Attachment

Basic Design of Water Shield Wall at the Seaside

Regarding water shield walls at the seaside ("Water Shield Walls") to be installed in front of the existing seawalls of Units 1 to 4, we have made a basic design in the procedure as shown in Figure-1 mainly to prevent further seawater contamination by underground water.

1. Purpose of installment of Water Shield Walls

Water Shield Walls (Figure-2) will be installed in front of the existing seawalls of Units 1 to 4. By the installment and the control of underground water, we will prevent further seawater contamination caused by underground water.

2. Structure design of Water Shield Walls

(1) Required specifications

Water Shield Walls will be designed to ensure required specifications on water shut-off, earthquake-proofing and durability.

- Water shut-off: a specification as a boundary between underground water and the ocean
- Earthquake-proofing: a specification to maintain boundary functions against earthquakes that we assume will occur while we control Water Shield Walls.
- Durability: a specification to maintain boundary functions against corrosions etc. that we assume while we control Water Shield Walls.

(2) Design criteria

Steel pipe sheet piles will be used for Water Shield Walls and we have set up the following design criteria.

- Water shut-off: the coefficient of water permeability of Water Shield Walls will be 10^{-6}cm/sec that is nearly equal to that of the low-permeable layer around reactor and turbine buildings.
- Earthquake-proofing: we will review as shown in Chart-1 based on "Technical criteria and their interpretation on port facility (July 2007, The Ports and Harbors Association of Japan)" (Port Facility Criteria)

・ Durability: we assume the durable years will be 30 years.

Chart-1: Evaluation method in earthquake-proofing of Steel pipe sheet piles

	Earthquake motion	Response for review	Evaluation criteria
Level 1 reviewing	Level 1 earthquake motion (horizontal seismic coefficient: 0.25)	・Embedded length required to shut off water in permeable layers ・Stress intensity ・Strain (water shut-off)	・Embedded length based on Port Facility Criteria ・Stress intensity based on Port Facility Criteria ・Strain based on existing literature
Level 2 reviewing	Level 2 earthquake motion (existing basic earthquake ground motion Ss)	・Stress intensity ・Strain (water shut-off)	・Stress intensity based on Port Facility Criteria ・Strain based on existing literature

(3) Specification review

We will review specification of Water Shield Walls.

[Basic Specification of steel pipe sheet piles]

We have set up the basic specification of steel pipe sheet piles (pipe diameter: Φ1,000mm, tube thickness: 14-22mm, pipe length: 22-23) in consideration of construction work, ease of procurement, durability and hydrogeological structures etc..

[Review result]

・ Water shut-off

Regarding the water shut off of steel pipe sheet piles, we have conducted literature surveys on existing construction achievements and confirmed that it will satisfy design criteria.

・ Earthquake-proofing

As a result of reviewing seismic response analyses etc., we have confirmed that review items on Level 1 earthquake motion and Level 2 earthquake motion will satisfy all evaluation criteria.

We have confirmed from the above that Water Shield Walls made of steel pipe sheet piles will satisfy required specifications.

3. Control of underground water

Regarding the control of underground water, as shown in Figure-2, we will install underground water drains between Water Shield Walls and existing seawalls so that the underground water level at the underground water drains will be equal to or lower than the mean sea level and control to prevent underground water from leaking to the ocean after the installment of Water Shield Walls.

4. Confirmation of preventive effects of further seawater contamination

Regarding the installment of Water Shield Walls and preventive effects of further seawater contamination by underground water control, we modelized hydrogeological structures around Units 1 to 4 buildings and buildings etc. (FIgure-3) based on the result of existing geological surveys and confirmed the effects by three dimensional groundwater and trajectory analyses.

As a result of analyses, we confirmed that multiple particles disposed at the bottom of buildings (mock radioactive materials) had been trapped in underwater drains and not flown from the inside of Water Shield Walls to the ocean (Figure-4) when the underground water level around buildings was almost the same as that in the current state (Figure-5).

