Progress Status of the Groundwater Bypass Construction and Preparation for Operational Commencement

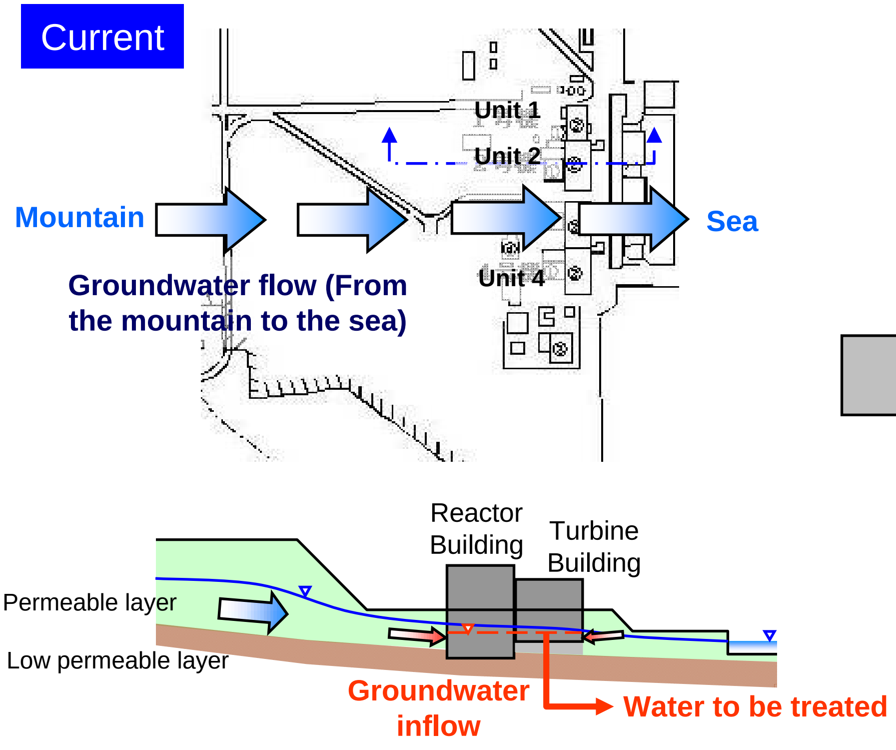
February 28, 2013

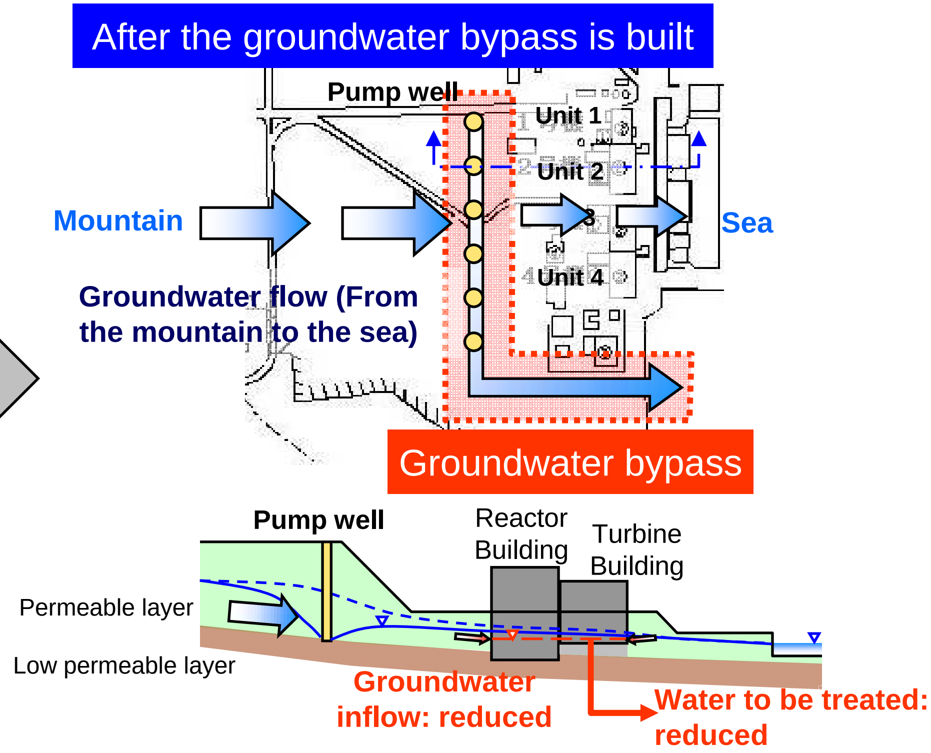
Tokyo Electric Power Company

東京電力

TEPCO

1. Groundwater Bypass



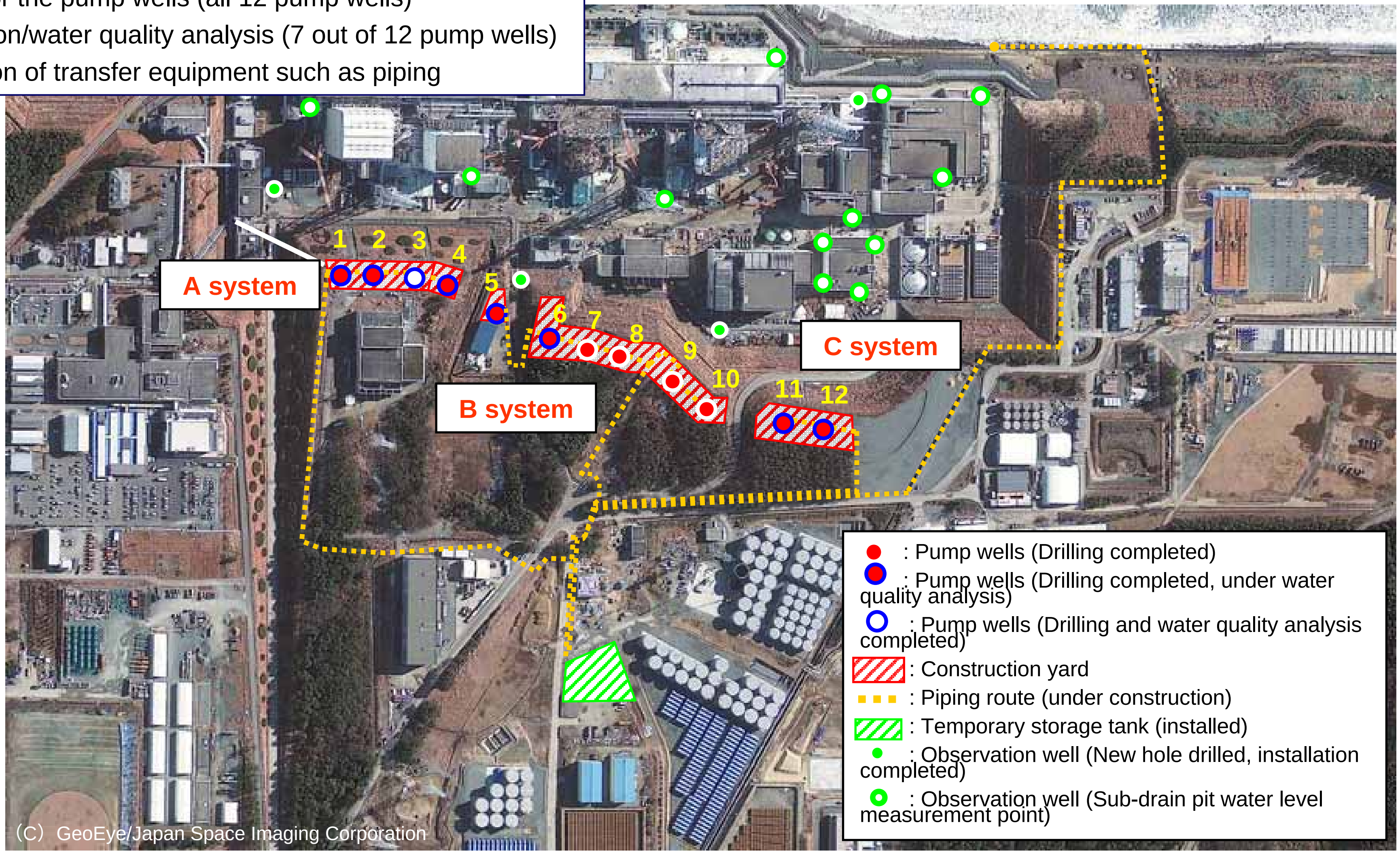


- Groundwater usually flows through the permeable layer from the mountain side to the sea side.
- Part of groundwater flows into the buildings in the process of flowing towards the sea, causing the accumulated water in the buildings to increase.
- The sub-drain is being restored in order to reduce the amount of groundwater flowing into the buildings.

- Groundwater flowing from the mountain side is pumped up in the upstream of the buildings and change the groundwater flow channel **(Groundwater bypass)**
- With the groundwater bypass, the groundwater level around the buildings (mainly in the mountain side) will be reduced and the amount of groundwater flowing into the buildings will also be reduced.
- The restoration of the sub-drain will be continued.

