Evaluation of the report of Tokyo Electric Power Company regarding the leakage from the RO concentrated water storage tank at the Fukushima Daiichi Nuclear Power Station

31 March 2015
Nuclear Regulation Authority, Japan

On 10 December 2014, the Nuclear Regulation Authority of Japan authorized the “Evaluation of the report of Tokyo Electric Power Company regarding the leakage from the RO concentrated water storage tank at the Fukushima Daiichi Nuclear Power Station”.

Based on the evaluation above, on 12 February 2015, the NRA reported the final INES Rating for this incident as follows:

INES Rating: Not applicable (final)

- Rating Justification: Fukushima Daiichi nuclear power station has been severely damaged from a major accident. Due to its condition, incidents at Fukushima Daiichi are not necessarily comparable to incidents at other nuclear power stations, so INES Rating is not applicable.

（see also: http://www.nsr.go.jp/data/000096398.pdf）

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10 December 2014
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1. Overview

Around 9:50, 19 August 2013, a worker patrolling the site of the contaminated water storage facility found that there was an accumulation of water inside and outside of the dike built to surround the RO concentrated water tanks in the H4 north area (refer to Figure 1), and that the water inside of the dike was running outside of the dike from the drain valve of the dike. At the time, the portable dosimeter set off an alarm.

Immediate measures were taken to prevent the spread of the leakage, and to collect the leaked water, which led to the reduction of the water level of No.5 tank of the RO concentrated water tank in H4 north area (hereinafter, referred to as "leaking tank").

In the same day, the Nuclear Regulation Authority (hereinafter, referred to as "NRA") received the report regarding accidents and failures based on the Article 62-3 of the Act on Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors from Tokyo Electric Power Company (hereinafter, referred to as "TEPCO").

Subsequently, the NRA received the report regarding causes and countermeasures of the aforementioned event (the final report) from TEPCO as of 30 June 2014 (partial correction as of 31 October 2014) and the NRA reviewed the contents and summarized the evaluation result.

Report from TEPCO
http://www.tepco.co.jp/en/press/corp-com/release/2014/1247181_5892.html

2. Overview of the report submitted by TEPCO

(1) Environmental impact assessment (expansion of contaminated water)

In terms of an environmental impact, no obvious increase in measurement results of total beta was detected in the seawater monitoring (refer to Figure 2) at the north/south discharging outlets (refer to Figure 3).

Radioactive strontium contained in the leaked amount (approximately 300m^3) is estimated to be 4.5×10^{13}Bq, based on evaluations of the water level decrease in the leaking tank (3m). Approximately 80% (3.7×10^{13}Bq) of the radioactive strontium contained in the leaked amount was collected by removal of contaminated soils (soil contaminated by radioactive materials with radiation dose rate of the beta ray with 0.01 mSv/h or more). Additional surveys will be implemented to collect the radioactive strontium as much as possible while the replacement of the aforementioned H4 north area tanks are implemented(scheduled to be started from February 2015).

(2) Radiation dose rate survey on the ground

Figure 4 and Table 1 show the results of radiation dose rate survey of the contaminated ground surface. Figure 5 shows recovery locations.

Figure 6 shows an external exposure radiation dose rate of beta ray on the workers who patrolled the tank around H4 north area.

(3) Survey result of tank leakage point

Survey of the tank leakage was conducted at each stage.

As a result, it was found that the leakage point was located at the discovered protrusion

of packing at the flange section of the tank bottom plate (refer to Figure 7). The assumed cause was estimated to be a reduction of bolt torque to tighten the packing, due to the impact of thermal expansion/shrinking of the flange caused by a subtle waving of the packing at the time of tightening the bolt at the location of the leakage. In addition, it was accompanied with the opening of the lower end of the flange. It is presumed that this led to the protrusion of the packing which shifted downward out of the bottom of the tank due to the inability to resist the water pressure of the tank.

(4) Countermeasures

(4) - 1 Countermeasures against tank leakage

a. Replacing with welded tanks

Flange type tanks on which the leakage was discovered shall be replaced with welded tanks, and the replacement shall be preferentially applied to the TYPE-1[*1] on which the leakage was found.

*1: Flange type tanks are largely categorized into TYPE-1 through 5 depending on the bottom plate waterproofing structures.

b. Tentative countermeasures until replacing with welded tanks

As tentative countermeasures until replacing with welded tanks, the implementation of following measures shall be considered (refer to Figure 8): 1) Waterproofing by caulking , etc. at the bottom of the tank, 2) Filling sealing material underneath the bottom plate, and 3) Filling sealing material at the bottom plate section (inside).

(4) - 2 Countermeasures against leakage expansion

a. Drain valves were closed

Drain valves of the dike were closed as a countermeasure against leakage expansion to the outside of the dike (normally ‘closed’).

b. Tank dike’s height was raised

Tank dike’s height was raised by building steel plate on the existing dike in order to prevent leakage of the standing water inside of tanks. (refer to Figure 9)

Tank dike’s height was further raised (height to hold the leakage amount of a one tank capacity per 20 tanks) as a countermeasures to improving reliability (refer to Figure 10).

c. Double diking was implemented. Preventing rain water permeation into the ground at the ground surface between the inner and the outer dike, and between outer dikes was implemented.

Double diking was implemented. In addition, facing by watertight asphalt concrete, spraying concrete was implemented in order to prevent rain permeation into the ground at the ground surface between outer dike surface and dike, and between outer dikes. (refer to Figure 11)

d. Preventing flowing into drainage ditch

Lining the inside B drainage ditch was implemented to prevent expansion of contamination (refer to Figure 12). Covering the channel of B drainage ditch for 800m and the section to 440m from the joint of the C drainage ditch and B drainage ditch through the 35m board outlet was implemented that may have possible flowing-in from the contaminated water storage facility such as tanks (refer to Figure 13 and Figure 14).

e. Countermeasures to contaminated soils difficult to be recollected

Recollect the contaminated soil such as those beneath concrete foundation of the tank area was planned in accordance with the progress of the replacing work of H4 north tank area.

(4) - 3 Countermeasures for the detection in early stage

a. Enhancing the patrol

The following three items shall be implemented.

- The patrol was conducted twice a day (2 workers x 2 times). Patrolling frequency and the number of persons have been increased since 2 September 2013, and have been increased to four times a day (30 workers x 4 times) since 21 September 2013.
- In addition to the visual check, radiation dose and water level of each tank are measured.
- Recording format is changed in order to ensure proper visual check, radiation dose measurement and water level check, as well as necessary education and training are given to the patrolling persons.

b. Suppressing the in-flow of rain water

The rain water gutters on top of the tank were installed to allow draining rain water to outside the dike (refer to Figure 15).

c. Building the measuring instrument per tank

One measuring instrument per tank group had been installed for controlling the whole water levels of the group in transfer. One measuring instrument with setting up alarms per tank has been installed (refer to Figure.16), and remote monitoring was enabled.

d. Continuous radiation monitoring on the side ditch

A continuous monitoring device (refer to Figure.17) has been installed in the ditch which is an out-flow route to the ocean in case leakage occurs from tanks. The construction work has been conducted to set up a drainage ditch route from the C ditch to inside of the port (refer to Figure.18).

