

September 3, 2013

Agency for Natural Resources and Energy, METI of Japan

2<sup>nd</sup> Fact sheet: Overview of Contaminated Water Issue at TEPCO's Fukushima Daiichi NPS

On June 19, 2013, TEPCO announced that ground water in the area between the turbine buildings and plant port in Fukushima Daiichi NPS had been contaminated with radioactive materials. Furthermore, TEPCO announced that on July 22 a part of this contaminated ground water leaked into the plant port.

Radioactive influence in the sea water was only observed in the limited area of the plant, (smaller than 0.3 km<sup>2</sup>), for instance total beta activity in other points of the plant port and open sea was below the detection limit, or similar. Of course, no problem happens in the sea at Tokyo which is located about 200 km away from Fukushima Daiichi NPS (refer to Attachment 1 and 2).

Minister of Economy, Trade and Industry expressed that the immediate and fundamental countermeasures for contaminated water would be implemented in accordance with three principles, 1) removing the source of the contamination, 2) isolating ground water from the contamination source, and 3) preventing leakage of the contaminated water.

Under the principles, TEPCO took immediate countermeasures and planned fundamental countermeasures to be implemented within one to two years. The immediate countermeasures are i) enclosing contaminated soil with sodium silicate walls, ii) pumping out contaminated water from the trenches and isolating them, and iii) bypassing groundwater. The fundamental countermeasures are i) pumping out the ground water from the sub-drain before reaching to the reactor buildings, ii) installation of sea-side impermeable walls, iii) installation of land-side impermeable walls, and iv) installation of contaminated water treatment equipment with superior performance.

On August 19, TEPCO found that about 300 m<sup>3</sup> of highly contaminated water leaked from a bolted joint tank. The tank is located about 500 m away from the sea. While the Nuclear Regulation Authority evaluated this event on INES rating Level 3, most of the side ditch which connects to the sea was not contaminated. It is currently considered that there is the low possibility of that the leaked contaminated water flowed into the sea through the side ditch.

METI Minister, Motegi gave the following five directions to TEPCO during his visit to Fukushima Daiichi NPS on August 26, i) enhanced management of the tanks and the surrounding area, ii) reinforced patrol, iii) accelerated replacement from bolted joint tanks to welded joint tanks, iv) acceleration of the highly-contaminated water treatment and a decrease of radiation dose of the surrounding area by collecting the contaminated soil, and v) identification of the risks of storing highly-contaminated water and taking actions against the risks.

The Government of Japan itself has determined to play a proactive role, such as providing financial support, in TEPCO's implementing these countermeasures, including reinforcement of monitoring activities, in order for the earliest and fundamental settlement of the contaminated water issue.

(This document is intended to provide a series of factual information regarding the contaminated ground water leakage situation and the countermeasures dealing with this issue.)

1. On June 19, 2013, TEPCO announced that it had detected contaminated ground water in Observation Well No. 1 at the eastward (seaward) area between the turbine buildings and plant port in Fukushima Daiichi NPS. The contaminated ground water was found during the following investigations. TEPCO conducted investigations to identify the cause of the fact that a few points of the plant port contamination remained at a certain level by setting up an external Expert Group this April. Against this backdrop, TEPCO dug observation wells in the eastward area of the turbine buildings and conducted radioactive analyses of the ground water in the wells.

2. Furthermore, TEPCO announced on July 22 that the contaminated ground water was leaking to a zone of near the plant port. There were a few points which indicated significant changes in radioactive material concentrations in the near plant zone (smaller than 0.3 km<sup>2</sup>), and that a significant change was not observed at the other parts inside or outside of the port. The radioactive material concentrations near the port boundary have been, at most, a low level becquerels per liter or below detection limit. It is considered that no meaningful influence to the surrounding environment can be assumed to have occurred outside the port, according to the observations made. Attachment 2 illustrates the radioactive material concentrations of seawater both inside and outside the port. According to TEPCO, the amount of tritium leaked in 2 years and 2 months, from May 2011 to July 2013, is estimated to range from 20 trillion to 40 trillion becquerels. For reference, the maximum allowed annual release of tritium during the normal operation phase of Fukushima Daiichi is 22 trillion becquerels per year. If TEPCO's estimation is correct, the amount of leaked tritium is within the maximum allowed annual release.

