Reference-1

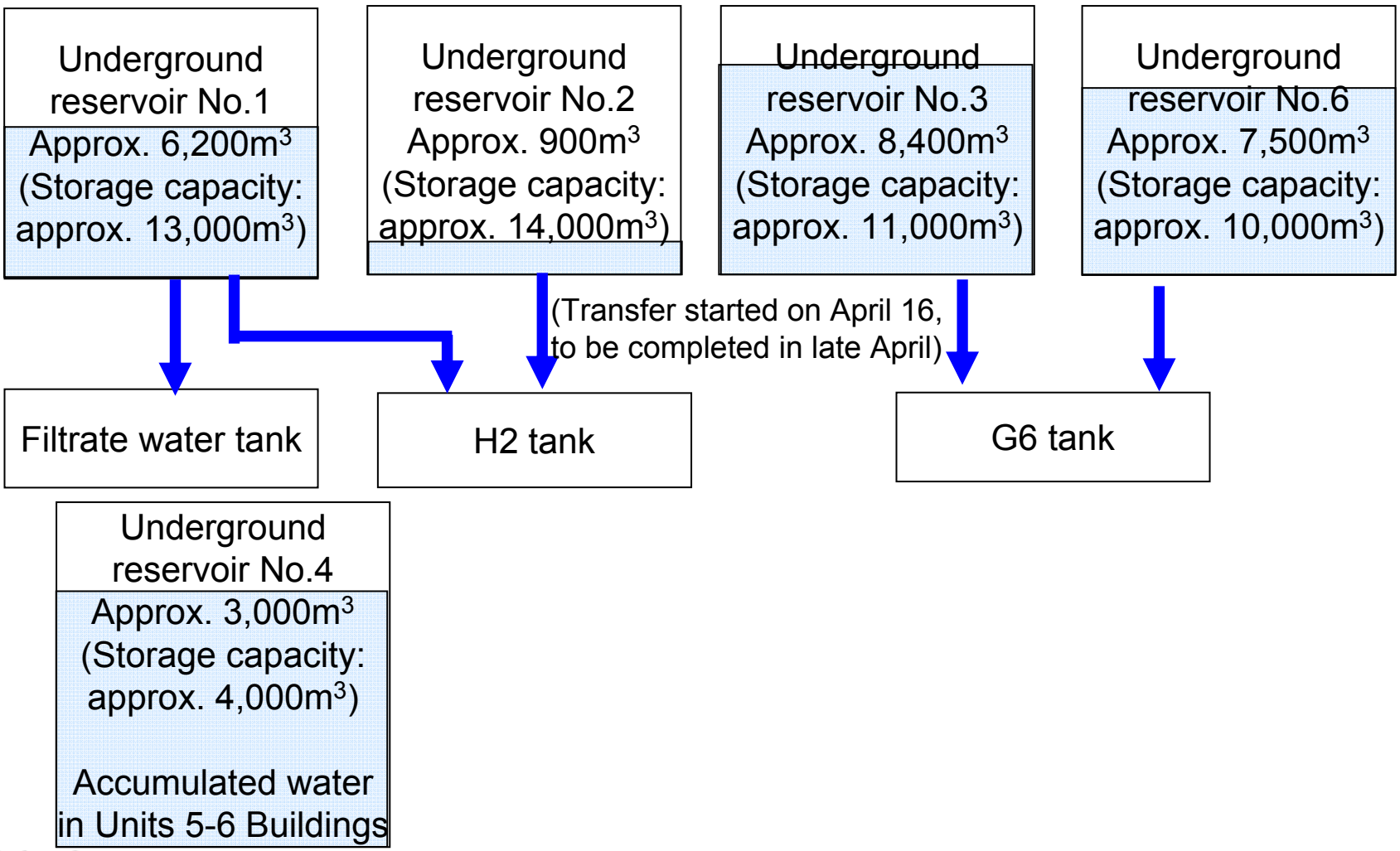
Water Transfer from the Underground Reservoir No. 2 to the H2 Area Tank

April 17, 2013

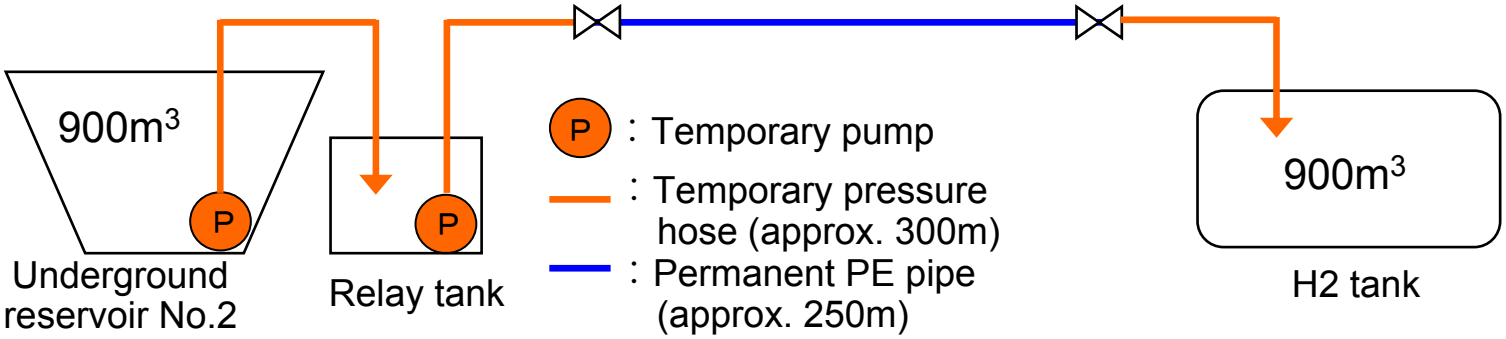
Tokyo Electric Power Company

TEPCO 東京電力

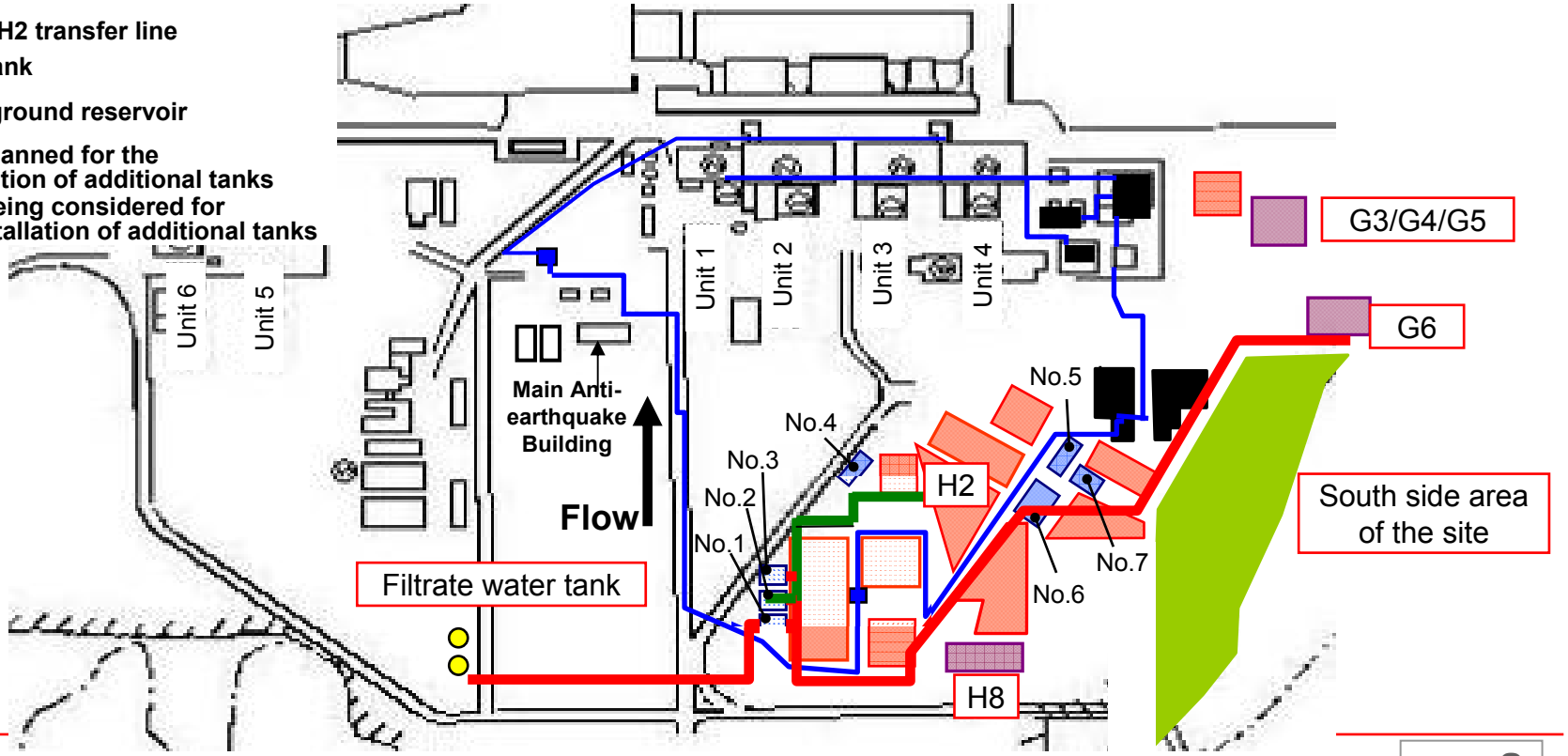
Current Water Storage Amount of Each Underground Reservoir



Method of Water Transfer from the Underground Reservoir No.2 to the H2 Area Tank

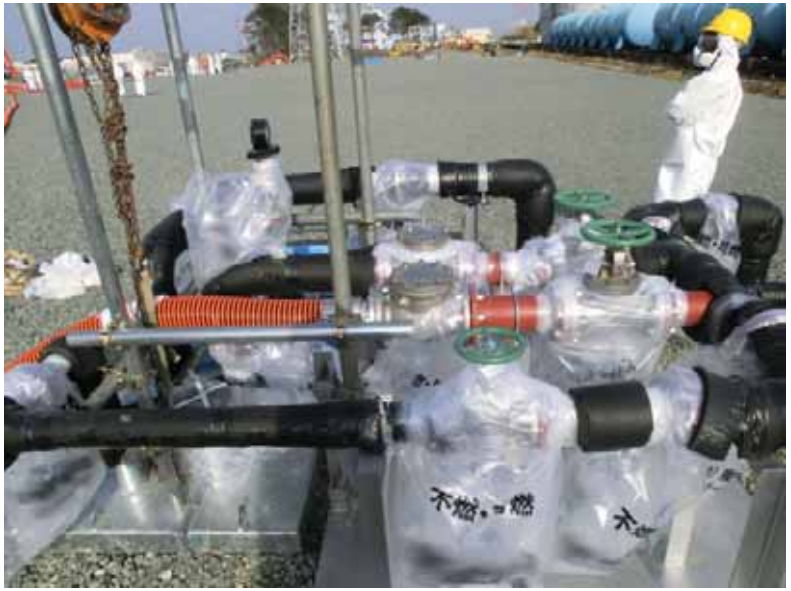


: Circulatory water injection line
: Underground reservoir transfer line
: No.2→H2 transfer line
: Steel tank
: Underground reservoir
: Area planned for the installation of additional tanks
: Area being considered for the installation of additional tanks