3. NRA's evaluation with regard to the report submitted by TEPCO and the future response

(1) Environmental impact (expansion of contaminated water)

There is no obvious fluctuation in the monitoring results at the vicinity of the south discharging outlet (T-2-1) before and after the leakage of the tank. There is no detection of total beta that suggests leakage of the contaminated water leaked from the tank (total beta/radioactive cesium concentration rate is 10^3 to 10^4 (refer to Table 3)) to the ocean at the point T-2 which is the closest to the C drainage ditch after finding leakage.

TEPCO estimates approximately 80% of the radioactive materials (radioactive strontium 90) contained in the leaked contaminated water were recovered by removal of the contaminated soil around the tank area.

Based on the facts above, the NRA evaluates that there has been no contamination of the ocean that raises any concern about influence to health and the environment from the measurement result of strontium contained in soil as a result of the oceanic monitoring.

Also, TEPCO is scheduling the recovery of the remaining contaminated soil starting from February 2015 along with the replacing construction work of the H4 north tank area, and the NRA will be checking the situation of the implementation through the safety inspection at an appropriate timing.

(2) Exposure radiation dose

Equivalent radiation dose to skin caused by effective exposure of radiation dose of the gamma ray and the beta ray to the workers who conducted patrol was evaluated in consideration of higher concentration of the beta ray radiation nuclide in the contaminated water leaked from the tank that is as high as the total beta/cesium concentration rate of 10^3 to 10^4 (refer to Table 2).

The effective dose had no identified difference before and after discovery of the

leakage. The equivalent radiation dose to skin was well below annual radiation dose limitation of 500mSv although the maximum dose per single entry zone significantly increased. Thus, the NRA evaluates that there is no exposure to concern.

(3) Countermeasures

TEPCO indicated the assumed cause from the obtained information indicated countermeasures relating to tank leakage, the countermeasures for the leakage expansion prevention and the early stage detection. The NRA has evaluated them as the followings.

i. Countermeasures relating to tank leakage

The Secretariat of the NRA has checked on the purification work and draining water by the purification system that are not described in the report in addition to replacing the tanks to welded tanks and tentative countermeasures in the Secretariat of the NRA's document for a meeting with TEPCO. It can be evaluated to have a certain level of effect for reducing risk of leakage since more than two countermeasures are implemented for both areas of tanks (refer to Table 4). Countermeasures summarized by TEPCO such as the replace measure of the flange type tank shall be checked about its implementation situation at an appropriate timing by safety inspection, etc. (refer to Figure 19).

ii. Countermeasures against leakage expansion prevention, early stage detection, etc.

Countermeasures against leakage expansion prevention, early stage detection, etc are implemented as needed for the existing area of tanks, and the countermeasures for the area of tank with contaminated water stored have been all completed (refer to Table 5, 6, 7), so that they can be evaluated as reducing a risk of leakage expansion. Countermeasures summarized by TEPCO shall be checked about its implementation situation at an appropriate timing by safety inspection, etc.

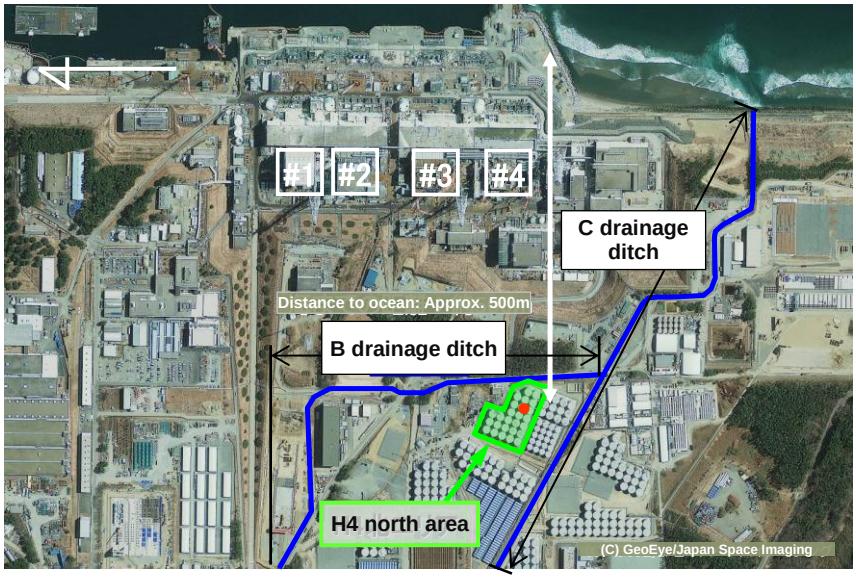


Figure 1 H4 north area*2

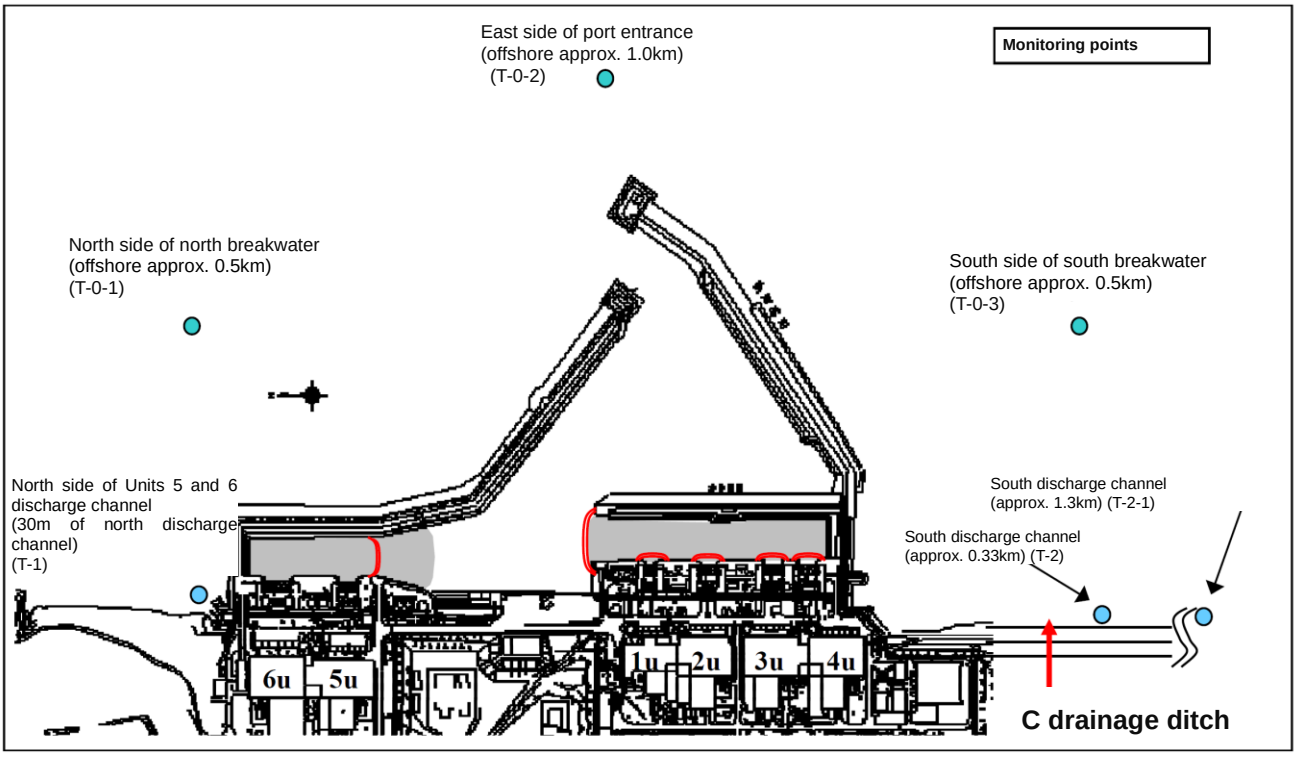
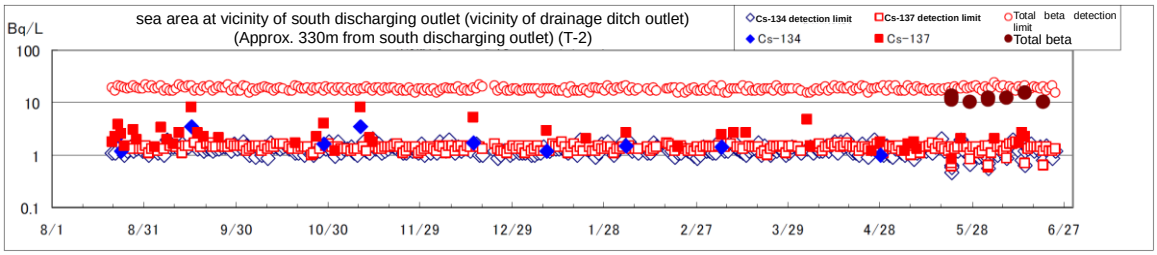
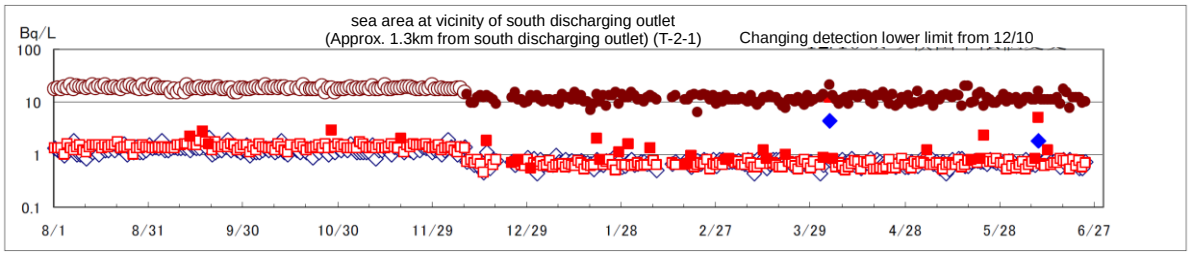


