Control Measures for Water Leaked from the H4 Area Tank

- A Field Test for Collecting Strontium Present in the Soil -

January 30, 2014

Tokyo Electric Power Company

Among the three measures to tackle the issue of contaminated water provided in the “Preventive and Multi-layered Measures for Decommissioning and Contaminated Water Management”, announced by Nuclear Emergency Response Headquarters on December 20, 2013, the Measure (1): the [Additionally Implemented Measure] for “Remove sources of contamination” is prescribed as follows:

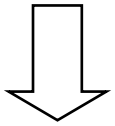
[Additionally Implemented Measure] (An excerpt from the applicable part)

＜Multilayered Measures＞

These are intended to prevent ground water contaminated by the water leaked from the tank from flowing out into the ocean. (**Soil improvement using the adsorbent for collecting strontium is to be implemented in a speedy manner downstream of the tank area.** Soil improvement in the bank protection area where seawater-derived contents are present will be conducted after the verification of the relevant technology and the confirmation of the effect.)

→DOE has informed us of the technology for collecting Sr present in the soils of the Hanford Site.

→We have adopted the technology for collecting Sr proposed by IRID*.



*This technology has been classified as the “(3) technology which is expected to have some effect, but needs to be confirmed/verified before it is used”, among the main technologies that should be newly utilized on the basis of the public invitation for technologies.

A field test is to be implemented to examine the applicability

2. Technology for Collecting Sr Present in the Soils of the Hanford Site Informed by DOE

- This technology is now being conducted at the Hanford Site of U.S. as a measure to prevent radioactive Sr from flowing down.
- At first, soil improvement using apatite material (adsorbent) was carried out along the distance of about 300ft. Currently, it has been extended to about 2500ft. It is reported that this resulted in the effect of reducing the Sr content of the groundwater by about 90%.
- At present, we are adjusting the contents of the information provided by DOE.