3. While investigating other possibilities of paths and root causes, TEPCO currently estimates that the source of the contamination is the remaining contaminated water in the power supply cable trenches connecting the turbine building of Unit 2 and the sea water circulation pumps near the sea shore, where highly contaminated water from the reactor building intruded during the aftermath of the accident in April 2011, and that this water is leaking and contaminating part of the ground water which flows into the plant area from the mountain side of the facilities, and is flowing into the sea port water. TEPCO estimates that the whole plant area of Units 1 to 4 has approx. 1000 m<sup>3</sup> of ground water flow every day and 400 m<sup>3</sup> of this flows into the basement of the facility buildings. Some part of the other ground water is considered to be contaminated by the remaining water in the trench and flows into the port through the soil.

4. Minister of Economy, Trade and Industry expressed that the immediate and fundamental countermeasures for contaminated water would be implemented in accordance with three principles, 1) removing the source of the contamination, 2) isolating ground water from the contamination source, and 3) preventing leakage of the contaminated water. The followings are countermeasures either being, or to be taken against the contaminated ground water leakage (refer to Attachment 3).

#### Immediate Countermeasures

1) Enclosing contaminated soil with sodium silicate walls

In the eastwards area from the turbine building where the contamination of ground water was detected, preparation is underway to enclose the soil for preventing contaminated ground water leakage to the sea, to pave the land surface with asphalt to prevent rain water inflow, and to pump out the dammed up ground water. TEPCO estimates the amount of pumping to be around 140 m<sup>3</sup> per day.

The injection of sodium silicate started from July 8 for enclosing the soil between Units 1 and 2 and the enclosure was completed on August 10. The contaminated ground water dammed up by the sodium silicate walls has been being pumped out since August 9. Consequently, the ground water level has been lower than the top of the sodium silicate walls since August 18. In addition, TEPCO started preparation for isolating the contaminated area to be completed in October. TEPCO started the enclosure of the soil between Units 2 and 3 as well as between Units 3 and 4.

2) Pumping out contaminated water from the trenches and isolating them

For the countermeasures against the highly contaminated water in the trenches, TEPCO plans to pump out the contaminated water from a part of the trenches and isolate them by the end of October.

Furthermore, TEPCO will start pumping out water from other trenches in September. TEPCO will examine a freezing method to block the water flow between the turbine buildings and the trenches as soon as possible in order to confirm technical problems. If the freezing method is feasible, TEPCO will start isolating the trenches by the freezing method. It is planned to be completed around April 2014.

3) Bypassing groundwater

This countermeasure is to pump out groundwater at the mountainside area from the reactor buildings in order to reduce the amount of ground water inflow into this area. The facilities have been installed already. The current status is the explanation process to the local stakeholders.

#### Fundamental Countermeasures

- 4) Pumping out the ground water from the sub-drain before reaching to the reactor buildings (currently under planning)

This countermeasure is discussed under the Committee on Countermeasures for Contaminated Water Treatment of the Council for the Decommissioning of TEPCO's Fukushima Daiichi NPS.

- 5) Installation of sea-side impermeable walls (under construction)

The sea-side impermeable walls have been under construction since FY 2012 (e.g. digging holes from June 2012 and placing steel pipe sheet piles from April 2013.) The estimated completion date is around September 2014.

- 6) Installation of land-side impermeable walls

Installation of land-side impermeable walls which enclose the area of Units 1 to 4 is being considered. This measure is being prepared in case the other measures (e.g. bypassing ground water and pumping out water from sub-drains adjacent to the reactor buildings) to control ground water level do not work sufficiently. The land-side impermeable walls will be constructed by the frozen soil method, which is evaluated to have good impermeability and on-site workability, and are aimed to be operational as soon as possible. The feasibility study for the land-side impermeable walls by the frozen soil method will be implemented by the end of FY 2013. The land-side impermeable walls will be installed in the first half of FY 2015.

