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

August 25, 2016

TEPCO

Tokyo Electric Power Company Holdings, Inc.

Landside Impermeable Wall

- 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.

Changes in soil temperatures over time

Note
- Average Soil Temperature (AST) of medium-grained sandstone layer (blue line): average value of thermometer temperatures measured at 1m intervals except for the areas between ground surface and Ground Level 2m and the areas around the first muddy layer boarder.
- Average Soil Temperature (AST) of alternating strata layer (red line): Average value of thermometer temperatures measured at 1m intervals except for the areas around the upper and lower parts of the alternating layer boarder.

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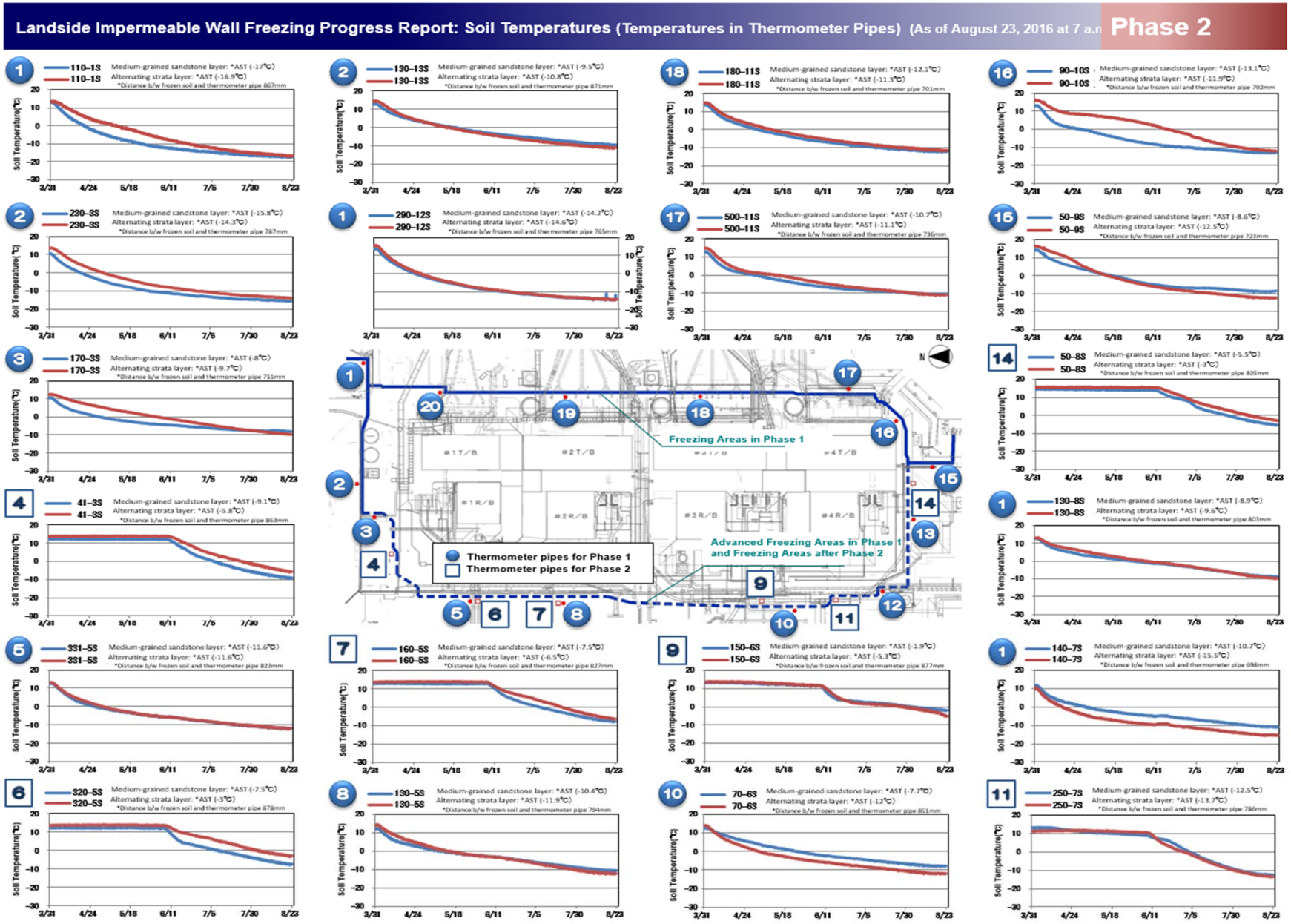
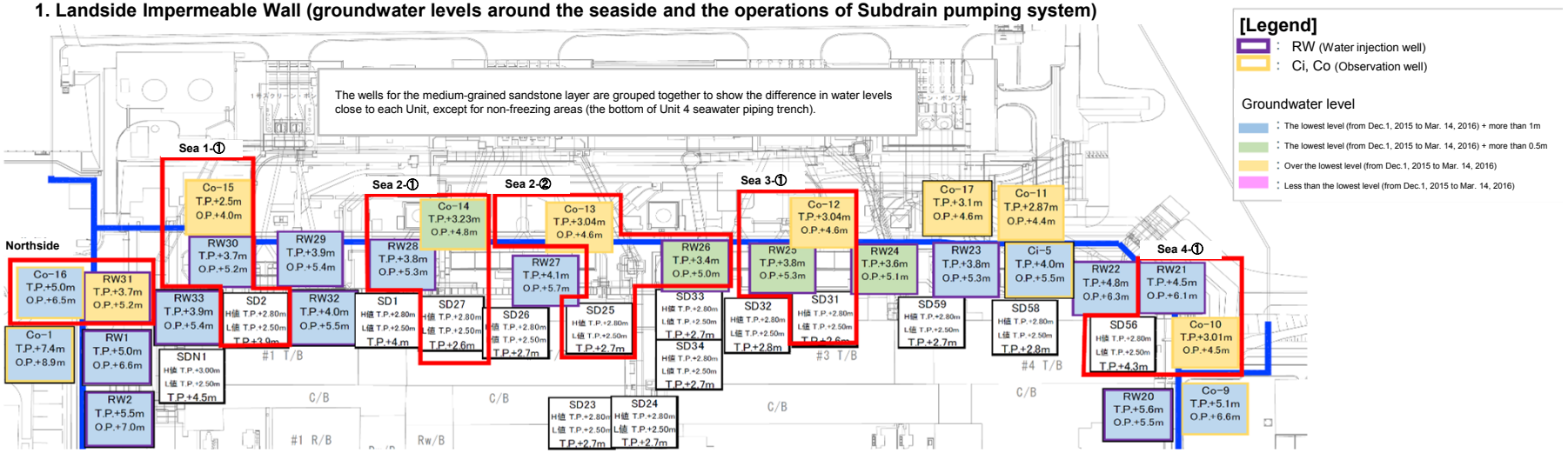


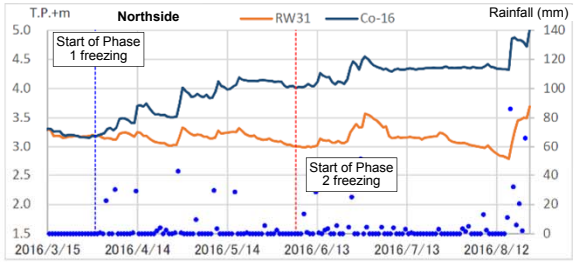
Groundwater levels and hydraulic heads
(in the medium-grained sandstone layer 1 on the seaside)

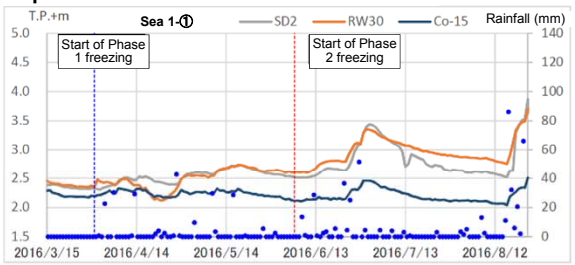
Monitoring items at the beginning of ice wall freezing (Phase 1 Stage 1, seaside, water levels in the middle-grained sandstone layer)

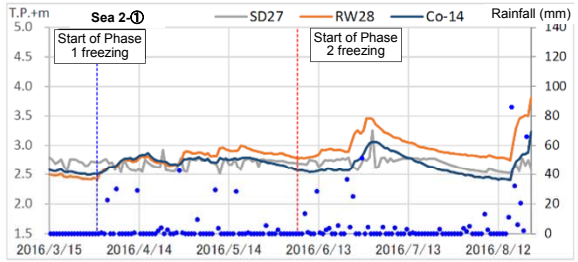
1. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)

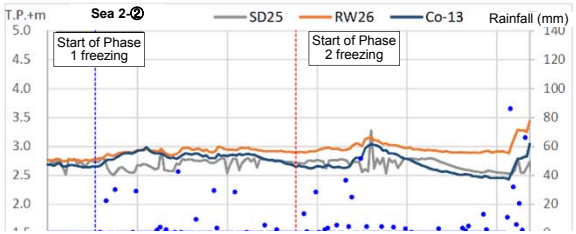


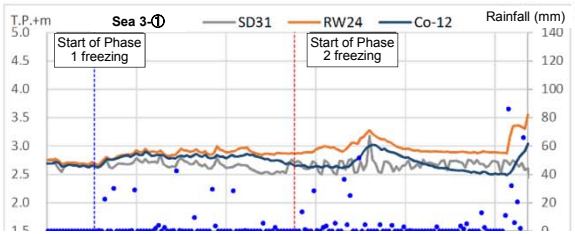
2. Groundwater levels inside and outside of the Landside Impermeable Wall

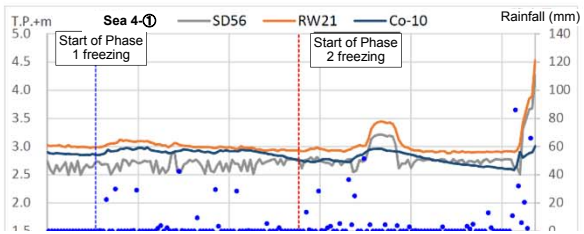










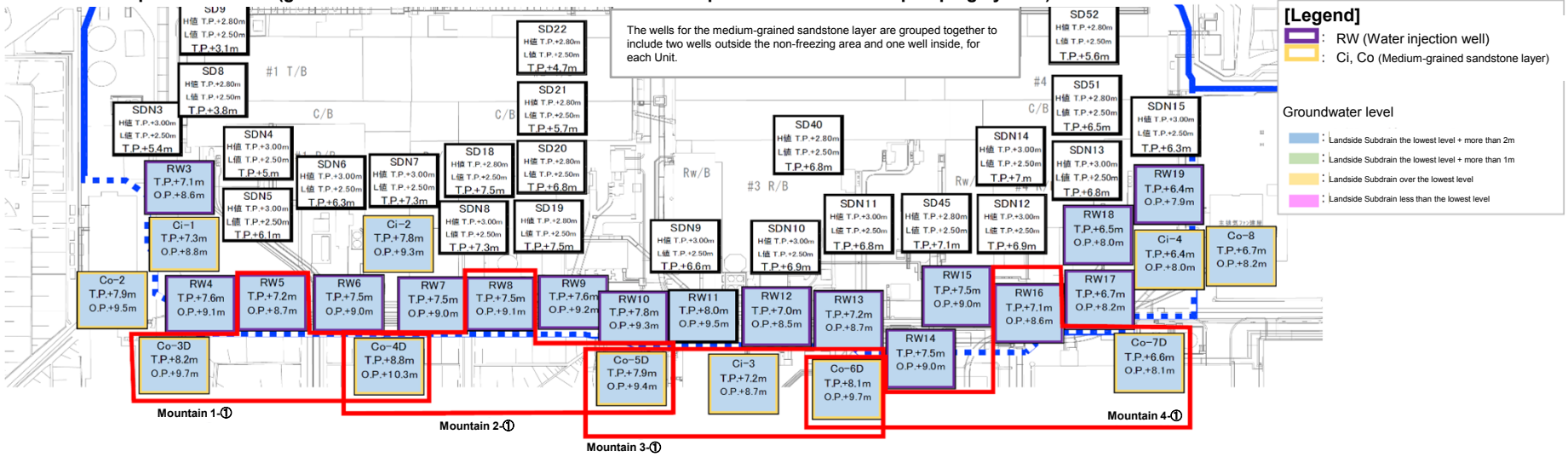


The data of groundwater levels as of 12 p.m. on August 23.