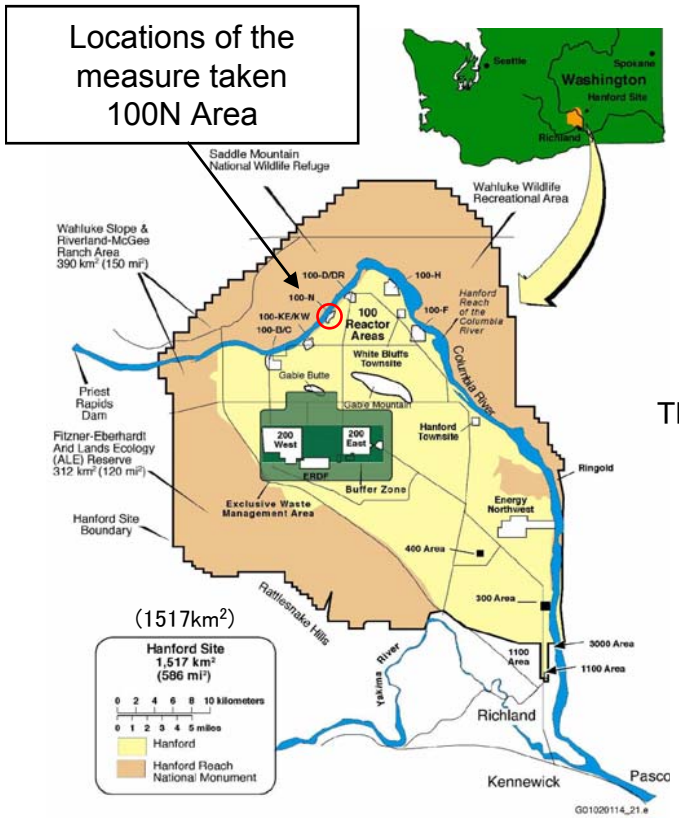


Figure. Hanford Site*1

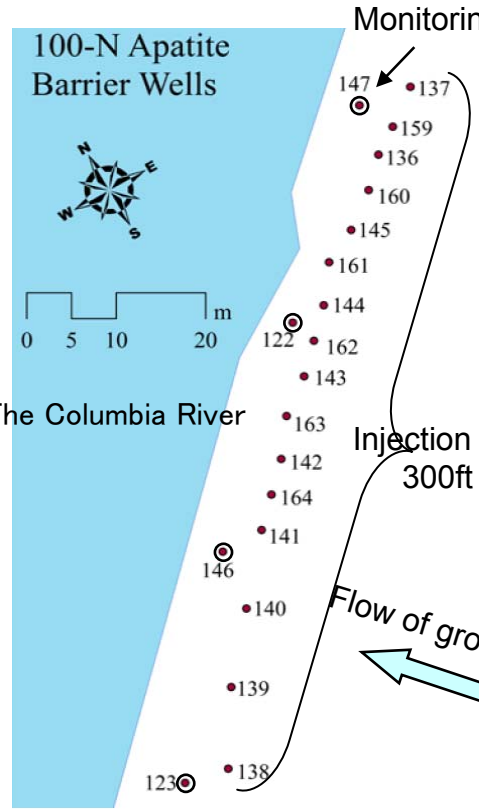


Figure. Apatite injection location (300ft)*1

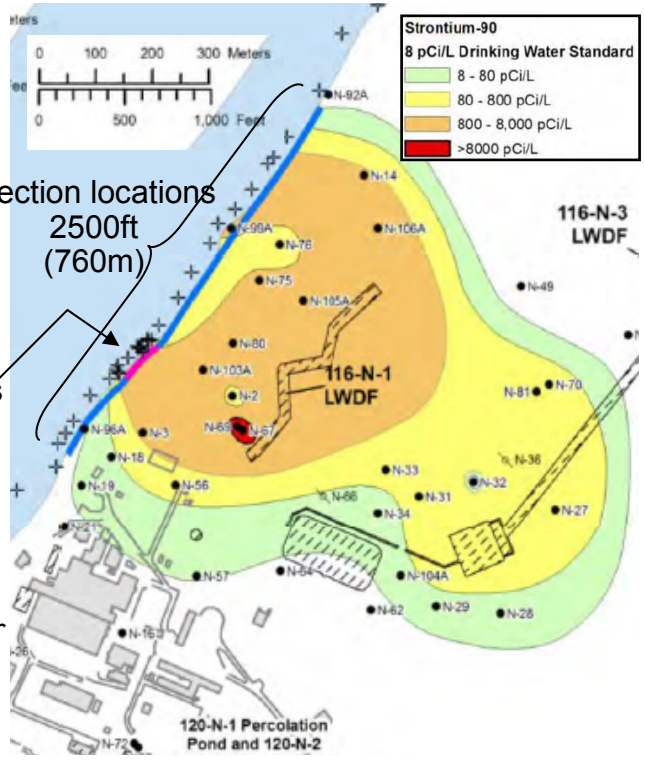


Figure. Apatite injection location (2500ft)*2

*1 Source: Supplementary Note to "100-NR-2 Apatite Treatability Test: High-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization FINAL REPORT September 2010, Pacific Northwest NATIONAL LABORATORY"

*2 Source: Supplementary Note to "U.S. Department of Energy 100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton County, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary September 2010, United States Environmental Protection Agency"

3. Overview of the Technology Proposed by IRID

- Proposal No.: 229
- Field of the technology: (5) (Site management for the purpose of controlling the inflow of groundwater)
- Name of proposal: Construction of permeable reactive barrier for groundwater contaminated with strontium
- Proposer: A joint proposal of TAISEI Corporation and CH2MHILL

(Overview of the proposed technology)

