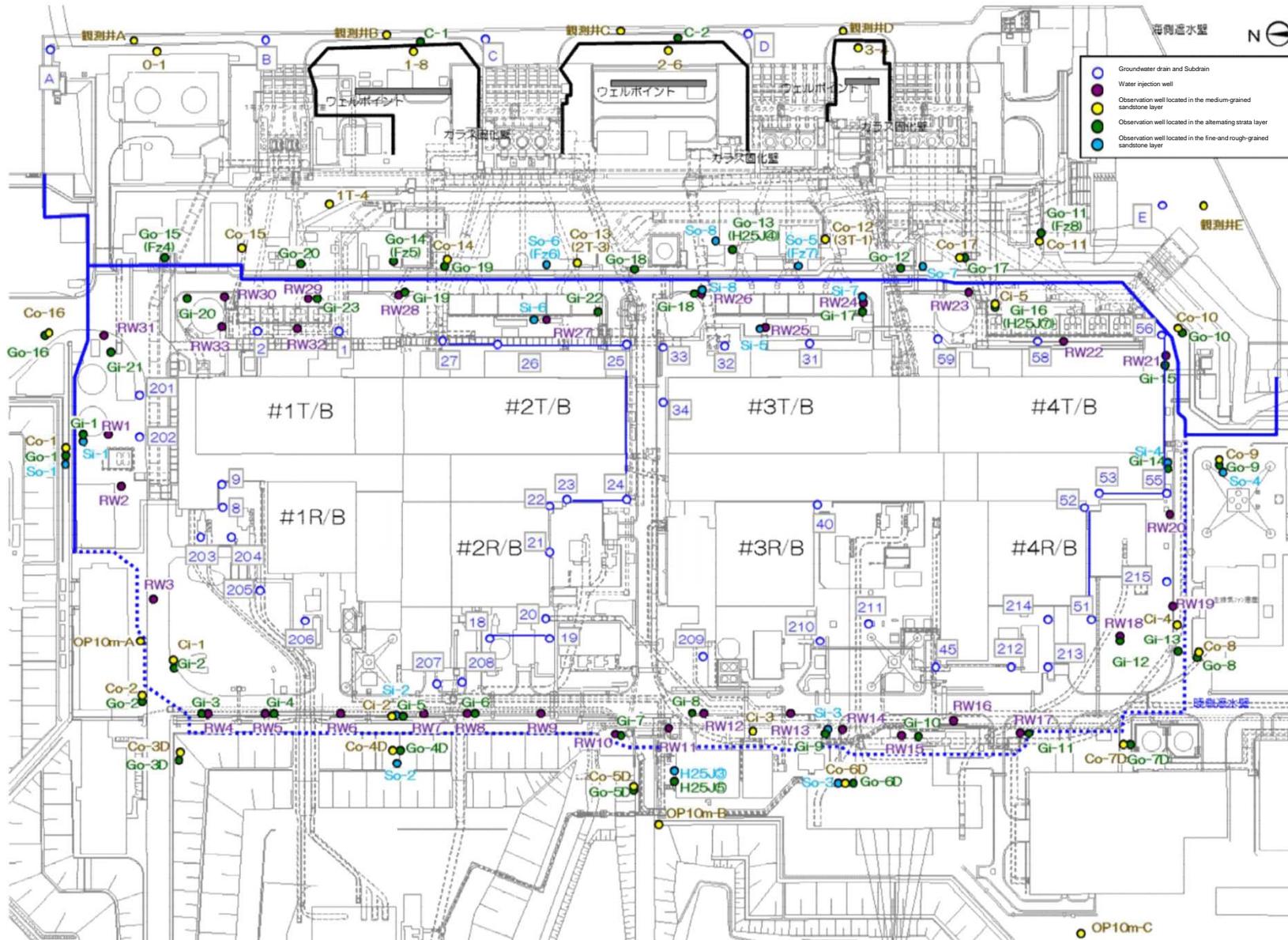


- There are seven areas on the mountainside, about 5% of the total length (about 860m) of the wall on the mountainside, where freezing is yet to begin. These areas are originally excluded from the phase 2 freezing of the first stage. (The location and length of each “not frozen area” are shown in the map below.)
- “Not frozen areas” of west side ① and west side ⑤ were chosen to be frozen because it will not change the balance of groundwater inflow. The areas are located close to the other “not frozen areas” (north side and south side) and also located in the symmetrical positions.
- On October 17, an application to obtain approval for changes in the freezing plan was submitted to the Nuclear Regulatory Authority, which is being reviewed at present.



Note: Figures on the map indicate the length of “not frozen areas.”

[Reference] Location map of groundwater level observation wells (as of June 2016)



(Reference) Amount of groundwater pumped up from the ground 4m above sea level and changes in groundwater levels of the Landside Impermeable Wall on the seaside and of the landfill area **TEPCO**