We confirmed from the above that we will be able to prevent further seawater contamination by the installation of Water Shield Walls and underground water control.

5. Construction work plan

Construction work will be divided at the inside and the outside of the port due to different construction environments (please see Figure-2). We assume construction by a work barge in the sea (Seaborne Construction) and construction by onshore machines from a temporary jetty etc. (Jetty Construction). We will try to shorten work periods by conducting Seaborne Construction and Jetty Construction in parallel etc. (Figure-6).

6. Monitoring during construction work and after installation

We will conduct monitoring during construction work of Water Shield Walls and after their installation as shown in Chart-3.

Chart-3: Monitoring plan (tentative)

Monitoring		Items to be surveyed
During construction work	Present underground water	Underground water level, Underground water quality etc.
	Construction work impacts	Seawater quality, Water levels of sub-drains etc.
After installation	Effects of Water Shield Walls	Underground water level, qualities of underground water and seawater etc.
	Impacts on other projects	Water lever of Sub-drains etc.

7. Study of impacts on other projects and countermeasures

As Water Shield Walls etc. do not interfere with important facilities to stabilize the power station and the underground water level is controlled by underground water drains, we consider they will have small impacts on other projects. We will continue watching the impacts of the installation of Water Shield Walls etc. by conducting the above-mentioned monitoring during construction work and after the installation.

8. Others

We may change specifications of Water Shield Walls, the construction work plan and construction periods, due to the result of a future detailed study and progress situation of other projects etc..