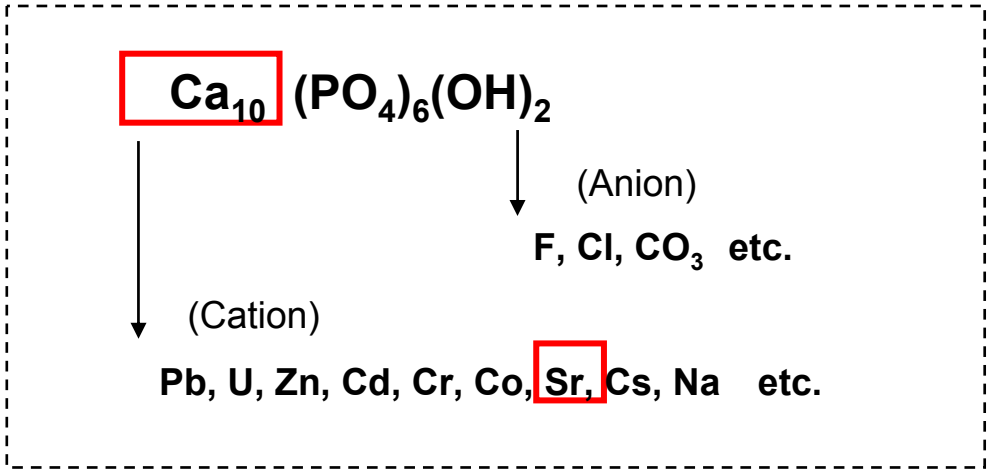
- Highly permeable barrier made by mixing reactive materials which can adsorb or decompose the pollutants present in groundwater.
- A control technology which doesn't disturb the flow of groundwater.
- Long term maintenance is not required after the construction of the permeable barrier.
- Many actual instances of controlling groundwater contaminated with volatile organic compounds and heavy metals etc.
- CH2MHILL possesses the technology and application records of permeable reactive barrier made by improved soils using an adsorbent (apatite) at the Hanford Site of U.S.
- It is possible to combine and apply on site the technology possessed by CH2MHILL and that of TAISEI Corporation for planning/constructing permeable reactive barrier in Japan after the applicability test of reactive materials.

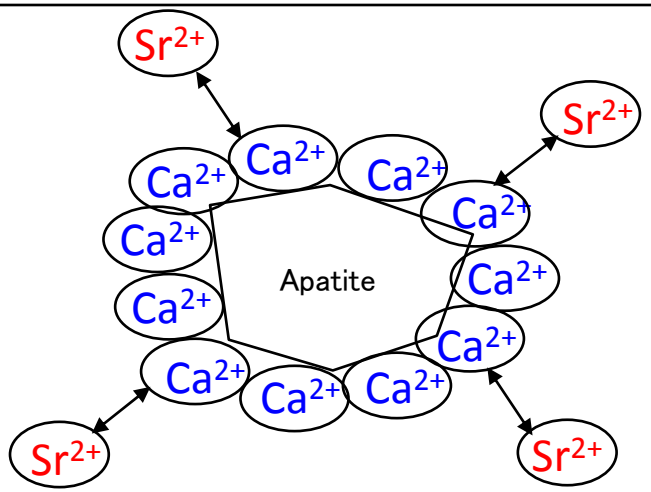
⇩

Based on the construction result and the effect of the Sr-collecting, consider the applicability of the technology to the site

4. The Principle of Collecting Sr

- Soil improvement using an adsorbent is to be carried out to collect the radioactive Sr present in groundwater.
- As the adsorbent apatite, which was included in the proposal of IRID and was actually used by DOE, is used for this purpose.
- The apatite is mixed with the soils, and it is allowed to take in Sr and stabilize itself by means of ion exchange between Ca contained in the apatite and Sr contained in the groundwater.
- The adsorbent is placed in the area without contaminated soils for the purpose of preventing the spread of contamination.