Condition of the Construction Site

Relay tank – temporary line

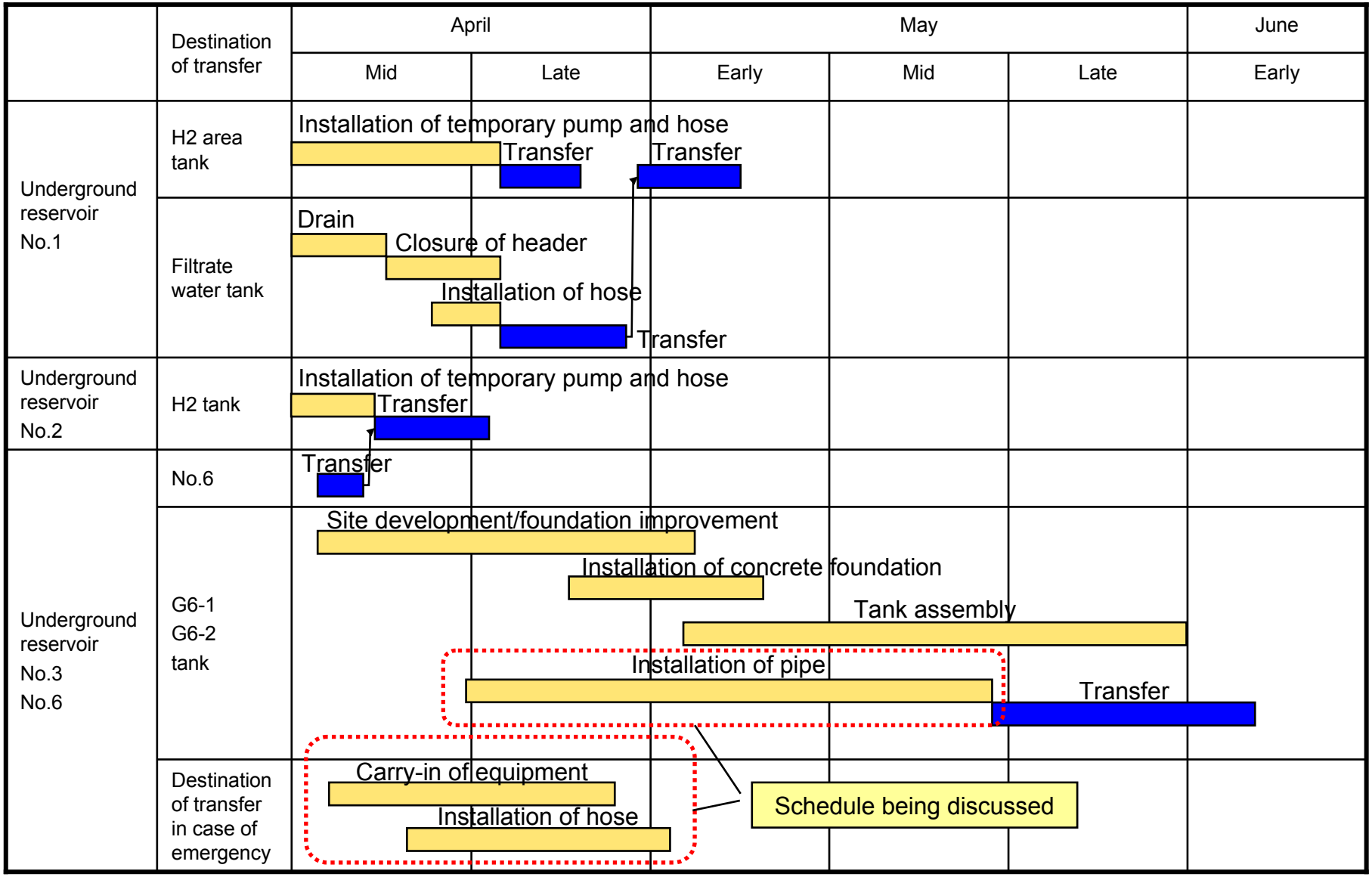


Temporary line – permanent line

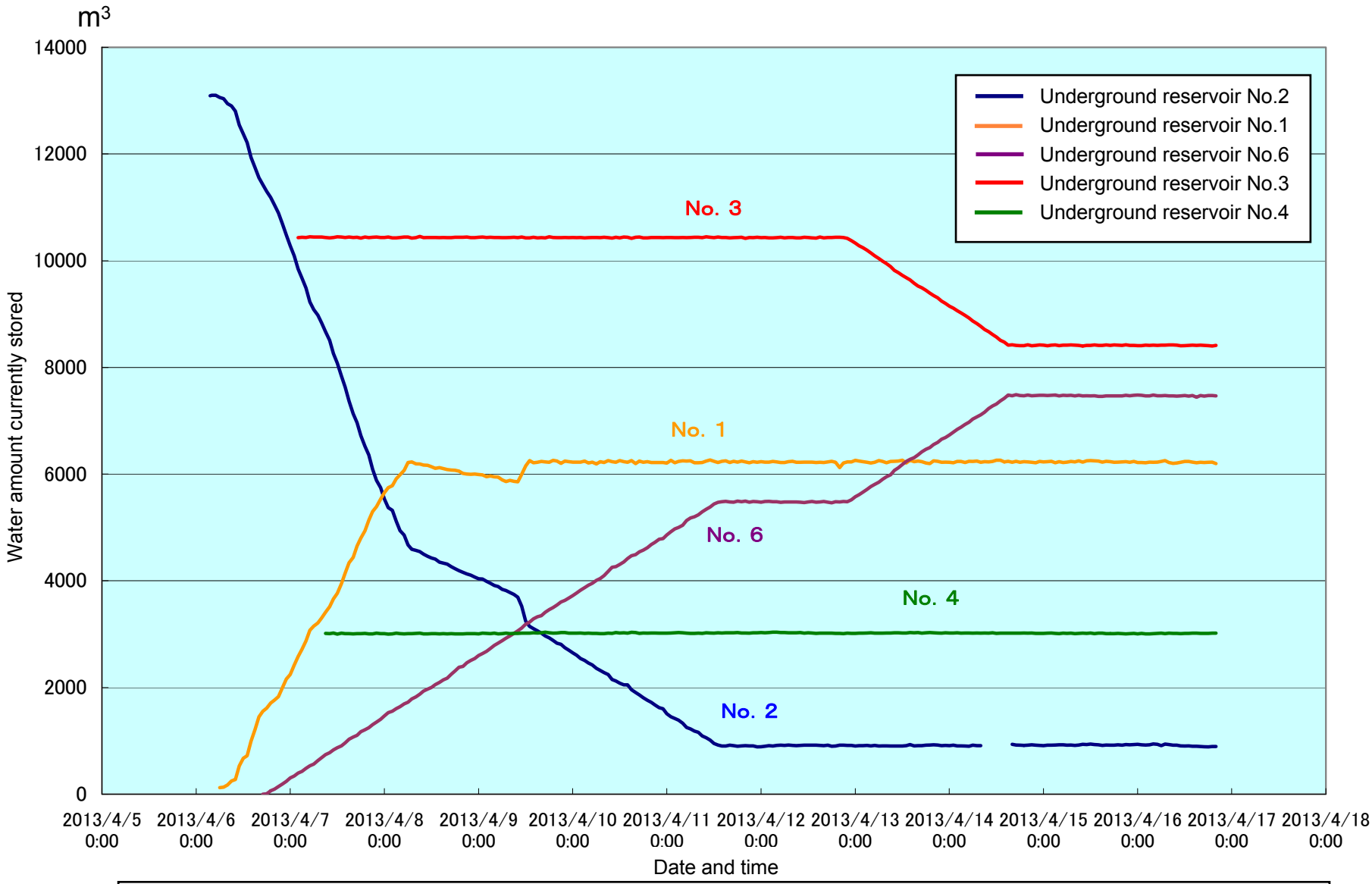
Permanent line – temporary line

Temporary line – H2 area tank

Schedule of the Water Transfer from the Underground Reservoirs



(Reference) Changes in the Storage Water Amount of Each Underground Reservoir



- The data of No. 2 water level was not obtained from 9:00 AM to 3:00 PM on April 14 due to the removal and installation of the water gauge for the installation of temporary pump used for water transfer from the underground reservoir No.2 to the H2 tank.

Reference-2

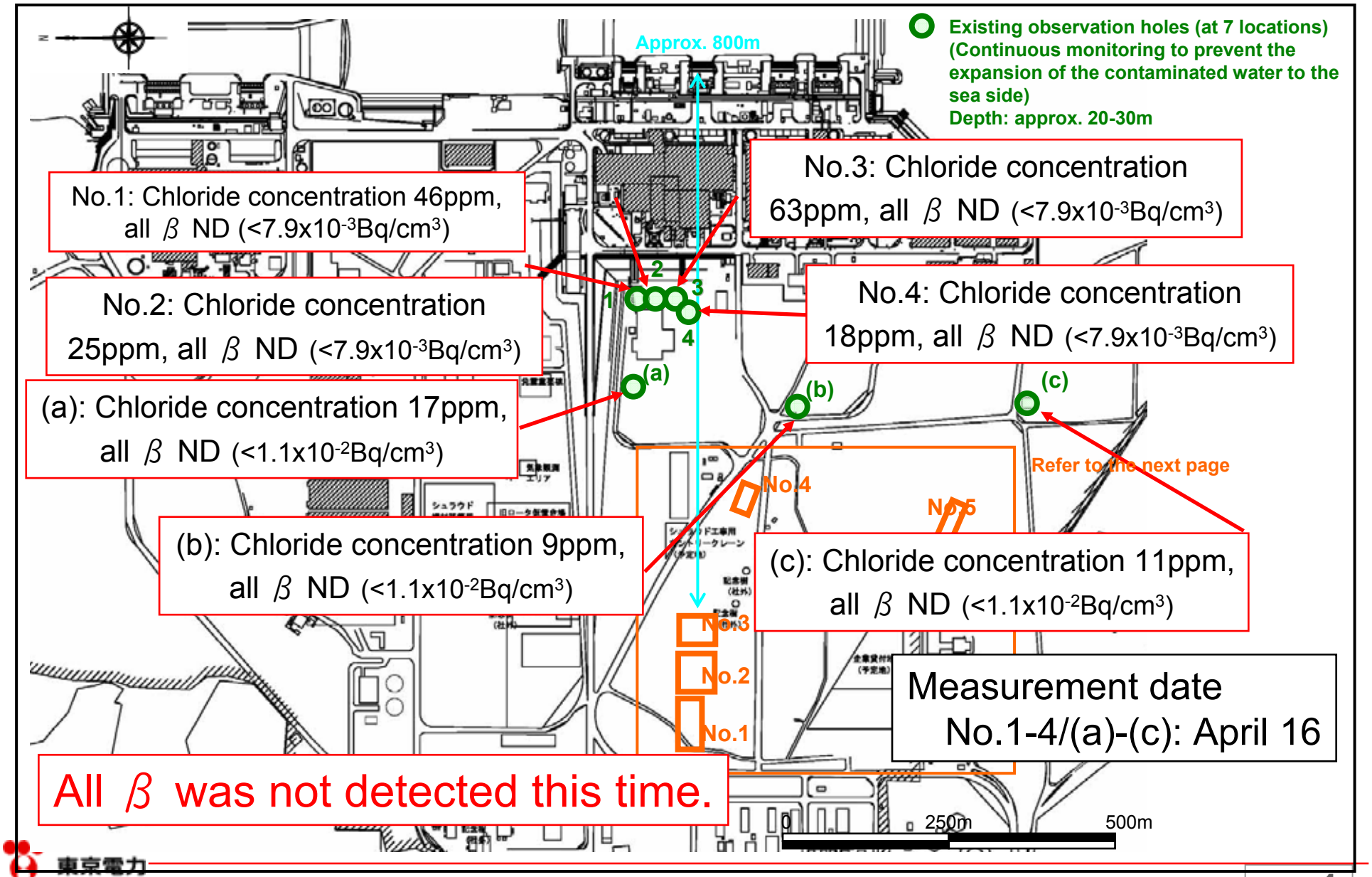
Evaluation of Impact of the Leakage on the Surrounding Environment (Progress of the Boring Investigation)

April 17, 2013

Tokyo Electric Power Company

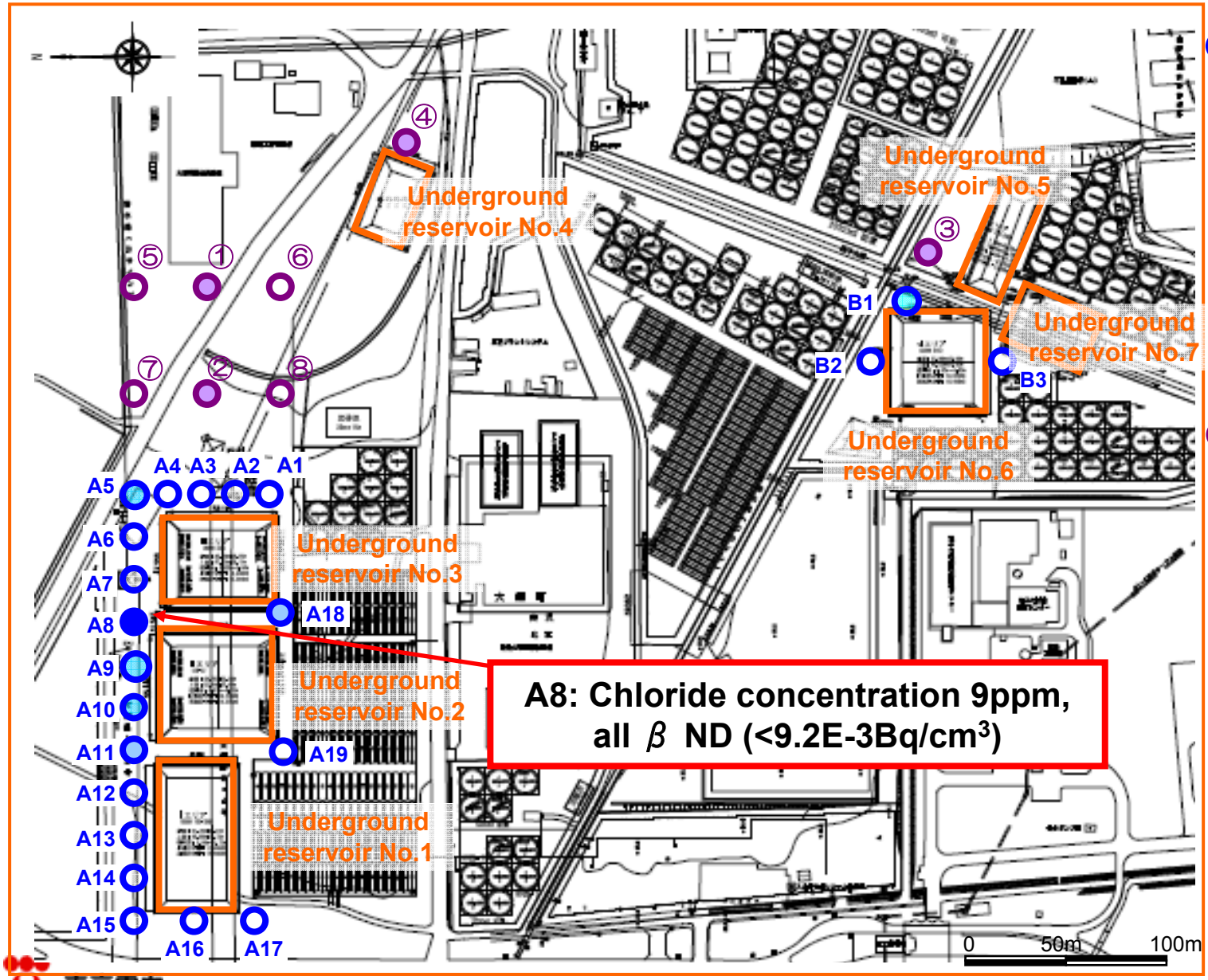
TEPCO 東京電力

1. Groundwater Monitoring Results (1): Existing Observation Holes



ND: Below the detection limit

2. Groundwater Monitoring Results (2): New Observation Holes



New observation holes (at 22 locations)
(Understanding the contamination condition in the surrounding area of the underground reservoirs)
Depth: Approx. 7-15m

- ●: Drilling and water sampling completed
- ◎: Being drilled
- ○: Being prepared

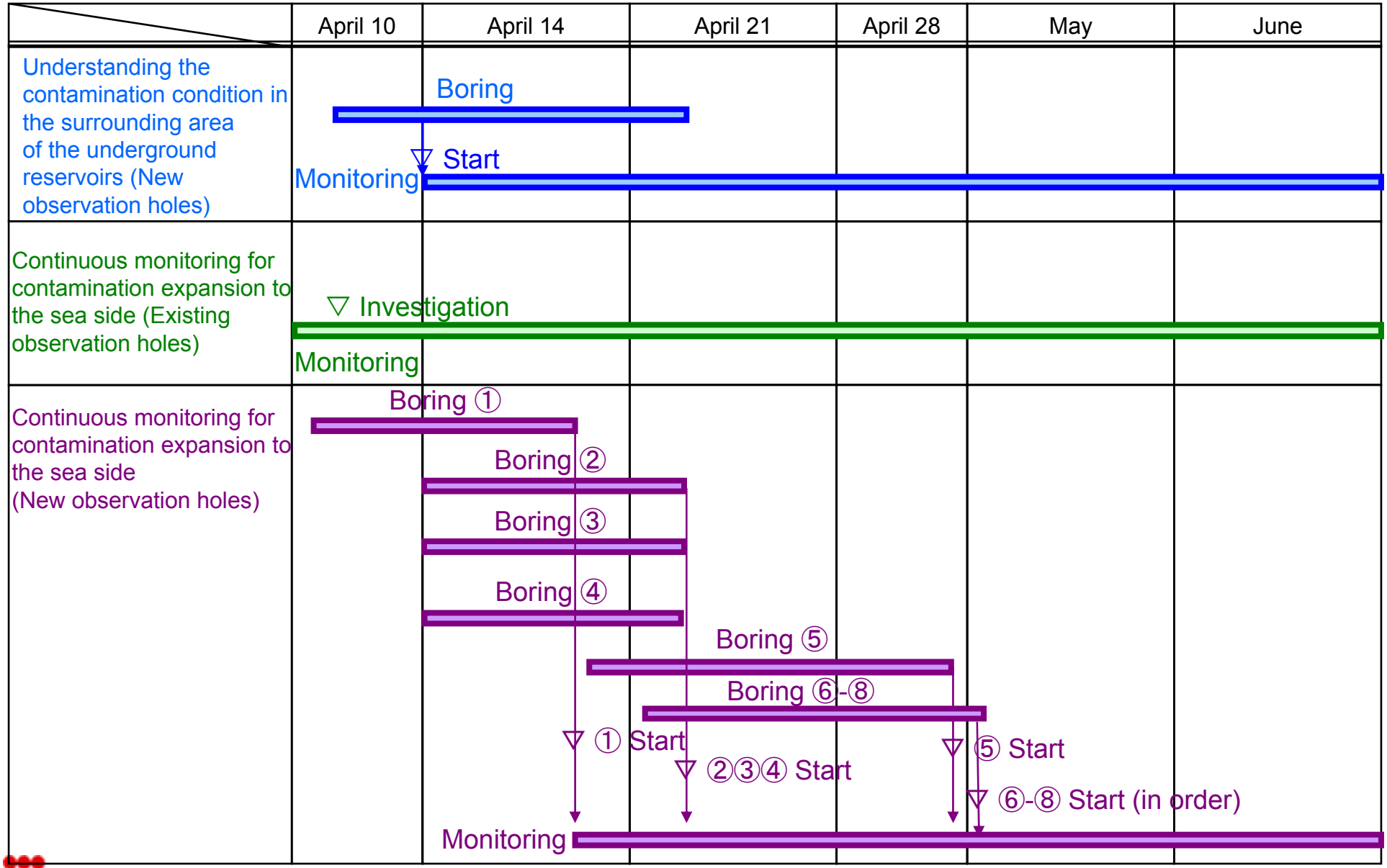
New observation holes (at 8 locations)
(Continuous monitoring for contamination expansion to the sea side)
Depth: Approx. 20-30m

- ●: Drilling and water sampling completed
- ◎: Being drilled
- ○: Being prepared

Measurement date: April 16

ND: Below the detection limit

3. Future Schedule



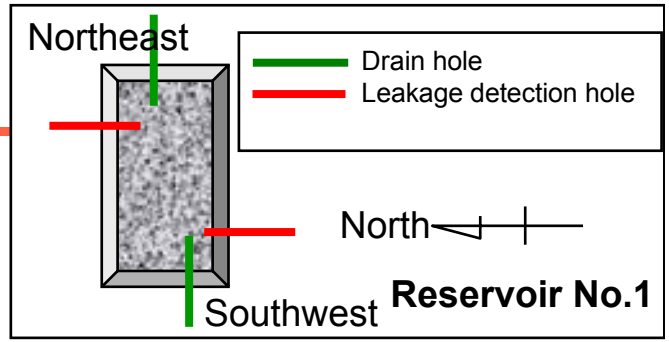
Monitoring Results of the Underground Reservoirs