Figure 2 Sampling points of seawater*2
(As of October 2013)

*2: Extracted from TEPCO report



Vicinity of south discharging outlet (Approx. 0.33km from South discharging outlet) (T-2)



Vicinity of south discharging outlet (Approx. 1.3km from south discharging outlet) (T-2-1)

Figure 3　Results of seawater monitoring[*2]

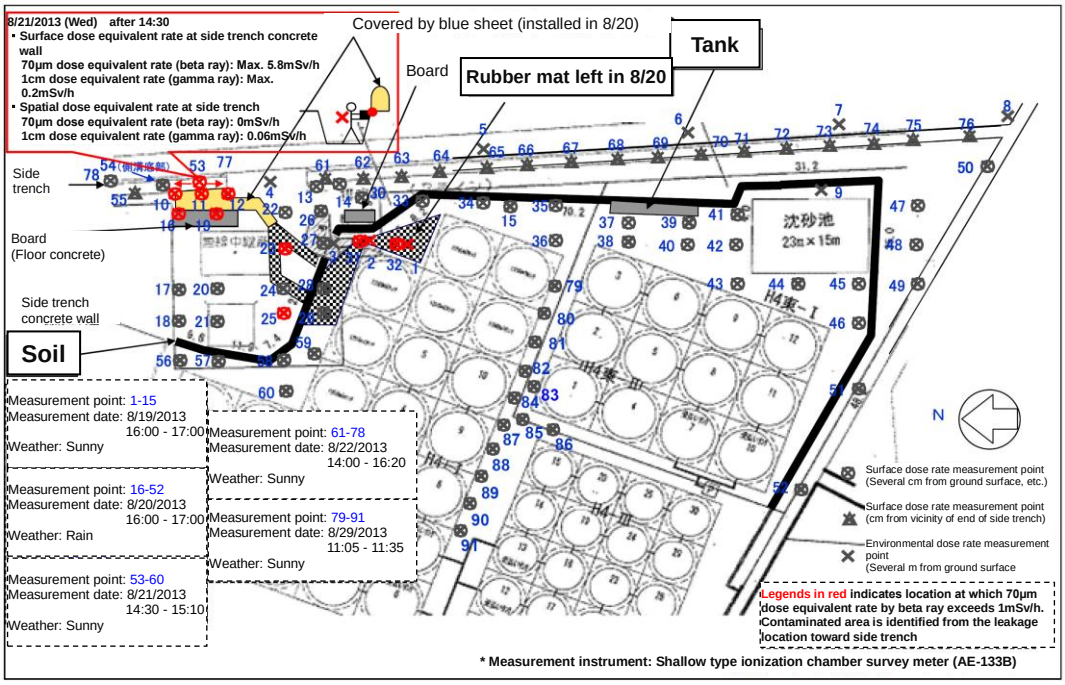


Figure 4　Radiation dose rate survey on ground surface (measurement point)[*2]
(Table 1 shows inspection results of radiation dose rate)

2: Extracted from TEPCO report

Table 1 Survey results of radiation dose rate *2
(Figure 4 shows location of measurement)

[mSv/h]

Measurement	Measurement date	Dose rate: 70μm dose equivalent rate (beta ray)	Dose rate: 1cm dose equivalent rate (gamma ray)	Weather	Remarks
1	8/19	>98.5	1.5	Sunny	Without rubber mat Approx. 50cm height
2	8/19	5.4	0.1	Sunny	Without rubber mat
3	8/19	0.03	0.05	Sunny	Without rubber mat
4	8/19	0	0.04	Sunny	
5	8/19	0	0.06	Sunny	
6	8/19	0	0.06	Sunny	
7	8/19	0	0.045	Sunny	
8	8/19	0	0.06	Sunny	
9	8/19	0.135	0.015	Sunny	
10	8/19	89.64	0.36	Sunny	Without sheet
11	8/19	95.55	0.45	Sunny	Without sheet
12	8/19	89.65	0.35	Sunny	Without sheet
13	8/19	0.28	0.07	Sunny	
14	8/19	0.01	0.11	Sunny	
15	8/19	0.009	0.015	Sunny	

[mSv/h]

Measurement	Measurement date	Dose rate: 70μm dose equivalent rate (beta ray)	Dose rate: 1cm dose equivalent rate (gamma ray)	Weather	Remarks
16	8/20	8.96	0.04	Rain	On concrete
17	8/20	0.03	0.10	Rain	
18	8/20	0.02	0.08	Rain	
19	8/20	1.96	0.04	Rain	On concrete
20	8/20	0.02	0.08	Rain	
21	8/20	0.09	0.08	Rain	
22	8/20	0.12	0.03	Rain	
23	8/20	2.90	0.10	Rain	
24	8/20	0.04	0.16	Rain	On rubber mat
25	8/20	1.24	0.06	Rain	
26	8/20	0	0.11	Rain	
27	8/20	0.04	0.03	Rain	Same as No.3
28	8/20	0.08	0.03	Rain	On rubber mat
29	8/20	0.8	1.2	Rain	On rubber mat
30	8/20	0.02	0.12	Rain	

* Measurement instrument: Shallow type ionization chamber survey meter (AE-133B)