- 7) Installation of high performance contaminated water treatment equipment

This countermeasure is to install the high performance decontamination equipment for highly-contaminated water.

5. On August 2, the Nuclear Regulation Authority settled the Working Group for Review on Contaminated Water Countermeasures of the Supervision and Evaluation Committee for the Specified Nuclear Power Facilities and started offering technical support to TEPCO.

6. At the Nuclear Emergency Response Headquarters meeting held on August 7, Prime Minister Abe stated that the Government of Japan itself would play a proactive role in TEPCO's implementing the countermeasures for the contaminated water leakage issue. On August 8, the Committee on Countermeasures for Contaminated Water Treatment of the Council for Decommissioning TEPCO's Fukushima Daiichi NPS decided to establish procedures and methodologies for each activity to completely settle the contaminated ground water leakage issue with both immediate and fundamental countermeasures by the end of the coming September based on the above mentioned three principles (refer to Attachment 3).

7. On August 19, TEPCO announced that it discovered a water leak from a drain valve of a tank dike in the H4 area, which is located about 500 m away from the sea and at one of the installation locations of the contaminated water tanks in Fukushima Daiichi NPS. Because high radiation doses were detected in a puddle of water that had leaked outside the dike, TEPCO determined that the water had leaked from the contaminated water tank. TEPCO found water spread in the neighborhood of the No.5 tank in the H4 area and confirmed that the water level of the No. 5 tank was 3 m lower than its normal level. TEPCO estimated that the amount of the leaked contaminated water was 300 m<sup>3</sup>. A high radiation dose point (5.8 mSv/h) was identified at the dike connecting from the near tank area to the sea, according to TEPCO's survey. At the same time, however, any meaningful increase in radioactive concentration was not observed in the sea, including at the outlet of the dike. The radioactive concentration at the outlet was extremely low level or below the detection limit. In cooperation with the Government of Japan, TEPCO is working to prevent any spread of contamination, investigating the cause of this issue, and prevent similar events (refer to Attachments 4 - 6).

8. METI Minister, Motegi gave five directions (e.g., enhancement of tank management and reinforcement of patrols) to TEPCO regarding the contaminated water leakage from the bolted joint tank during his visit to the Fukushima Daiichi NPS on August 26 (refer to Attachment 6). In addition, he stated that it was one of the most urgent challenges for the Government of Japan to address the contaminated water issue at Fukushima Daiichi NPS and that METI had prepared financial measures, in cooperation with financial authorities, including the use of reserve funds, to urgently support the R&D challenges and high technical difficulties faced.

9. The Government of Japan itself has determined to play a proactive role, such as providing financial support, in TEPCO's implementing these countermeasures, including reinforcement of monitoring activities, in order for the earliest and fundamental settlement of the contaminated water issue..

(End)



# Current radioactive concentration of the seawater in Miyagi, Fukushima, Ibaraki and Chiba

Att. 1

- Japan adopts the world highest level of standard for food and water, and conducts strict monitoring and distribution management.
- In Fukushima Prefecture where the accident occurred, annual radiation exposure from food and water is lower than 0.01 mSv.
- The results of monitoring of sea water in Japan are constantly below the standard of 10 Bq/L ("Guidelines for Radioactive Substances in Bathing Areas" )
- Influence of contaminated water is limited in the port of Fukushima Daiichi NPS, whose area is smaller than 0.3 km<sup>2</sup>.