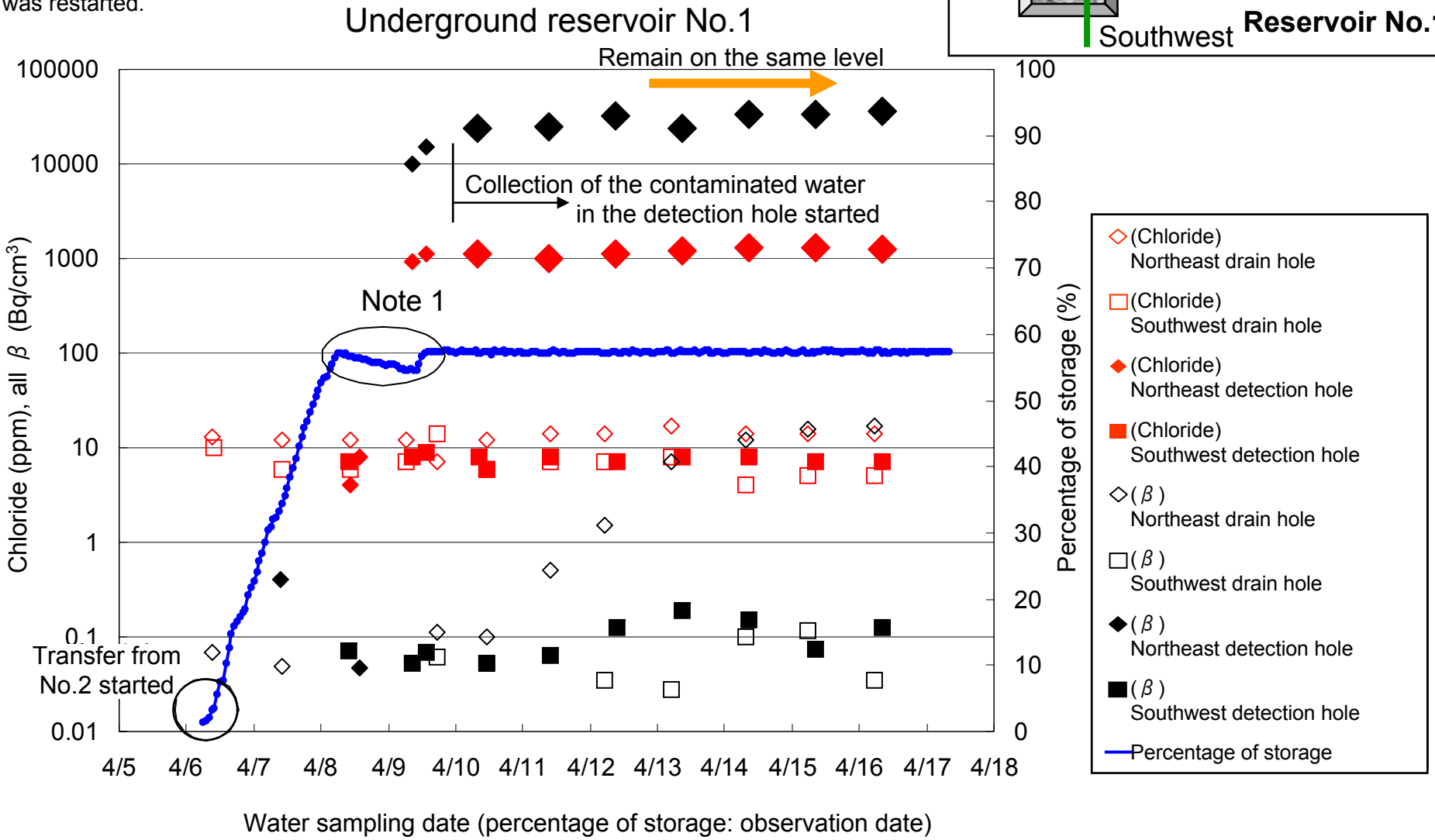
April 17, 2013

Tokyo Electric Power Company

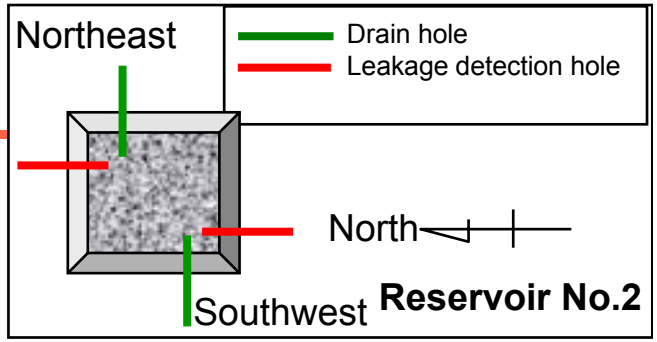
Monitoring Results of the Underground Reservoir No.1

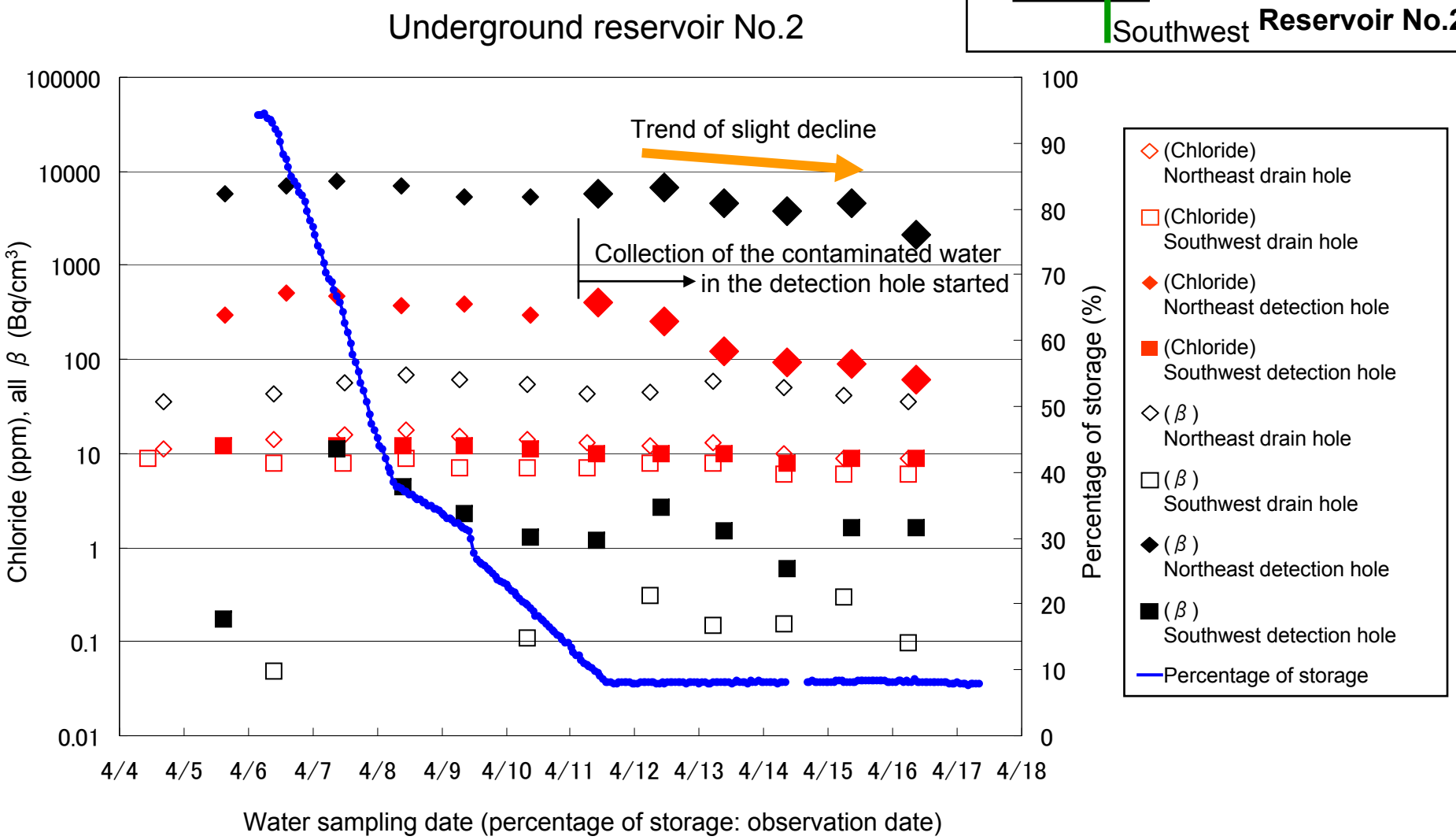
Note 1: The water level has declined since some of the water was returned to the underground reservoir No.2 due to the siphon effect after stopping the transfer pump used for water transfer from the underground reservoir No.2 to No.1. On April 9, water transfer was restarted.



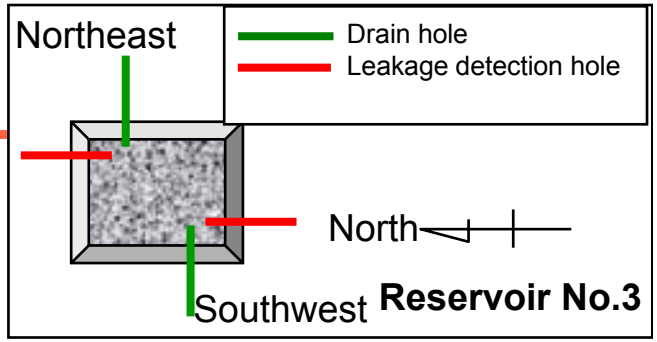


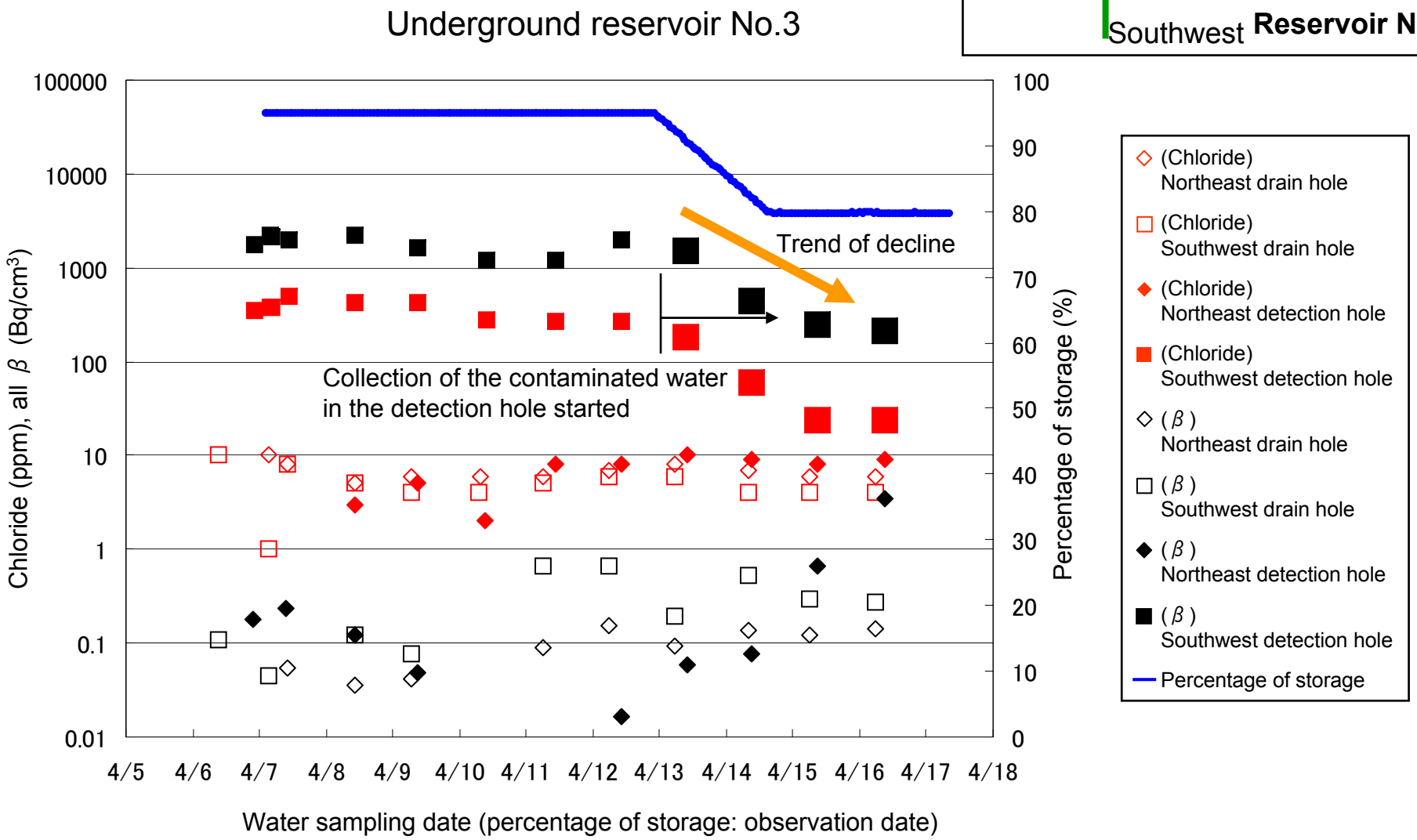
Monitoring Results of the Underground Reservoir No.2



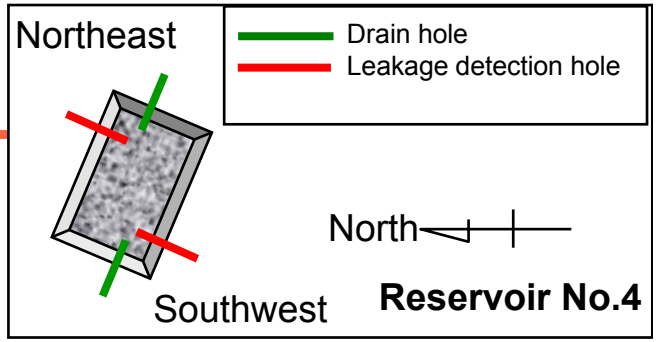


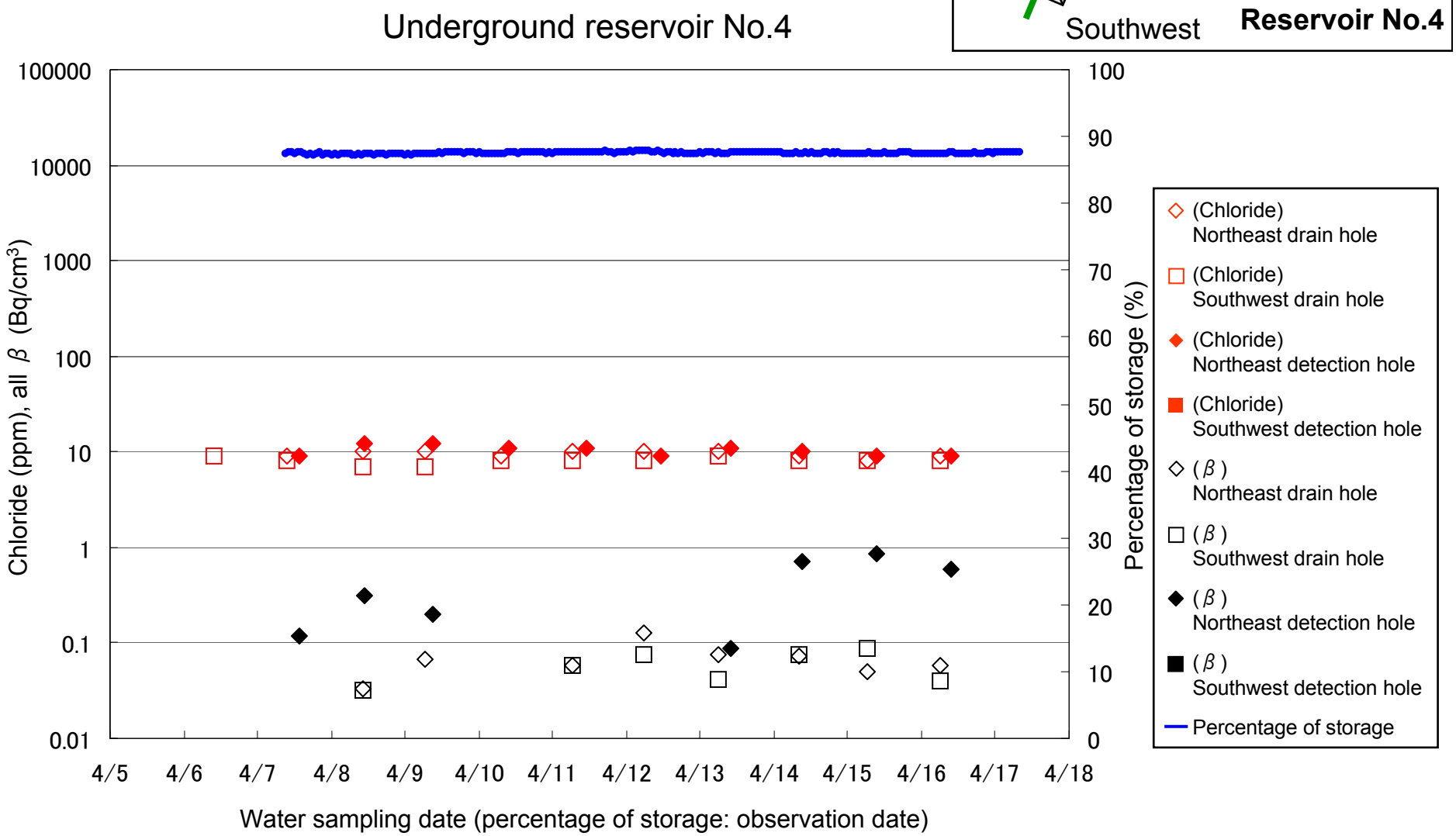
Monitoring Results of the Underground Reservoir No.3



