Cause for the Water Leak from a Top Plate of a Tank at B South Area in Fukushima Daiichi NPS and the Leak Prevention Measures

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Tokyo Electric Power Company

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Outline

- On October 2, 2013, a TEPCO employee found 1) a water leak from around the top plate of a tank located on the east end (B-A5) at B south tank area, and that 2) a part of the leaked water leaked outside the dike in B south tank area via a drainage hole for discharging rainwater at the bottom of a scaffold installed for inspection, when pumping up the rainwater accumulated inside the dike surrounding each tank area where contaminated water was stored.
- Estimated amount of leak: Approx.17m^3 (inside the dike)

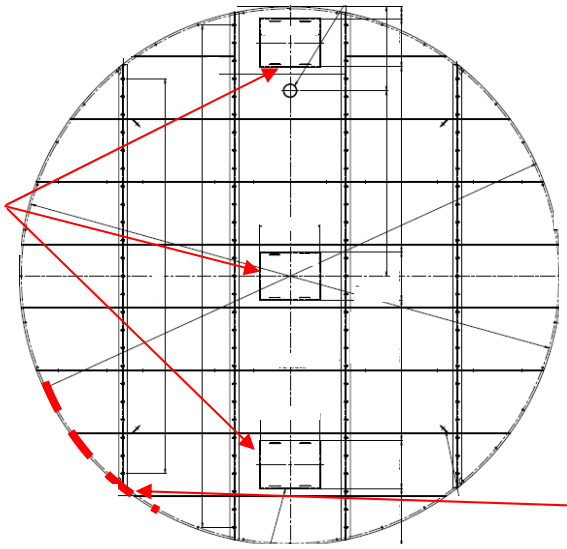
  Approx. 430L (outside the dike)
- We found that the leaked water was the RO treated water stored inside the B-A5 tank, after analyzing the leaked water inside the dike at the area*.

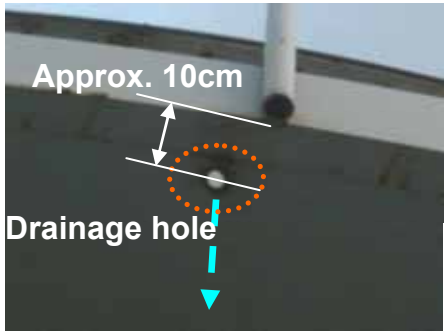
*It corresponds to ‘’a case when nuclear fuel material (not in the form of gas) or the like has leaked within an area controlled by the company due to an unpredictable event such as a failure of a nuclear reactor facility for power generation’ as per Article 18, item 12 of Fukushima Daiichi Regulations.

- We installed sand bags inside the side ditch leading to the drainage channel because the water leaking outside the B south tank area could leak into the sea via the side ditches located on the south of B-A5 tank.
- At 2:00 PM on October 3, we confirmed the dropping from around the top plate of B-A5 tank stopped.