[An image of ion exchange]
→Sr is substituted by Ca contained in apatite

Figure. Substitutionof Sr with Ca contained in apatite

5. Consideration of the Applicability of Soil improvement (Sr-collection)

- In considering the applicability, a field test is to be carried out on the basis of the result of the laboratory test.
  Laboratory test: Confirm the effect of apatite (adsorbent) for collecting Sr, and decide on the specifications of soil improvement (for blending a soil conditioner*1).
  Field test: Confirm the workability and quality as a main purpose, and confirm the effect of collection*2 as a supplementary purpose.

*1 The soil conditioner is a material made by mixing apatite with crushed stones, and is highly permeable.
*2 The effect of collection is determined from the result of the laboratory test. In the field test, it should be checked if operation is possible based on the blending method.

[Laboratory Test]

The following tests are conducted in the laboratory:
- Batch test (Capability test of the adsorbent)
- Column test (Simulation test of the soil conditioner)

⇩ Reflect the result

[Field Test]

A full-scale verification test is conducted on site.
- Confirmation of workability and quality (Main purposes)
- Confirmation of the effect of collecting Sr (Supplementary)

6. Overview of the Laboratory Test

- In order to determine the soil improvement specifications (design of blending), conduct **(1) a batch test (on the capability of the adsorbent) and (2) a column test (simulating the soil conditioner)** to confirm the Sr adsorbing capability of apatite.
- The batch test is to be a test using Sr (with varying quantity), and conducted using distilled water, seawater, and groundwater made by simulating the site conditions etc.
- The column test is to be conducted under the conditions determined on the basis of the result of the batch test.

(Polypropylene container)

(Tube rotator)

- This test is conducted by creating solutions using distilled water, seawater, and groundwater made by simulating the site conditions etc. with different Sr concentrations.
- The purpose is to confirm the basic adsorbing capability of apatite.

Main parameters: apatite quantity, seawater contents, groundwater contents

Figure. (1) Batch test

- Confirm the effect of eliminating Sr from groundwater when the groundwater containing Sr is passed through the soil conditioner and comes into contact with apatite.
- Fill the specimen added with apatite into a cylindrical container (column), infiltrate Sr-mixed water from below, and measure the Sr concentration of the water discharged from the top and the side.

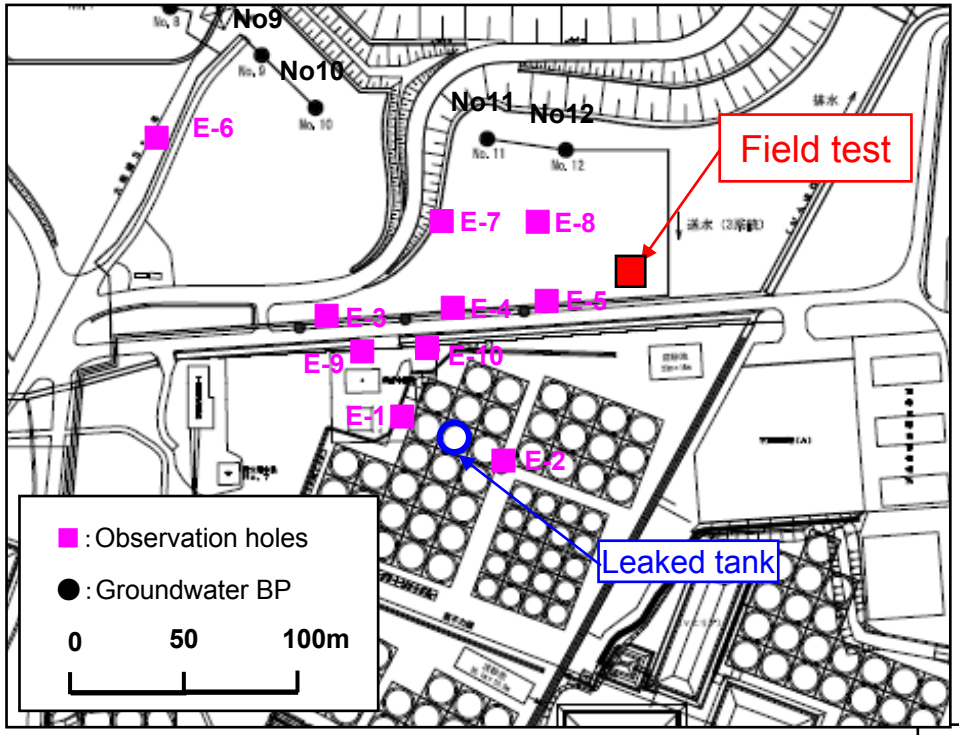
Considered cases:
To be determined on the basis of the batch test