[mSv/h]

Measurement	Measurement date	Dose rate: 70μm dose equivalent rate (beta ray)	Dose rate: 1cm dose equivalent rate (gamma ray)	Weather	Remarks
31	8/20	4.89	0.11	Rain	On rubber mat Same as No.2
32	8/20	15	1	Rain	On rubber mat Same as No.1
33	8/20	0	0.06	Rain	
34	8/20	0.06	0.02	Rain	
35	8/20	0.01	0.02	Rain	
36	8/20	0	0.02	Rain	
37	8/20	0.03	0.04	Rain	
38	8/20	0.01	0.04	Rain	
39	8/20	0	0.04	Rain	
40	8/20	0.03	0.03	Rain	
41	8/20	0	0.03	Rain	
42	8/20	0	0.03	Rain	
43	8/20	0.06	0.03	Rain	
44	8/20	0	0.03	Rain	
45	8/20	0	0.03	Rain	

[mSv/h]

Measurement	Measurement date	Dose rate: 70μm dose equivalent rate (beta ray)	Dose rate: 1cm dose equivalent rate (gamma ray)	Weather	Remarks
46	8/20	0.01	0.02	Rain	
47	8/20	0	0.04	Rain	
48	8/20	0	0.04	Rain	
49	8/20	0.03	0.03	Rain	
50	8/20	0.04	0.03	Rain	
51	8/20	0.02	0.03	Rain	
52	8/20	0.02	0.03	Rain	
53	8/21	5.80	0.20	Sunny	
54	8/21	0	0.06	Sunny	
55	8/21	0.02	0.08	Sunny	
56	8/21	0	0.05	Sunny	
57	8/21	0.01	0.04	Sunny	
58	8/21	0.01	0.04	Sunny	
59	8/21	0.01	0.04	Sunny	
50	8/21	0	0.05	Sunny	

* Measurement instrument: Shallow type ionization chamber survey meter (AE-133B)

*2: Extracted from TEPCO report

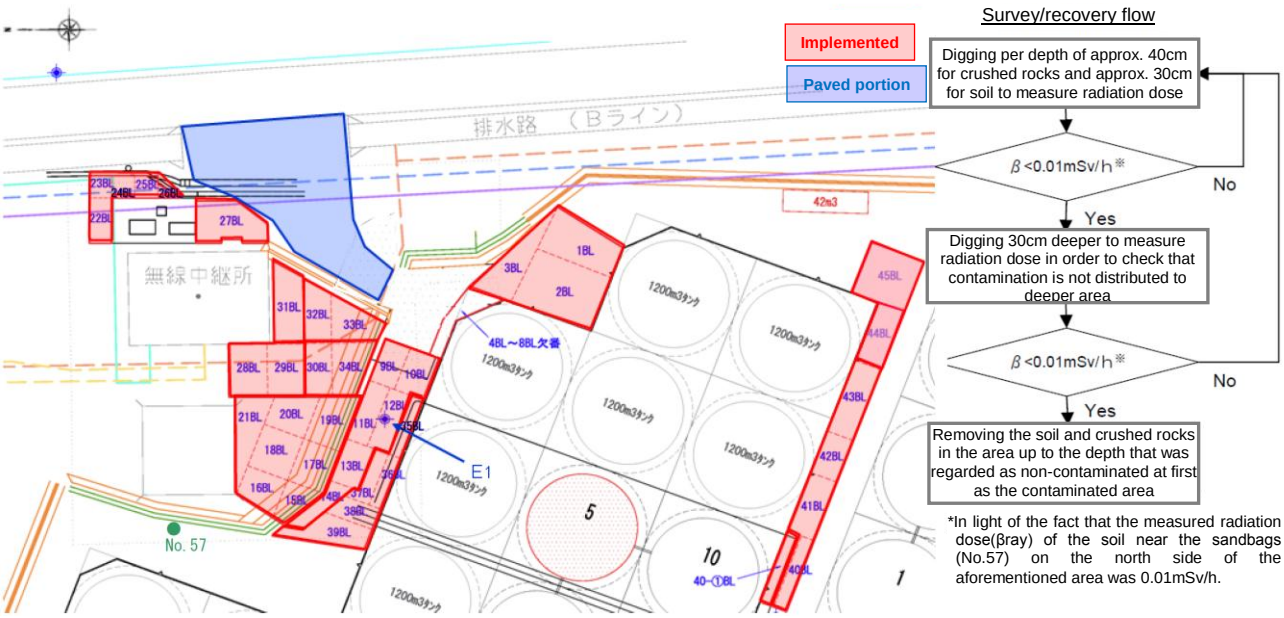


Figure 5　Contaminated soil recovery portion*2

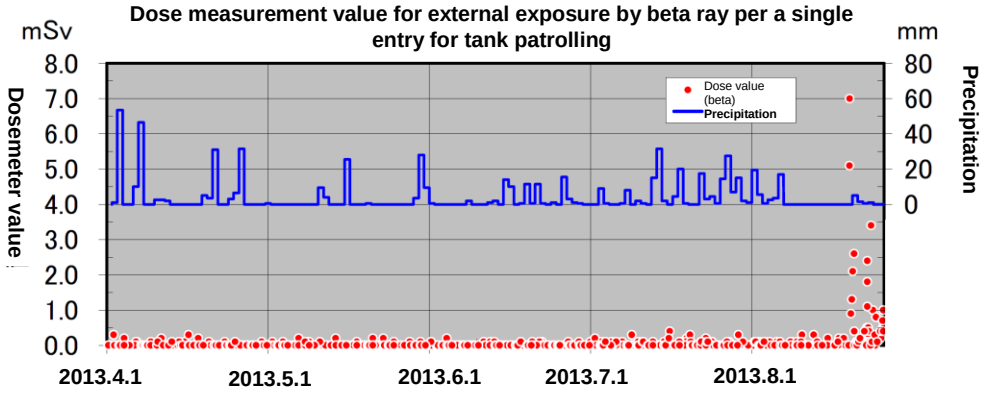
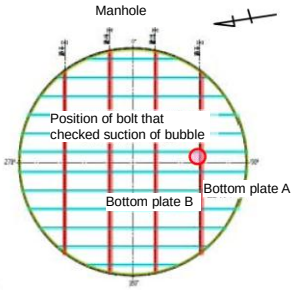


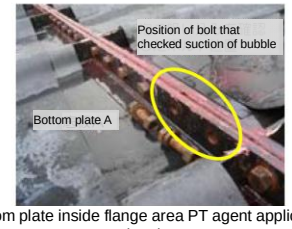
Figure 6　External exposure dose values of beta ray on the workers who patrolled the tanks*2

*2: Extracted from TEPCO report

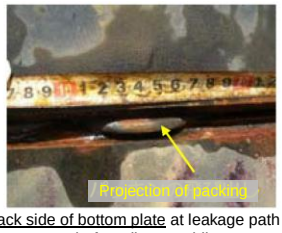
Table 2　Radiation exposure evaluation results (extracted from TEPCO's document for a meeting with the NRA)