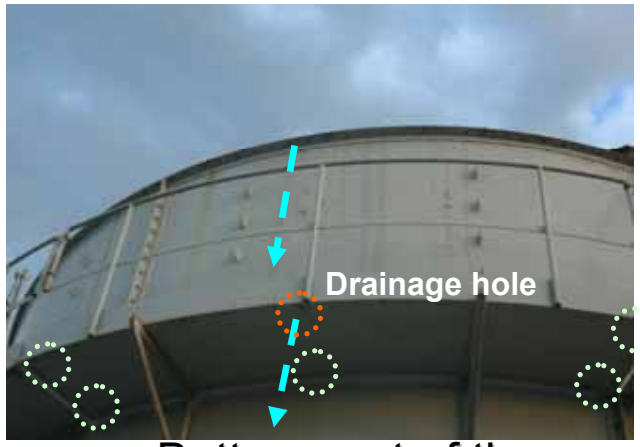
Leakage points at B-A5 tank

Manhole





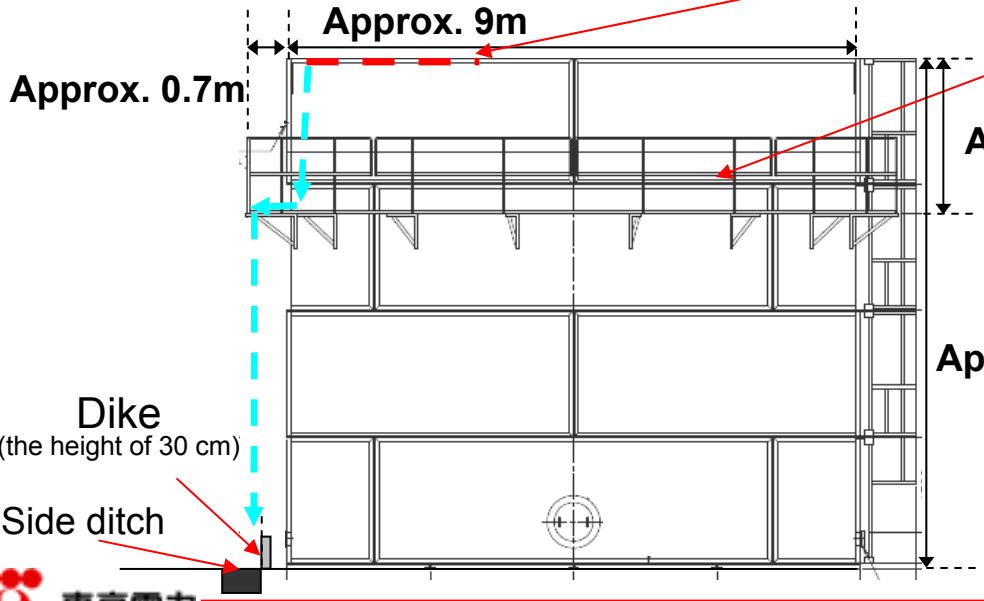
Enlarged image of the bottom part of the scaffold for inspection



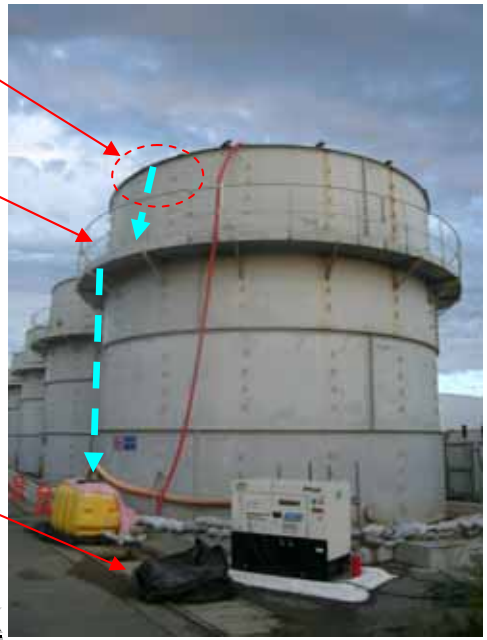
Bottom part of the scaffold for inspection