END

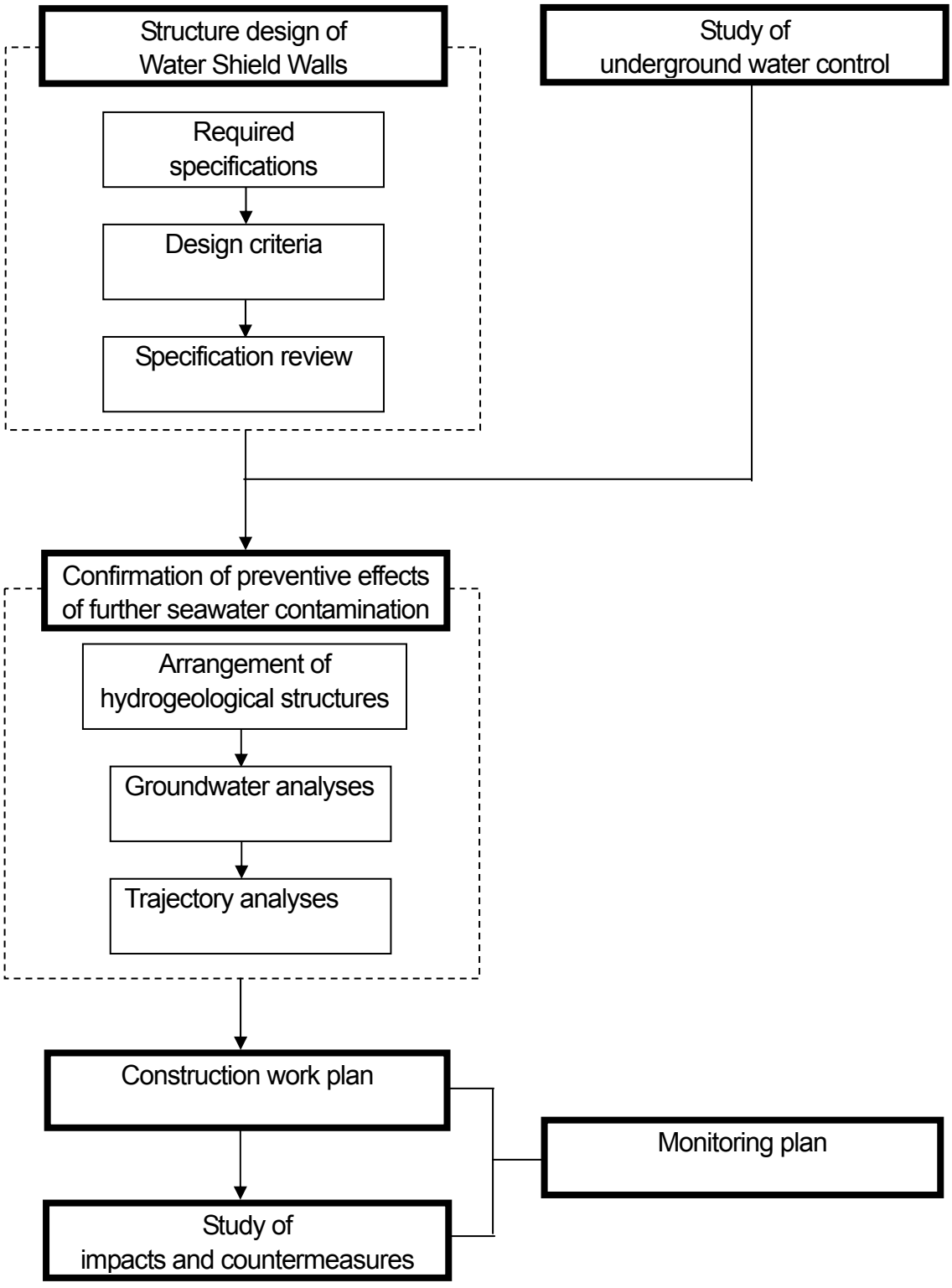