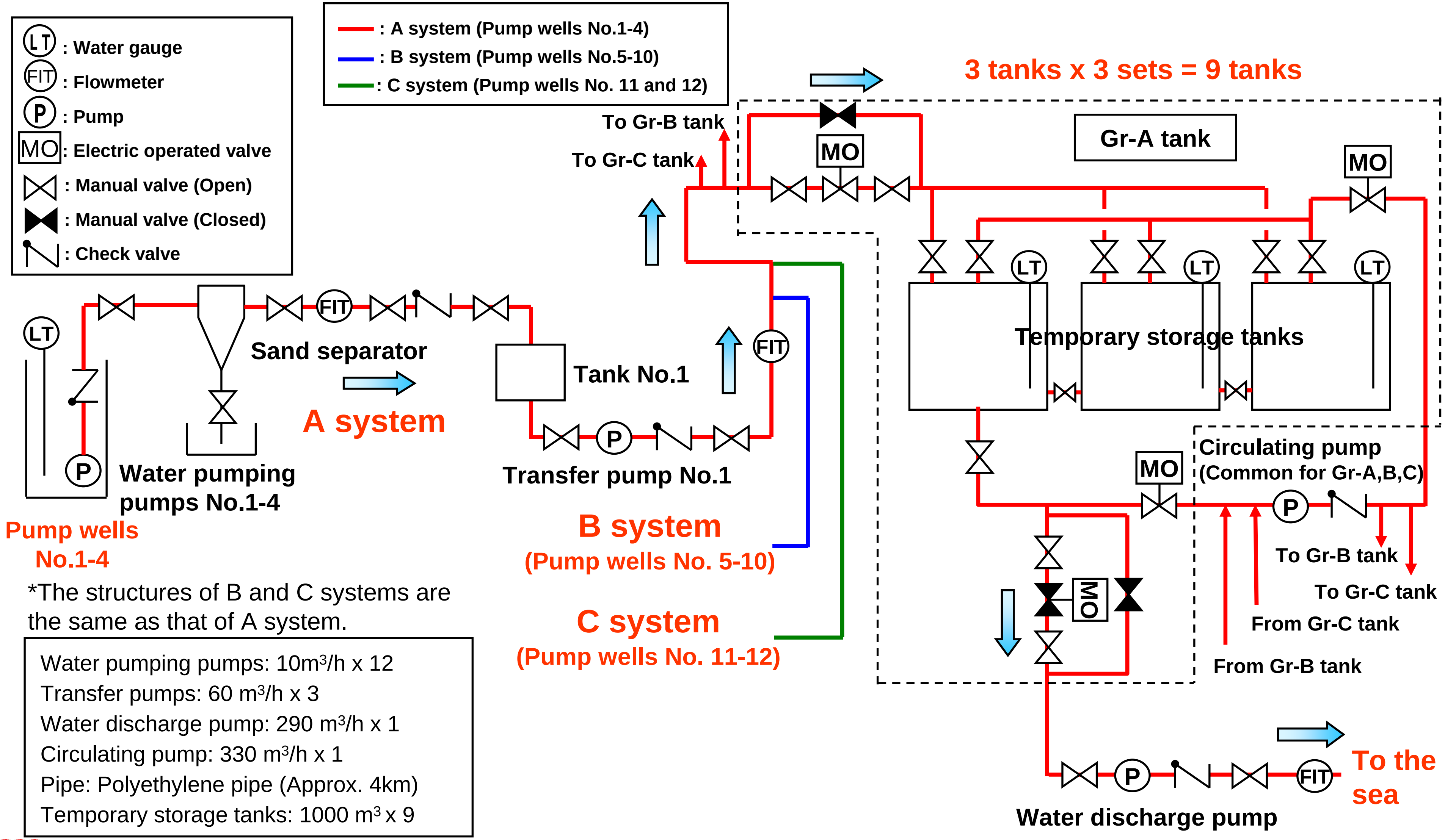
2. Construction Progress

Work ongoing (as of February 28)
- Drilling for the pump wells (all 12 pump wells)
- Purification/water quality analysis (7 out of 12 pump wells)
- Installation of transfer equipment such as piping



3. Water Pumping/Transfer System Structure

Water is transfer from the 3 systems (A-C) to the temporary storage tanks. 9 temporary storage tanks will be installed (1Gr: 3 tanks will be used per day (3-day cycle)). The equipment is designed to allow for detailed transfer control.



*The structures of B and C systems are the same as that of A system.

- Water pumping pumps: 10m³/h x 12
- Transfer pumps: 60 m³/h x 3
- Water discharge pump: 290 m³/h x 1
- Circulating pump: 330 m³/h x 1
- Pipe: Polyethylene pipe (Approx. 4km)
- Temporary storage tanks: 1000 m³ x 9

4. Construction Progress Status (Pump Well Installation)

Foundation installation for A system piping

Drilling completed for pump well No.5 (B system)

Yard development for pump wells No.7-8 (B system)

Inner pipe installation for pump well No.10 (B system)