Leakage point

Scaffold for inspection

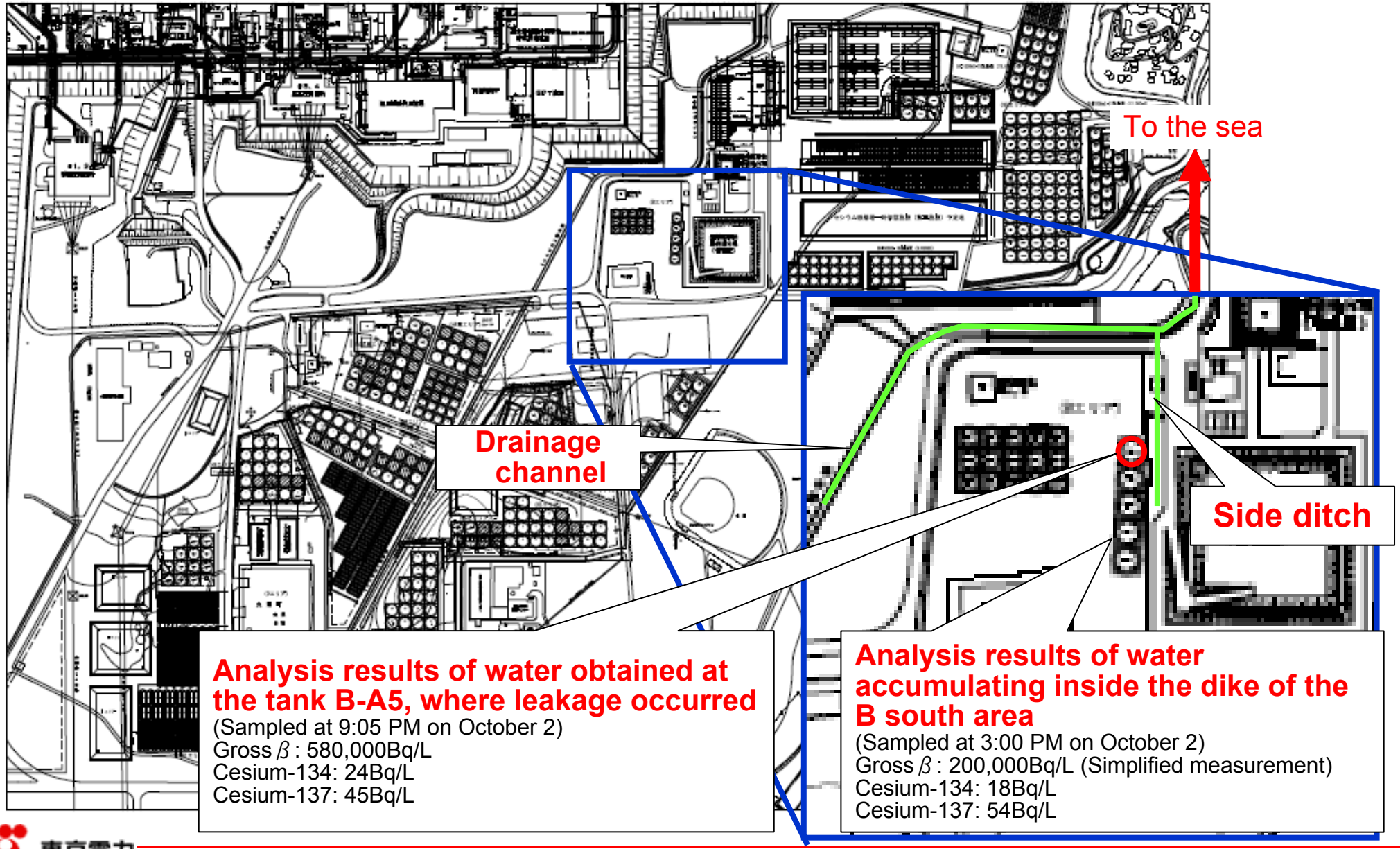


Side ditches

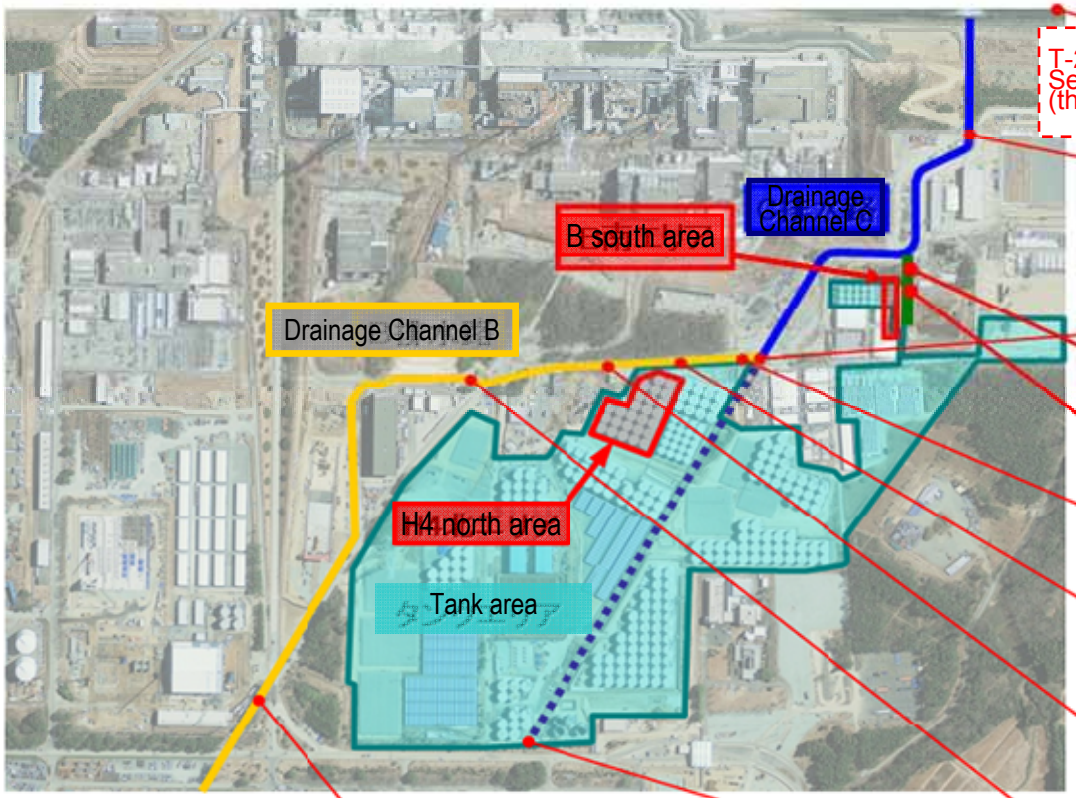


Appearance of the tank

Assessment of influence on environment (the analysis results around B-A5 tank)



Assessment of influence on environment



T-2
Seawater near the south water outlet (the drainage channel box) *

C-2
Drainage channel C OP. 35m exit

C-1
Junction of the drainage channel B and C

X-1
Point immediately short of the junction with the drainage channel C *

X-2
Side ditch next to the tank

B-3