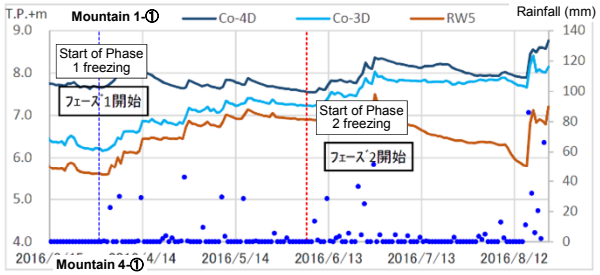
Groundwater levels and hydraulic heads
(in the medium-grained sandstone layer 2 on the landside)

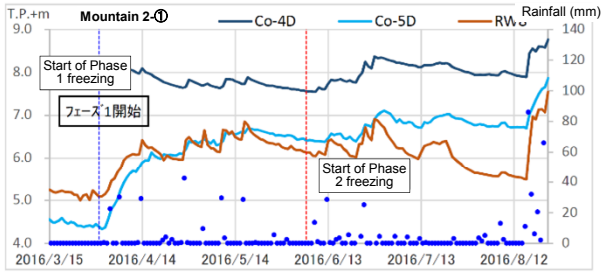
Monitoring items at the beginning of ice wall freezing (Phase 1 Stage 1, seaside, water levels in the middle-grained sandstone layer)

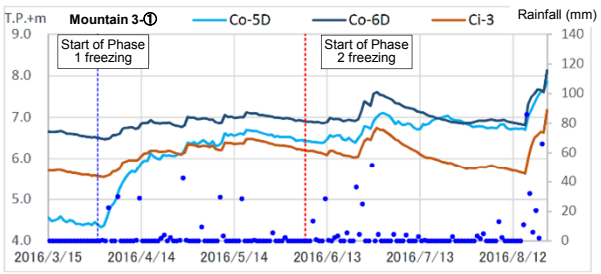
3. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)

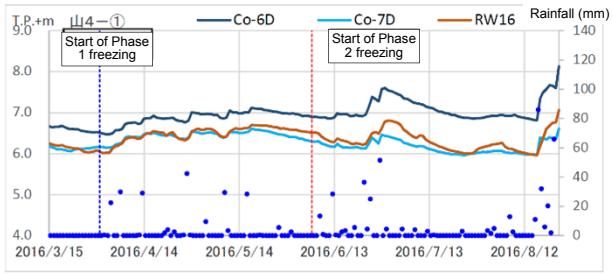


4. Groundwater levels inside and outside of the Landside Impermeable Wall







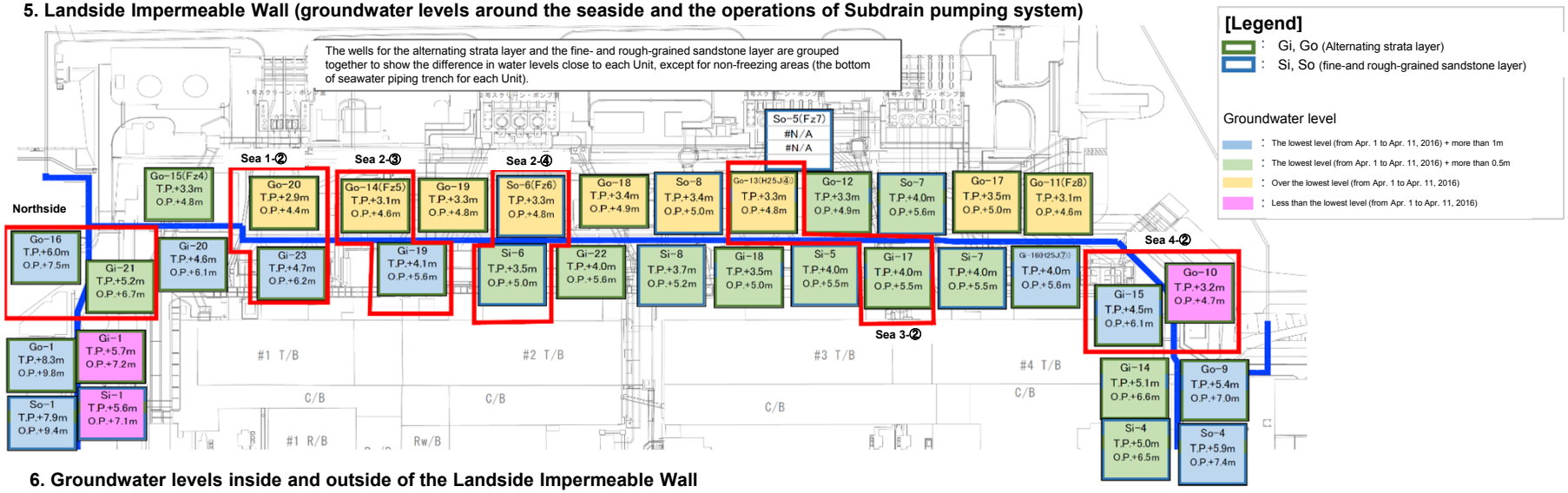


The data of groundwater levels as of 12 p.m. on August 23.

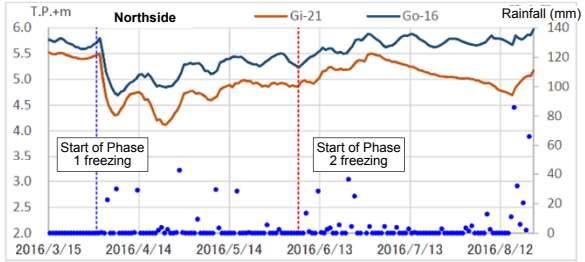
Groundwater levels and hydraulic heads
(in the alternating strata layer and the fine- and rough-grained sandstone layer 1 on the seaside)

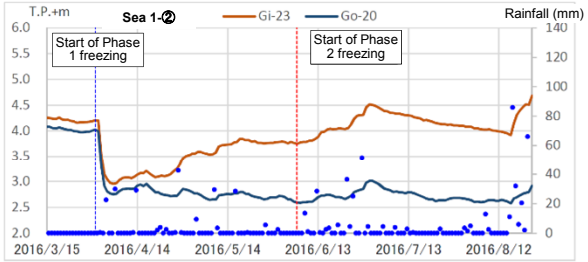
Monitoring items at the beginning of ice wall freezing (Phase 1 Stage 1, seaside, water levels in the alternating strata layer and the fine- and rough-grained sandstone layer)

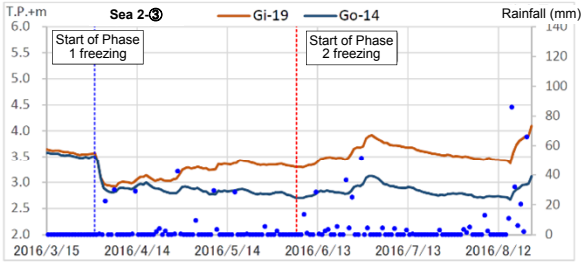
5. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)

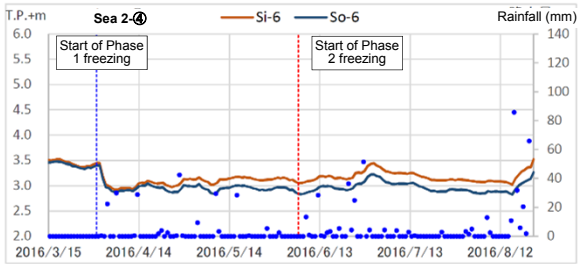


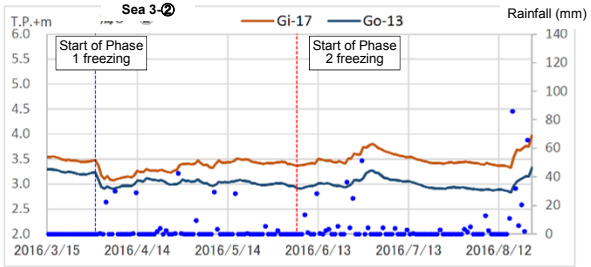
6. Groundwater levels inside and outside of the Landside Impermeable Wall

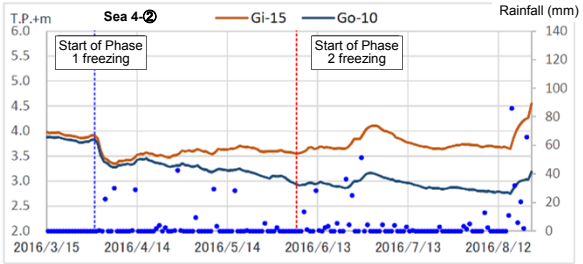










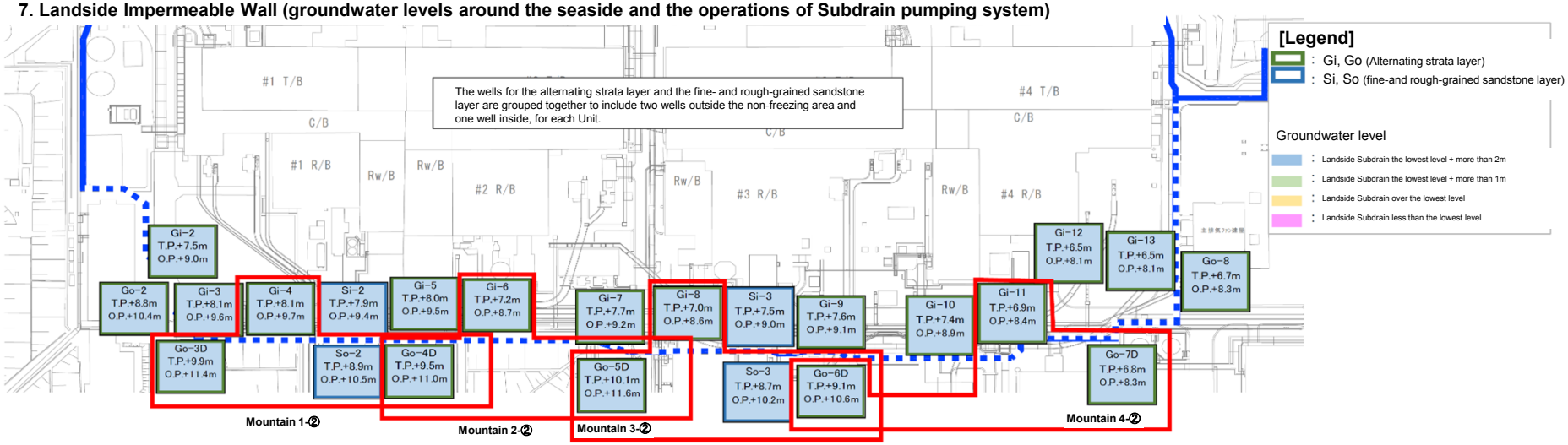


The data of groundwater levels as of 12 p.m. on August 23.