Figure. (2) Column test

7. Overview of the Field Test (1)　Locations for Implementation

- The field test is mainly intended to confirm workability and quality, while the effect of collecting Sr is to be confirmed as a supplementary purpose.
- The locations for implementing the field test have been selected at the places with the lowest contamination levels in the vicinity of the H4 Area.

[Ground Plan]



[Cross Section]

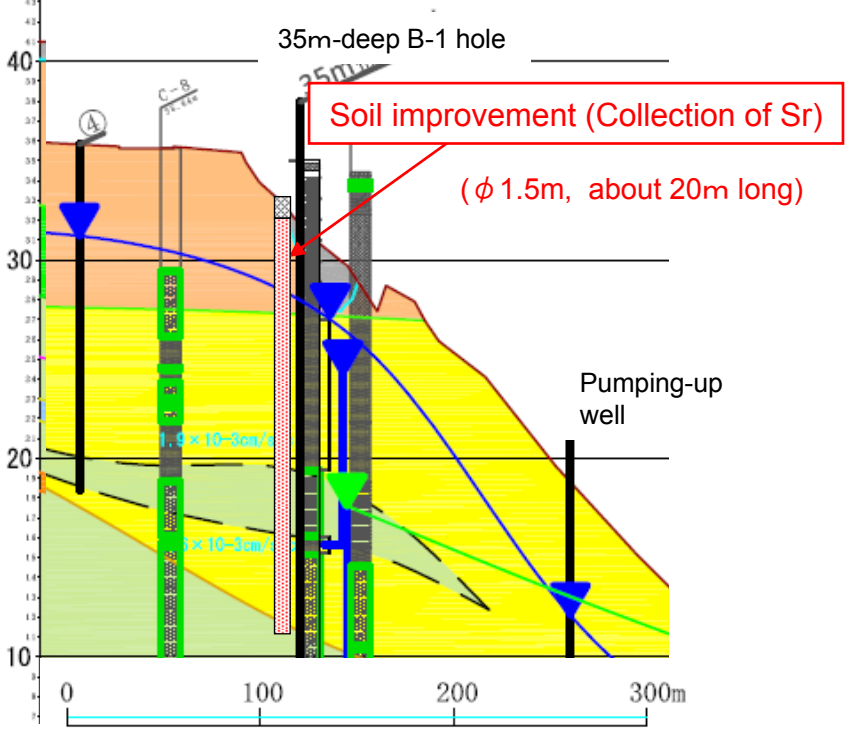


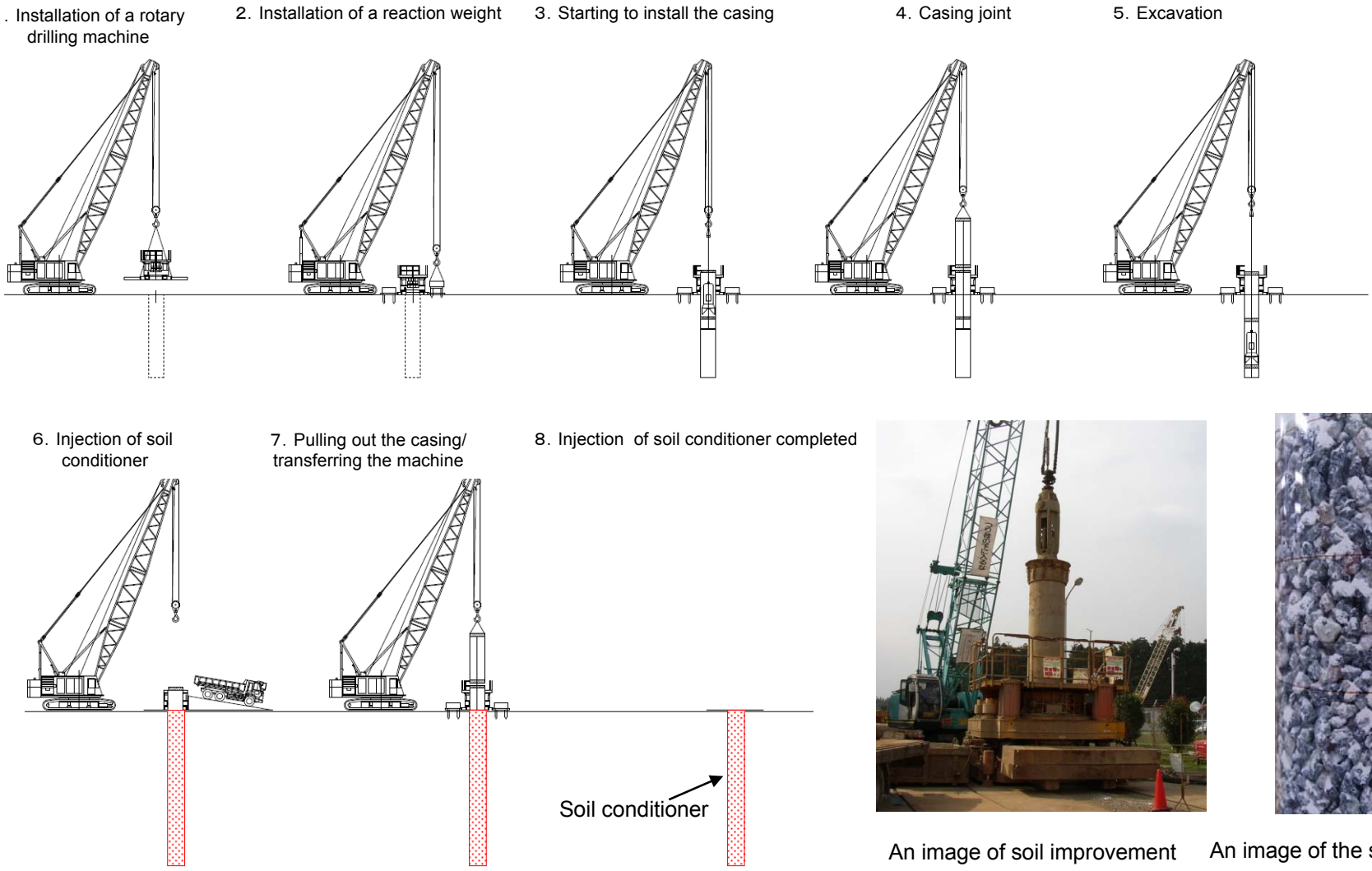
Figure. Locations for implementing the field test

Geological legend

- Backfill soil
- Quaternary Formation　Terraced deposit layer
- Tomioka Layer　T3 member medium-grained sandstone layer (Member I)
- Tomioka Layer　T3 member lutaceous member (Member I, member II, member Iv)

7. Overview of the Field Test (2)　An Image of the Operation

Soil improvement is carried out by injecting soil conditioner (apatite + crushed stones) after installing the casing and excavating/eliminating the soils from the casing.