Point immediately short of the junction with the drainage channel C

B-2
Downstream of b-1

B-1
Point that showed a high dose equivalent rate on August 21

B-0-1 Point near Fureai Intersection in the drainage channel B

C-0 Point near Fureai near the main gate in the drainage channel C

B-0
Upstream of B-1

*

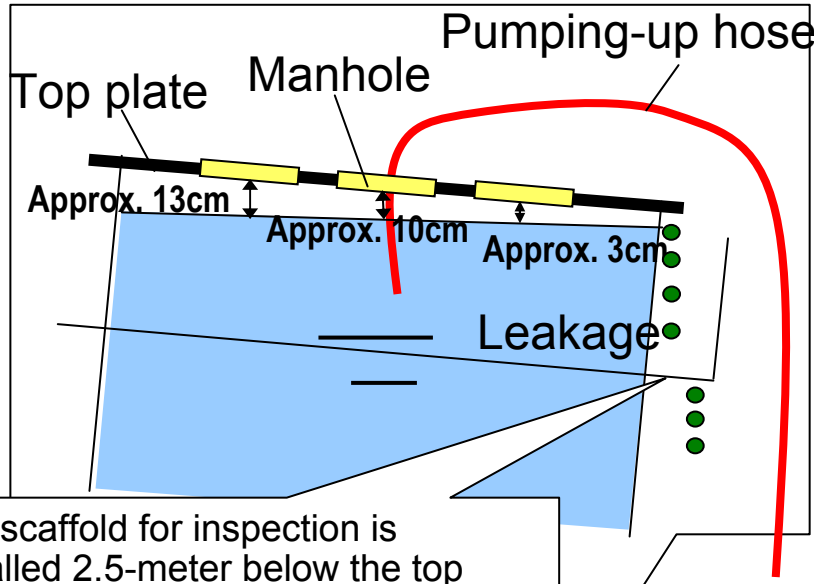
Point immediately short of the juncture of the side ditch near the tank and the drainage channel C (X-1)
(Sampled at 11:10 PM on October 2)
Gross β: 15,000Bq/L
Cesium-134: 120Bq/L
Cesium-137: 310Bq/L