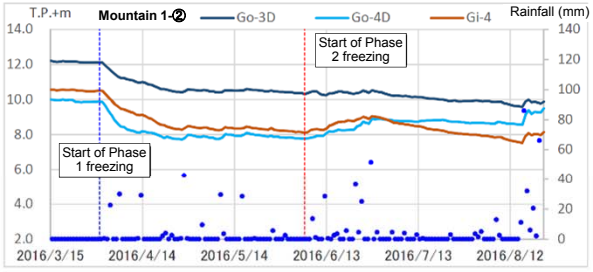
Groundwater levels and hydraulic heads
(in the alternating strata layer and the fine- and rough-grained sandstone layer 2 on the landside)

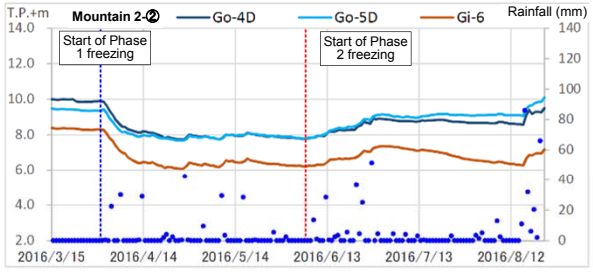
Monitoring items at the beginning of ice wall freezing (Phase 1 Stage 1, seaside, water levels in the alternating strata layer and the fine- and rough-grained sandstone layer)

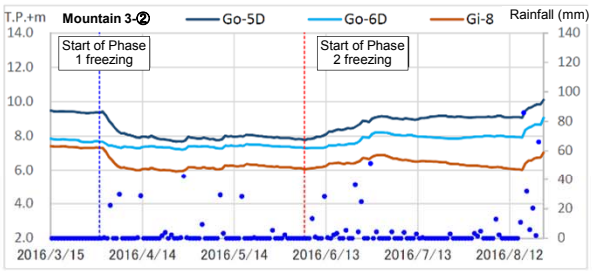
7. Landside Impermeable Wall (groundwater levels around the seaside and the operations of Subdrain pumping system)

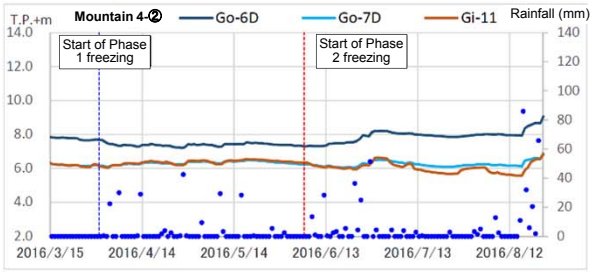


8. Groundwater levels inside and outside of the Landside Impermeable Wall



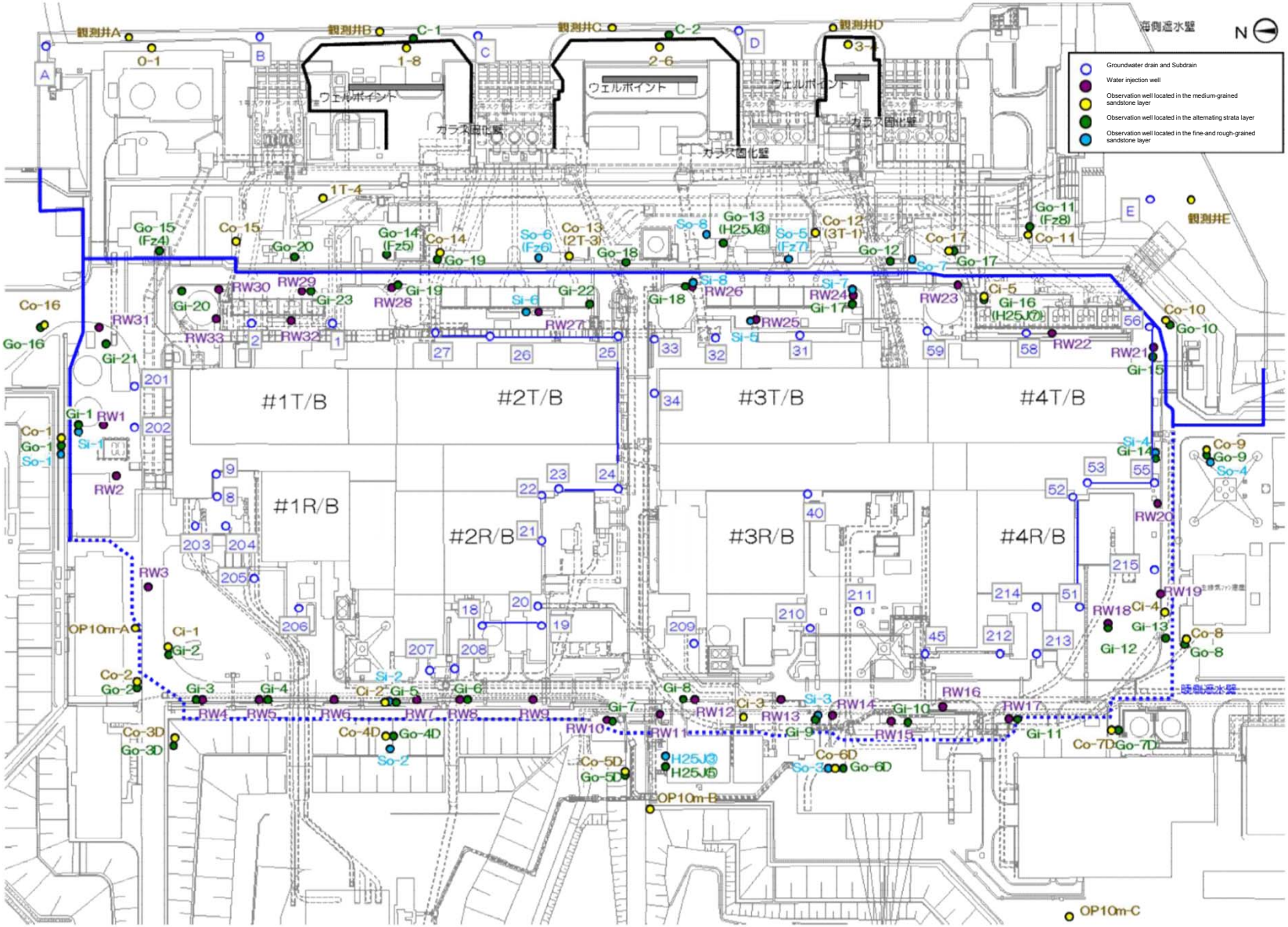






The data of groundwater levels as of 12 p.m. on August 23.

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

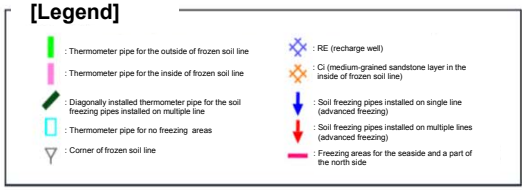


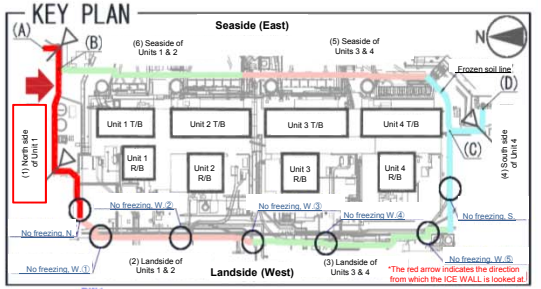
Distribution map of soil temperatures (north side of Unit 1)

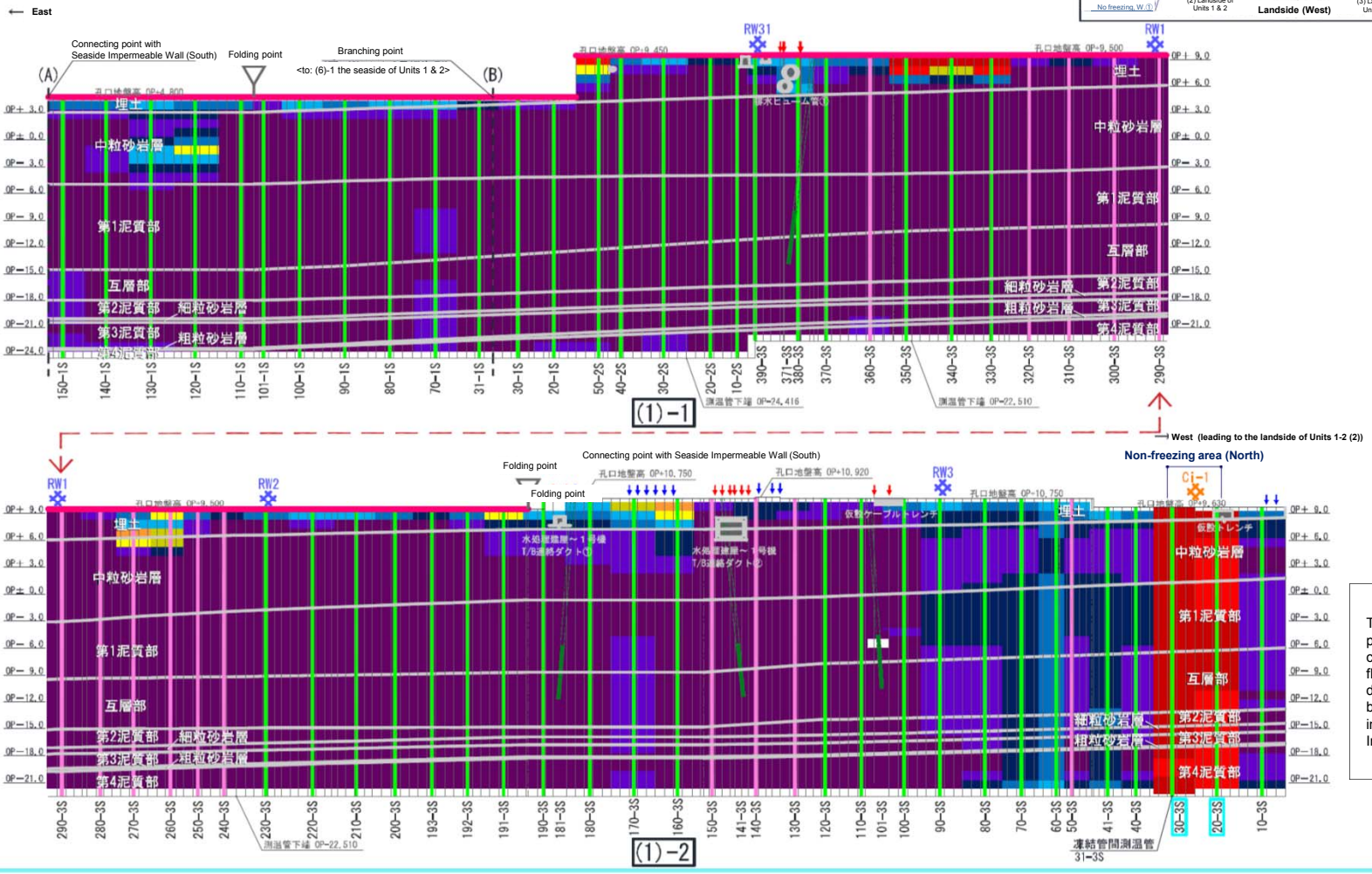
■ Distribution map of soil temperatures

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

(The temperature data as of 7 a.m. on August 23.)







*No measurement: white
Buried part: grey

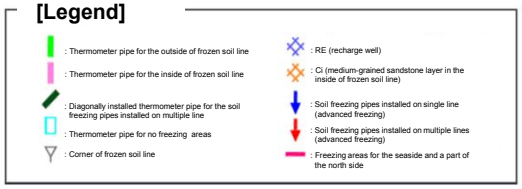
The distribution maps on pages 7-12 are for reference to check soil temperature fluctuations of the depth direction which are measured by the thermometer pipes installed around the Landside Impermeable Wall.

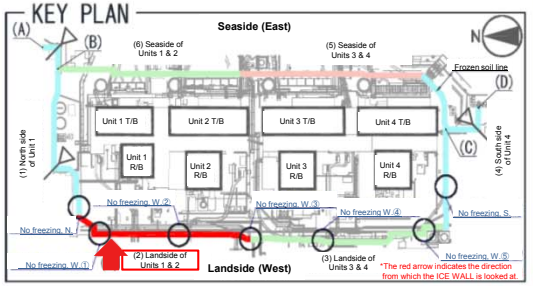
Distribution map of soil temperatures (west side of Units 1-2)