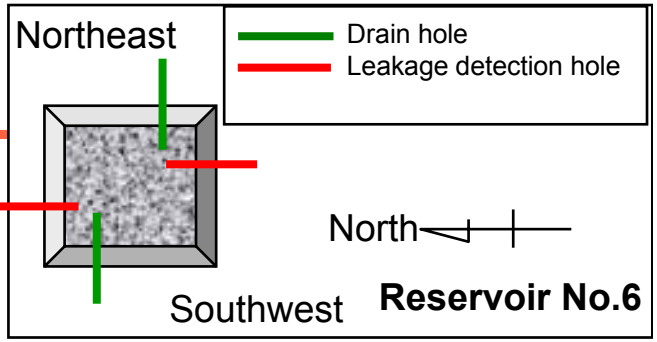


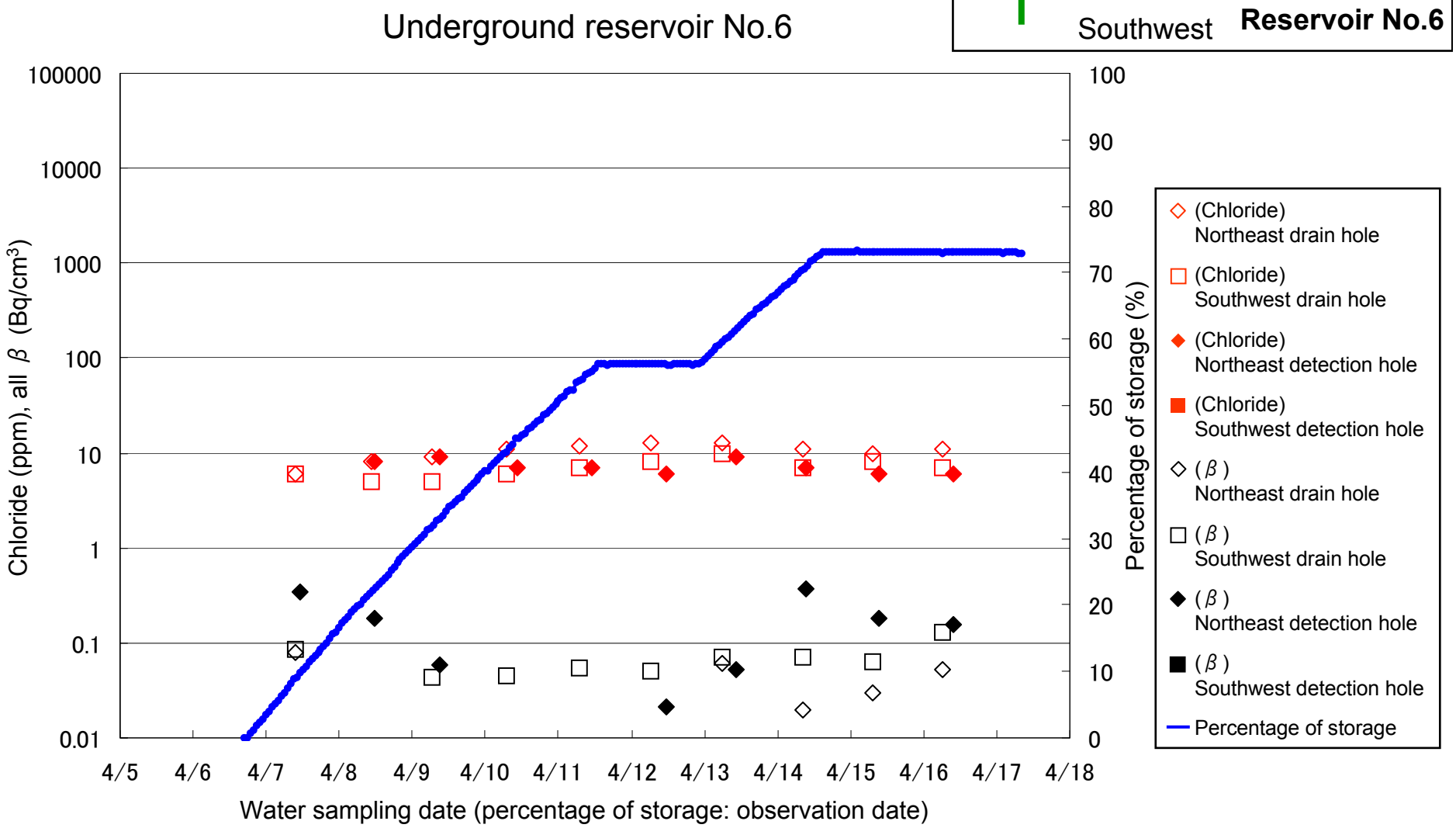
Monitoring Results of the Underground Reservoir No.4





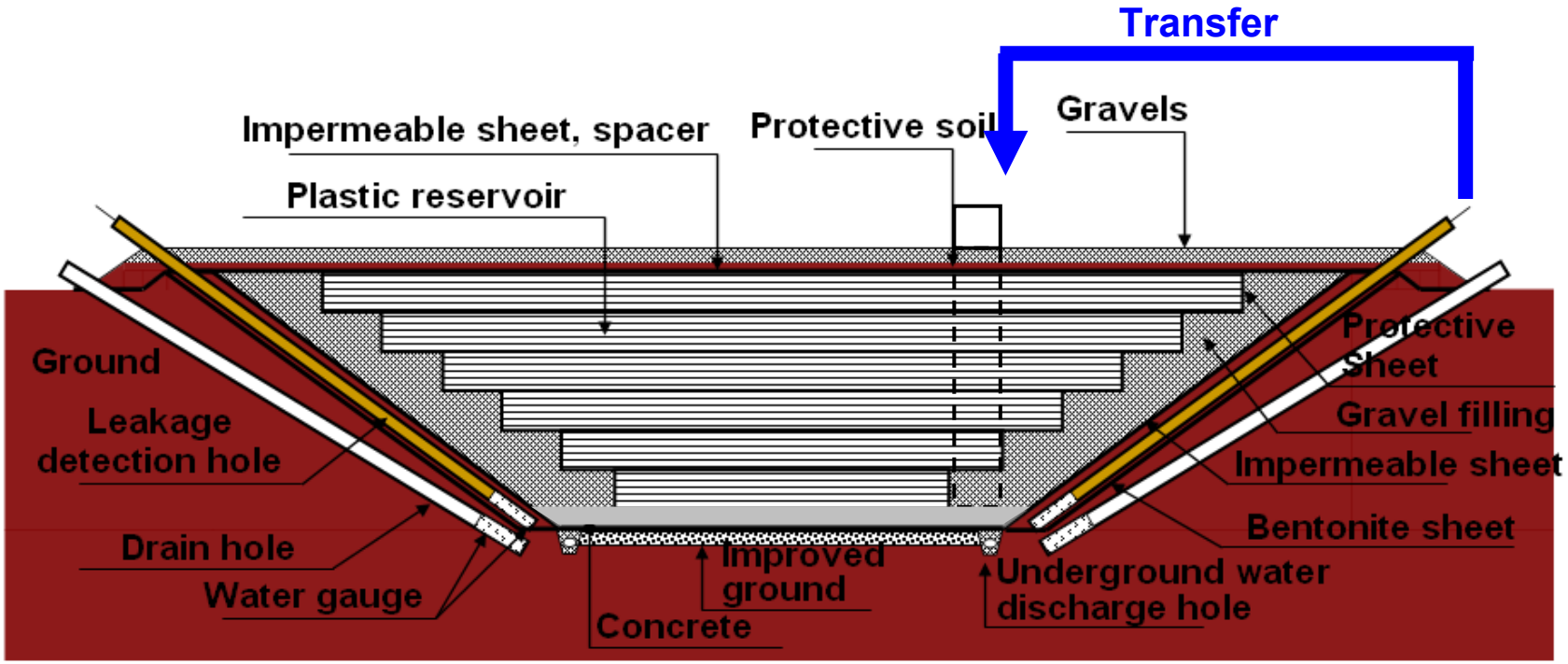
Monitoring Results of the Underground Reservoir No.6



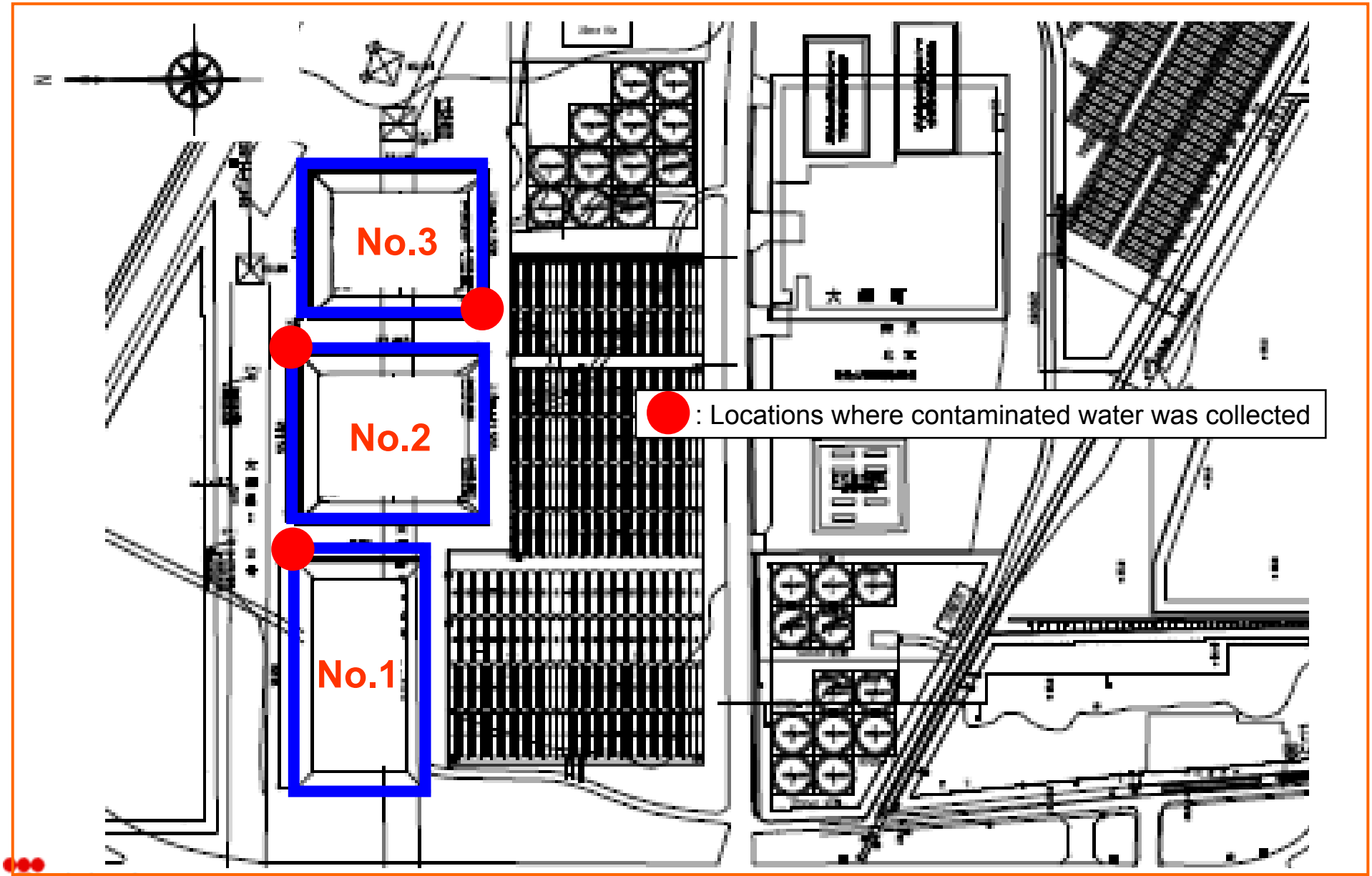


Measures to Prevent the Expansion of Contaminated Water Leakage from the Underground Reservoirs

- Collection of the contaminated water in the leakage detection holes
  - Underground reservoir No.1: Started on April 10 and conducted 14 times during the period until April 16
  - Underground reservoir No.2: Started on April 11 and conducted 9 times during the period until April 16
  - Underground reservoir No.3: Started on April 13 and conducted 10 times during the period until April 16



Locations Where Contaminated Water was Collected



Reference-3

Progress of Measures Implemented by the Electrical Equipment Countermeasure Team of the “Emergency Response Headquarters for Reliability Improvement at Fukushima Daiichi Nuclear Power Station”

April 17, 2013

Tokyo Electric Power Company

東京電力
TEPCO

Organization of the “Emergency Response Headquarters for Reliability Improvement at Fukushima Daiichi Nuclear Power Station”

Emergency Response Headquarters for Reliability Improvement at Fukushima Daiichi Nuclear Power Station

Chief: President Naomi Hirose
Deputy chiefs: Executive Vice President Hiroshi Yamaguchi, Executive Vice President Zengo Aizawa, Executive Vice President Yoshiyuki Ishizaki
Members: Relevant management executives, general managers and chiefs of nuclear power stations
(Secretariat: Management Restructuring Division, Corporate Planning Department, Nuclear Power & Plant Siting Division)

- Contaminated Water Countermeasure Team
- Mechanical Equipment Countermeasure Team
- **Electrical Equipment Countermeasure Team**
  - Executive Vice President Hiroshi Yamaguchi
  - Fukushima Daiichi Nuclear Power Station
  - Nuclear Power & Plant Siting Division
  - Transmission Dept.
  - Distribution Dept.
  - Sales Dept.
  - Electronic Telecommunications Dept.
- Construction Equipment Countermeasure Team
- Safety Measure Team
- Information/Communication Team (Provisional)

1. Purpose

In response to the troubles continuing to occur at Units 1-4 of Fukushima Daiichi Nuclear Power Station, a countermeasure team comprised of engineering departments specialized in the power facilities of critical facilities/equipment has been established to perform intensive inspections and implement reliability improvement measures for the power facilities.

[Reference] Recent major troubles related to power facilities
- Failure of Units 1-4 power facility system (March 18, 2013)
- Suspension of Unit 3 spent fuel pool alternative cooling system (April 5, 2013)

The causes of the troubles and the countermeasures are being reported to the “Committee for monitoring and evaluating the specified nuclear facilities ” (provisional translation) of the Nuclear Regulation Authority.
- The multiplication of the high voltage power supply circuits is almost complete. As for the low voltage power supply circuits and the load systems, a procedure manual to follow in the case of trouble has been prepared.

2. Target Facilities/Equipment

Points considered when selecting the critical facilities/equipment

1. Risk of additional release of radioactive materials to the outside
2. Risk of loss of the fuel cooling system functions
3. Risk of causing anxiety for the local people and broader society (other than 1 and 2 above) (Fire, power failure of critical facilities/equipment, etc.)

Based on the three points above, the following facilities/equipment have been designated as “critical facilities/equipment” by the Electrical Countermeasure Team.

Target critical facilities/equipment (7)

Countermeasures will be considered and implemented in steps 1 and 2.

[Step 1]
- Spent fuel pool alternative cooling system
- Common pool cooling system
- Reactor water injection system

[Step 2]
- PCV gas control system
- Nitrogen injection system
- Power supply facilities within the power station
- Emergency power supply facilities in the Main Anti-earthquake Building

3. Implementation Policies

Points to be considered upon measure implementation

1. Is there a “weakness in terms of facility formation”?
2. Is there a “weakness in terms of facility installation environment”?
3. Is there a “weakness in terms of facility maintenance/management”?