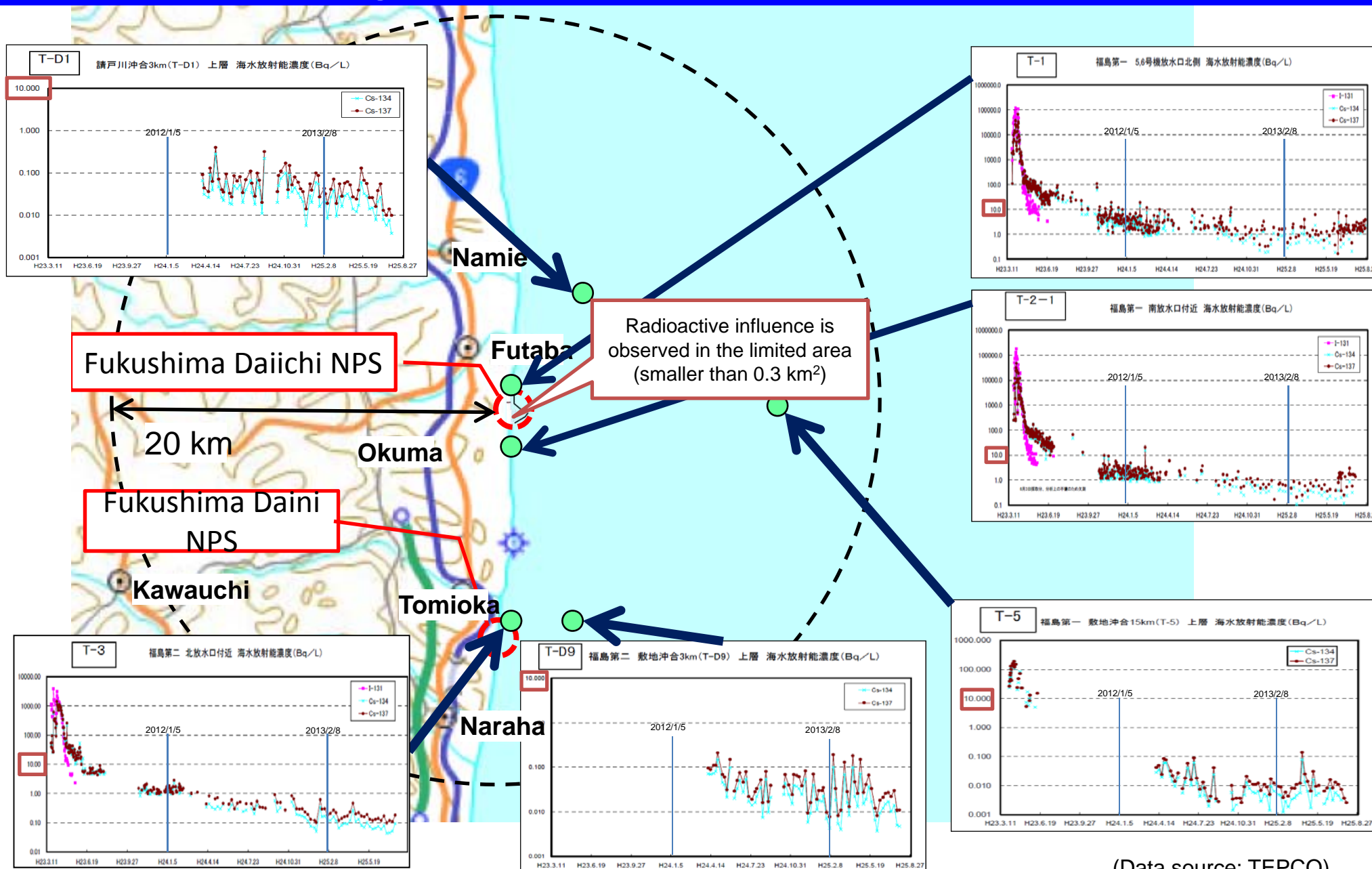
## <Explanation note>

- Sea Area Monitoring at offshore of Miyagi, Fukushima, Ibaraki and Chiba Prefecture (sampling date: May 16 – Jun 2, 2013, published on August 7 by Nuclear Regulation Authority (NRA)) indicates 0.021 Bq/L or less for Cs-134 and Cs-137, most results are not detectable for Cs-134, much lower than the standard of 10 Bq/L.
- "Guidelines for Radioactive Substances in Bathing Areas" released by Ministry of Environment gives an indication of the water quality for municipalities to open bathing areas as follows :
  - The concentration of radioactive Cs (Cs-134 and Cs-137) is lower than or equal to 10 Bq/L.
- Not detectable indicates the case that the detected radioactivity concentration in seawater was lower than the minimum detectable activity 0.001Bq/L.