Difference of radiation exposure　per work		Effective dose rate (gamma ray)		Equivalent radiation dose (skin) (beta ray)	
		Annual dose limits: 50mSv		Annual dose limits: 500mSv	
		Average dose per a single entry [mSv]	Maximum dose per a single entry [mSv]	Average dose per a single entry [mSv]	Maximum dose per a single entry [mSv]
Tank patrol					
	Before discovering leakage (4/1 - 6/30)	0.05	0.81	0.01	0.3
	Before discovering leakage (7/1 - 8/18)	0.05	0.36	0.03	0.4
	After discovering leakage (8/19 - 9/1)	0.05	0.13	0.54	7.0
	After enhancing patrol (9/2 – 9/20)	0.07	0.33	0.05	4.2
	After re-enhancing patrol (9/21 – 9/30)	0.03	0.17	0.02	2.2
	After re-enhancing patrol (10/1 – 10/31)	0.03	0.53	0.08	0.5
	After re-enhancing patrol (11/1 – 11/30)	0.02	0.22	0.01	1.0
	After re-enhancing patrol (12/1 – 12/31)	0.02	0.15	0.01	0.9

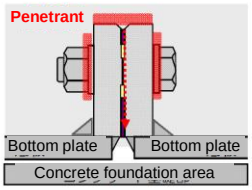


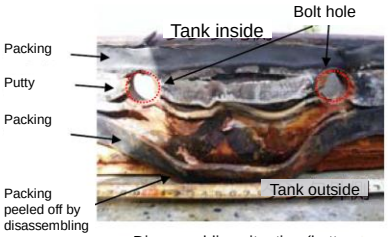


Bottom plate inside flange area PT agent application situation

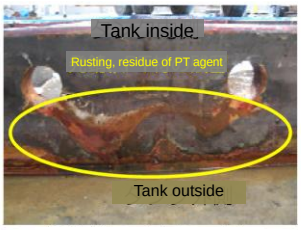


Back side of bottom plate at leakage path area before disassembling
(Sling bottom plate A and B straight up and check)

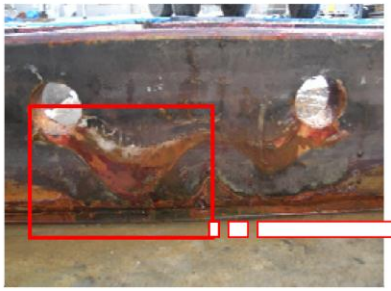


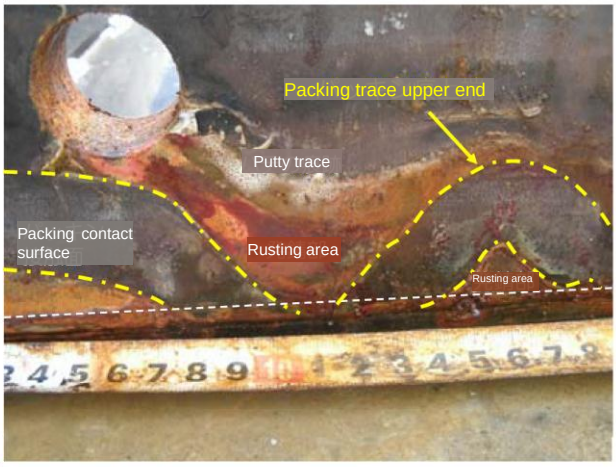


Disassembling situation (bottom plate B side)



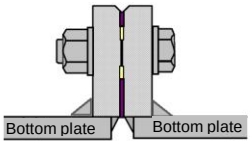
Disassembling situation (bottom plate A side)



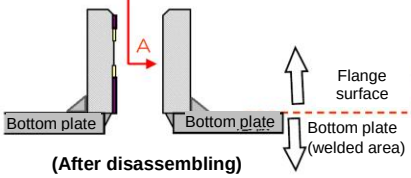


Bottom plate A side

Flange surface lower end
(Bottom plate upper end)



(Before disassembling)



(After disassembling)

Packing is lowered due to temporal deterioration

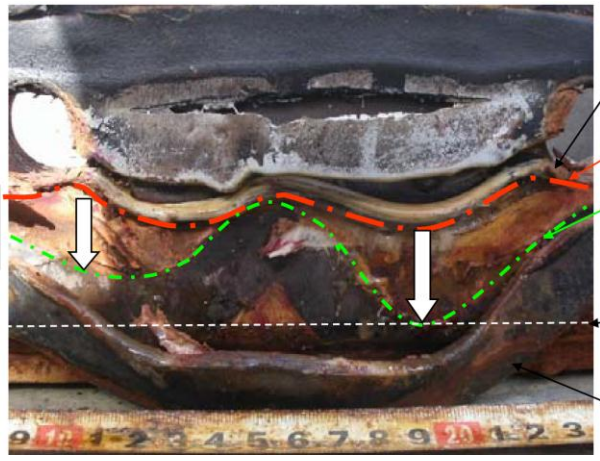


Figure 7 Location of leakage[*2]

*2: Extracted from TEPCO report

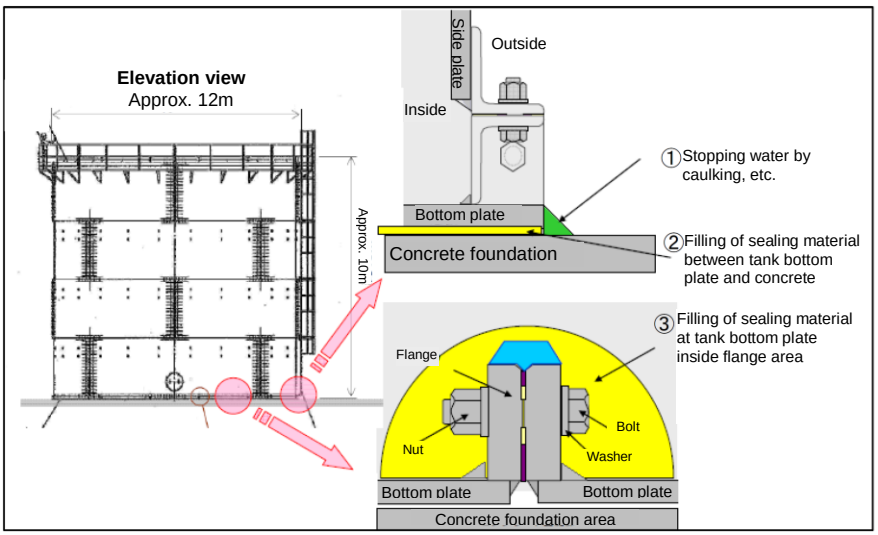


Figure 8 Tentative countermeasures until replacing with welded tanks*2

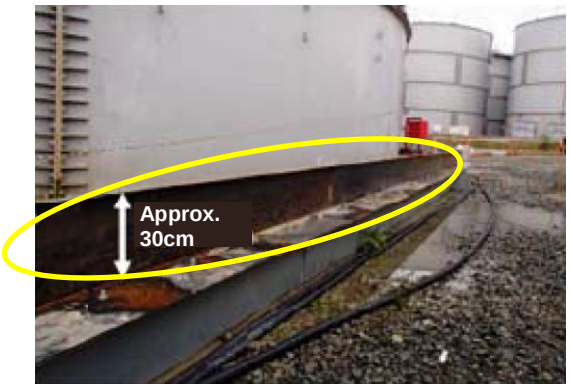


Figure 9 Situation of height raising of dike by steel plate*2
(H4 north area)

Figure 10 Situation of further height raising of dike*2
(J1 area)