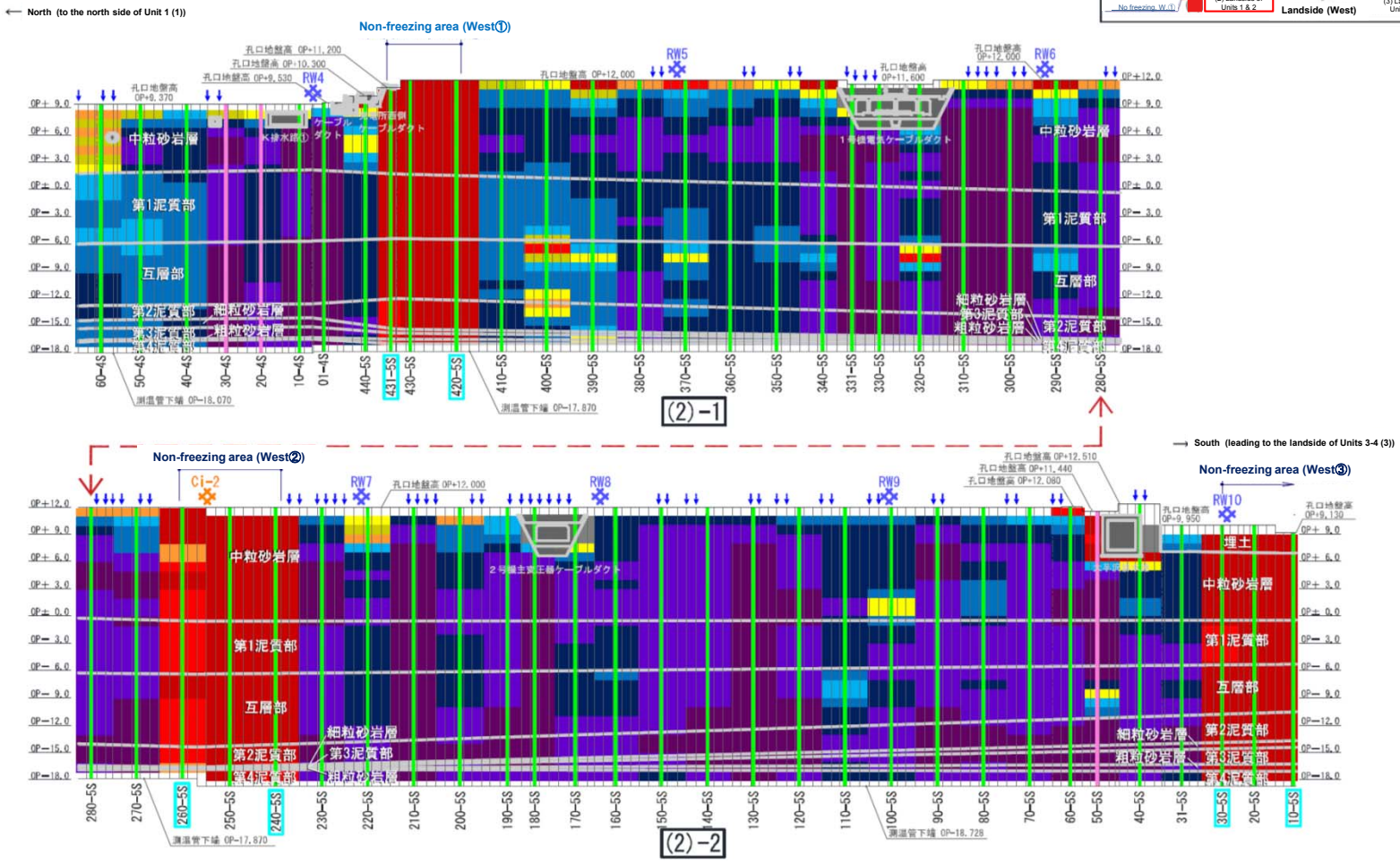
■ Distribution map of soil temperatures

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

(The temperature data as of 7 a.m. on August 23.)





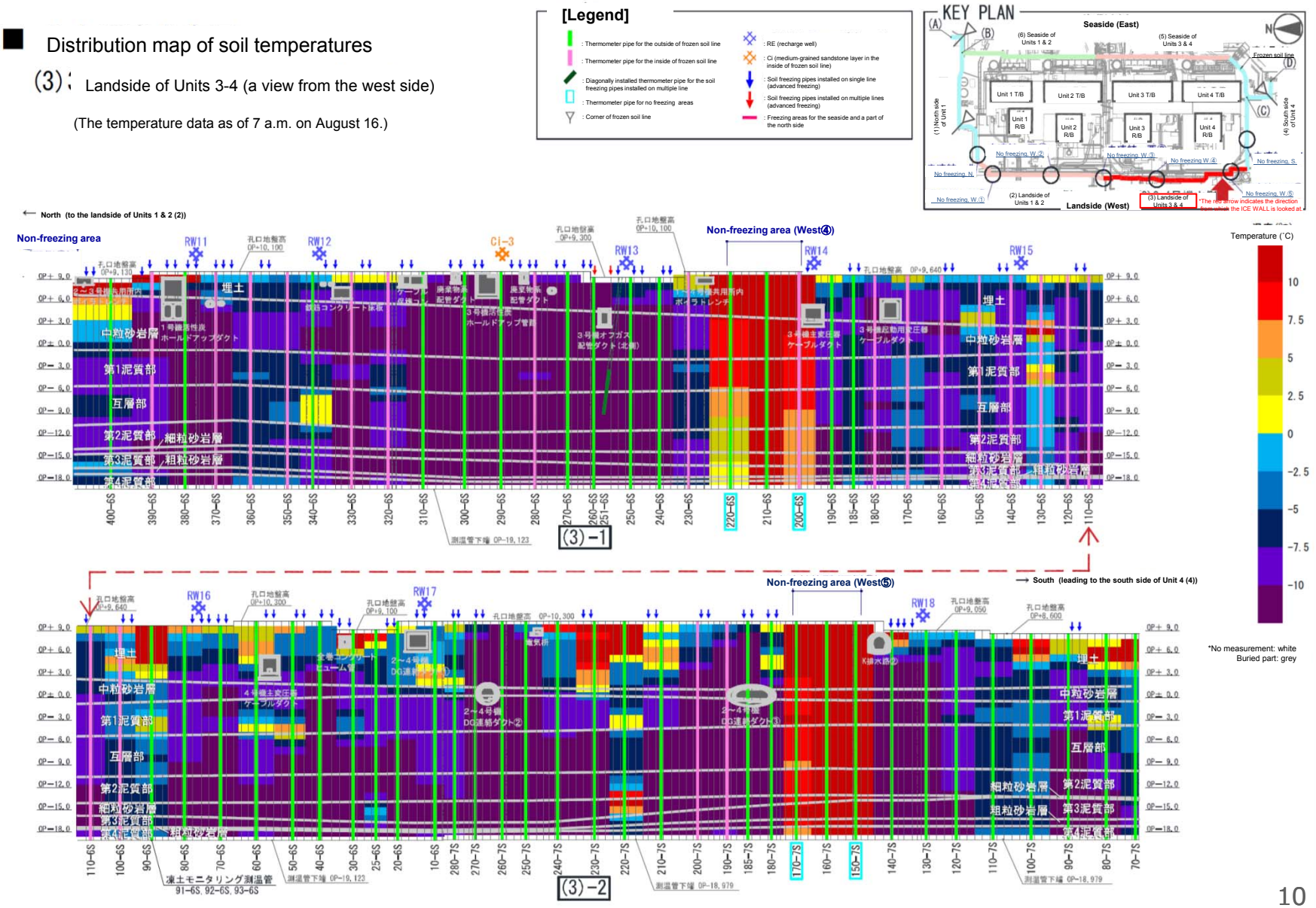


Distribution map of soil temperatures (west side of Units 3-4)

■ 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 August 16.)

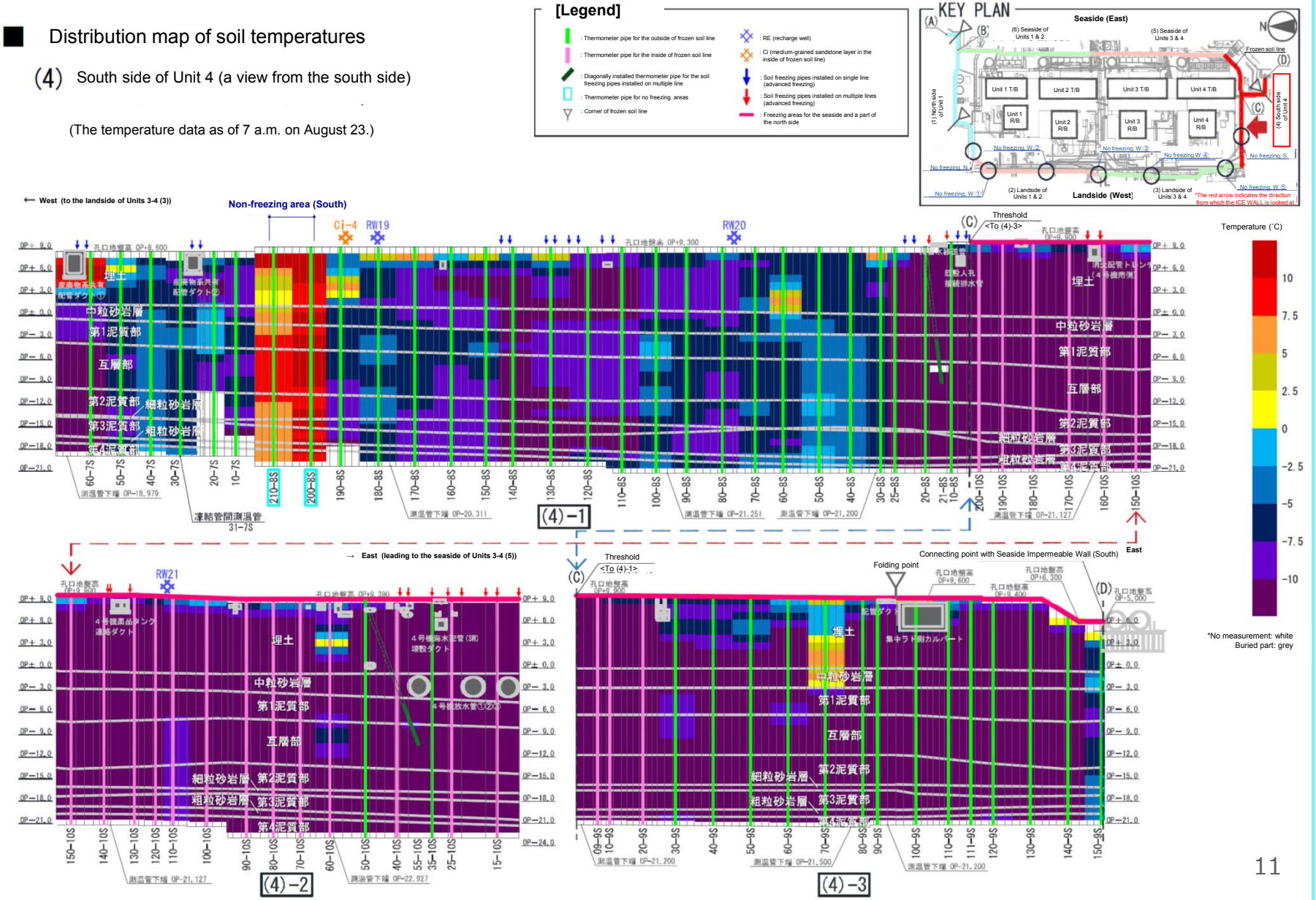


Distribution map of soil temperatures (south side of Unit 4)

■ 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 August 23.)

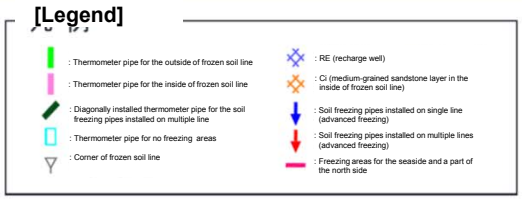


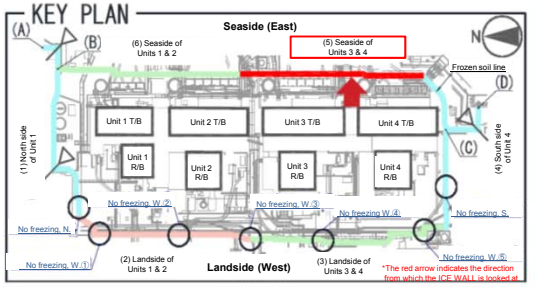
Reference: Distribution map of soil temperatures (east side of Units 3-4)

■ 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 August 23.)





