# Updates on TEPCO's Fukushima Daiichi NPS - Groundwater bypassing: as a measure for contaminated water management -

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# Seawater Monitoring around the Port (the highest and latest values)

"The highest value" → "the latest value (sampled during May 19-26)", Unit (Bq/L);
ND represents a value below the detection limit; values in ( ) represent the detection limit; ND (2013) represents ND throughout 2013

【Northeast side of port entrance(offshore 1km)】

| | | |
|---|---|---|
| Cesium-134: | ND (2013) → ND (0.66) | |
| Cesium-137: | ND (2013) → ND (0.79) | |
| Gross β: | ND (2013) → ND (18) | |
| Tritium: | ND (2013) → ND (1.7) | |

【East side of port entrance (offshore 1km)】

| | | | |
|---|---|---|---|
| Cesium-134: | ND (2013) | → ND (0.66) | |
| Cesium-137: | 1.6 (2013/10/18) | → ND(0.69) | Below 1/2 |
| Gross β: | ND (2013) | → ND (18) | |
| Tritium: | 6.4 (2013/10/18) | → ND (1.7) | Below 1/3 |

【Southeast side of port entrance(offshore 1km)】

| | | |
|---|---|---|
| Cesium-134: | ND (2013) | → ND (0.68) |
| Cesium-137: | ND (2013) | → ND (0.58) |
| Gross β: | ND (2013) | → ND (18) |
| Tritium: | ND (2013) | → ND (1.7) |

| | | | |
|---|---|---|---|
| Cesium-134: | ND (2013) | → ND (0.60) | |
| Cesium-137: | ND (2013) | → ND (0.59) | |
| Gross β: | ND (2013) | → ND (18) | |
| Tritium: | 4.7 (2013/ 8/18) | → ND(1.7) | Below 1/2 |

【North side of north breakwater(offshore 0.5km)】

【Port entrance】

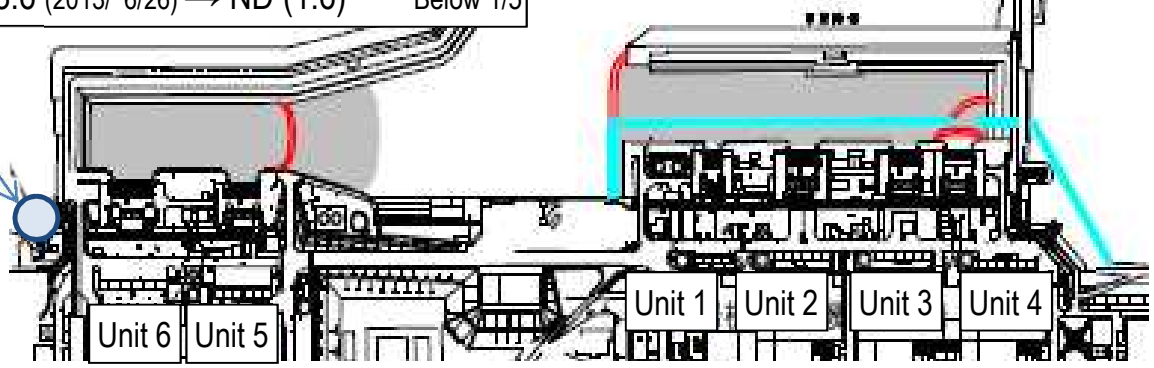
| | | | |
|---|---|---|---|
| Cesium-134: | 3.3 (2013/12/24) | → ND (1.3) | Below 1/2 |
| Cesium-137: | 7.3 (2013/10/11) | → ND (1.1) | Below 1/6 |
| Gross β: | 69 (2013/ 8/19) | → ND (15) | Below 1/4 |
| Tritium: | 68 (2013/ 8/19) | → ND (1.9) | Below 1/35 |

【South side of south breakwater(offshore 0.5km)】

| | | |
|---|---|---|
| Cesium-134: | ND (2013) | → ND (0.68) |
| Cesium-137: | ND (2013) | → ND (0.58) |
| Gross β: | ND (2013) | → ND (18) |
| Tritium: | ND (2013) | → ND (1.7) |