Implementation policies

1. Facility formation

The power supply circuits of the critical facilities/equipment will be multiplied and diversified.

2. Facility installation environment

The facility installation environment at the site will be improved with measures against small animals, fire, etc. thoroughly implemented.

3. Facility maintenance/management

Measures to improve the reliability of remote monitoring system, etc. will be implemented from the perspective of facility maintenance/management.

4. Problems with the Current Power Facilities and Countermeasures

Problems with the current power facilities of the critical facilities/equipment
[Current status]
The multiplication of the high voltage power supply circuits is almost complete. As for the low voltage power supply circuits and the load systems, a procedure manual to follow in the case of trouble has been prepared.
[Problems]
Improvements such as power supply separation and optimization of the setting value of the protective relay need to be implemented from the perspective of electrical engineering. The current power facilities have risks such as facility suspension, entry of small animals and electric fire.

Preliminary site investigation and inspection have been performed by the Electrical Equipment Countermeasure Team (April 12, 2013).

5. Results of Site Investigation and Inspection (April 12, 2013)

[Points considered]

1. Is there a "weakness in terms of facility formation"?
2. Is there a "weakness in terms of facility installation environment"?
3. Is there a "weakness in terms of facility maintenance/management"?

[Weaknesses found at the site investigation and inspection]

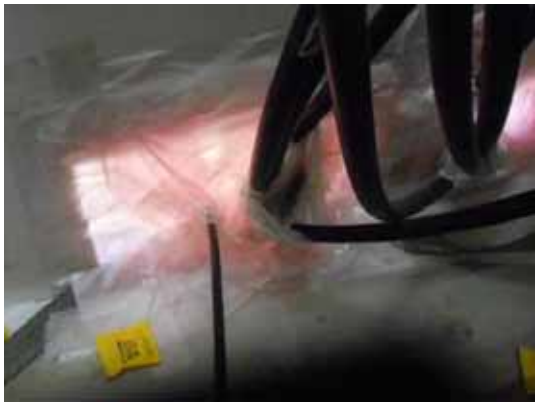
✓: Weakness found

Weakness found		Unit 2 spent fuel pool alternative cooling system					Unit 3 spent fuel pool alternative cooling system				
Category	Item	Point ①	Point ②	Point ③	Point ④	Point ⑤	Point ①	Point ②	Point ③	Point ④	Point ⑤
Environment	(1) Measures to prevent the entry of small animals	✓					✓				
Maintenance	(2) Cable protection measure	✓	✓				✓	✓			
Maintenance	(3) Electric shock prevention measure	✓	✓	✓			✓	✓			
Facility	(4) Securing electric circuit		✓							✓	
Facility	(5) Cable guiding		✓							✓	
Facility	(6) Pipe/cable route separation		✓							✓	
Environment	(7) Handling redundant cable								✓		
Maintenance	(8) Fixture of distribution board				✓					✓	
Maintenance	(9) Connection with the ground net					✓					✓

Investigation/inspection points: ① Inside of the electric goods container, ② Inside of the primary system facility container, ③ Inside of the secondary system facility container, ④ Next to the electric goods container, ⑤ Ground

6. Improvements Made After the Site Investigation/Inspection (Examples)

Improvement made for Area A



Improvement made for Area B

Site investigation and inspection will be performed as necessary to find weaknesses and implement necessary measures.

7. Schedule

Schedule for implementing measures for power facilities of the critical facilities/equipment

Recurrence prevention measures	Apr. 2013	May 2013	Jun. 2013	Jul. 2013	Aug. 2013	Sep. 2013
Facility countermeasures						
Confirmation of facility documents						
Site investigation and inspection						
Find weaknesses, consider and implement countermeasures				Measure implementation		

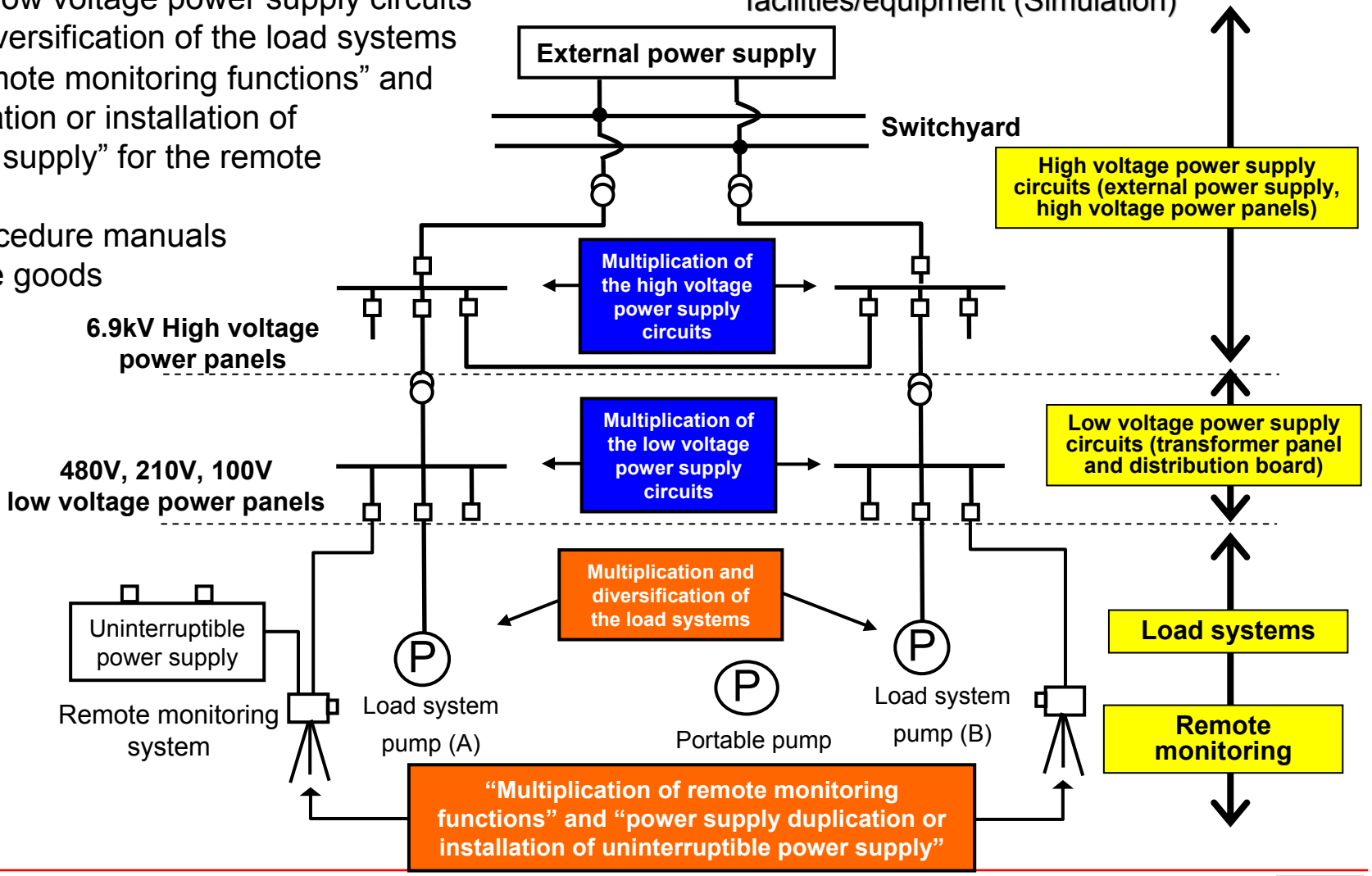
Reference (1)
“Facility Countermeasures”

[Simulation] Power Facility Structure of the Critical Facilities/Equipment

Measures implemented for the power facilities of the critical facilities/equipment

- Multiplication of the high voltage power supply circuits
- Multiplication of the low voltage power supply circuits
- Multiplication and diversification of the load systems
- “Multiplication of remote monitoring functions” and “power supply duplication or installation of uninterruptible power supply” for the remote monitoring system
- Development of procedure manuals
- Preparation of spare goods

Power supply structure of the critical facilities/equipment (Simulation)



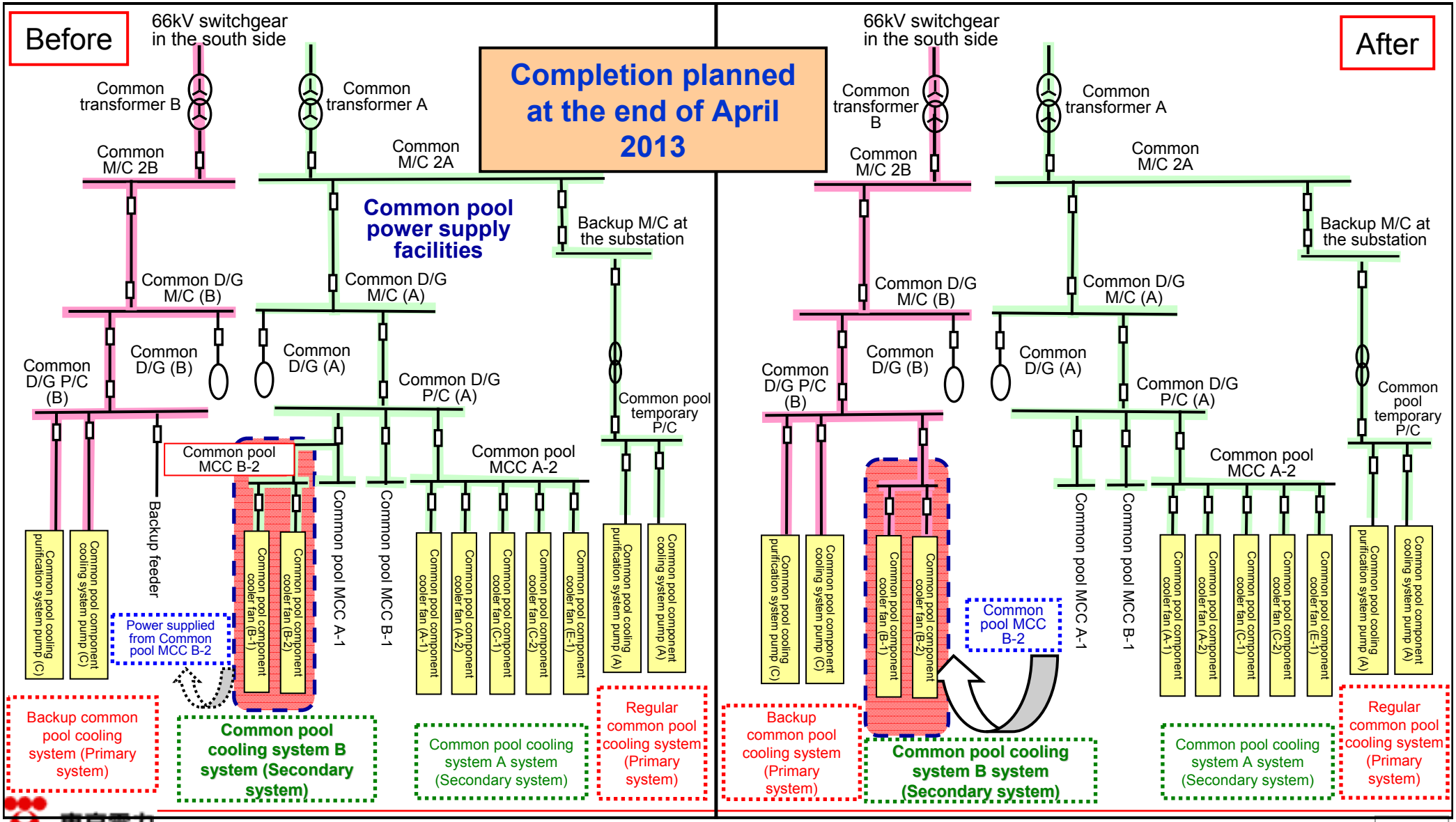
Current Statuses of Power Facilities of the Critical Facilities/Equipment

Facility/equipment	Multiplication of the high voltage power supply circuits	Multiplication of the low voltage power supply circuits	Multiplication and diversification of the load systems	"Multiplication of remote monitoring functions" and "power supply duplication or installation of uninterruptible power supply	Development of procedure manuals	Preparation of spare goods
Spent fuel pool alternative cooling system	Completed	Partly completed*1	Partly completed*2	Partly completed*3	Completed	Completed*4
Common pool cooling system	Partly completed*5	Partly completed*5	Completed	Partly completed*3	Completed	Partly completed*6
Reactor water injection system	Completed	Completed	Completed	Completed	Completed	Completed
PCV gas control system	Completed	Completed	Completed	Completed	Completed	Completed
Nitrogen injection system	Completed	Completed	Completed	Partly completed*3	Completed	Completed
Power supply facilities within the site	Completed	Partly completed*7	N/A	Completed	Completed	Completed
Emergency power supply facilities in the Main Anti-earthquake Building	Completed	Completed	N/A	N/A	Completed	Partly completed*6

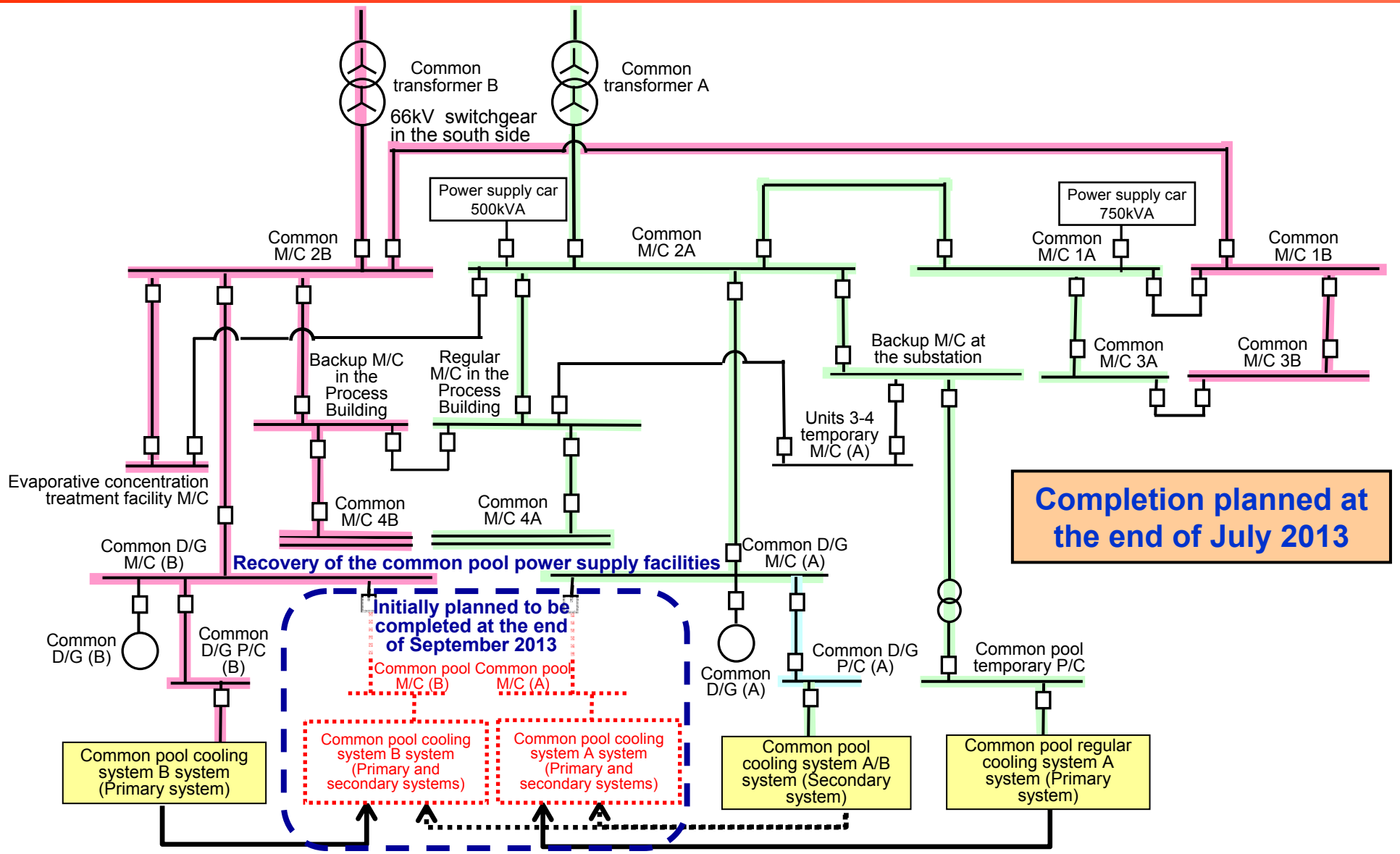
*1 The switchboard installation for Unit 4 primary system is planned to be completed at the end of May 2013 (Power board installation is under consideration).
*2 Excluding the control circuit. *3 Completion planned at the end of May 2013.
*4 Part of long lead goods (motor, etc.) are currently being ordered.
*5 The cooling primary system has been duplicated. The duplication of the secondary system (temporary installation) is planned to be completed at the end of April 2013. The permanent facility installation is planned to be completed at the end of July 2013.
*6 Spare goods are under consideration. *7 The distribution board is under consideration.