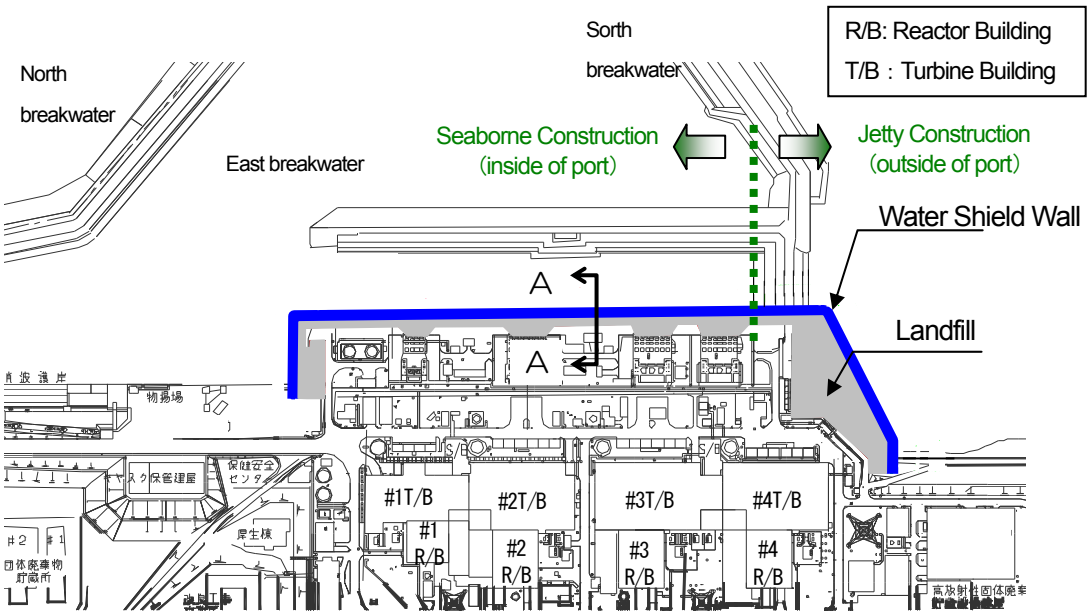
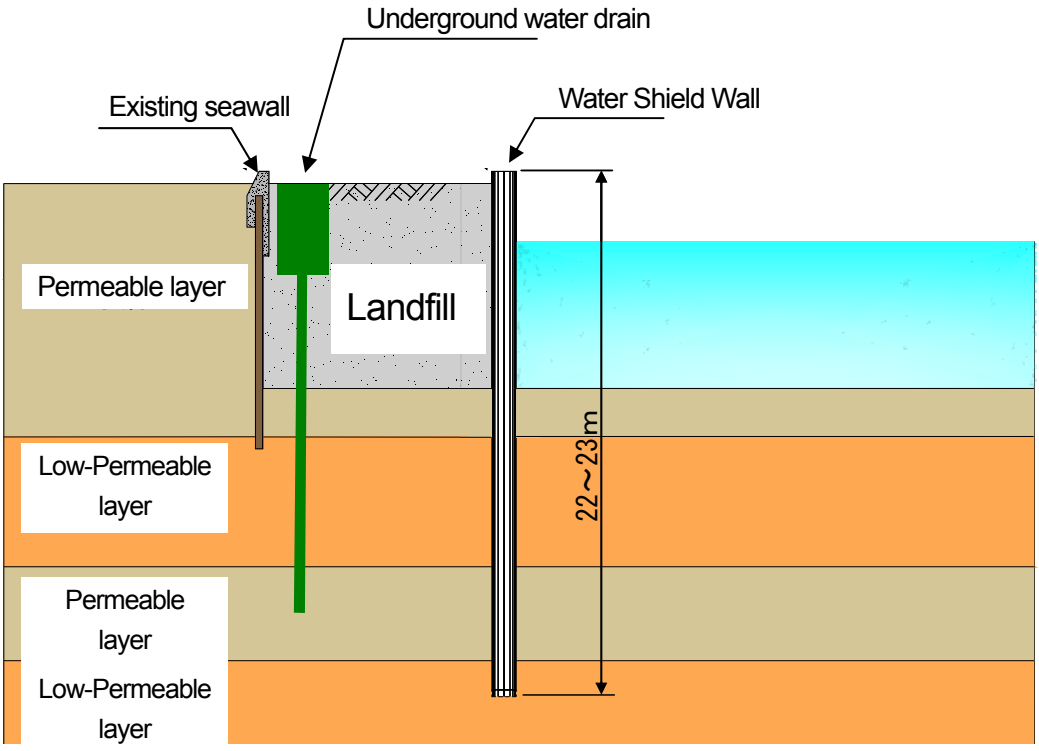