5. Construction Progress Status (Transfer Facility Installation)

A system buffer tank installation

Transfer pipe from A system to the temporary storage tank

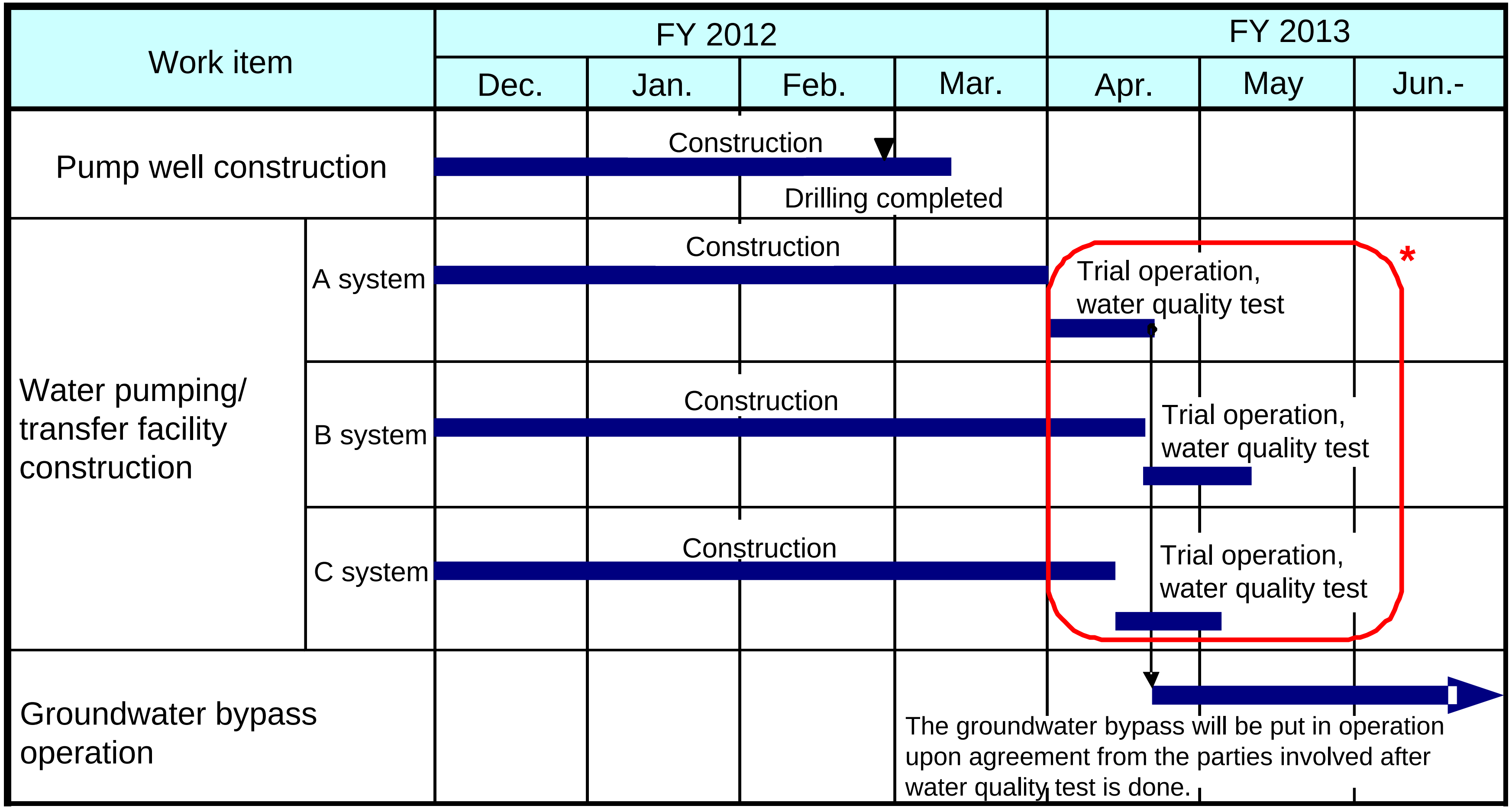
Transfer pipes from each system to the temporary storage tank

Temporary storage tank

6. Overall Schedule

Current status (as of February 28)

- Drilling for the pump wells completed (for all 12 pump wells)
- Water pumping/transfer facility construction: A system transfer pipe and the pipes around the temporary storage tanks are being installed.



*The schedule for water pumping/transfer facility construction for B and C systems and trial operation of all systems has been changed as a result of terminating work due to weather conditions (snow, heavy rain, strong wind) and human disasters. (The schedule is subject to change depending on weather conditions and the progress of trial operation and water quality test.)

7. Water Quality Test Results

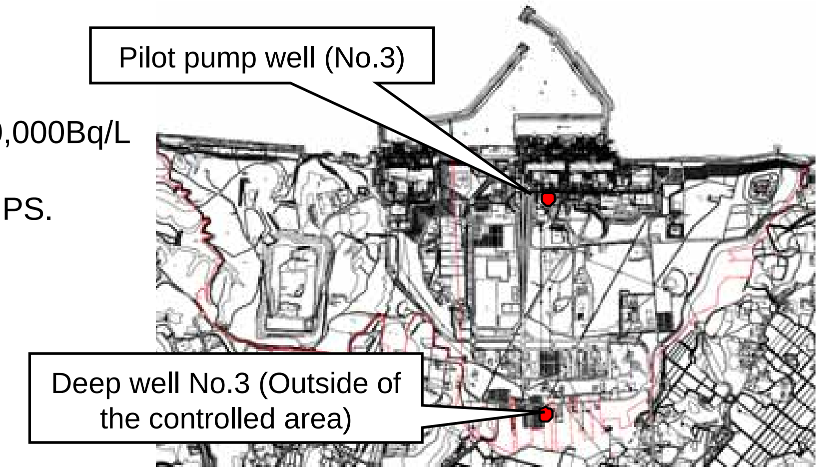
- Groundwater was sampled from the pilot pump well (No.3) for water quality test at TEPCO (Fukushima Daiichi NPS and Kashiwazaki-Kariwa NPS) and a third party organization.
- The in-house test results were similar to that of the third party organization and both of the results are considered to be valid.
- Water quality test will be performed for other pump wells before operational commencement.

(Bq/L)

Test item \ Location	Pilot pump well (No.3)*1		< Reference > Deep well No.3*2
	In-house	Third party organization	
Cesium-134	0.011	ND (< 0.01)	0.010-0.015
Cesium-137	0.012	ND (< 0.01)	0.012-0.027
Strontium-89	ND (< 0.236)	*3	ND (< 0.017)
Strontium-90	ND (< 0.068)	ND (< 0.005)	ND (< 0.0067)
Tritium	10	ND (< 3.7)	9
All **α**	ND (< 1.0)	ND (< 0.1)	ND (< 2.8-3.0)
All **β**	ND (< 2.7)	ND (< 0.2)	ND (< 5.9-6.7)

Density limits specified by the Reactor Regulation:
Cs-134: 60Bq/L, Cs-137: 90Bq/L, Sr-89: 300Bq/L, Sr-90: 30Bq/L, Tritium: 60,000Bq/L
ND: Below the detection limit (provided in the parenthesis).
In-house water quality test for cesium is performed at Kashiwazaki-Kariwa NPS.
As for other nuclides, test was performed at Fukushima Daiichi NPS.