Seawater near the south water outlet (the drainage channel box) (T-2)
(Sampled at 7:00 AM on October 3)
Gross β: ND (The detection limit value: 20Bq/L)
Cesium-134: ND (The detection limit value: 1.5Bq/L)
Cesium-137: ND (The detection limit value: 1.2Bq/L)

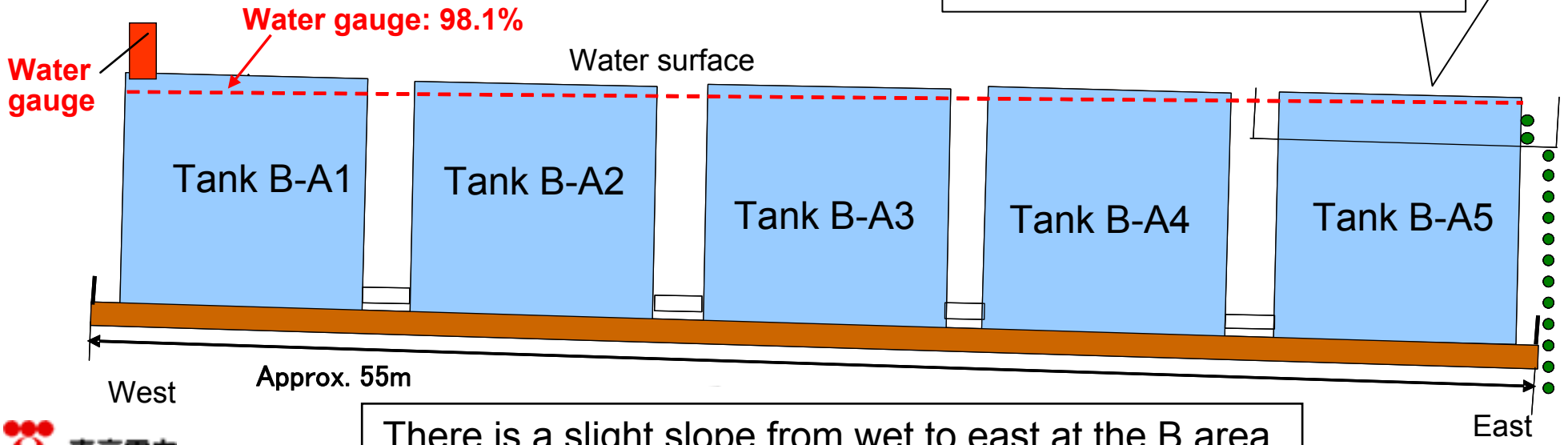
We determined there was no influence of radiation from the water leaked from B-A5 tank on environment.

Tanks established at B south area

- In order to prevent rainwater from entering the tanks, the top plate and the flange part are fastened with bolts. (Approx. one bolt hole per 4 to 5 bolt holes is screwed.)
- The tanks have no packing on their top plates, and is not very good at water stopping. They are not supposed to be operated fully filled with water. The water gauge installed at the tank B-A1watches the water level of tanks.
- The tanks are operated with the maximum amount of water capacity, 99% (approx. 40 cm from the top plate).
- Due to the slight slope on the ground, the water reached the top plate at the east-end tank (B-A5), and leaked, when the water gauge at the tank (B-A1) indicated 98.1%.
- Most of the leaked water dropped inside the dike, but some leaked outside the dike via the drainage hole on the scaffold for inspection.



The scaffold for inspection is installed 2.5-meter below the top plate, and the water dropped through the drainage hole outside the dike.



There is a slight slope from wet to east at the B area.