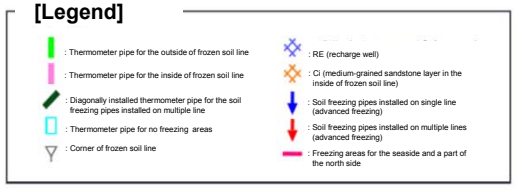
*No measurement: white
Buried part: grey

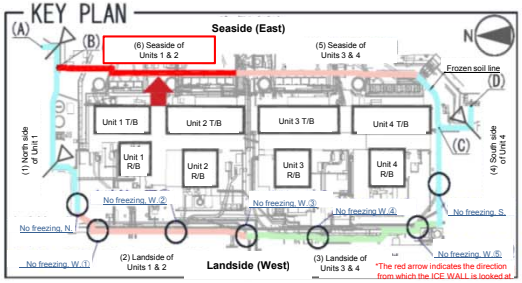
Distribution map of soil temperature (east side of Units 1-2)

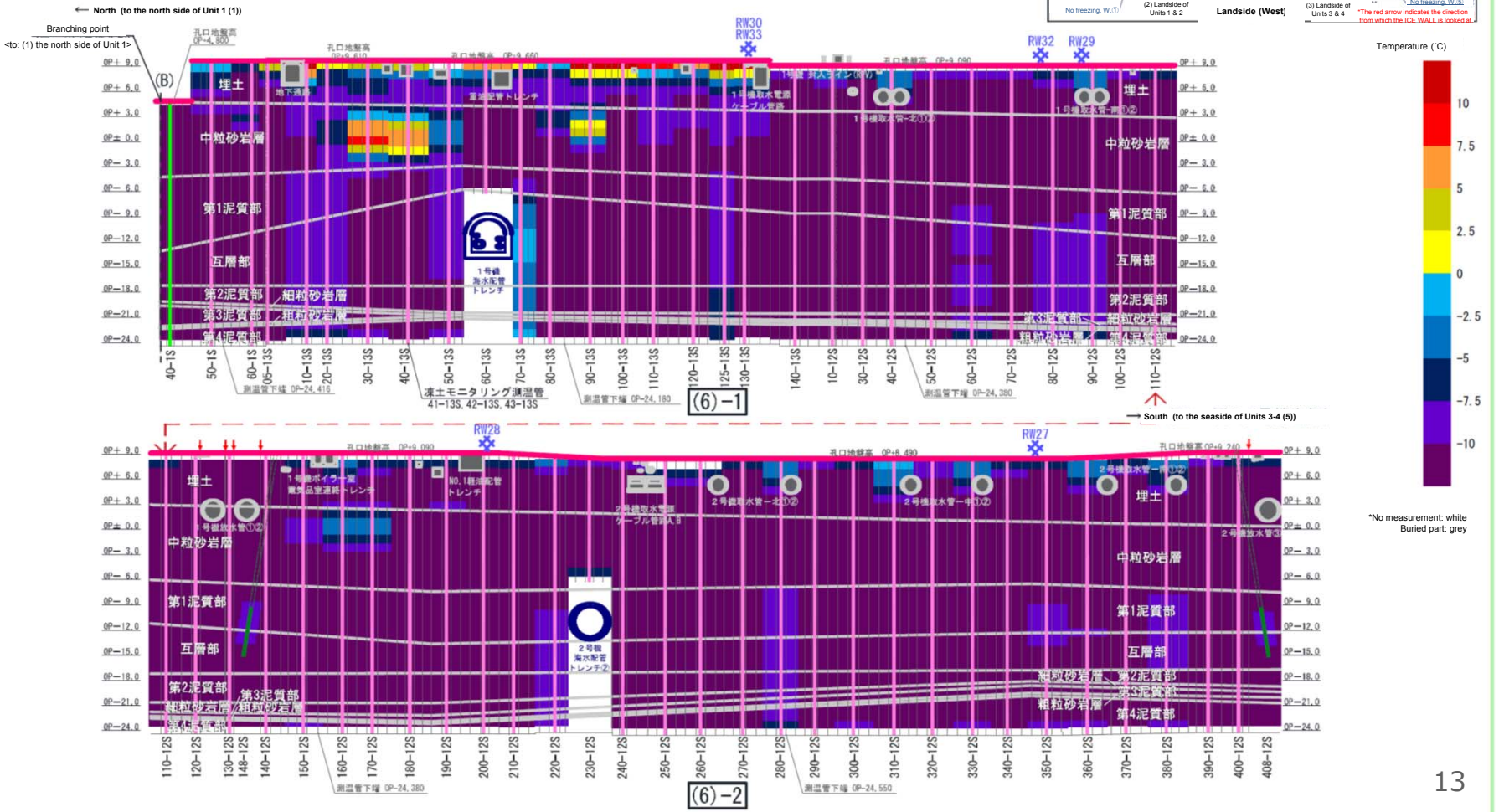
■ Distribution map of soil temperatures

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

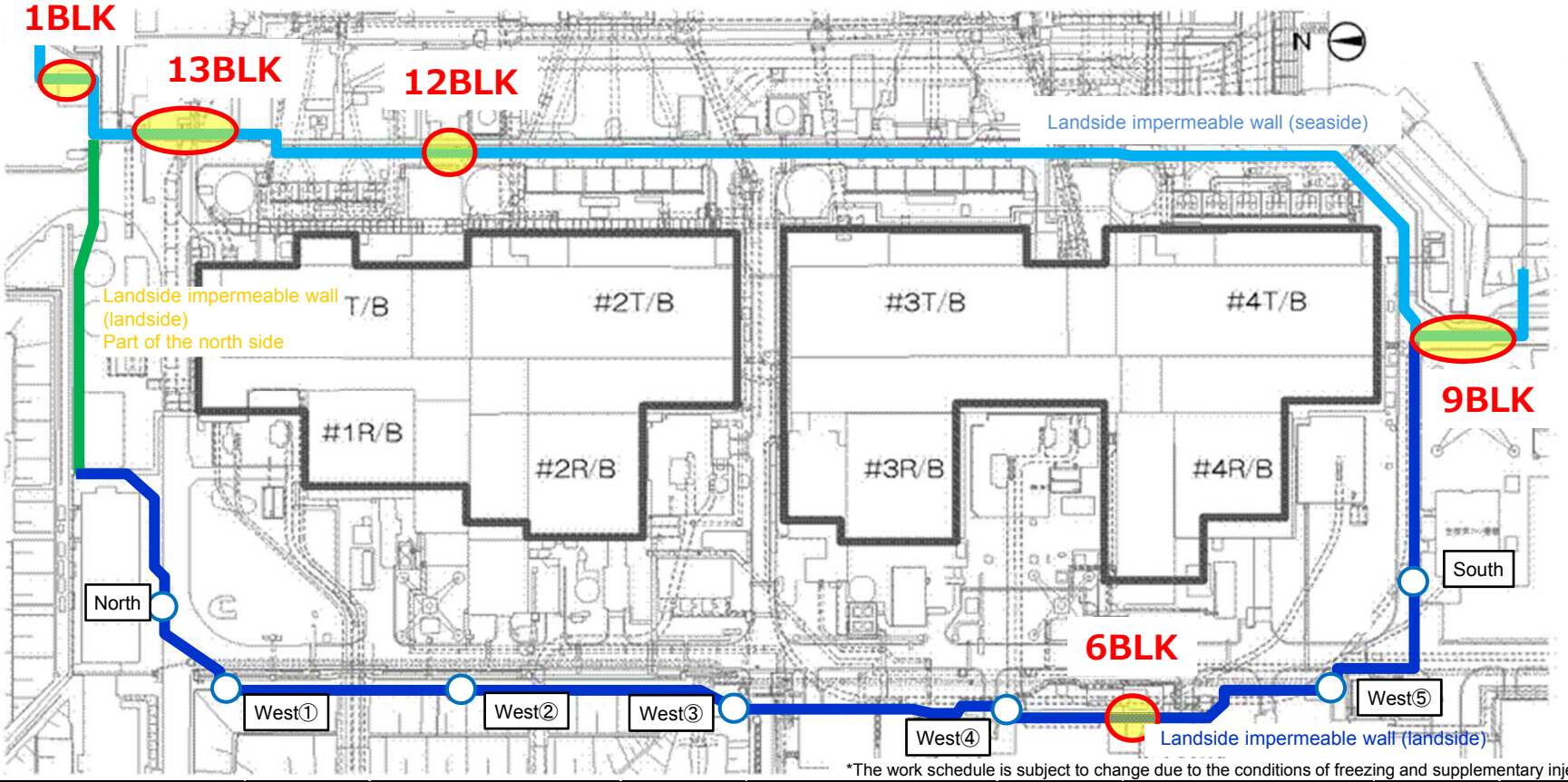
(The temperature data as of 7 a.m. on August 23.)







Progress in supplementary work

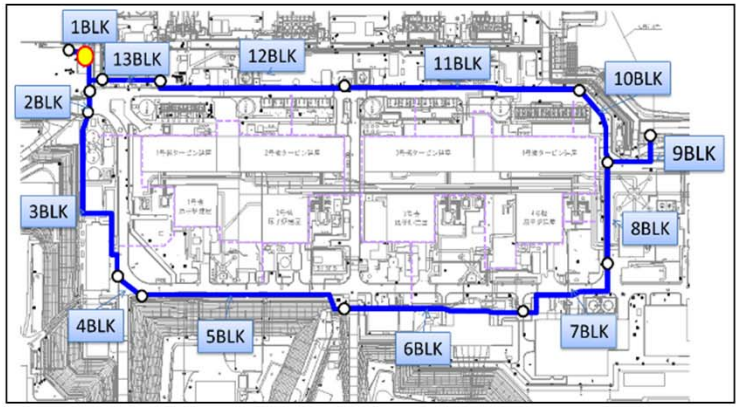


*The work schedule is subject to change due to the conditions of freezing and supplementary injections.

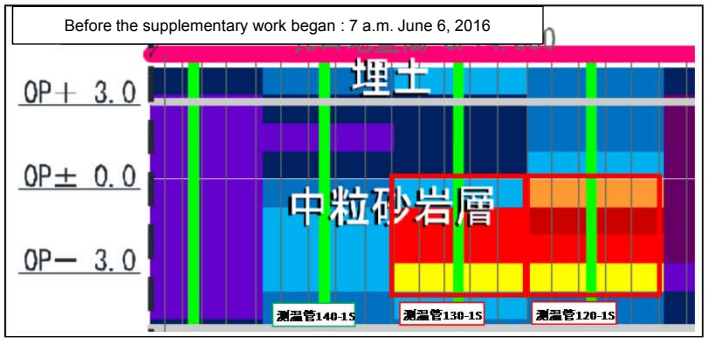
	June	July	August	9月
North side of Unit 1 (1BLK)	1st injection 6/6 Start – 6/30 Completion	2nd injection 7/14 Start		
East side of Unit 1 (12,13BLK)	1st injection 6/27 Start – 7/14 Completion		2nd injection 8/3 Start	
South side of Unit 4 (9BLK)	1st injection 6/6 Start – 6/24 Completion	2nd injection 7/22 Start		
Mountain side			1st injection (It will be conducted sequentially prioritizing the seaside.) 8/10 Start	

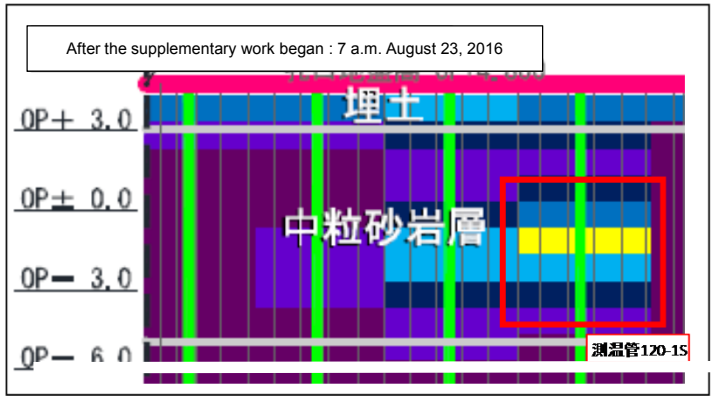
Progress in supplementary work (1BLK)

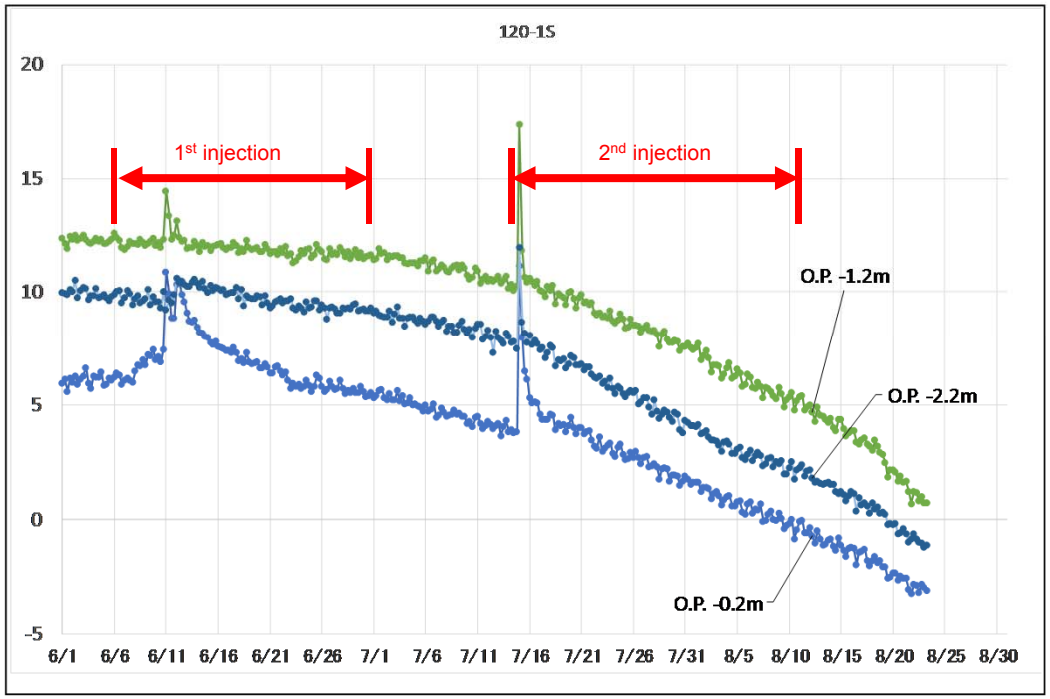
North side of Unit 1: Changes in soil temperatures over time in the areas where the supplementary work is under way



[120-1S]
After completing the second round of supplementary injection, soil temperatures have gradually decreased. In all of the sandstone layers, soil temperatures will reach 0℃ in a short while. In 130-1S, the temperature has already gone down to 0℃.