*1 Water sampled from the pilot pump well (No.3) on December 11, 2012.
*2 Water sampled from the deep well No.3 on May 30 and June 13, 2012.
*3 As for radioactive strontium, test was performed only for strontium-90.



8. Water Quality Test Results of the Rivers Around the Power Station (After the Accident)

Sampling location		Density (Bq/L)	
		Cesium-134	Cesium-137
Ota River	Minamisoma City	ND (<1) - 1	ND (<1) - 2
Maeda River	Futaba Town	ND (<1) - 1	ND (<1) - 1
	Namie Town	ND (<1) - 1	ND (<1) - 1
Ukedo River	Namie Town	ND (<1)	ND (<1) - 1
Kuma River	Okuma Town	ND (<1)	ND (<1)
Tomioka River	Tomioka Town	ND (<1)	ND (<1)
Kido River	Kawauchi Village	ND (<1)	ND (<1)
	Naraha Town	ND (<1)	ND (<1)

* The detection limit of cesium-134 and cesium-137 used in the investigation performed by the Ministry of the Environment is 1Bq/L.

* Source: “Radioactive material monitoring results of the public water in Fukushima Prefecture (Sampled in April-June)” (announced on July 31, 2012), “Radioactive material monitoring results of the public water in Fukushima Prefecture (Sampled in July-September)” (announced on October 11, 2012), Radioactive material monitoring results of the public water in Fukushima Prefecture (Sampled in September-November)” (announced on January 10, 2013) (Announced by the Ministry of the Environment)

9. Evaluation of the Groundwater in the Pilot Pump Well

- The cesium density of the groundwater in the pilot pump well (No.3) is substantially lower than that of the samples collected in the river near the power station after the accident (approx. 1-2Bq/L) and is equivalent to that of the deep well No.3 located near the site boundary in the west side.
- The densities of strontium, all **α** and all **β** are below the detection limits. Though tritium was detected in the internal analysis, the density is less than one-several thousandths of the limit specified by the Reactor Regulation and the impact on the human body is considered to be quite small.
- The impact on the surrounding environment is considered to be quite small.

1. Fish and shell fish: Even if fish and shellfish who live in the seawater of the radioactivity density equivalent to that of the sampled groundwater concentrated cesium density to 100 times more* within their bodies, the cesium level would be only about one fortieth of the food standard value (100Bq/kg). (*IAEA technical report No.422)
2. Human body: The cesium 134+137 densities of the sampled groundwater is one-four hundredth of the standard value for drinking water (10Bq/L). In the case that 2L of water containing tritium of the density equivalent to that of the sampled groundwater was taken into body every day, the annual radiation exposure dose would be 1.3×10^{-4}mSv*[1], which is about one-sixteen thousandths of the annual exposure dose due to natural radiation of 2.09mSv (average in Japan)*[2].

[1] 10Bq/L x 2L x 365 days x 1.8 x 10^{-8}= 1.3×10^{-4}mSv (*Radiation dose factor in the case of oral intake of tritium (mSv/Bq))

*[2] Source: “Environmental radiation: National dose calculation” (new edition) (provisional translation) by the Nuclear Safety Research Association

10. Water Quality Test Before the Operational Commencement (Draft)

1. Before operational commencement, groundwater will be sampled from all the pump wells for water quality test (See page 7 for test items).
2. Besides from the water quality test, cesium-137 density will be checked to see if it's 1Bq/L or less (maximum allowed cesium density for water to be discharged) and sufficiently lower than the densities detected in the surrounding marine area and rivers.

	Monitoring before the operational commencement of the groundwater bypass
Purpose	Determine the feasibility of operational commencement
Location	Temporary storage tank
Items to check*1	1. Whether cesium-137 density is 1Bq/L or less (maximum allowed density) 2. Whether the density is sufficiently lower than that of samples collected in the surrounding marine area and rivers (representative nuclide: cesium-137)
Analysis items*2 (Detection limit)	Cesium-137 (0.01Bq/L) Tritium (3Bq/L) All **α** (4Bq/L) All **β** (7Bq/L)

*1 Each tank to be checked before the first operational commencement.

*2 Strontium-90 will be checked after the operational commencement.

11. Water Quality Test After the Operational Commencement (Draft)

1. The maximum allowed cesium-137 density of the water to be discharged is 1Bq/L taking into considerations the regulation values, detection limits of public water, etc.
2. Besides from the above, detailed analysis will be performed on a regular basis (about once every 3 months (once a month for the first 3 months)) to monitor changes over a long period of time. (Data check will be performed at a third party organization as well.)