The sequence of the leak of contaminated water from B-A5 tank

- On the day the leak occurred、we were urgently pumping up the water accumulated inside dikes at B south tank area as a rainfall measure against approaching typhoon. The pumping-up was conducted twice without setting the maximum water level limit corresponding to the ground slope quantitatively.
- After completing the second pumping-up, the tank water level of B-A1 tank was 98.6%, but it decreased finally down to 98.1% after the leak stopped. The percentage remained the same after that, therefore, when the water level exceeded 98.1% at B-A1, the water level probably almost reached the top plate at the east end part of B-A5. The RO treated water inside the tank leaked from the flange part between the top and the side plate which has low water-stopping ability.
- Most of the RO treated water leaking from B-A5 tank leaked inside the dike at B south tank area via a chink between a tank side plate and a scaffold. Some of the water leaked on the ground outside the dike via drainage holes on the bottom of scaffold because a part of scaffold was sticking out over the dikes in the area.
- When watching out for leak from B-A5 tank twice, he failed in finding that the actual water level at the east-end point of the tank almost reached the top plate because he checked the actual water tank at the manhole in the middle, but not the east-end manhole located in the lowest part on the slope. And he misunderstood the water leaking from the top of the tank as rainwater on the tank top plate. As a result, the leak from the tank was overlooked.

Cause and measure: Water transfer

	Analysis of cause	Measure
Direct cause	A group manager in charge of tank management established neither a clear criteria, nor a procedure corresponding to the slope on the ground, when pumping up the accumulated water in B south area.	<Procedure manual> ・Standard procedure manual will be constructed clearly stating the maximum water level based on each tank situation, regarding 1) transfer and 2) pumping-up of accumulated water inside dikes. ・In case of any change, the changes should be reflected in the procedure manual, and the workers/employees on the site should be well informed of such changes in prior to the start of work
Contextual cause	・Group Manager (tank management) did not share information on the slope of the ground etc. with Tank Management and Tank Installation Departments. ・General manager (tank management) did not indicate tank operation corresponding to the slope on the ground. ・Group Manager (tank management) pumped up the accumulated water to a tank in B south area because 1) there was no criteria for the accumulated water inside the dike, therefore no policy concerning water treatment fixed, and 2) no preparation for water transfer was made.	Common measures <Human resource empowerment> Providing with personnel necessary for planning, examining, and implementing work. <Site management empowerment> Securing space for office administration at the site, so that personnel including managers can stay there, and strengthen on-site management. <Information sharing> When installing a tank, Tank Installation and Tank Management Departments work in cooperation each other, and share information on installation situation and structure among related Departments.

Cause and measure: Oversight of leak

	Analysis of cause	Measure
Direct cause	・A group manager in charge of tank management did not give appropriate instruction corresponding to the slope on the ground such as water level check at the east-end manhole etc. to the observer (TEPCO employee). ・Rainfall made the visual check (made by a TEPCO employee) for the top part of the tank difficult. ・Only one person was checking the leak, but he was not very aware of the risk of leak.	・We clarify the procedure to check the water level of tanks, when establishing a procedure manual or revising it. ・We will administrate risk management, taking the leak of contaminated water into account.
Contextual cause	・Group Manager (tank management) overlooked the lower tank water level caused by the leak, for he did not indicate the record of tank water level before/after work. ・Group Manager (tank management) did not share information on the slope on the ground in B south tank area etc. with Tank Installation Department. ・General Manager (tank management) did not indicate tank operation corresponding to the slope on the ground. ・Empowerment for human resource in Tank Management department was too late.	Common measures <Human resource empowerment> Providing with personnel necessary for planning, examining, and implementing work. <Site management empowerment> Securing space for office administration at the site, so that personnel including managers can stay there, and strengthen on-site management. <Information sharing> When installing a tank, Tank Installation and Tank Management Departments work in cooperation each other, and share information on installation situation and structure among related Departments.

Prevention measures on facilities

Common prevention measures are implemented in B south and other areas:

- A notch tank group is (total capacity of 4000m^3) prepared for receiving accumulated water inside dikes. In addition, a transfer line is built between the tank group to Unit 2 turbine building. (completed)
- Flange parts and bolted parts between tank top plates and side plates are applied with caulking, in order to enhance their water-stopping. (Under construction)
- Water gauge is installed flange type tanks. (completed)
- Tank area dikes are raised higher upward to prevent overflow from dikes. (Under construction)
- Rain gutters are installed at the top part of tanks. (Under construction)

Caulking treatment for the top plate at B south tank area

Dike raised upward at B south tank area