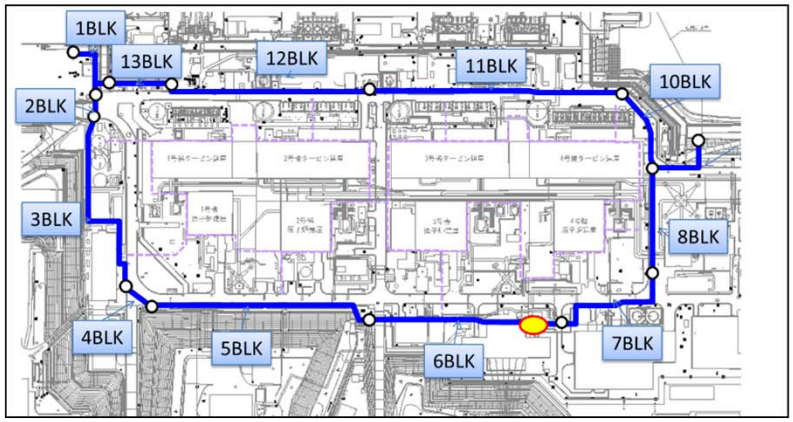






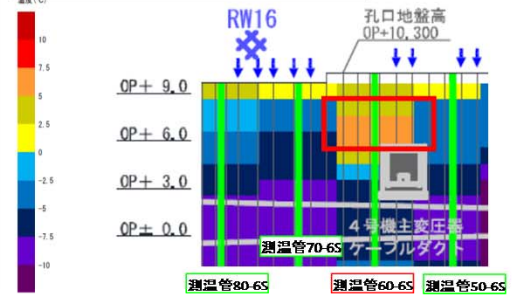
Progress in supplementary work (6BLK)

West side of Unit 3: Changes in soil temperatures over time in the areas where the supplementary work is under way

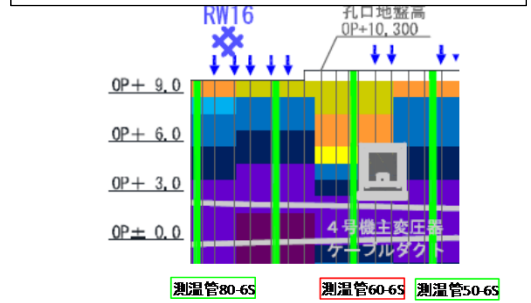


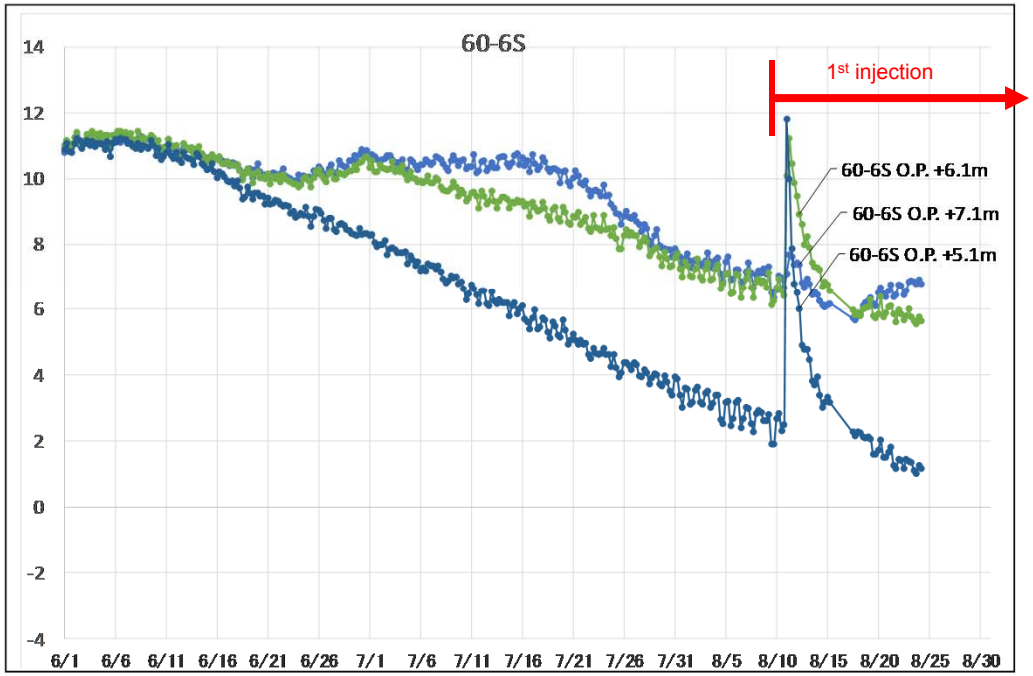
[60-6S]
The first round of supplementary injection began on August 10. It will continue to be conducted prioritizing the work on the seaside.

Before the supplementary work began : 7 a.m. June 6, 2016



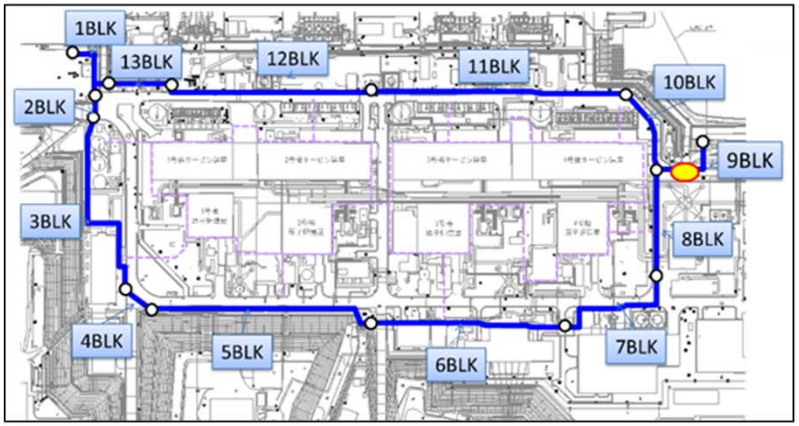
After the supplementary work began : 7 a.m. August 23, 2016



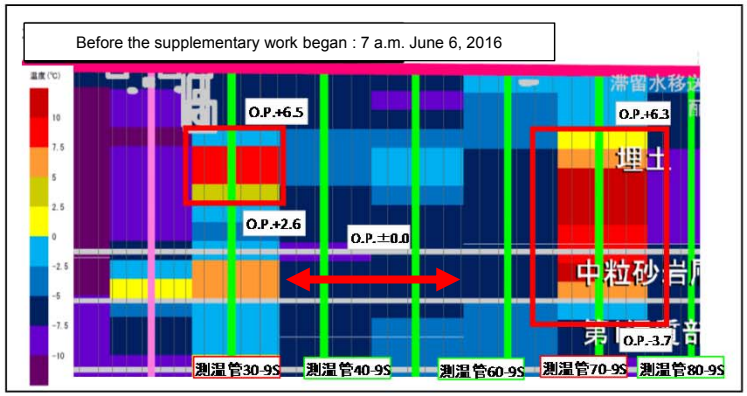


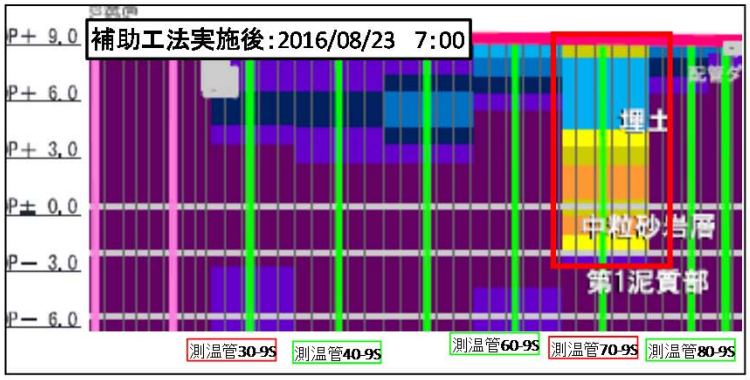
Progress in supplementary work (9BLK)

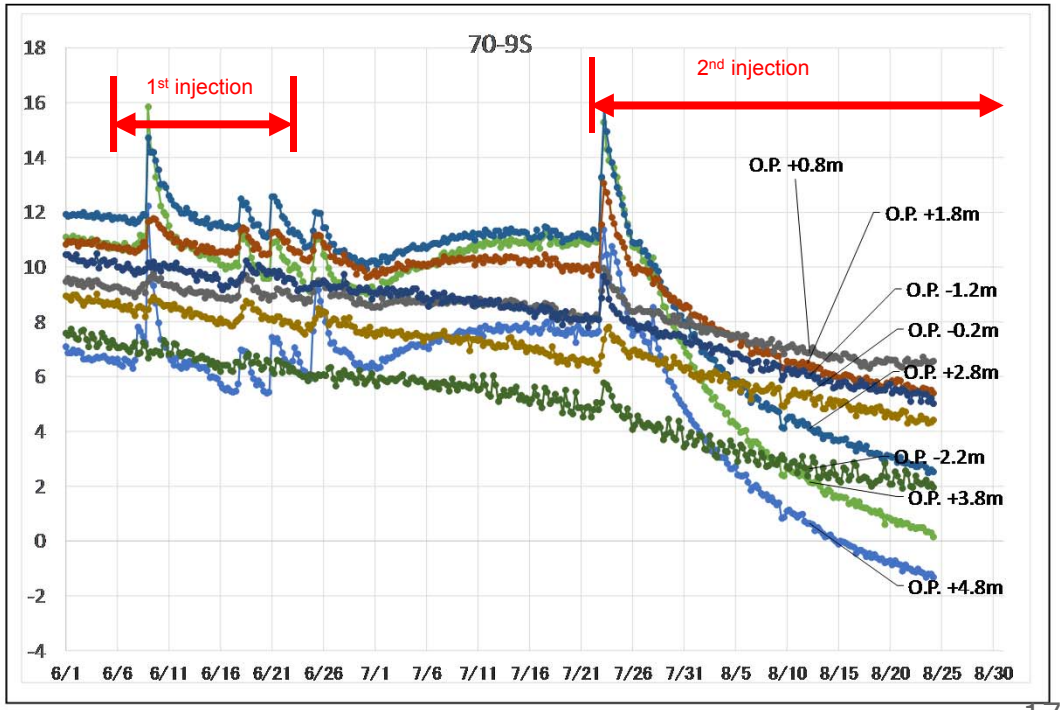
South side of Unit 4: Changes in soil temperatures over time in the areas where the supplementary work is under way



[70-9S]
After completing the second round of supplementary injection, soil temperatures show a tendency to decrease overall. However, the decrease in temperatures is slow in some layers and thus the supplementary injections will continue to be conducted.