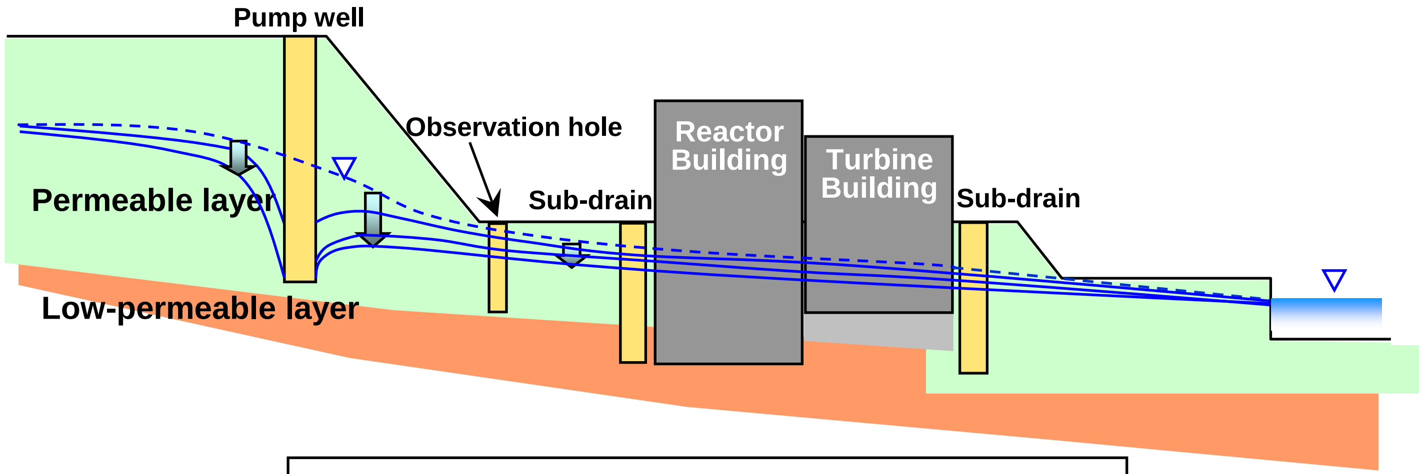
	Monitoring after the operational commencement of the groundwater bypass	
Purpose	Determine the feasibility of water discharge	Monitor density fluctuations in a long period of time
Frequency	Timing of water discharge (Monitoring to be done beforehand)	On a regular basis (About once every 3 months (once a month during the first 3 months)) - Mix the samples obtained in 3 months (composite sample) for analysis
Location	Temporary storage tank	Temporary storage tank
Item to check	Whether cesium-137 is 1Bq/L or less (maximum allowed density)	Whether the density is sufficiently lower than that of the samples collected in the surrounding marine area and rivers (representative nuclide: cesium-137) [Detailed analysis]
Analysis items (Detection limit)	Cesium-137 (1Bq/L or less)	Cesium-137 (0.01Bq/L) Strontium-90 (0.01Bq/L) Tritium (3Bq/L) All **α** (4Bq/L) All **β** (7Bq/L)

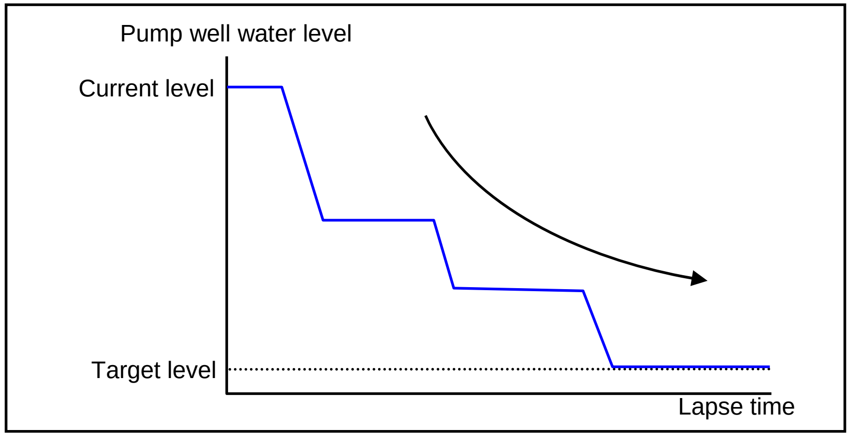
[Reference] Examples of regulation values of radioactive cesium density
(Drinking water) Cesium-134 + cesium-137 ≦ 10Bq/L
(Fish and shellfish) Cesium-134 + cesium-137 ≦ 100Bq/kg
(Density limit specified by the Reactor Regulation) Cesium-134: 60Bq/L, cesium-137:90Bq/L
(Investigation performed by the Ministry of the Environment*) Detection limit of cesium-134 and 137: 1Bq/L

*Radioactive material monitoring of groundwater and public water performed by the Ministry of the Environment

12. Gradual Reduction of Groundwater

The groundwater level will be gradually reduced with the groundwater bypass put in operation. Careful water level control will be implemented to prevent the accumulated water in the buildings from leaking to the outside while monitoring the groundwater level reduction and its water quality. The sub-drains installed around the buildings will be fully utilized for the monitoring. An observation hole will be newly installed between the Reactor Building and the pump well.