Figure-1 Flow of study of basic design

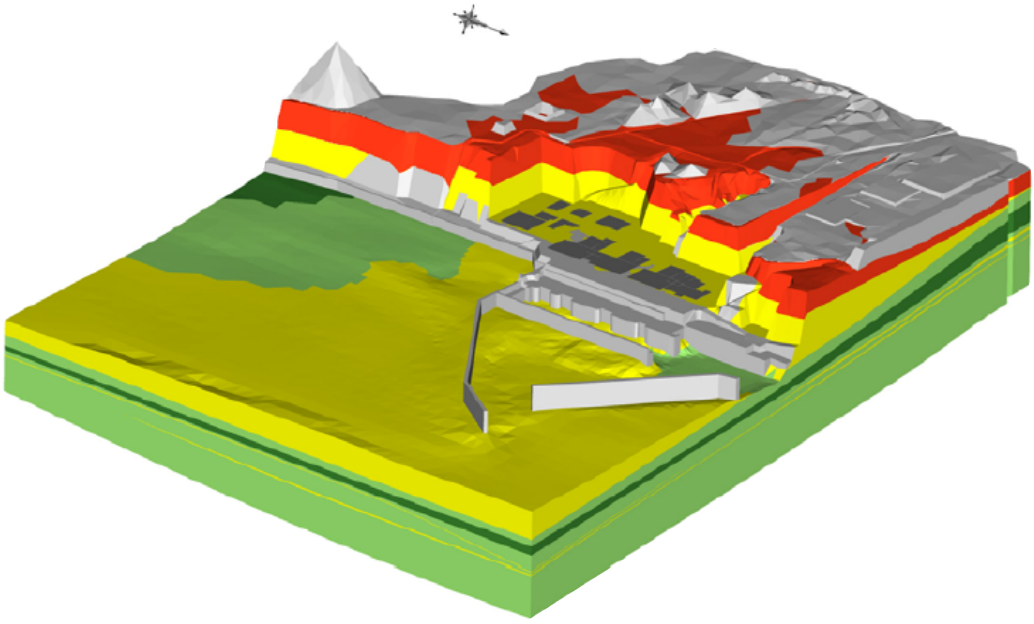


(1) Plain view

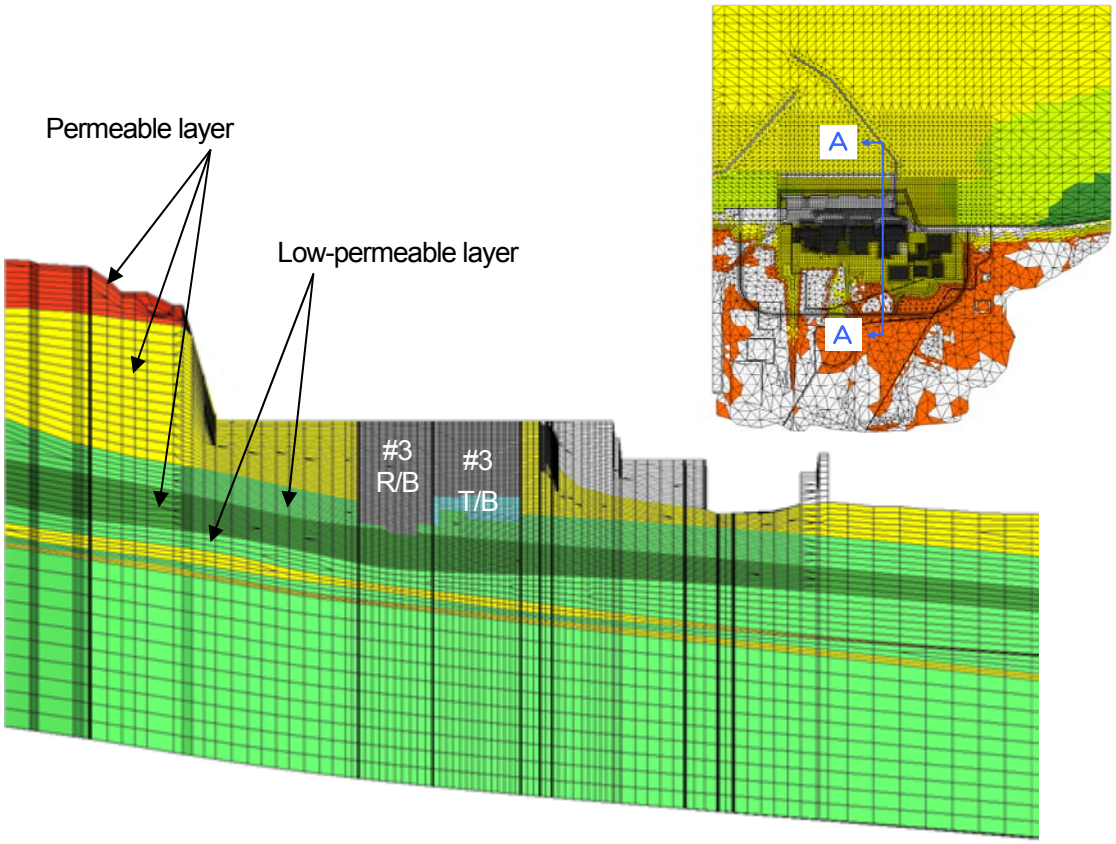


(2) Cross-section view (A-A cross-section)