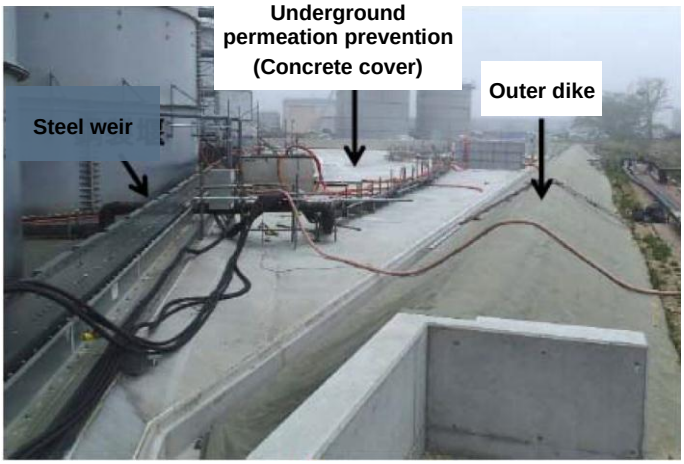


Figure 11 Situation of doubling dike and underground permeation prevention*2

*2: Extracted from TEPCO report

Figure 12　Situation of B drainage ditch lining*2

Figure 13　Situation of covering B drainage ditch*2

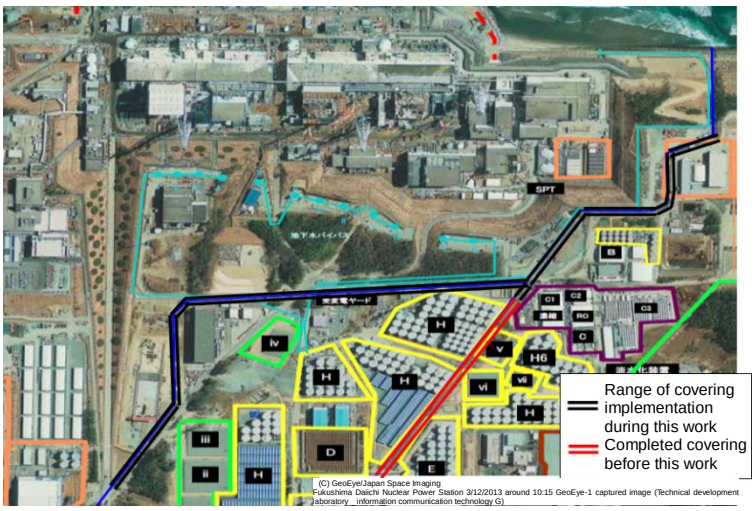


Figure 14　Drainage ditch covering range
(Extracted from TEPCO's document for a meeting with the NRA.　Partially added)

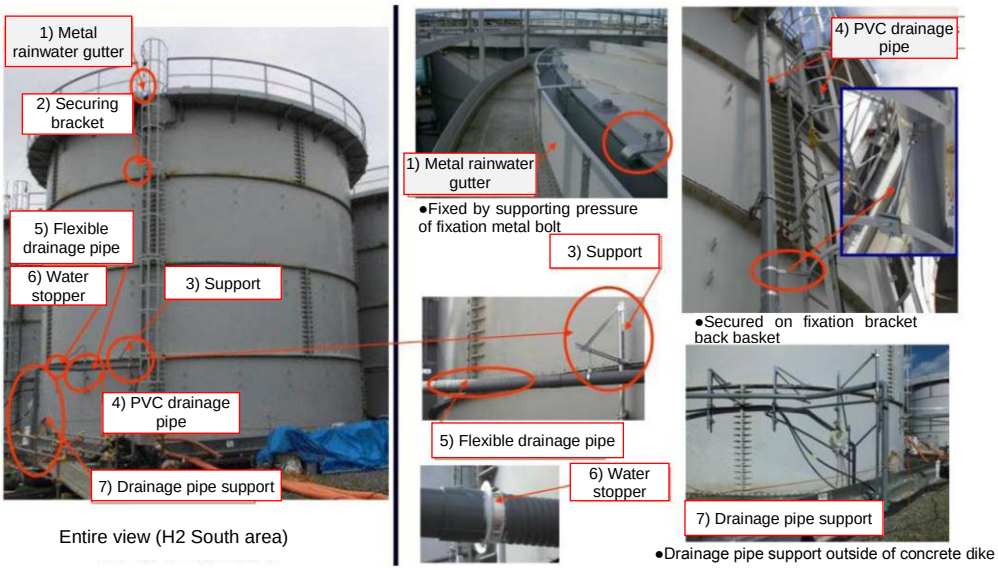
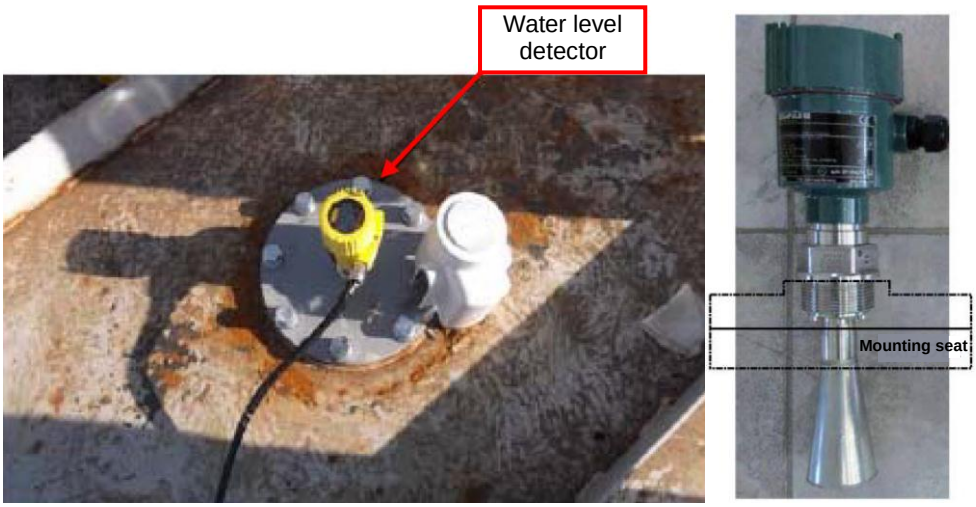


Figure 15　Situation of rainwater gutter installation to tank ceiling plate※2

*2: Extracted from TEPCO report



Situation of installation of tank water level gauge　　radar type water level gauge