【North side of Units 5 and 6 discharge channel】

| | | | |
|---|---|---|---|
| Cesium-134: | 1.8 (2013/ 6/21) | → ND (0.87) | Below 1/2 |
| Cesium-137: | 4.5 (2013/ 3/17) | → ND (0.72) | Below 1/6 |
| Gross β: | 12 (2013/12/23) | → 9.5 | Below 8/10 |
| Tritium: | 8.6 (2013/ 6/26) | → ND (1.6) | Below 1/5 |




| | | | |
|---|---|---|---|
| Cesium-134: | ND (2013) | → ND (0.75) | |
| Cesium-137: | 3.0 (2013/ 7/15) | → ND (0.72) | Below 1/4 |
| Gross β: | 15 (2013/12/23) | → 9.5 | Below 2/3 |
| Tritium: | 1.9 (2013/11/25) | → 5.6 | |

Sea side impermeable wall

Silt fence

【Around south discharge channel】

Summary of TEPCO data as of May 28

Source: TEPCO website, Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station, http://www.tepco.co.jp/nu/fukushima-np/f1/smp/index-j.html

# Seawater Monitoring in the Port (the highest and latest values)

"The highest value" → "the latest value (sampled during May 19-26)"; Unit (Bq/L); ND represents a value below the detection limit

| | | | |
|---|---|---|---|
| Cesium-134: | 3.3 (2013/10/17) | → ND (1.0) | Below 1/3 |
| Cesium-137: | 9.0 (2013/10/17) | → ND (1.2) | Below 1/7 |
| Gross β: | 74 (2013/ 8/19) | → ND (15) | Below 1/4 |
| Tritium: | 67 (2013/ 8/19) | → ND (1.9) | Below 1/35 |

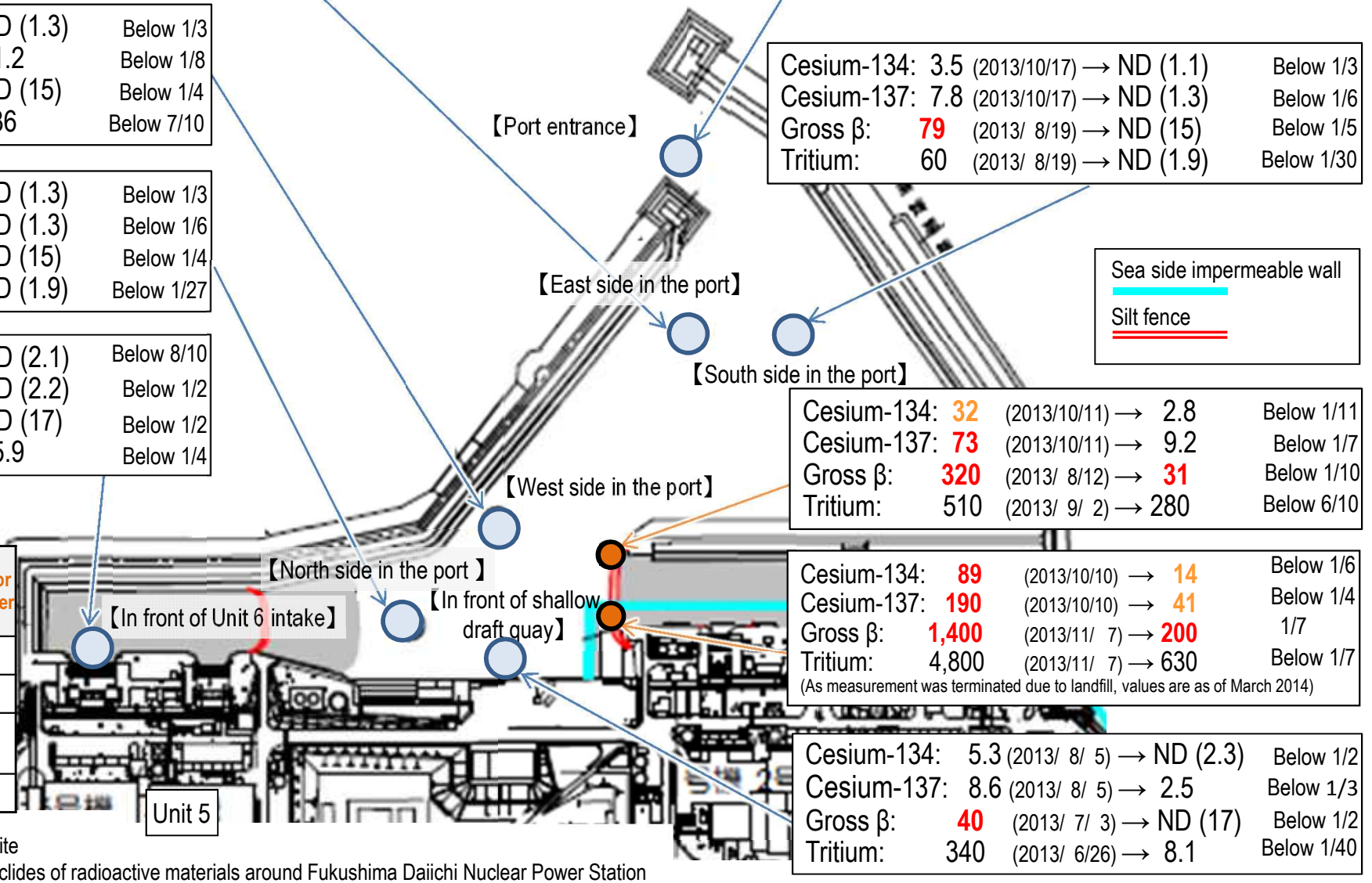
| | | | |
|---|---|---|---|
| Cesium-134: | 3.3 (2013/12/24) | → ND (1.3) | Below 1/2 |
| Cesium-137: | 7.3 (2013/10/11) | → ND (1.1) | Below 1/6 |
| Gross β: | 69 (2013/ 8/19) | → ND (15) | Below 1/4 |
| Tritium: | 68 (2013/ 8/19) | → ND (1.9) | Below 1/35 |