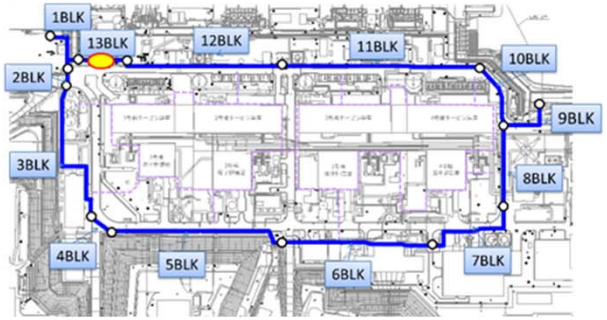






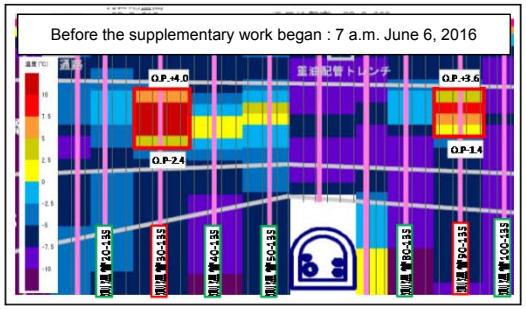
Progress in supplementary work (13BLK)

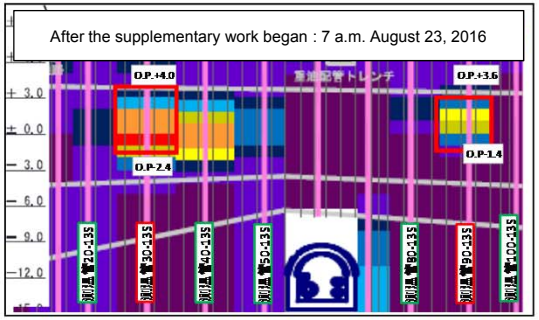
East sides of Units 1-2 (13BLK): Changes in soil temperatures over time in the areas where the supplementary work is under way

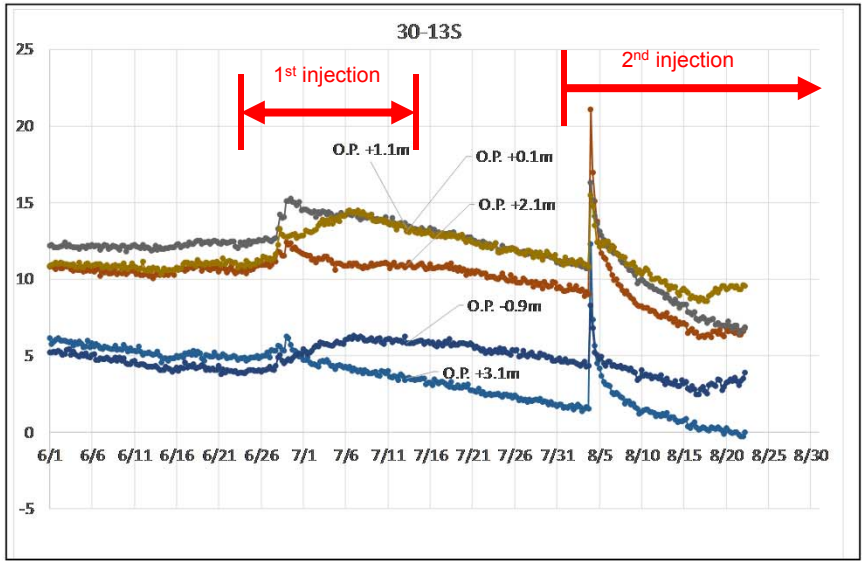


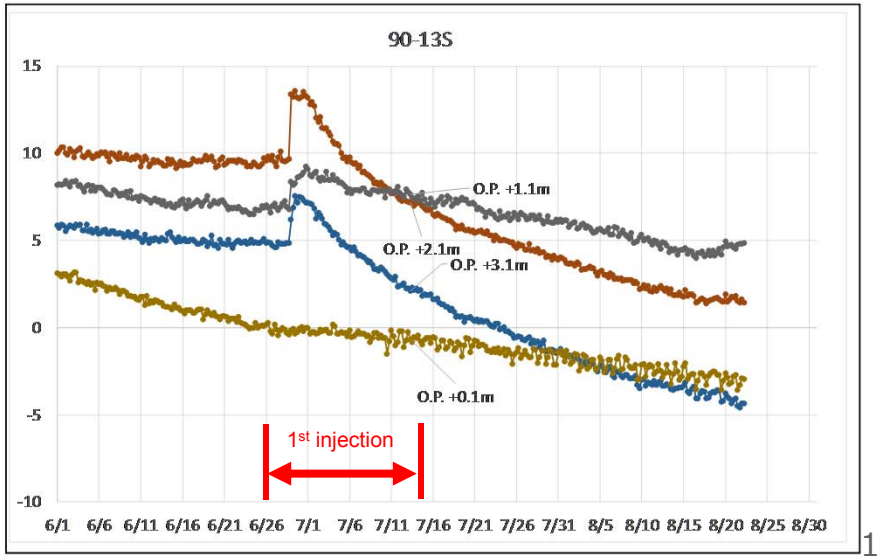
[30-13S]
After completing the second round of supplementary injection, soil temperatures show a tendency to decrease overall. However, the decrease in temperatures is slow in some layers and thus the supplementary injections will continue to be conducted.

[90-13S]
After completing the first round of supplementary injection, decline in soil temperatures has been observed except for certain layers. The changes in soil temperatures will continue to be monitored.









[Reference] Purpose of supplementary work

■ Purpose

• To accelerate freezing in the areas where decrease in soil temperatures is slow, flow speed of groundwater is made slow by reducing the permeability as low as surrounding ground.

• The purpose of this supplementary work is not to construct a different wall from the Landside Impermeable Wall but to lower the permeability of the areas where the freezing is not proceeding as scheduled.

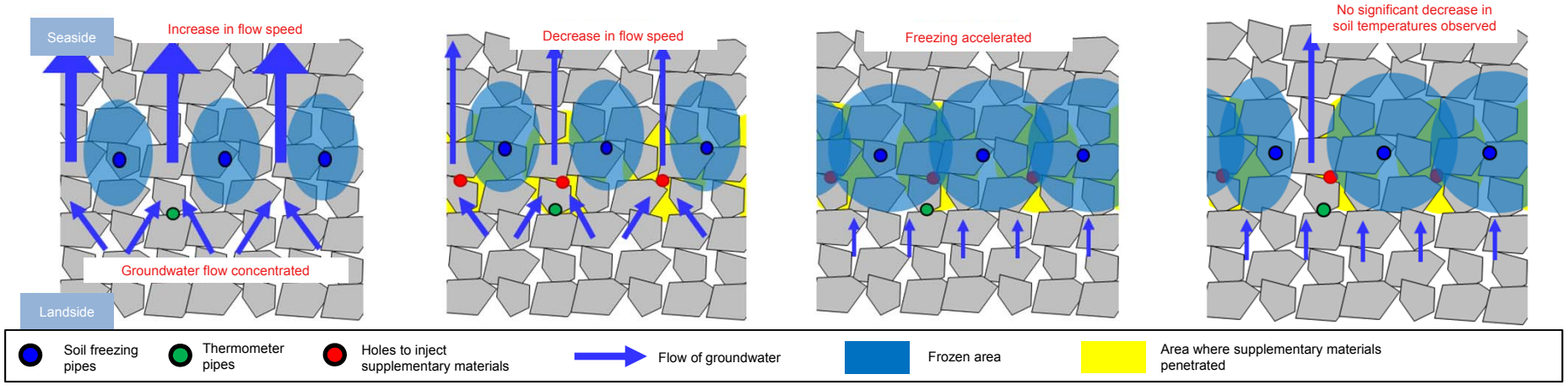
■Process

① Original condition:
The freezing is not proceeding as scheduled in the areas where permeability is high and groundwater flow is concentrated.

②Supplementary injection：
Permeability of the ground is lowered and speed of groundwater flow is made slow by injecting some supplementary materials into ground spaces.

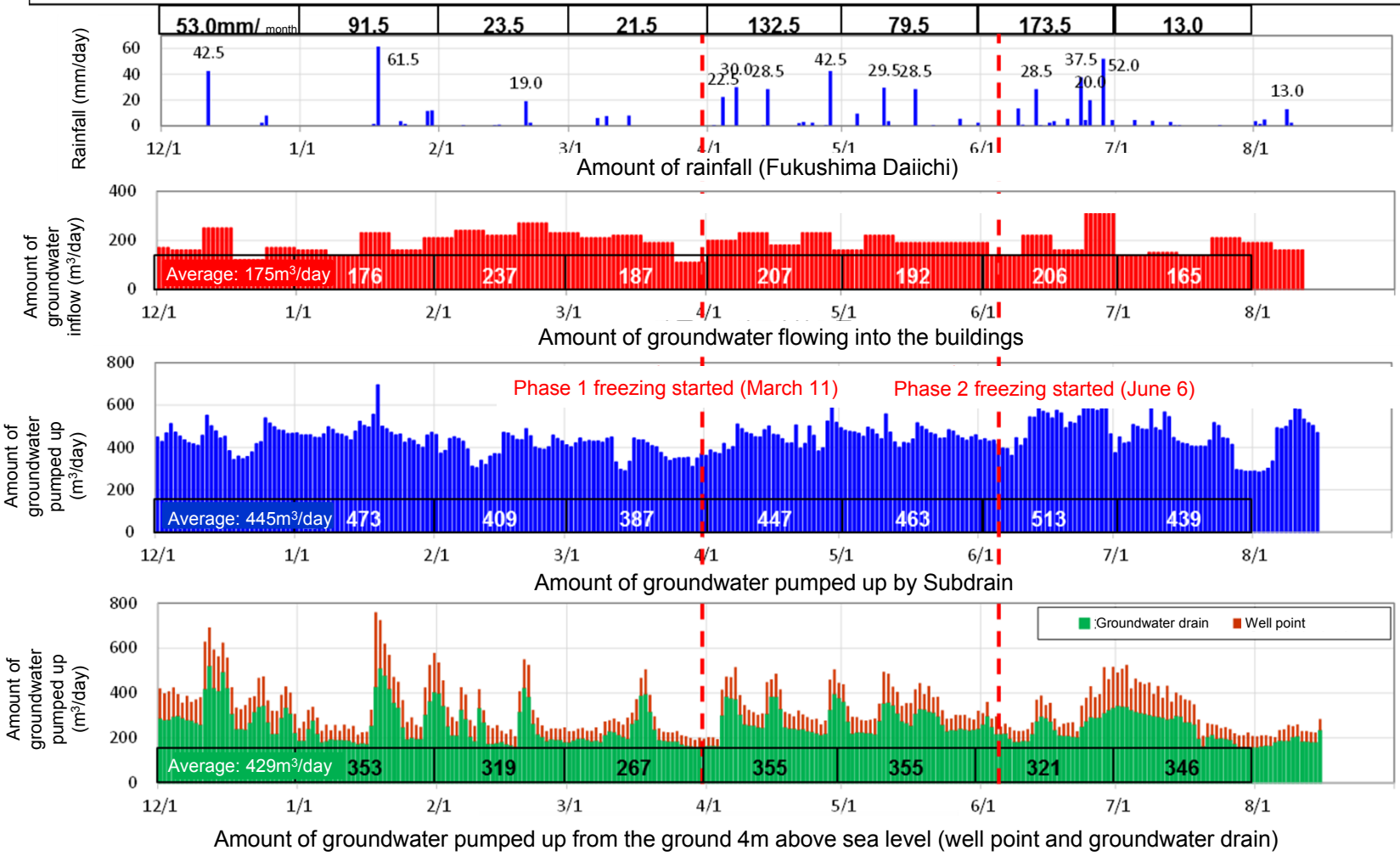
③Freezing speed accelerated: Reduction in groundwater speed makes soil easier-to freeze and expands frozen areas. Decrease in soil temperatures can be gradually observed with thermometer pipes.

④When significant decrease in soil temperatures cannot be observed, the second round of supplementary injection will be conducted.

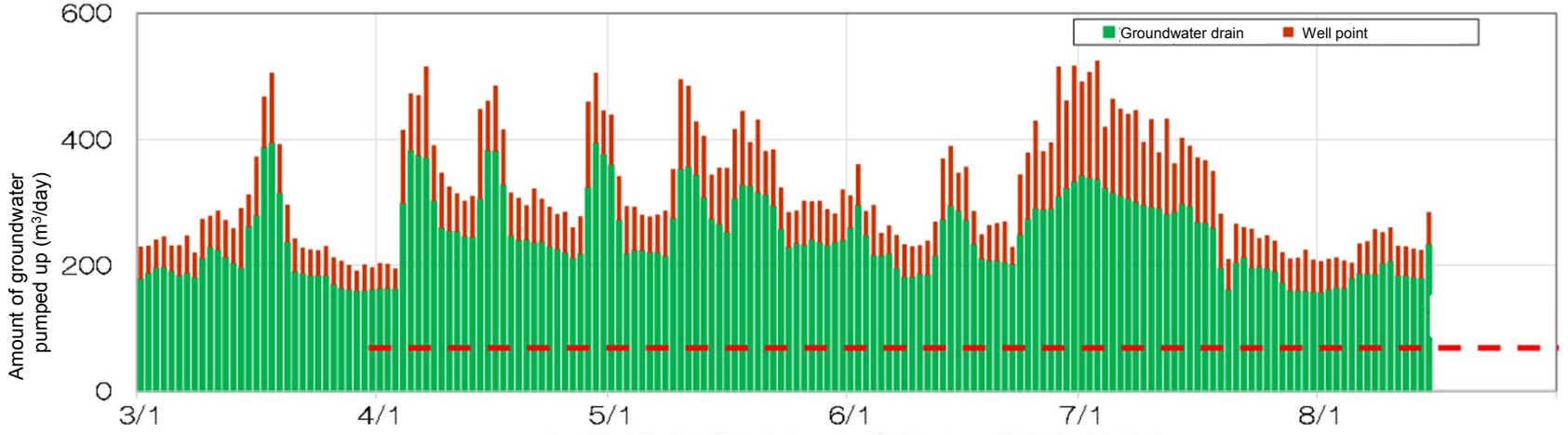


[Reference] Changes in amount of groundwater flowing into the buildings and being pumped up

- The average amount of groundwater flowing into the buildings was approximately 200m³ per day, but in July, it decreased to 170m³ per day.
- The average amount of groundwater pumped up by the Subdrain pumping systems was approximately 450m3 in April and May and approximately 510m3 in June due to rain. From the end of June to the beginning of August, the amount was affected by maintenance of the Subdrain pumping systems.
- The average amount of groundwater pumped up from the ground 4m above sea level was approximately 350m³ per day in April and May after the phase 1 freezing began. In June and July, the amounts were approximately 320 m³ per day and 350 m³ per day, respectively.