Gradual reduction of groundwater level

13. Policy of Water Level Reduction in the Early Stage

- Basic policy of water level reduction in the early stage

- Water level will be reduced while carefully controlling it to prevent the accumulated water in the buildings from leaking to the outside. [Leakage prevention]
- The accuracy of groundwater control will be improved by examining the data on water level fluctuation obtained in the early stage of pump well operation. [Accuracy improvement of the next step]

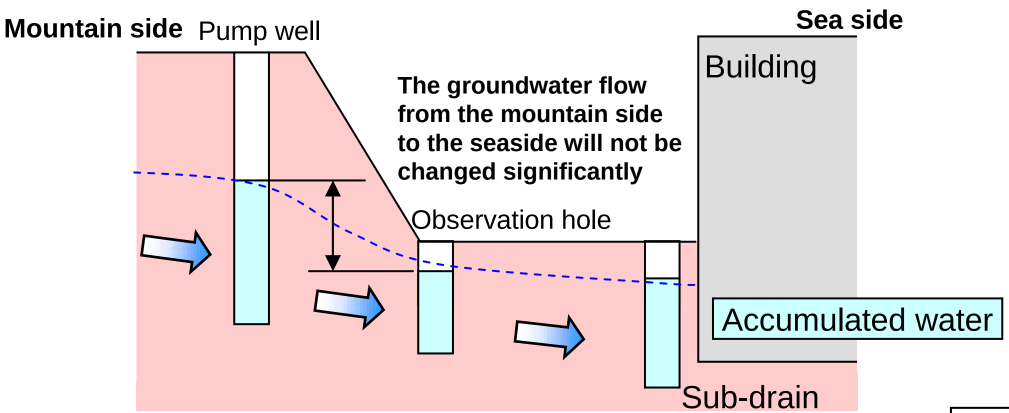
- Control method

- The following will be implemented in the early stage of water level reduction in order to prevent the leakage of accumulated water.

Control item	Control method
1. Groundwater level control near the pump well by utilizing the observation hole *Confirm the effectiveness of the groundwater bypass in the early stage of its operation.	Pump well water level > Observation hole water level
2. Groundwater level control near the building by utilizing the sub-drains *Prevent the leakage of accumulated water in the buildings	Sub-drain water level > Accumulated water level in the building

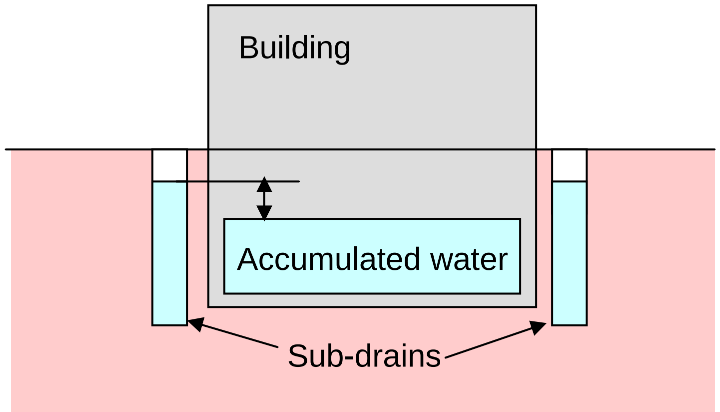
*In the case of unexpected water level reduction, measures such as suspending the pump well operation will be implemented.

1. Groundwater level control near the pump well by utilizing the observation hole



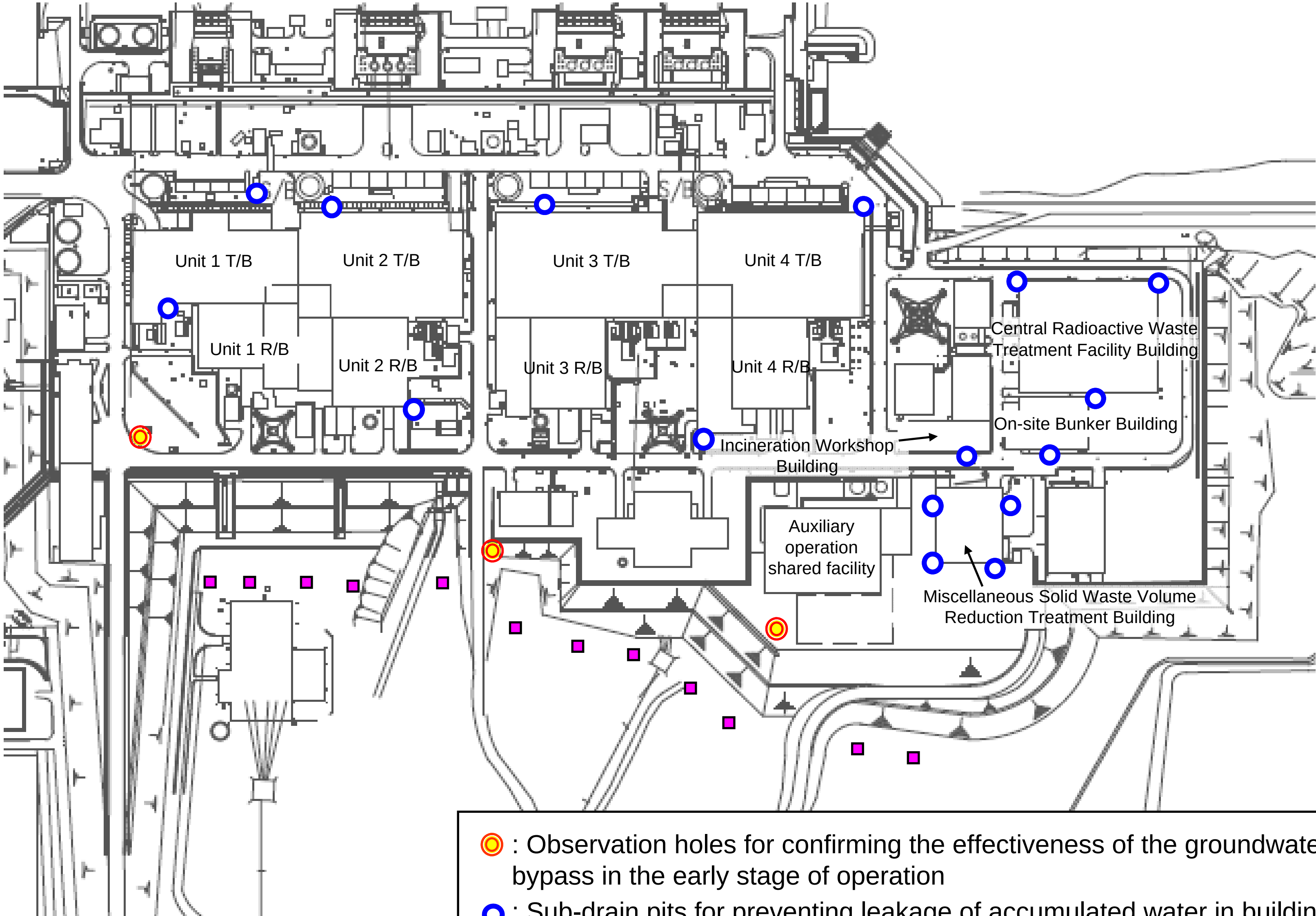
Pump well water level > Observation hole water level