Figure-2 Basic plan of Water Shield Wall



(1) Hydrogeological structure model around Units 1 to 4 buildings（based on the result of existing geological surveys）



(2) Cross-section view in the analytical model (around Unit 3, in the orthogonal direction of the shoreline)

Figure-3 Analytical model

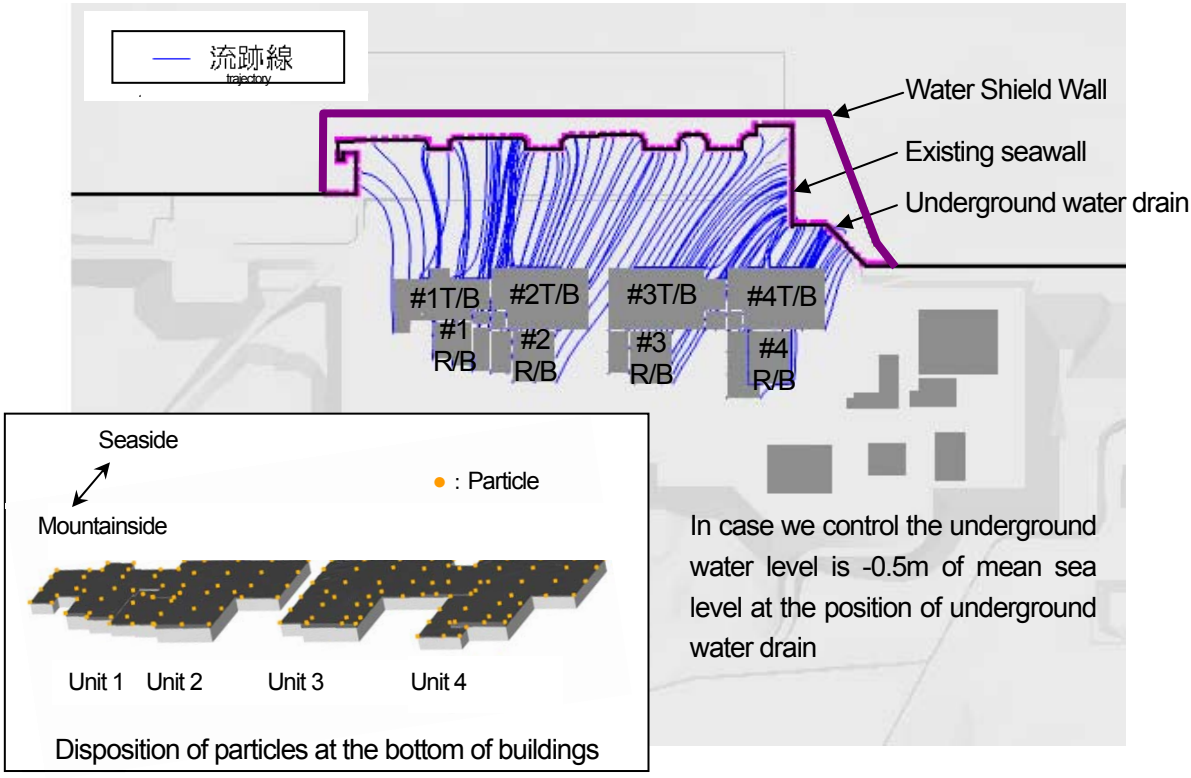
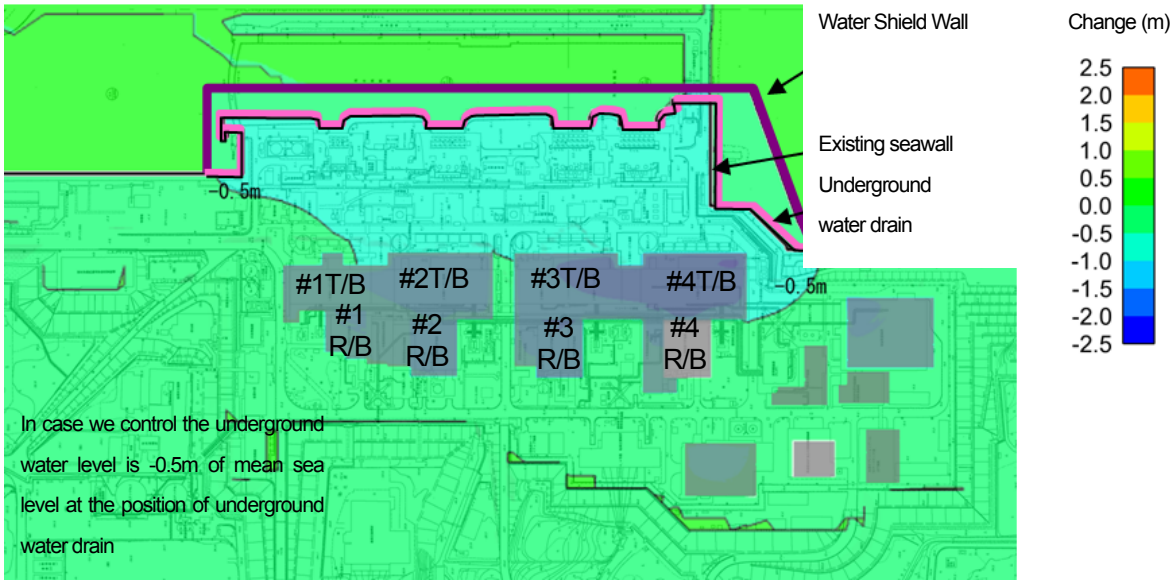