| | | | |
|---|---|---|---|
| Cesium-134: | 4.4 (2013/12/24) | → ND (1.3) | Below 1/3 |
| Cesium-137: | 10 (2013/12/24) | → 1.2 | Below 1/8 |
| Gross β: | 60 (2013/ 7/ 4) | → ND (15) | Below 1/4 |
| Tritium: | 59 (2013/ 8/19) | → 36 | Below 7/10 |

| | | | |
|---|---|---|---|
| Cesium-134: | 3.5 (2013/10/17) | → ND (1.1) | Below 1/3 |
| Cesium-137: | 7.8 (2013/10/17) | → ND (1.3) | Below 1/6 |
| Gross β: | 79 (2013/ 8/19) | → ND (15) | Below 1/5 |
| Tritium: | 60 (2013/ 8/19) | → ND (1.9) | Below 1/30 |

| | | | |
|---|---|---|---|
| Cesium-134: | 5.0 (2013/12/ 2) | → ND (1.3) | Below 1/3 |
| Cesium-137: | 8.4 (2013/12/ 2) | → ND (1.3) | Below 1/6 |
| Gross β: | 69 (2013/ 8/19) | → ND (15) | Below 1/4 |
| Tritium: | 52 (2013/ 8/19) | → ND (1.9) | Below 1/27 |

| | | | |
|---|---|---|---|
| Cesium-134: | 2.8 (2013/12/ 2) | → ND (2.1) | Below 8/10 |
| Cesium-137: | 5.8 (2013/12/ 2) | → ND (2.2) | Below 1/2 |
| Gross β: | 46 (2013/ 8/19) | → ND (17) | Below 1/2 |
| Tritium: | 24 (2013/ 8/19) | → 5.9 | Below 1/4 |




| | | | |
|---|---|---|---|
| Cesium-134: | 32 (2013/10/11) | → 2.8 | Below 1/11 |
| Cesium-137: | 73 (2013/10/11) | → 9.2 | Below 1/7 |
| Gross β: | 320 (2013/ 8/12) | → 31 | Below 1/10 |
| Tritium: | 510 (2013/ 9/ 2) | → 280 | Below 6/10 |

| | | | |
|---|---|---|---|
| Cesium-134: | 89 (2013/10/10) | → 14 | Below 1/6 |
| Cesium-137: | 190 (2013/10/10) | → 41 | Below 1/4 |
| Gross β: | 1,400 (2013/11/ 7) | → 200 | 1/7 |
| Tritium: | 4,800 (2013/11/ 7) | → 630 | Below 1/7 |

(As measurement was terminated due to landfill, values are as of March 2014)

| | | | |
|---|---|---|---|
| Cesium-134: | 5.3 (2013/ 8/ 5) | → ND (2.3) | Below 1/2 |
| Cesium-137: | 8.6 (2013/ 8/ 5) | → 2.5 | Below 1/3 |
| Gross β: | 40 (2013/ 7/ 3) | → ND (17) | Below 1/2 |
| Tritium: | 340 (2013/ 6/26) | → 8.1 | Below 1/40 |