2. Groundwater level control near the building by utilizing the sub-drains



Sub-drain water level > Accumulated water level in the building

14. Monitoring Points



◎ : Observation holes for confirming the effectiveness of the groundwater bypass in the early stage of operation

○ : Sub-drain pits for preventing leakage of accumulated water in buildings

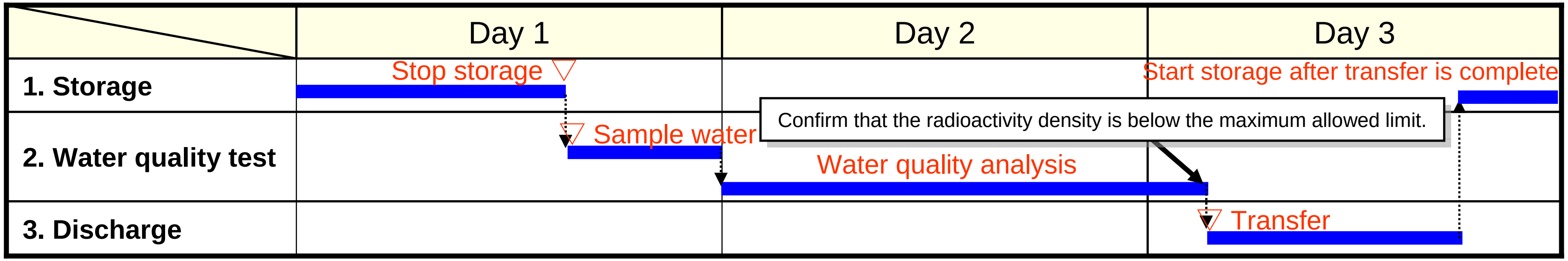
■ : Pump wells

15. Operation Method

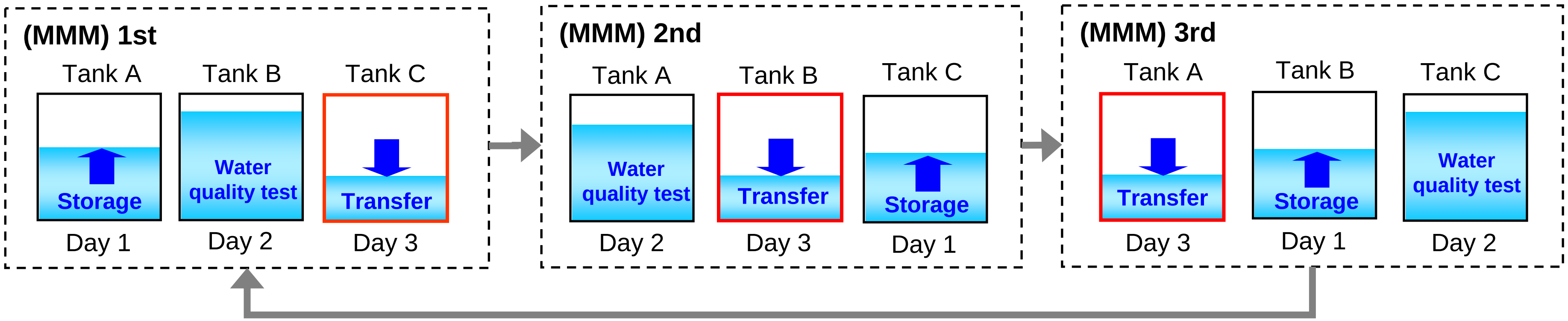
■Basic Policy

The pumped up ground water is temporarily stored in the tank for water quality test (to confirm that its radioactivity density is below the maximum allowed limit) before being transferred to the sea.

■Operational cycle



3 sets x 3 days cycle



The process is repeated and the water quality is confirmed before being transferred to the sea.