Figure-4 Example of a result of trajectory analyses



Change from current distribution of underground water level

Figure-5 Example of a result of groundwater analyses

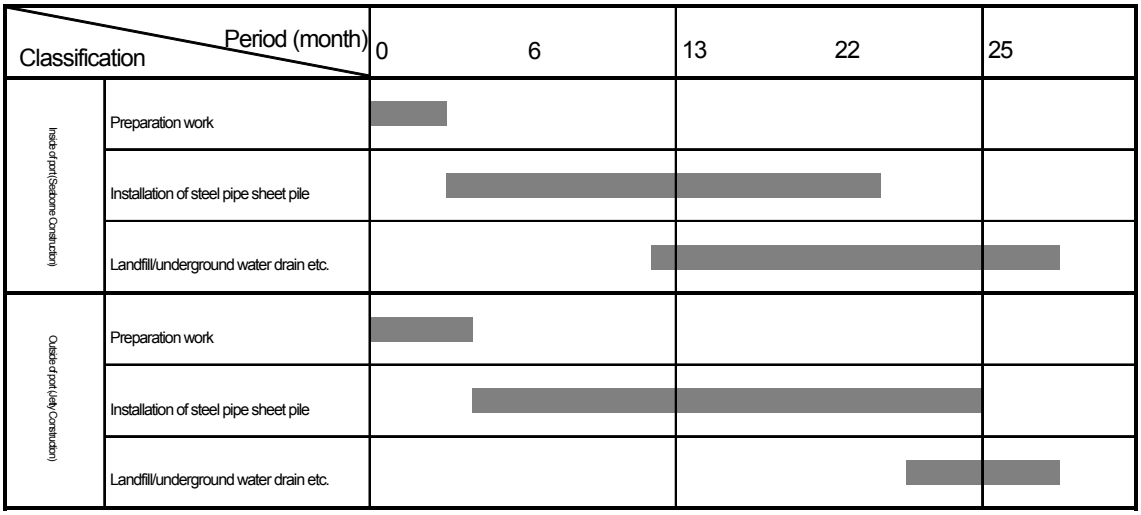


Figure-6 Outline of construction work schedule