An image of soil improvement

An image of the soil conditioner

7. Overview of the Field Test (3)　Test Item (1) Confirmation of Workability/Quality (Main Purpose)

- Workability and quality are to be confirmed under the conditions of the site as the main purpose of the field test.
- When workability is to be confirmed, the points for consideration regarding the actual operation will be mainly screened out, while when quality is to be confirmed, it will be examined if it is possible to install the equipment according to the blending design.
- The implementation period is scheduled from February to March 2014.

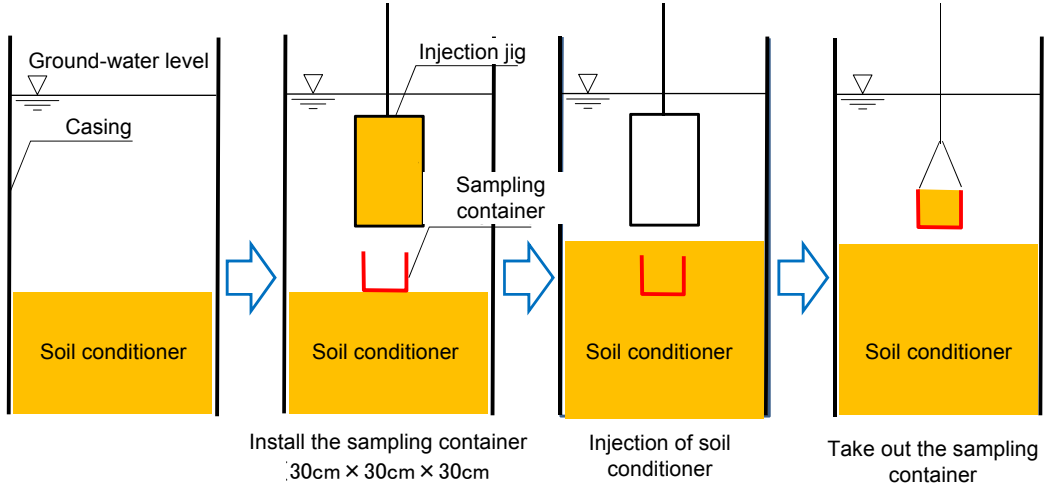


Figure. Sampling method of soil conditioner (during operation)