(Data source: NRA)

# Time-series radioactive concentration of the seawater surrounding Fukushima Daiichi NPS (2011.3.11 – current)

Att. 2



(Data source: TEPCO)

# Countermeasures for the contaminated ground water leakage at TEPCO's Fukushima Daiichi Nuclear Power Station

Att. 3

- Contaminated ground water was detected in the area between the turbine buildings and plant port of the Fukushima Daiichi NPS.
- Fundamental countermeasures will be taken in several phases in addition to the immediate countermeasures.

## Three principles for contaminated water countermeasures

1. Removing the source of the contamination
2. Isolating ground water from the contamination source
3. Preventing leakage of the contaminated water

## Immediate countermeasures

1. Removing water containing high amount of radioactive materials from the trench (underground space where the pipes and electronic cables are set ) (start from August 22) **【Removing】**
2. Improving the soil by sodium silicate (liquid glass), paving the land surface with asphalt, pumping out the underground water (pumping out: start from August 9) **【Isolating】【Preventing leakage】**
3. Pumping out ground water from the mountain side (Bypassing ground water) **【Isolating】**

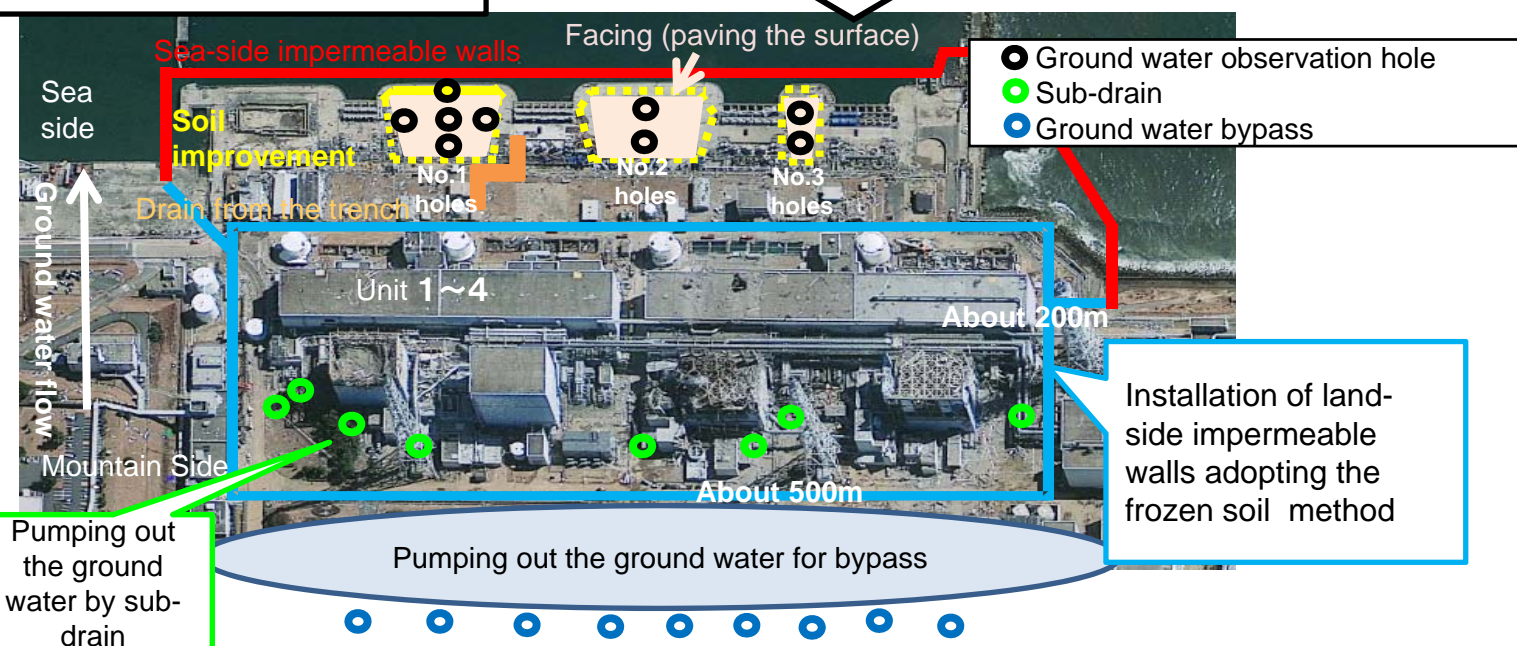
## Fundamental countermeasures (Coming 1-2years)