The multiplication of the high voltage power supply circuits is almost complete. As for the low voltage power supply circuits and the load systems, a procedure manual to follow in the case of trouble has been prepared.

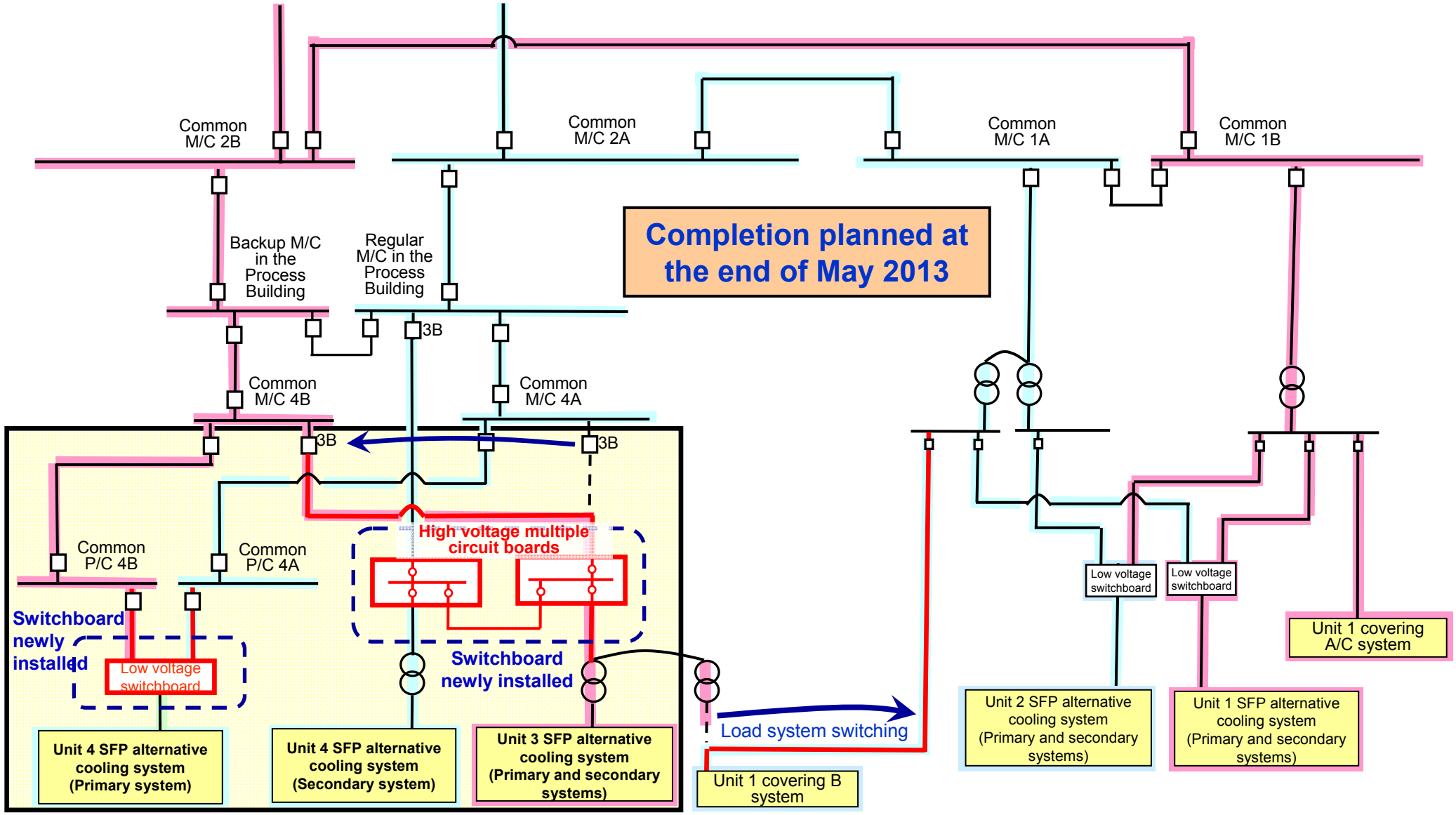
Power Supply Duplication for the Common Pool Cooling System (Temporary Installation)



Power Supply Duplication for the Common Pool Cooling System (Permanent Installation)



Power Supply Duplication for Units 3-4 Spent Fuel Pool Alternative Cooling Systems (Switchboards Newly Installed, Power Supply for A/B Systems Separated)



Countermeasures Against Small Animals

Permanent M/C has been installed inside the building after being sealed to prevent easy access to the current-carrying area.

Cable penetration area has been closed and mousetraps have been installed.

Planned completion
High voltage power panels: End of April 2013
Low voltage power panels: End of May 2013
Distribution boards of the load systems: End of August 2013

After investigating the openings of the permanent M/C, additional countermeasures for small animals will be discussed.

Statuses of Remote Monitoring Systems for the Critical Facilities/Equipment and the Reliability Improvement Measures

Facility/equipment (Monitoring parameters)	Current status		Necessity of reliability improvement measures*
	Multiplicity and diversity of remote monitoring functions	Countermeasures for power supply facility failure	
Spent fuel pool alternative cooling system (SFP primary system flow rate)	Yes (Except for Unit 1)	No	Necessary
Spent fuel pool alternative cooling system (SFP secondary system status display)	No	No	Necessary
Common pool cooling system (FPC/FPCW status indicator lamp)	No	No	Necessary
Reactor water injection system (Injection water flow rate)	Yes (Camera duplication)	Power supply for the duplicated camera has been separated	Already implemented
Reactor water injection system (RPV/PCV temperatures)	Yes (Digital recorder duplication)	Battery has been installed in one of the digital recorders	Already implemented
PCV gas control system	Yes (PC, camera)	Power supply for the monitoring PC has been separated.	Already implemented
Nitrogen injection system (Operation status of the nitrogen separator)	Yes (Digital recorder duplication)	No	Necessary
Nitrogen injection system (RPV/PCV N2 injection flow rate)	Yes (Camera duplication)	No	Necessary
Nitrogen injection system (Unit 1 PCV N2 pressure)	Yes (Camera duplication)	No	Necessary
Power supply facilities within the power station site (M/C voltage)	Yes (Remote monitoring system duplication)	Yes	Already implemented
Emergency power supply facilities in the Main Anti-earthquake Building	(Can be confirmed in the Main Anti-earthquake Building)	(Can be confirmed in the Main Anti-earthquake Building)	(Can be confirmed in the Main Anti-earthquake Building)

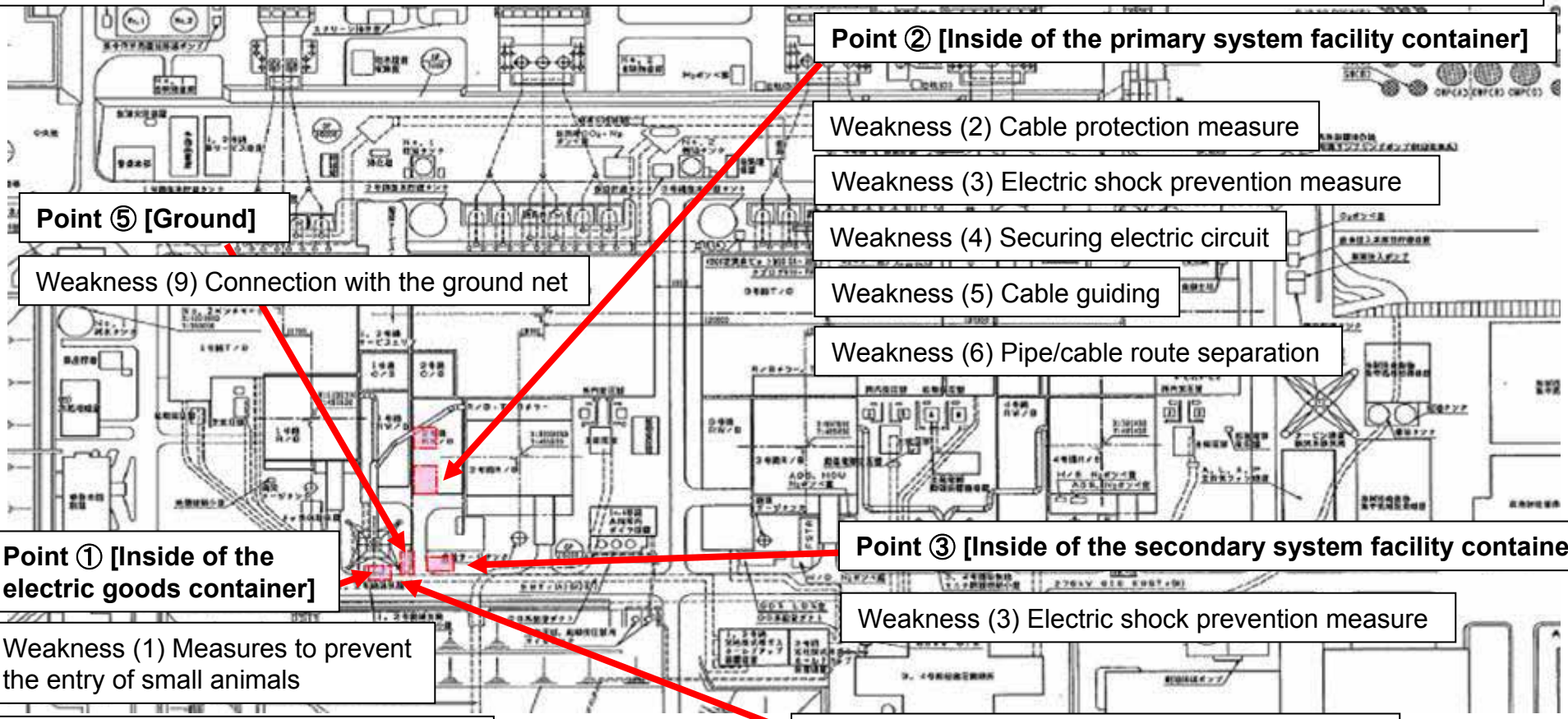
*“Multiplication of remote monitoring functions” and “power supply duplication or installation of uninterruptible power supply” are to be implemented for enhanced reliability of the remote monitoring system

Planned to be completed at the end of May 2013

Reference (2)
“Results of Site Investigation and Inspection”

[Overview] Site Conditions of Unit 2 Spent Fuel Pool Alternative Cooling System

As a result of site investigation and inspection of Unit 2 spent fuel pool alternative cooling system, the following weaknesses have been found.



Point ② [Inside of the primary system facility container]

Weakness (2) Cable protection measure

Weakness (3) Electric shock prevention measure

Weakness (4) Securing electric circuit

Weakness (5) Cable guiding

Weakness (6) Pipe/cable route separation

Point ⑤ [Ground]

Weakness (9) Connection with the ground net

Point ① [Inside of the electric goods container]

Weakness (1) Measures to prevent the entry of small animals

Weakness (2) Cable protection measure

Weakness (3) Electric shock prevention measure

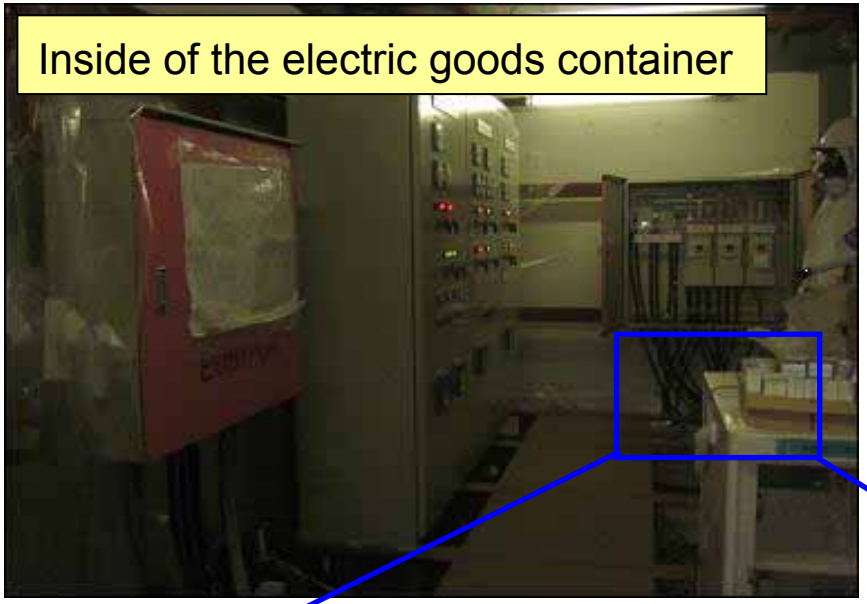
Point ③ [Inside of the secondary system facility container]

Weakness (3) Electric shock prevention measure

Point ④ [Next to the electric goods container]

Weakness (8) Fixture of distribution board

Site Conditions of Unit 2 Spent Fuel Pool Alternative Cooling System Weakness (1)



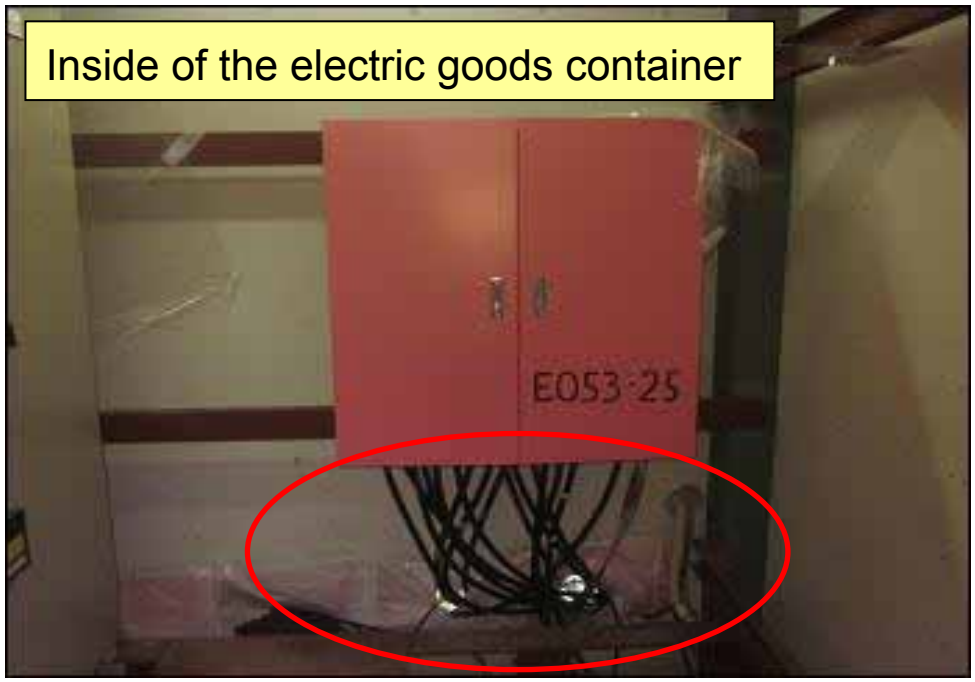
(1) Measures to prevent the entry of small animals

Sealing is insufficient with the opening in the lower part of the panel.

[Potential risk]

Short circuit/ground fault due to small animals entering the area.