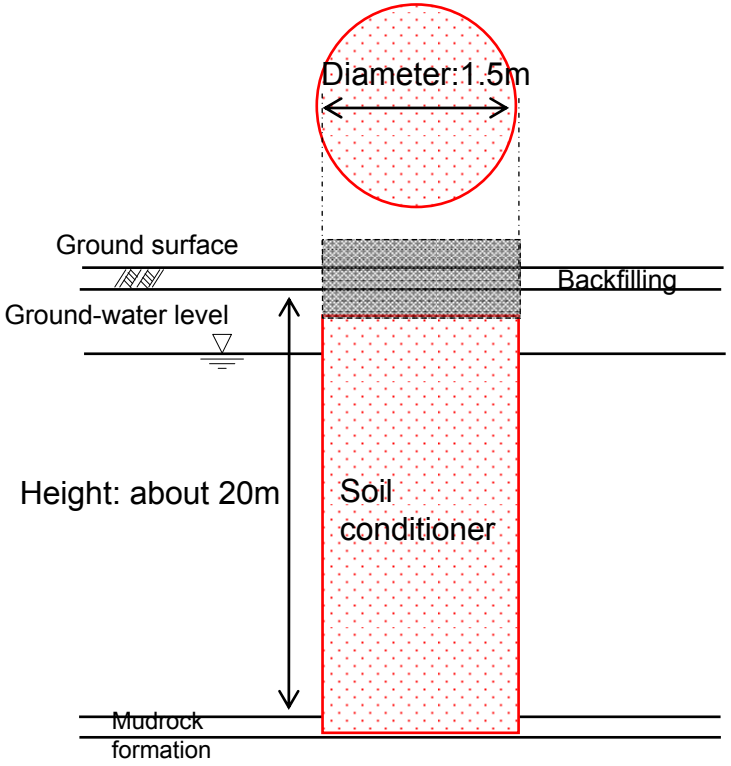
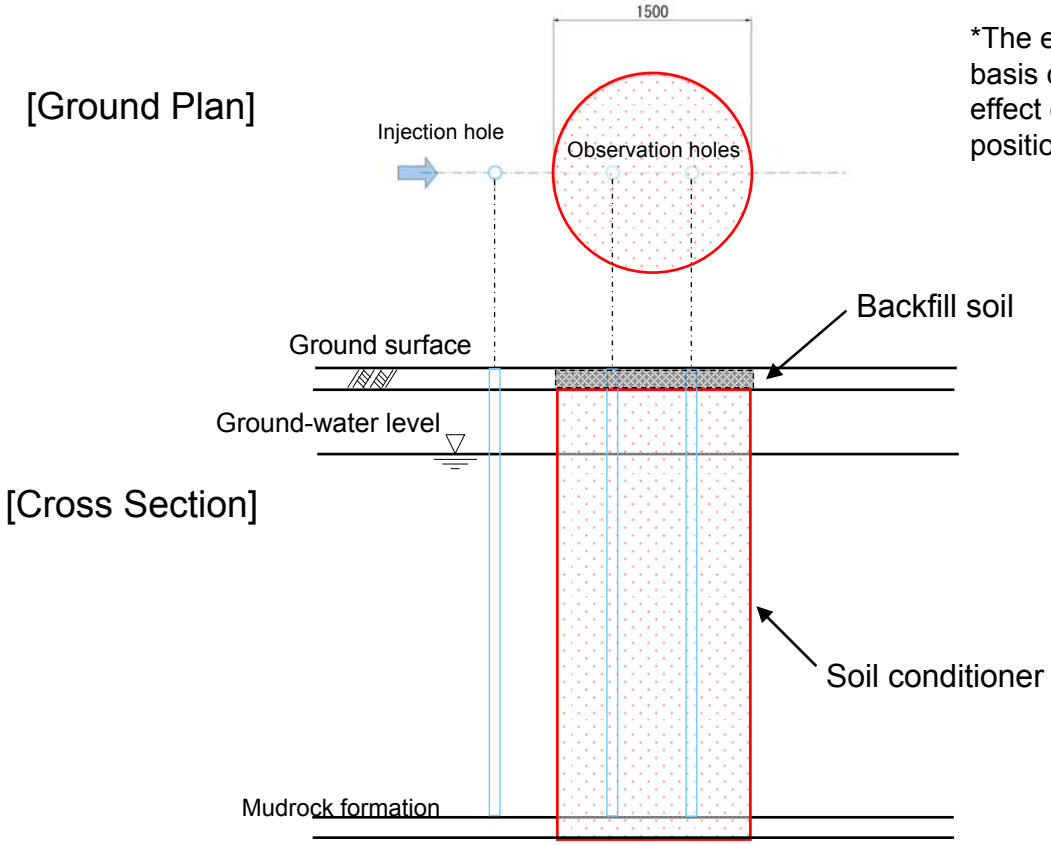


Figure. Test body

- As an item for supplementary confirmation during the field test, the effect of the on-site operation for collecting Sr* is to be confirmed.
- After conducting soil improvement, Sr injection hole and observation holes are installed, continuous observation is conducted after injection, and the effect of collection is confirmed.
- The implementation period is scheduled from February to May 2014.



*The effect of collecting Sr is determined on the basis of the laboratory test. Confirmation of the effect of collecting Sr during the field test is positioned as a supplementary purpose.

Figure. Locations of injection hole and observation holes

7. Overview of the Field Test (5) Implementation Processes

- During the field test, the processes of confirming workability/quality and the effect of collecting Sr are planned to be carried out from February to May.
- Implementation of measures will be determined on the basis of the result of the confirmation of workability and quality.
- Confirmation of the effect of collecting Sr during the field test will be considered in conjunction with the measures.