1. Pumping out the ground water from the sub-drains **【Isolating】**
2. Installation of sea-side impermeable walls **【Preventing leakage】**
3. Installation of land-side impermeable walls adopting the frozen soil method **【Isolating】【Preventing leakage】**
4. Installation of high performance contaminated water treatment equipment **【Removing】** etc.

## Current situation of the ground water

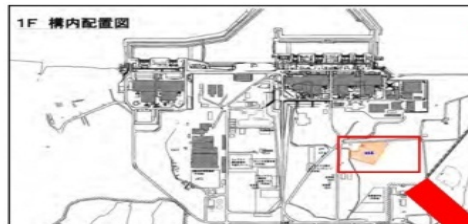
TEPCO estimates that the whole area of units 1 to 4 has approx. 1000 m<sup>3</sup> of ground water flow every day and 400 m<sup>3</sup> of this flows into the basement of the facility buildings. And some part of the other water is considered to be contaminated by the water in the trench and flows into the port through the soil.

## Overview of the countermeasures



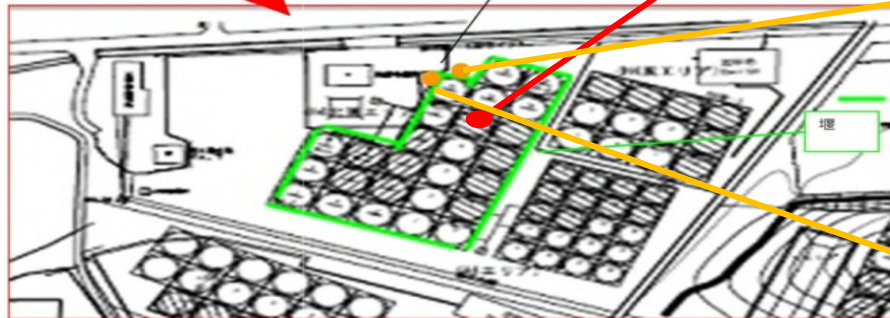


H4 area is located about 500 m away from the sea



The place where paddles were found

No. 5 tank



East area of the No.12 tank

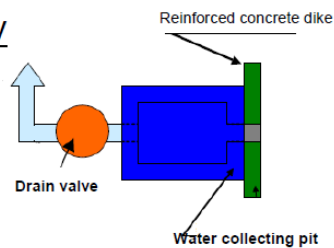


North area of the No.11 tank

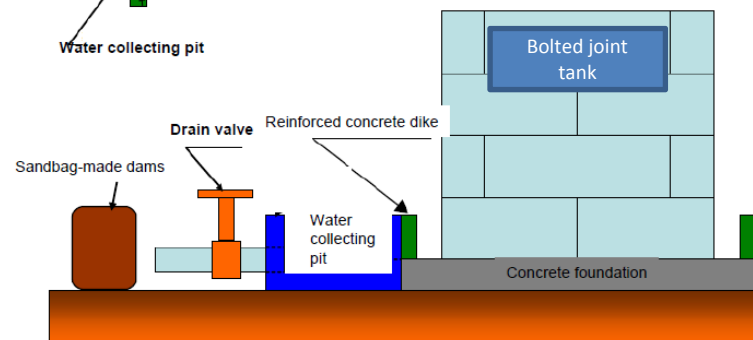


## Structure of the Tank Area

Plane view

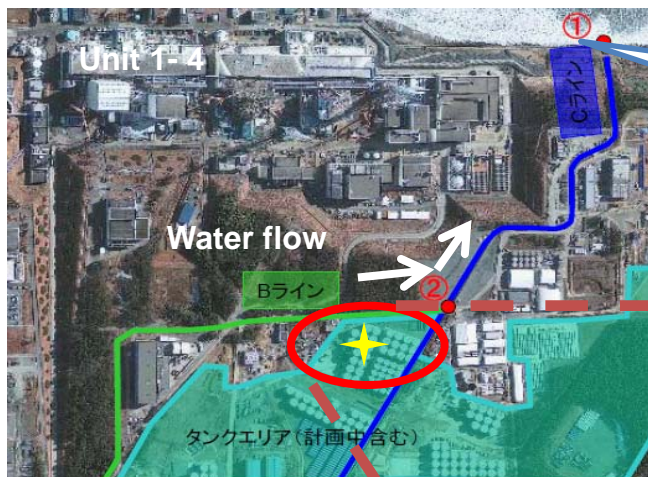


Section view



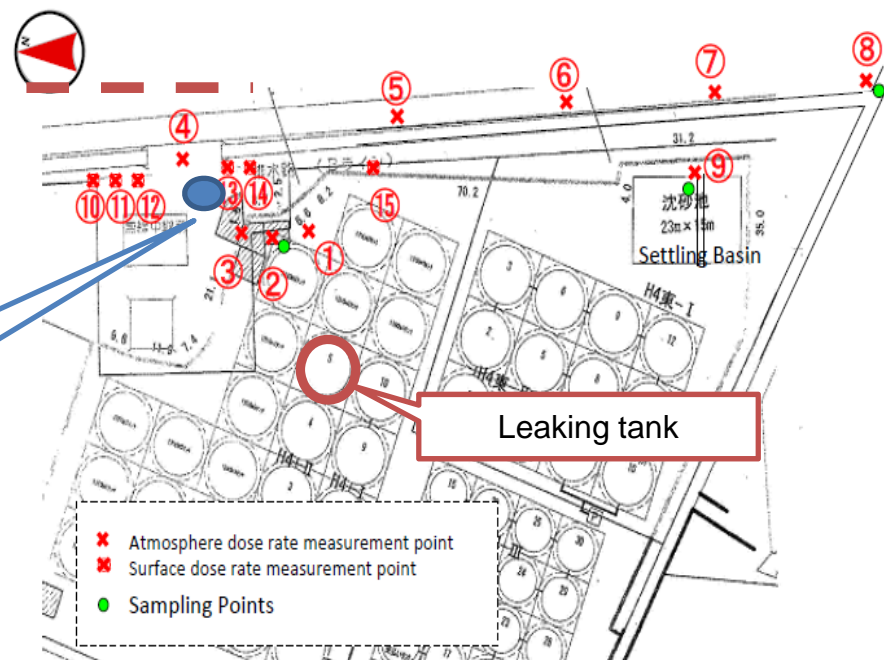
# Radiation dose at the surrounding area of the tank

Att. 5



Total beta and cesium concentration at outlet of the dike was under detection limit (sampled on August 26)

5.8 mSv was detected at the dike (on August 21)



## Dose Rate

Date: Aug. 19, 2013  
Unit: [mSv/h]