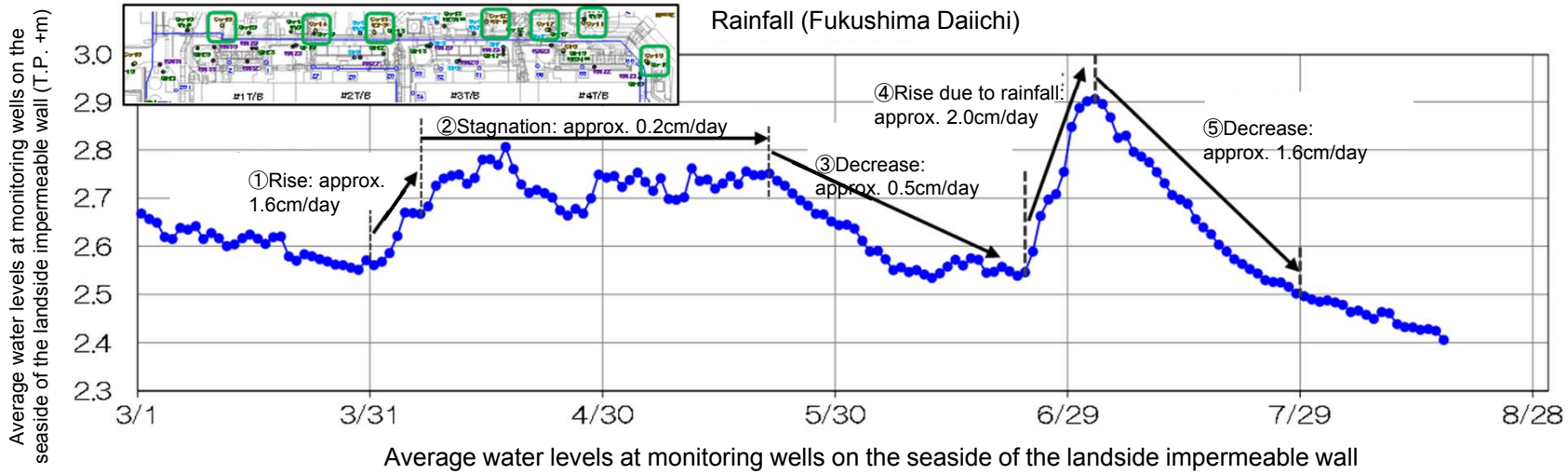


[Reference] Changes in amount of groundwater pumped up from the ground 4m above sea level



Amount of groundwater pumped up from the ground 4m above sea level (well points and groundwater drain)

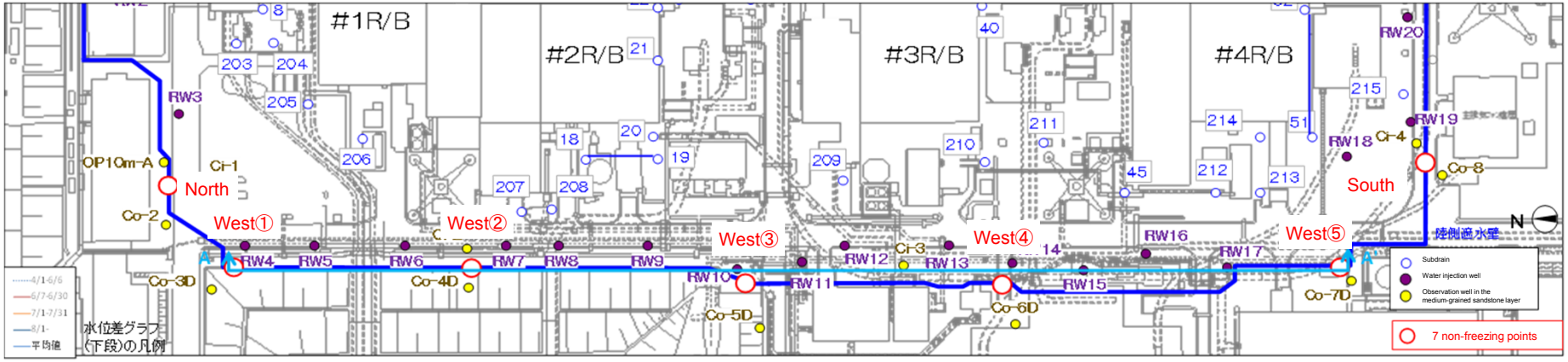
Rainfall (Fukushima Daiichi)



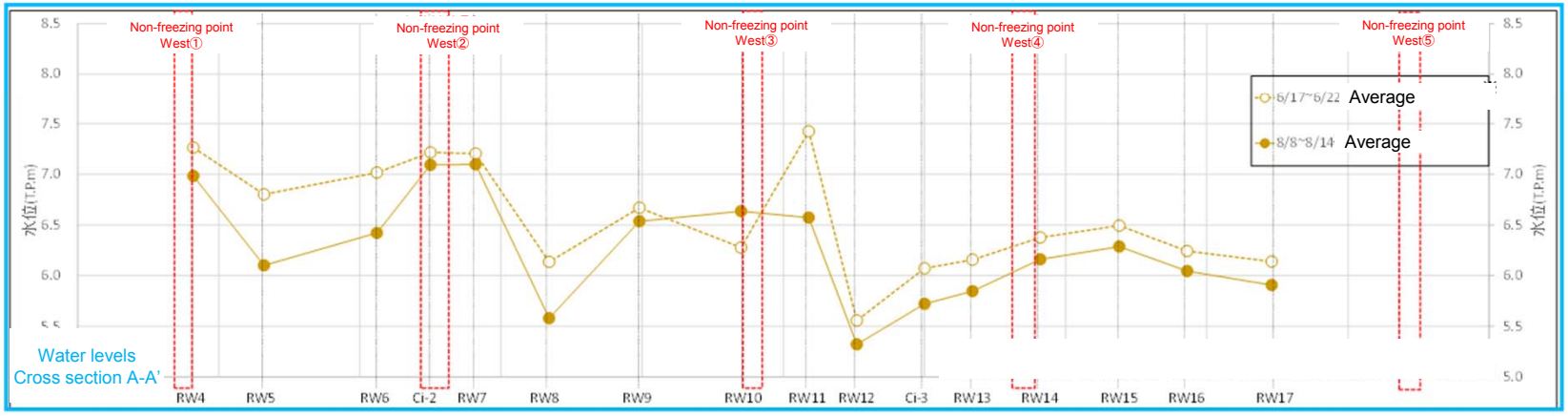
Average water levels at monitoring wells on the seaside of the landside impermeable wall

[Reference] Water levels in the medium-grained sandstone layer inside the landside of the Landside Impermeable Wall

- The following graph shows water level distribution in the medium-grained sandstone layer inside the landside of the Landside Impermeable Wall (north-south direction).
- Water levels have decreased overall, compared with those when the phase 2 freezing began.
- Water levels near the freezing areas tend to decrease more than those around the non-freezing points.



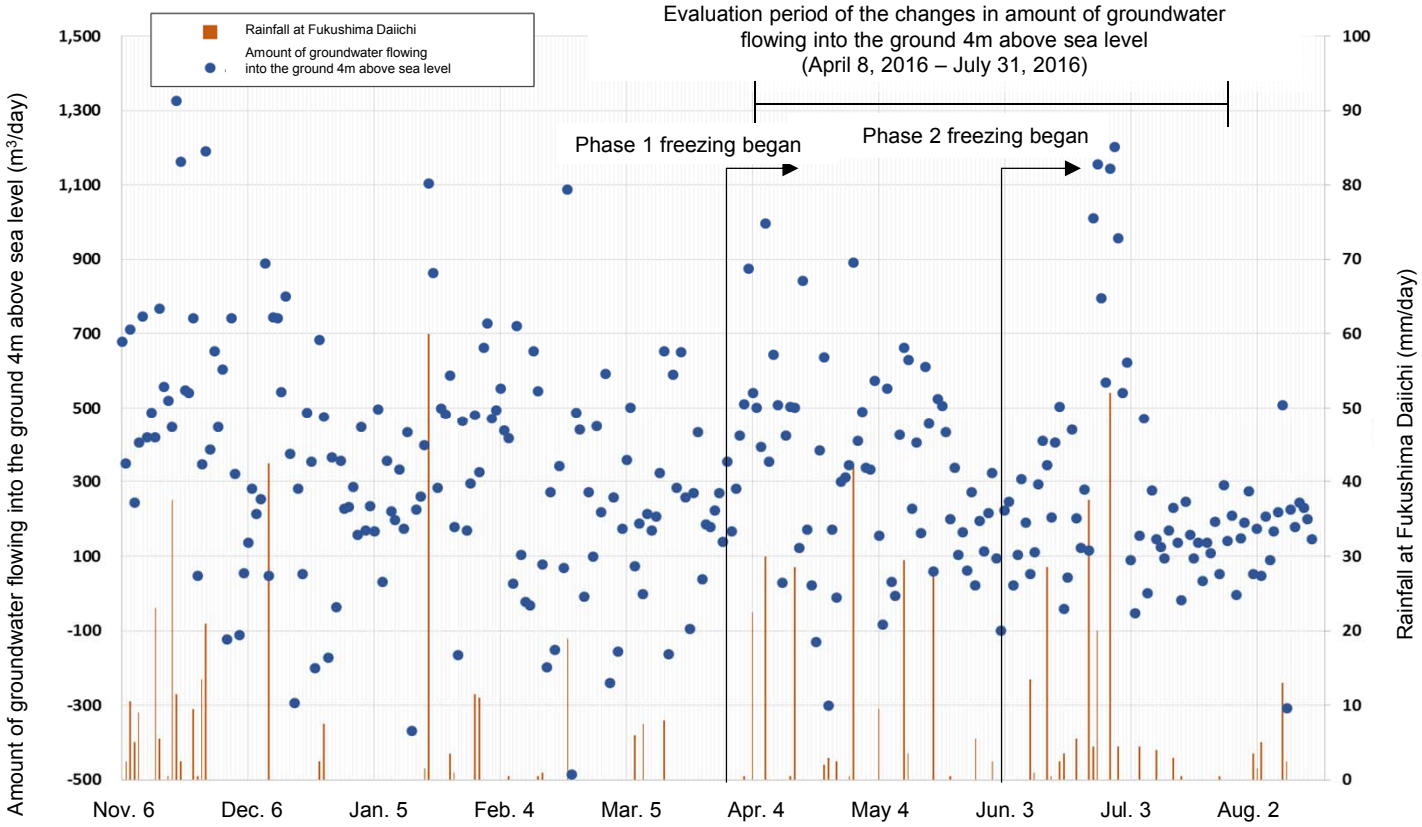
Location map of water level observation wells in the medium-grained sandstone layer



Water level distribution in the medium-grained sandstone layer inside the landside of the Landside Impermeable Wall

[Reference] Changes in amount of groundwater flowing into the ground 4m above sea level

- Amount of groundwater flowing into the ground 4m above sea level was calculated based on the amount of groundwater pumped up from the ground 4m above sea level (groundwater drain and well points) and changes in groundwater levels.
- The amount of groundwater flowing into the ground above 4m above sea level shows a tendency to decrease after July although it fluctuates due to rainfall.



Amount of groundwater flowing into the ground 4m above sea level (daily data)