Figure 16　Situation of installation of water level gauge*2

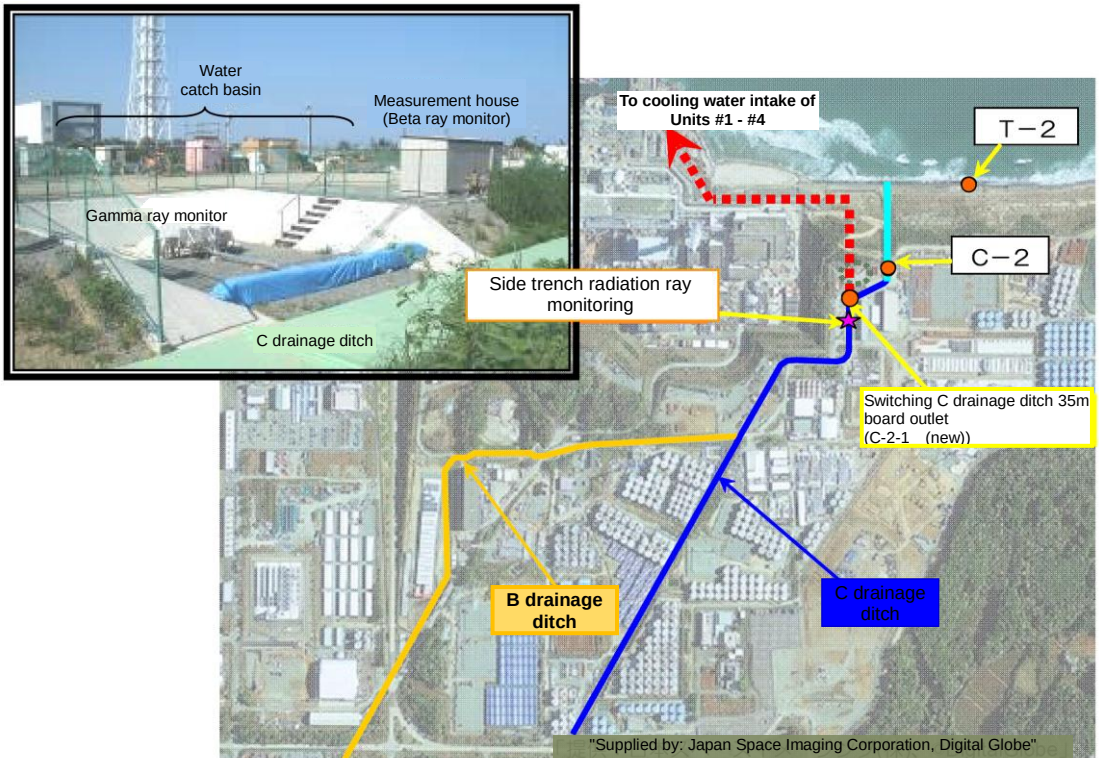


Figure 17　Side trench radiation ray monitoring*2

*2: Extracted from TEPCO report

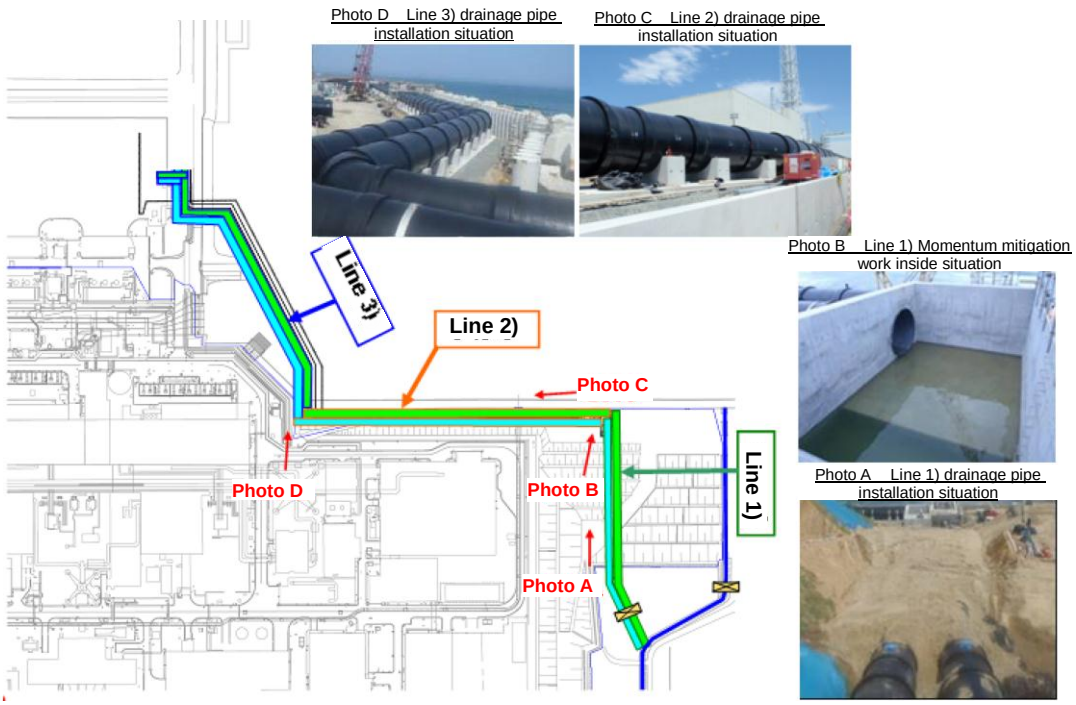


Figure 18 Situation of construction work of the drainage ditch route from the C drainage ditch to inside of the harbor*2

Table 3 Radioactive material concentration of leakage tank water and leakage water*2

Nuclide	No.5 tank water (Collection 8/23/2013 21:00)		[Reference] Leakage water (recovered from inside of dike) (Collection 8/19/2013 16:00)	
	Concentration (Bq/cm^3)	Leakage quantity (Bq)	Concentration (Bq/cm^3)	Leakage quantity (Bq)
Cs-134	4.4E+01	1.3E+10	4.6E+01	1.4E+10
Cs-137	9.2E+01	2.8E+10	1.0E+02	3.0E+10
Co-60	ND(3.8E+00)	1.1E+09	1.2E+00	3.6E+08
Mn-54	ND(5.2E+00)	1.6+09	1.9E+00	5.7E+08
Sb-125	5.3E+01	1.6E+10	7.1E+1	2.1E+10
Sr-90	1.5E+05	4.5E+13	-	-
H-3	2.4E+03	7.2E+11	2.1E+03	6.3E+11
Total beta	4.1E+05	1.2E+14	2.8E+05	8.4E+13

Note: Among the leakage quantity of No.5 tank water, the each quantity of Co-60 and Mn-54 was obtained by using detection lower limit value.

*2: Extracted from TEPCO report

Table 4　Progress situation of countermeasures relating to tank leakage
(Based on TEPCO's document for a meeting with the NRA)

Types of flange type tank	Installation area	Number of tanks	Tank replace countermeasures			Tentative countermeasures		
			Purification	Water drain (planned completion)	Disassembly/replace	1) Caulking, etc.	2) Sealing between bottom plate/foundation	3) Sealing at inside flange section
TYPE 1	H1 east	12	-	Jan. 2015	Replace	○	As a result of mock up test, implementation to actual system is difficult	Implementing replace
	H2	23	-	Feb. 2015				
	H4 north	8	-	Feb. 2015				
	H4	20	-	Mar. 2015				
	H4 east	12	-	Dec. 2014				
	H5	23	-	Jan. 2015	Not determined			
	H6	8	-	Mar. 2015				
	H9	5	-	Not determined	Not determined			○
	H9 west	7	-					
	B	20	-	Sep. 2015	Disassemble			Implementing purification/water drain, replace
TYPE 2	H4 north	16	-	Feb. 2015	Replace			
	H5 north	8	MobileSr	Not determined	Not determined			
	H6 north	16	-	Mar. 2015	Not determined			
TYPE 3	H3	10	-	Mar.2015	Not determined			
	E	25	-	Mar. 2015	Not determined			
TYPE 4	H3	1	-	Mar. 2015	Not determined			
	E	19	-	Mar. 2015	Not determined			
TYPE 5	H2	5	-	Dec. 2014	Replace			
	E	5	-	Mar. 2015	Not determined			
	C	13	MobileSr	Not determined	Not determined			
	G6	38	MobileSr	Not determined	Not determined			
	G4 south	17	MobileSr	Not determined	Not determined			
	G4 north	6	ALPS	Continue using	Not determined			
	G5	17	ALPS	Continue using	Not determined			