Sampling Point	Dose rate	
	$\gamma + \beta$	$\gamma$
①	>100	1.5
②	5.5	0.1
③	0.08	0.05
④	0.04	0.04
⑤	0.06	0.06
⑥	0.06	0.06
⑦	0.045	0.045
⑧	0.06	0.06
⑨	0.015	0.15
⑩	90.0	0.36
⑪	96.0	0.45
⑫	90.0	0.35
⑬	0.35	0.07
⑭	0.12	0.11
⑮	0.024	0.015

## Sample Water Analysis

Sampling Date: Aug. 19, 2013

Sampling Point	$\gamma$ nuclide (Bq/cm <sup>3</sup> )					Total $\beta$ (Bq/cm <sup>3</sup> )	Chlorine (ppm)
	Cs-134	Cs-137	Co-60	Mn-54	Sb-125		
Leaked Water	4.6E+1	1.0E+2	1.2E+0	1.9E+0	7.1E+1	8.0E+4	5,200
Settling Basin	<2.0E-2	<2.6E-2	<1.3E-2	-	-	4.1E+1	—
Gutter	<1.9E-2	<2.7E-2	<1.4E-2	-	-	1.3E-1	—

(Data source: TEPCO)

## Countermeasures for contaminated water leakage from the bolted tank Att. 6

- ❑ On August 19, TEPCO found 300 m<sup>3</sup> of highly-contaminated water leakage from a bolted joint tank in the H4 area. TEPCO has been investigating the root cause.
- ❑ TEPCO inspected all of bolt jointed tanks (305 units) on August 22 in accordance with the direction of METI. TEPCO found traces with high dose on two other tanks at near the bottom of the shell. These traces had dried up already and there was no indication that the leaked water had flowed out the dike. Also, the stored water level of each tank had been the same level as that of the beginning of storage.
- ❑ TEPCO started transfer of contaminated water from the leaking tank from August 19 and completed it on August 21.

### Directions of METI

1. **Enhanced management of the tanks and the surrounding area** (the switch to “normally closed” drain valve operation from “normally open,” reinforcing concrete at the bottom of the tanks, installation of water level gauges and leak detectors into the bolted joint tanks, and introduction of a central control system)
2. **Reinforced patrol** (increase of patrols from twice to four times a day, and checking & recording dose levels as well as detailed information)
3. **Accelerated replacement from bolted joint tanks to welded joint tanks**
4. **Acceleration of the highly-contaminated water treatment (operation of ALPS\* from mid-September) and a decrease of radiation dose of the surrounding area by collecting the contaminated soil**
5. **Identification of the risks of storing highly-contaminated water and taking actions against the risks**

\*ALPS: Advanced Liquid Processing System, multi-nuclide removal equipment

### Major Countermeasures of TEPCO

1. **Total inspection of bolted joint tanks:**
2. **Water transfer from tanks, similar to No.5 tank, which were moved after installation :** Transfer of contaminated water from the two tanks with a similar history to H4-I-No.5 tank had started. One of them completed on August 27.
3. **Contaminated soil collection :** Start from August 23. It is under examination for the early completion.
4. **Inspection and reinforcement of the surrounding dikes:** The dikes around the tanks were confirmed not to be contaminated on August 22. Land embankments and waterproof sheets have been added to the sandbags outside the H4 area where the leakage occurred.
5. **Enhanced monitoring:** Since August 20, monitoring for the trenches leading to the sea has been enhanced. The possibility of leakage into the sea is under investigation.
6. **Reinforced patrol:** Urgent reinforcement to approx. 50 patrol workers. Adoption of “post responsibility system” at each tank for early recognition of any sign of accident by carefully monitoring situation, and etc.
7. **“Normally closed” drain valve operation for contaminated water tanks:** Switch to “normally closed” drain valve operation from “normally open,” in addition to improvement of rainwater management in the dike.

*TEPCO is considering to include installation of water level gauges and leak detectors into the bolted joint tanks, introduction of a central control system and replacement from bolted joint tanks to welded joint tanks as its countermeasures.*