Site Conditions of Unit 2 Spent Fuel Pool Alternative Cooling System Weakness (2)



(2) Cable protection measure

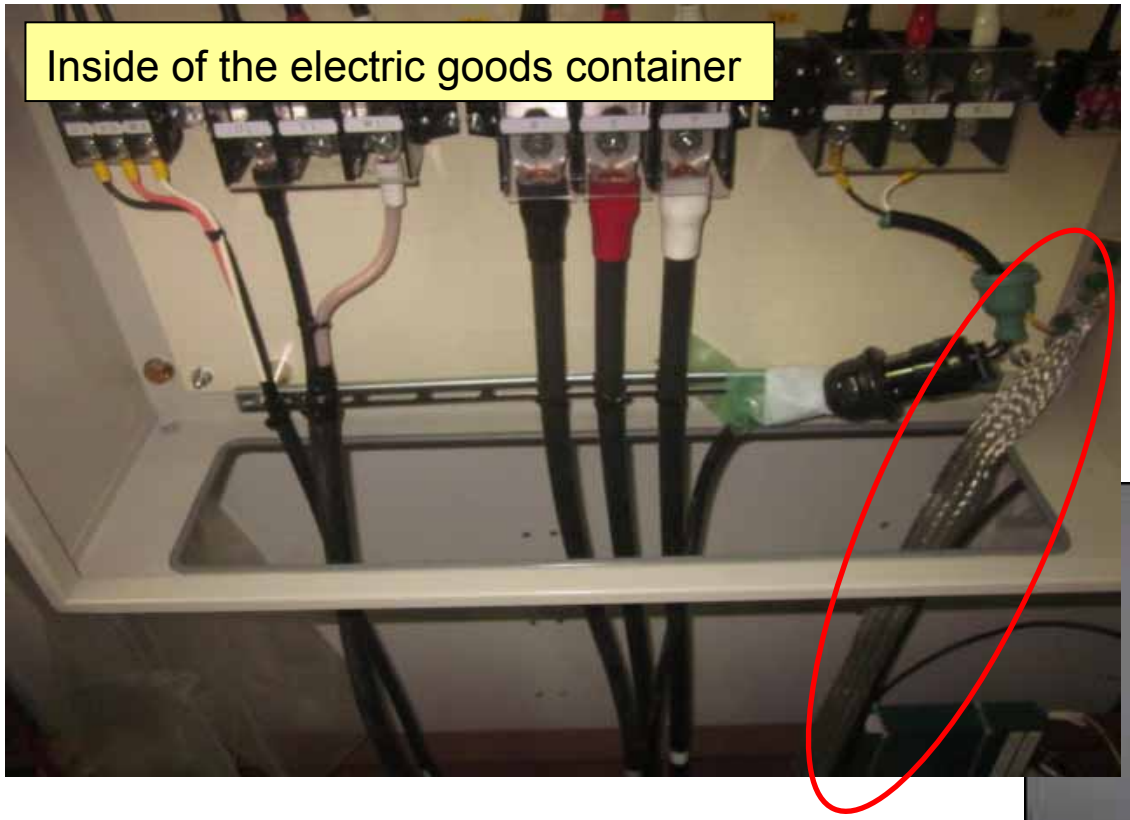
Protection against external force such as protection tube is not installed on the cable.

[Potential risk]

- The cable may get damaged due to external force.

- As for the cable installed outside, there is a possibility of deterioration due to ultraviolet rays.

Site Conditions of Unit 2 Spent Fuel Pool Alternative Cooling System Weakness (3)

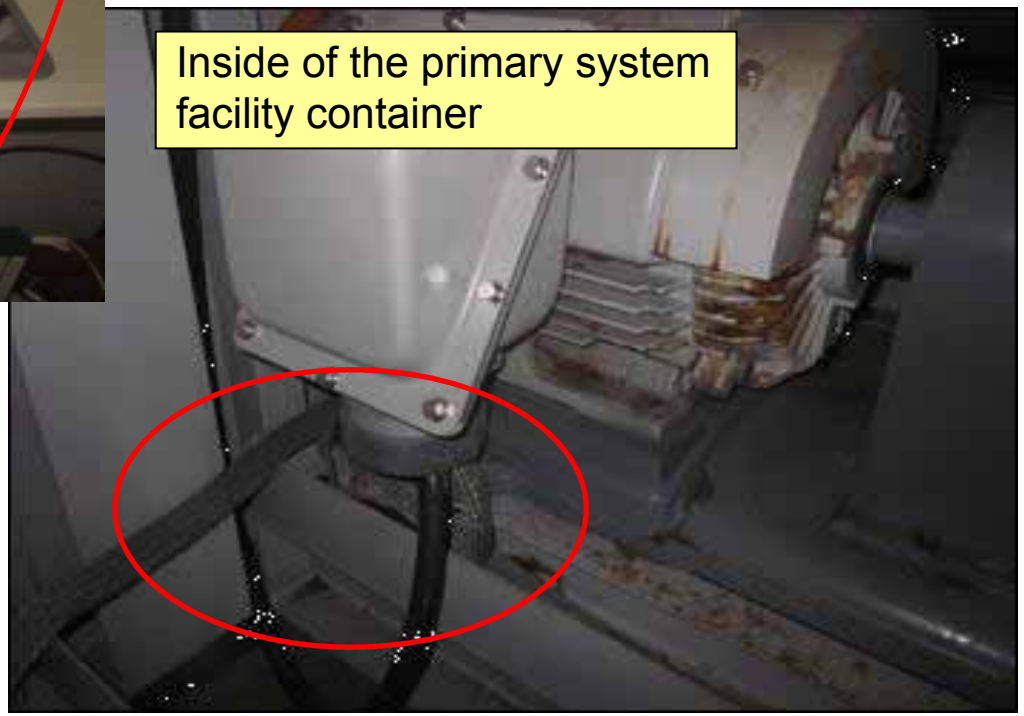


(3) Electric shock prevention measure

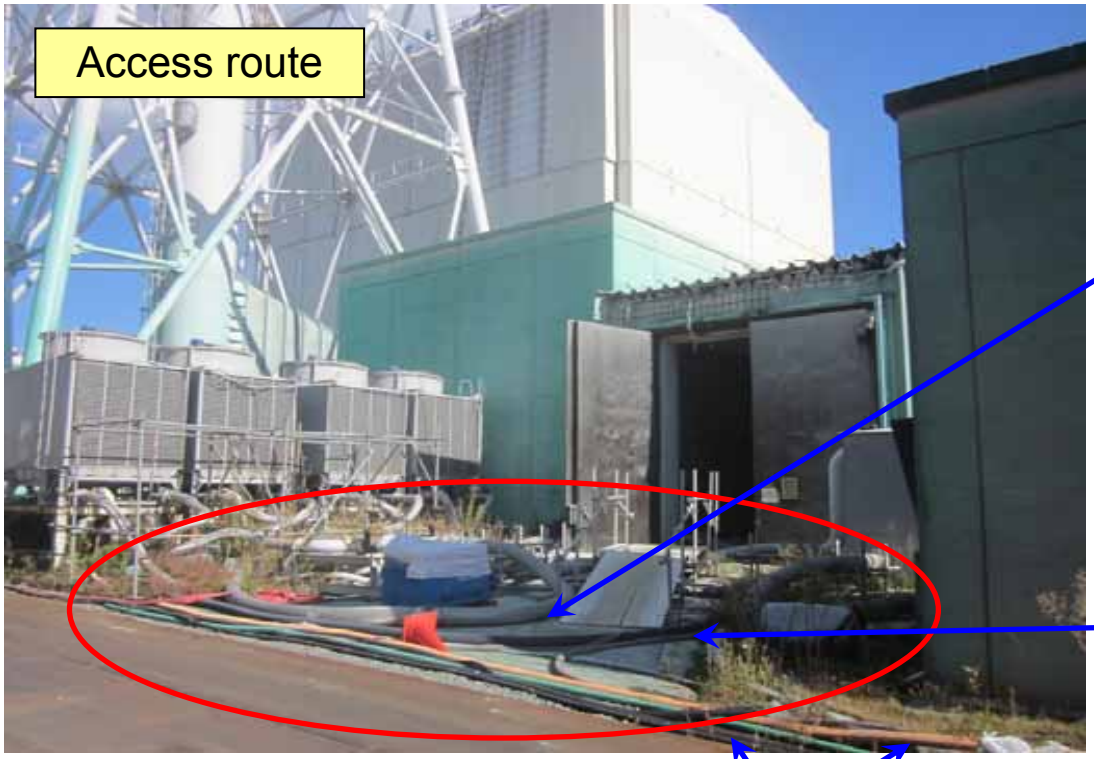
Though people do not enter the container often, exposed ground line is installed.

[Potential risk]

- Possibility of electric shock when touching the cable while a ground fault is occurring.



Site Conditions of Unit 2 Spent Fuel Pool Alternative Cooling System Weakness (4)-(6)



(4) Securing electric circuit

Cable and pipes are installed in the personnel access route

[Potential risk]

- As safe access route is not secured, there is a possibility of people falling.

- The cable may get damaged by being stepped on.

(5) Cable guiding

The power and control cable routes are not segregated from each other.

[Potential risk]

The control circuit may be affected by electromagnetic induction.

(6) Pipe/cable route separation

The pipe and cable routes are not segregated from each other.

[Potential risk]

The cable may be affected by pipe damage.

Site Conditions of Unit 2 Spent Fuel Pool Alternative Cooling System Weakness (8)

(8) Fixture of distribution board

As the distribution board is not fixed, sand bags are installed around it to prevent falling.

[Potential risk]

The distribution board may fall down due to earthquake, typhoon, etc.

Site Conditions of Unit 2 Spent Fuel Pool Alternative Cooling System Weakness (9)

(9) Connection with the ground net

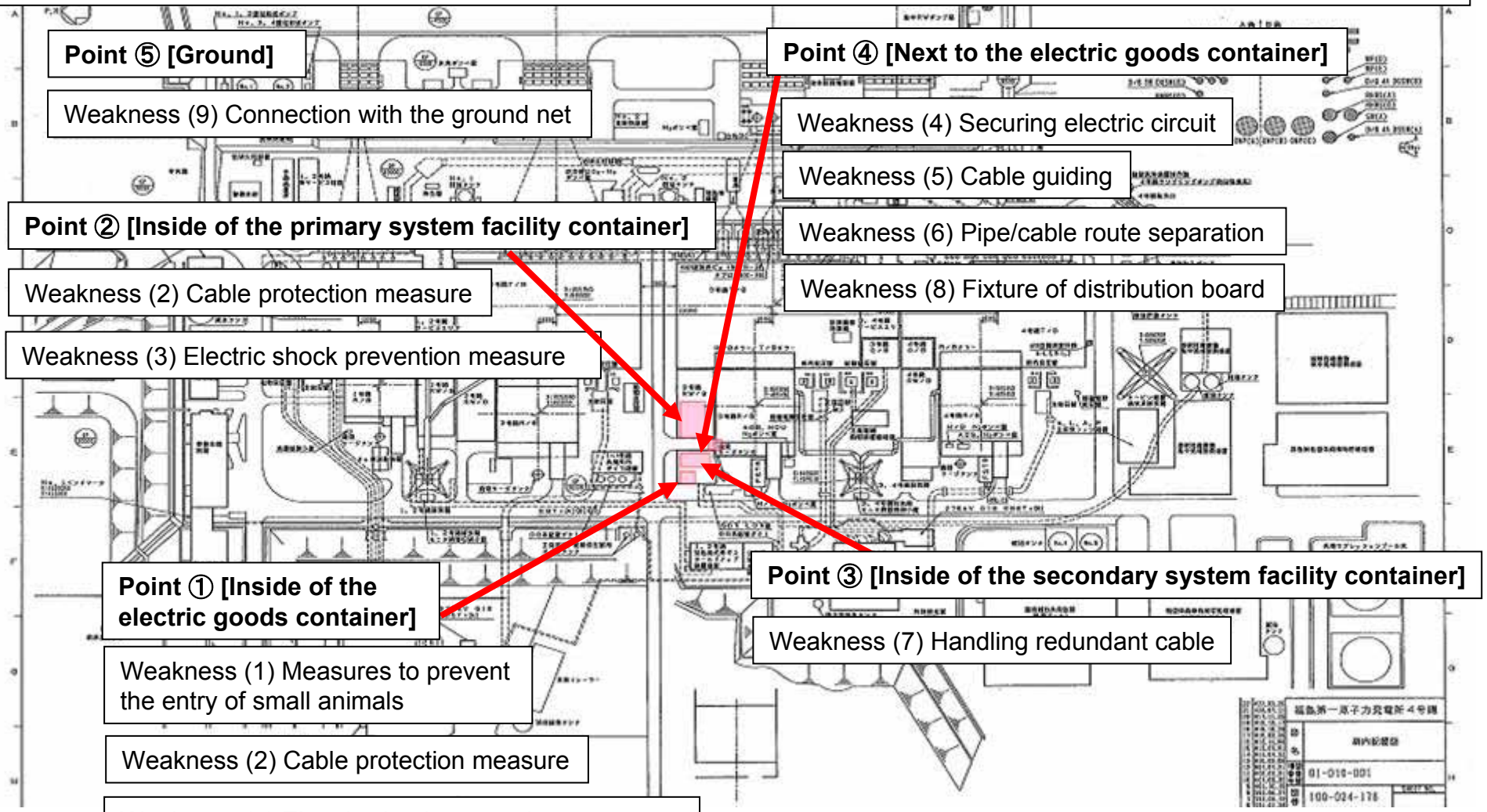
Since grounding was done by grounding electrode, there is no connection with the ground net in the power station site.

[Potential risk]

The signal line may be affected.

[Overview] Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System

As a result of site investigation and inspection of Unit 3 spent fuel pool alternative cooling system, the following weaknesses have been found.



Point ⑤ [Ground]

Weakness (9) Connection with the ground net

Point ④ [Next to the electric goods container]

Weakness (4) Securing electric circuit

Weakness (5) Cable guiding

Weakness (6) Pipe/cable route separation

Weakness (8) Fixture of distribution board

Point ② [Inside of the primary system facility container]

Weakness (2) Cable protection measure

Weakness (3) Electric shock prevention measure

Point ③ [Inside of the secondary system facility container]

Weakness (7) Handling redundant cable

Point ① [Inside of the electric goods container]

Weakness (1) Measures to prevent the entry of small animals

Weakness (2) Cable protection measure

Weakness (3) Electric shock prevention measure

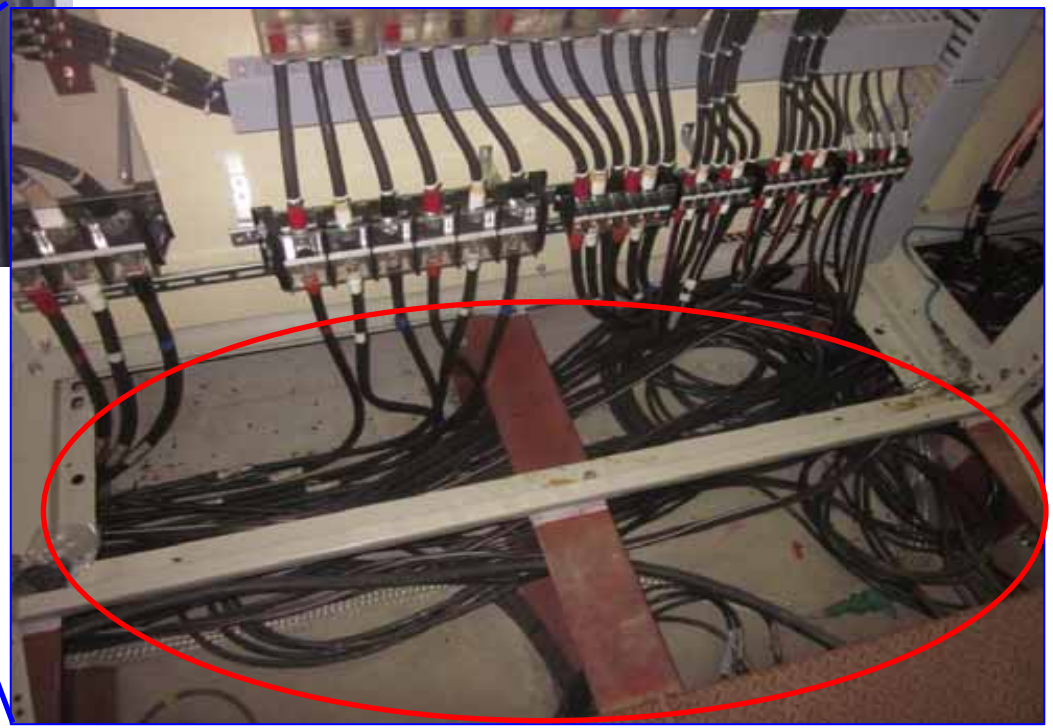
Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System Weakness (1)

(1) Measures to prevent the entry of small animals

Sealing is insufficient with the opening in the lower part of the panel.