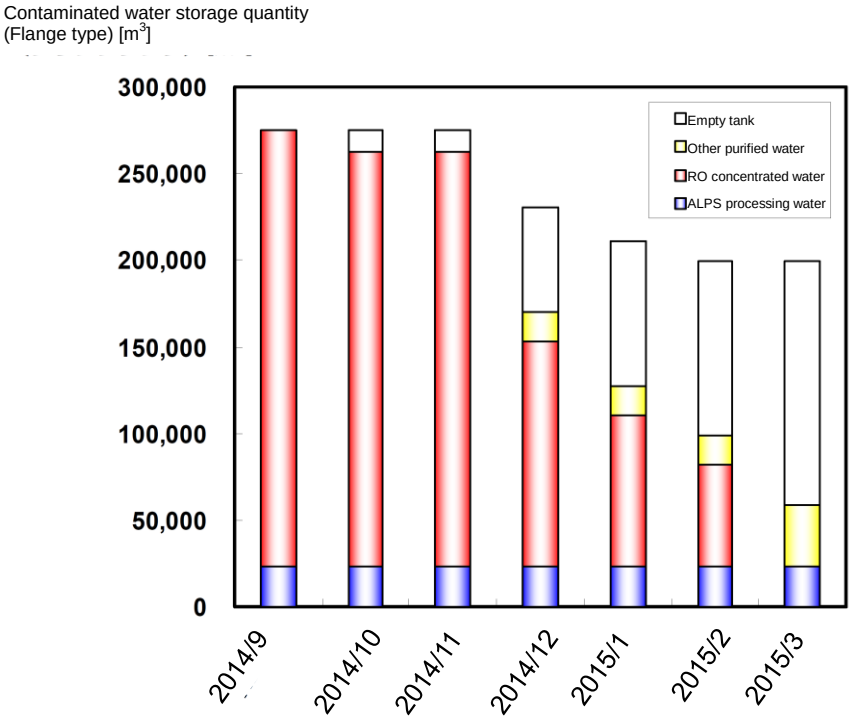


Figure 19　Future utilization principle of flange type tanks
(Extracted from the Secretariat of the NRA's document for a meeting with TEPCO)

Table 5　Situation of leakage countermeasures of existing tank area and countermeasures implementation of early stage detection, etc.
(As of 11/24/2014)
(Extracted from the Secretariat of the NRA's document for a meeting with TEPCO)

*

The blank column represents an installation plan being reviewed.

	Area	Weir height raising by steel members		Adequate dike height			Outer dike/preventing permeation			Rainwater gutter
		Weir installation	Covering dike	Name process	Inner dike	Covering dike	Name	Outer dike	Covering dike	
Existing/tank area	B north	Completed	Completed	<B> Concrete	Completed	Completed	<B>	Completed	Completed	Completed
	B south	Completed	Completed							Completed
	C east	Completed	Completed	<C> Concrete	Completed	Completed	<G>	Completed	Completed	Completed
	C west	Completed	Completed							Completed
	E	Completed	Completed	<E> Steel member	Completed	Completed	<E>	Completed	Completed	Completed
	H1 east	Completed	Completed	<H1> Steel member	Completed	Completed	<H1>	Completed	Completed	Completed
	H2 north	Completed	Completed	<H2> Steel member	Completed	Completed	<H2>	Completed	Completed	Completed
	H2 south	Completed	Completed							Completed
	H3	Completed	Completed	<H3> Steel member	Completed	Completed	<H3>	Completed	Completed	Completed
	H4 north	Completed	Completed	<H4A> Steel member	Completed	Completed	<H4>	Completed	Completed	Completed
	H4 east	Completed	Completed							Completed
	H4	Completed	Completed	<H4B> Steel member	Completed	Completed				Completed
	H5	Completed	Completed	<H5> Steel member	Completed	Completed	<H5>	Completed	Completed	Completed
	H6	Completed	Completed	<H6> Steel member	Completed	Completed	<H6>	Completed	Completed	Completed
	H8 north	Completed	Completed	<H8> Steel member	Completed	Completed	<H8>	Completed	Completed	Completed
	H8 south	Completed	Completed							
	H9 west	Completed	Completed	<H9> Steel member	Completed	Completed	<H9>	Completed	Completed	Completed
	H9 east	Completed	Completed							Completed
	G3 east	Completed	Completed	<G3A> Concrete	Completed	Completed	<G3-G5>	Completed	Completed	Completed
	G3 west	Completed	Completed	<G3B> Concrete	Completed	Completed				Completed
	G3 north	Completed	Completed	<G4> Concrete	Completed	Completed				Completed
	G4 south	-*	Completed							Completed
	G4 north	-*	Completed							Completed
	G5	-*	Completed	<G5> Concrete	Completed	Completed				Completed
	G6 south	Completed	Completed	<G6> Concrete	Completed	Completed	<G6>	Completed	Completed	Completed
	G6 north	Completed	Completed							Completed

Table 6　Situation of leakage countermeasures of addition/replace tank area and countermeasures implementation of early stage detection, etc.
(As of 11/24/2014)
(Extracted from the Secretariat of the NRA's document for a meeting with TEPCO)

* The blank column represents an installation plan being reviewed.

	Area	Temporary dike installation	Adequate dike height			Outer dike/preventing permeation			Rainwater gutter
		Weir height 25cm	Name process	Inner dike	Covering dike	Name	Outer dike	Covering dike	
New installation /replace tank area	D	Implementing as needed (per in service)							Implementing as needed
	G7	Completed	<G7> Concrete	Completed	Completed	<G7>	Completed	Completed	Completed
	J1 (east)	Completed	<J1 east> Concrete	Completed	Completed	<J1 east>	Early December planned completion	Mid December planned completion	Completed
	J1 (mid)	Completed	<J1 mid> Concrete	Completed	Completed	<J1 mid>	End November planned completion	End November planned completion	Completed
	J1 (west)	Completed	<J1 west> Concrete	Completed	End November planned completion	<J1 west>	End November planned completion	Early December planned completion	Completed
	J2	Implementing as needed (per in service)							Implementing as needed
	J3	Implementing as needed (per in service)							Implementing as needed
	J4	Implementing as needed (per in service)							Implementing as needed
	J5	Implementing as needed (per in service)							Implementing as needed
	J6								
	K1 (north)								

Table 7　Countermeasures completion time in existing tank area
(Based on TEPCO's document for a　meeting with the NRA)

Leakage expansion countermeasures and countermeasures for detection in early stage		Countermeasures completion time
Operation with drain valve closed		8/28/2013
Height raising of tank dike	Weir height raising by steel members	Late December 2013
	Adequate dike height	Early July 2014
Implementing doubling dikes, preventing permeation into the ground at the ground surface between outer dike and dike, and between outer dikes		Mid July 2014
Prevention of flowing into drainage ditch		Late February 2014
Enhancing patrol *3		9/21/2013
Suppressing in-flow of rain water		Late July 2014
Installation of water level gauge on individual tanks	Flange type tank	Late November 2013
	Steel cylinder tank (welding type)	Mid March 2014
Addition of warning function of water level gauge		Early December 2013 *4
Construction work of a route to drain from the C drainage ditch to inside of harbor		Late July 2014
Side trench radiation ray monitoring		Mid July 2014

*3: Before leakage check:　2 workers twice a day (total number of persons: 4)

From 9/2: Day time 30 workers x 3 times, Night time　4 workers x 1 time　(total number of persons: 94)

From 9/21: 30 workers x 4 times (total number of persons: 120)

Implementing the same system after installing water level gauge.

*4　Start time of the operations. This warning function is added in each installation of a new tank.