[Potential risk]

Short circuit/ground fault due to small animals entering the area.



Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System Weakness (2)

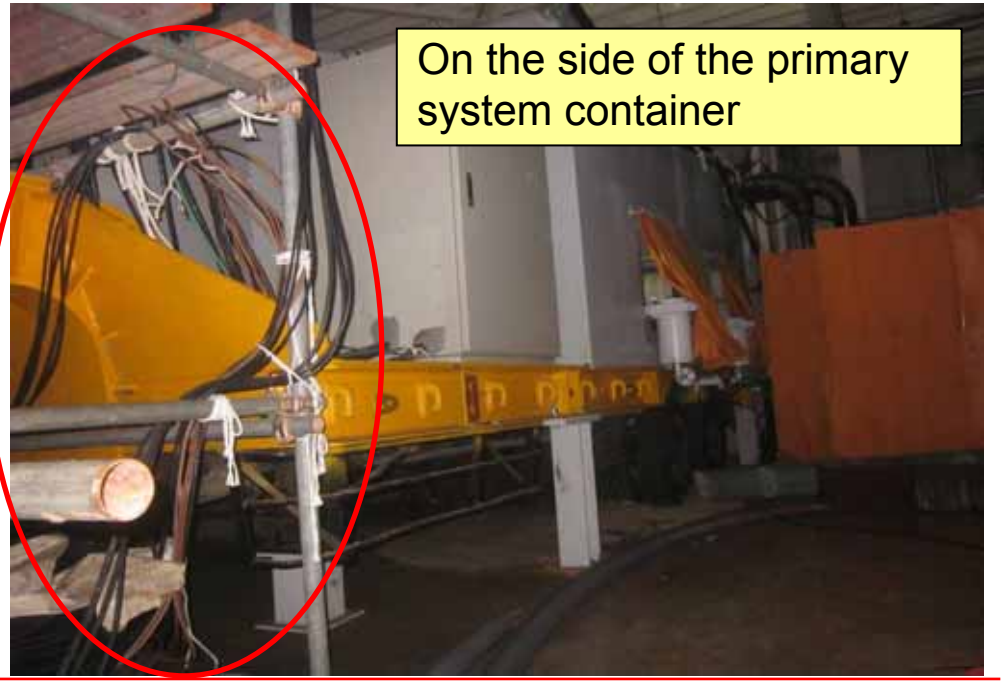
(2) Cable protection measure

Protection against external force such as protection tube is not installed on the cable.

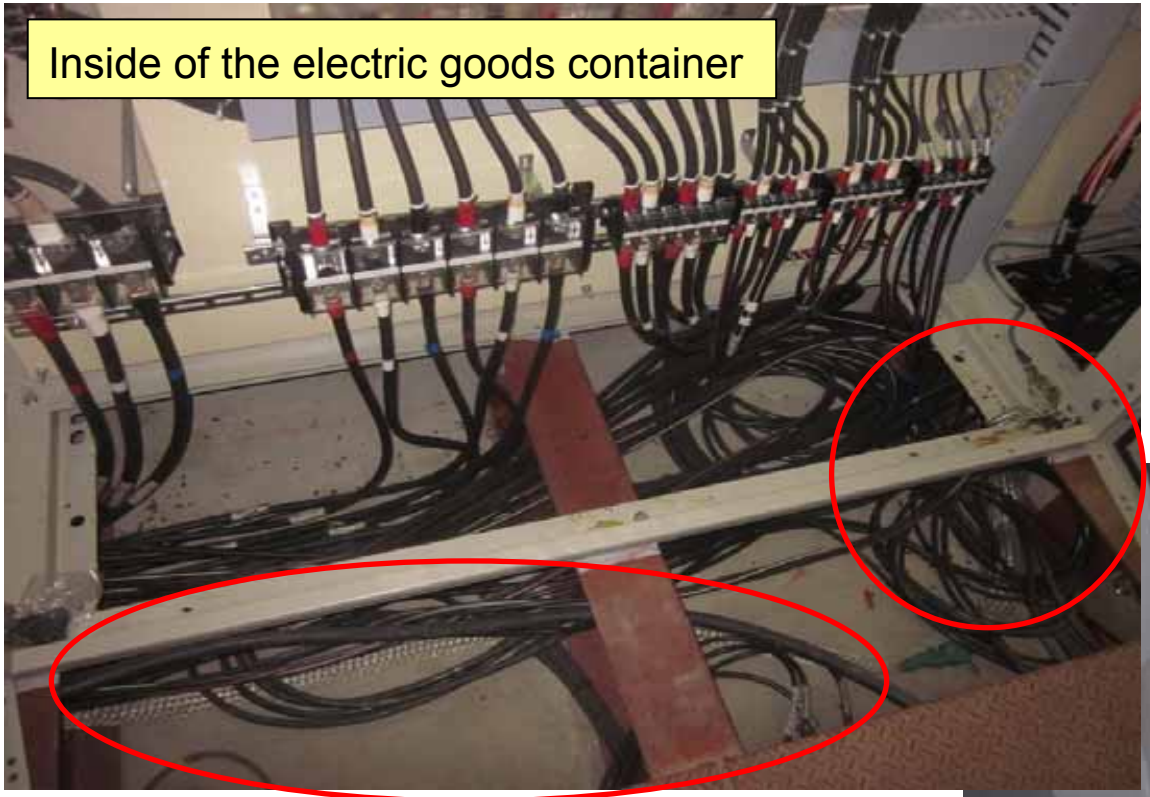
[Potential risk]

- The cable may get damaged due to external force.

- As for the cable installed outside, there is a possibility of deterioration due to ultraviolet rays.



Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System Weakness (3)

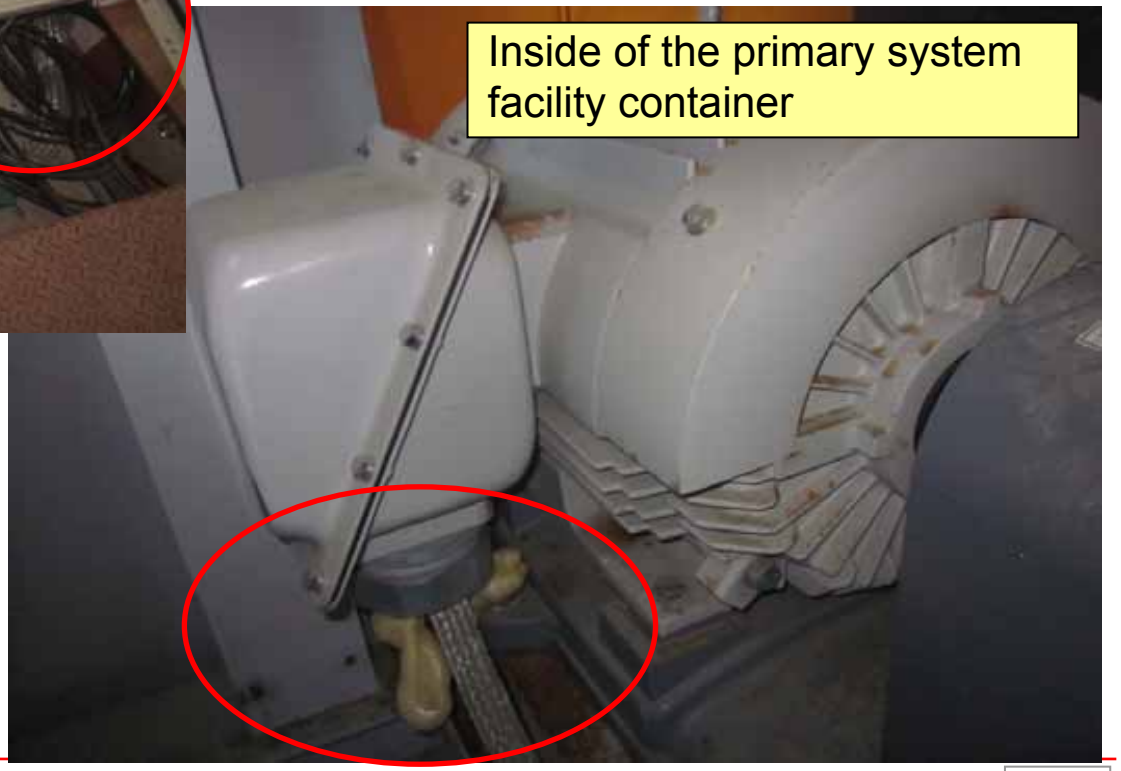


(3) Electric shock prevention measure

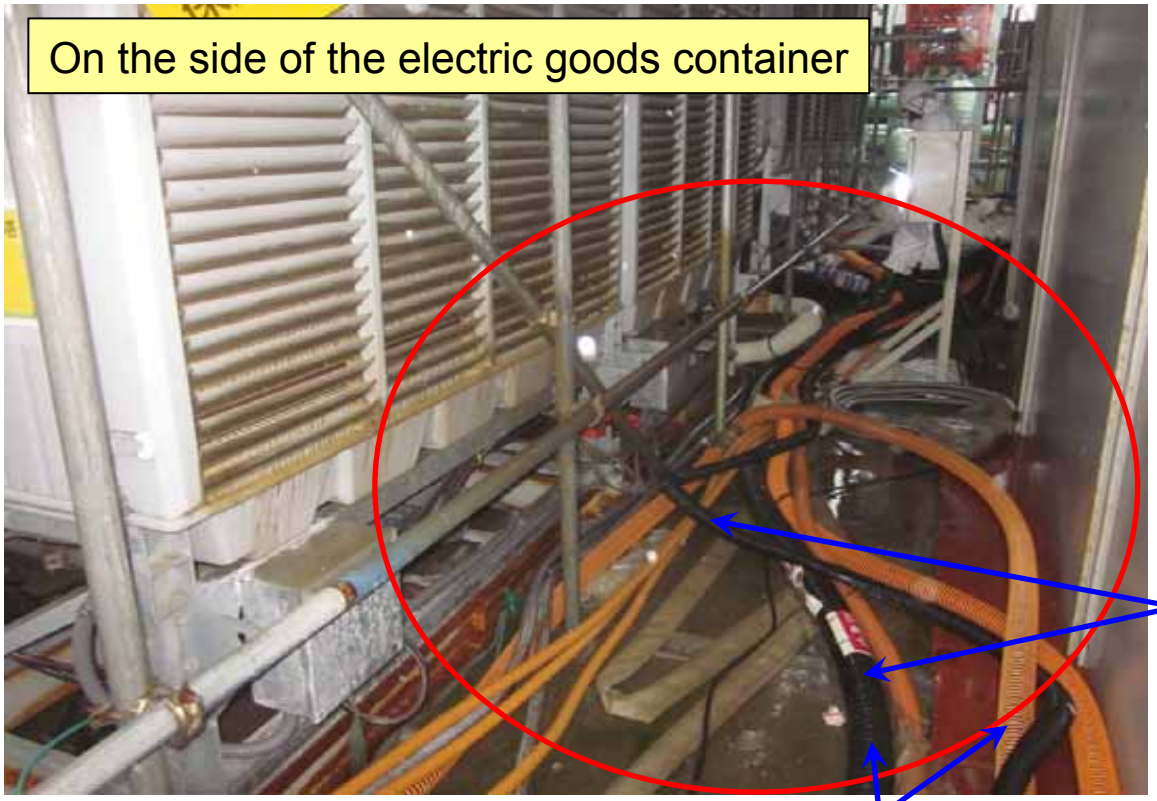
Though people do not enter the container often, exposed ground line is installed.

[Potential risk]

- Possibility of electric shock when touching the cable while a ground fault is occurring.



Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System Weakness (4)-(6)



(4) Securing electric circuit

Cable and pipes are installed in the personnel access route

[Potential risk]

- As safe access route is not secured, there is a possibility of people falling.

- The cable may get damaged by being stepped on.

(5) Cable guiding

The power and control cable routes are not segregated from each other.

[Potential risk]

The control circuit may be affected by electromagnetic induction.

(6) Pipe/cable route separation

The pipe and cable routes are not segregated from each other.

[Potential risk]

The cable may be affected by pipe damage.

Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System Weakness (7)

(7) Handling redundant cable

The Proper way to handle cable redundancy must be considered.

[Potential risk]

The cable may be burnt due to heat generation.

Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System Weakness (8)

(8) Fixture of distribution board

As the distribution board is not fixed, sand bags are installed around it to prevent falling.

[Potential risk]

The distribution board may fall down due to earthquake, typhoon, etc.

Site Conditions of Unit 3 Spent Fuel Pool Alternative Cooling System Weakness (9)

(9) Connection with the ground net

Since grounding was done by grounding electrode, there is no connection with the ground net in the power station site.

[Potential risk]

The signal line may be affected.

Reference (3)
“Implementation Method, Contents of Measures and Detailed Schedule”

Implementation Method and Contents of Measures

Implementation method

- As for the power facilities of the critical facilities/equipment, weaknesses in terms of (1) facility formation, (2) facility installation environment and (3) facility maintenance/management will be clarified through checking the facility documents and performing site investigation and inspection.

- As for weaknesses of urgency, necessary measures will be promptly implemented while implementing measures to prevent potential risks in a well-planned manner.

- In addition to facility countermeasures, operational measures such as reviewing the procedural manuals to achieve early recovery in the case of trouble, etc. will be implemented.

Contents of measures to be implemented

1. Confirmation of facility documents

Scope of multiplication, installation conditions of uninterruptible power supply, emergency D/G and earth leakage circuit breakers, reconfirmation of the setting value of the protective relay, review of procedural manuals, preparation of spare goods, monitoring status, etc.

2. Site investigation and inspection

Perform inspection in terms of “installation environment”, “construction condition” and “management condition” using a check sheet.

3. Clarification of weaknesses and consideration/implementation of countermeasures

Detailed Schedule (1/5)

[Step 1] Spent fuel pool alternative cooling system

Recurrence prevention measures	Apr. 2013	May 2013	Jun. 2013	Jul. 2013	Aug. 2013	Sep. 2013
Power supply duplication for Units 3-4 spent fuel pool alternative cooling system (changed to the switchboard type)	Switchboard installation					
Power supply separation for Units 3-4 spent fuel pool alternative cooling system A/B systems			Performed along with the switchboard installation			
Reliability improvement for the remote monitoring system			“Multiplication of remote monitoring functions” and “power supply duplication or installation of uninterruptible power supply”			
Confirmation of facility documents						
Site investigation and inspection						
Find weaknesses, consider and implement countermeasures			Countermeasure implementation			

Detailed Schedule (2/5)

[Step 2] Common pool cooling system

Recurrence prevention measures	Apr. 2013	May 2013	Jun. 2013	Jul. 2013	Aug. 2013	Sep. 2013
Power supply duplication for the common pool cooling system	Temporary installation		Permanent installation			
Reliability improvement for the remote monitoring system			“Multiplication of remote monitoring functions” and “power supply duplication or installation of uninterruptible power supply”			
Confirmation of facility documents						
Site investigation and inspection						
Find weaknesses, consider and implement countermeasures			Countermeasure implementation			

Detailed Schedule (3/5)

[Step 1] Reactor water injection system

Recurrence prevention measures	Apr. 2013	May 2013	Jun. 2013	Jul. 2013	Aug. 2013	Sep. 2013
Confirmation of facility documents						
Site investigation and inspection						
Find weaknesses, consider and implement countermeasures			Countermeasure implementation			

Detailed Schedule (4/5)

[Step 2] Nitrogen injection system

Recurrence prevention measures	Apr. 2013	May 2013	Jun. 2013	Jul. 2013	Aug. 2013	Sep. 2013
Reliability improvement for the remote monitoring system			“Multiplication of remote monitoring functions” and “power supply duplication or installation of uninterruptible power supply”			
Confirmation of facility documents						
Site investigation and inspection						
Find weaknesses, consider and implement countermeasures			Countermeasure implementation			

Detailed Schedule (5/5)

[Step 2] PCV gas control system, power supply facilities within the site, emergency power supply facilities in the Main Anti-earthquake Building

Recurrence prevention measures	Apr. 2013	May 2013	Jun. 2013	Jul. 2013	Aug. 2013	Sep. 2013
Confirmation of facility documents						
Site investigation and inspection						
Find weaknesses, consider and implement countermeasures			Countermeasure implementation			