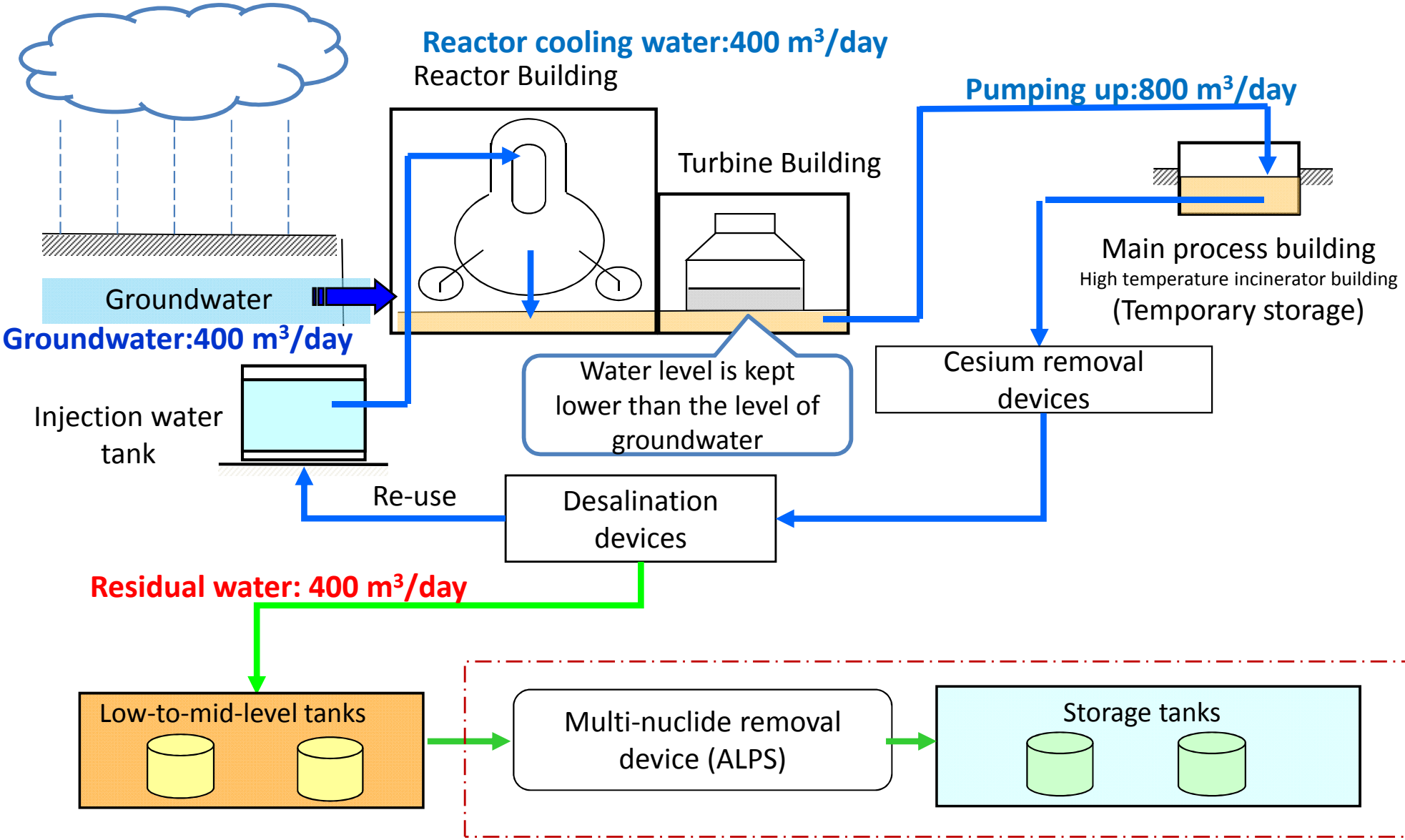
| | Legal discharge limit | WHO Guidelines for Drinking Water Quality |
|---|---|---|
| Cesium-134 | 60 | 10 |
| Cesium-137 | 90 | 10 |
| Strontium-90 (strongly correlate with Gross β) | 30 | 10 |
| Tritium | 60,000 | 10,000 |

Summary of TEPCO data as of May 28

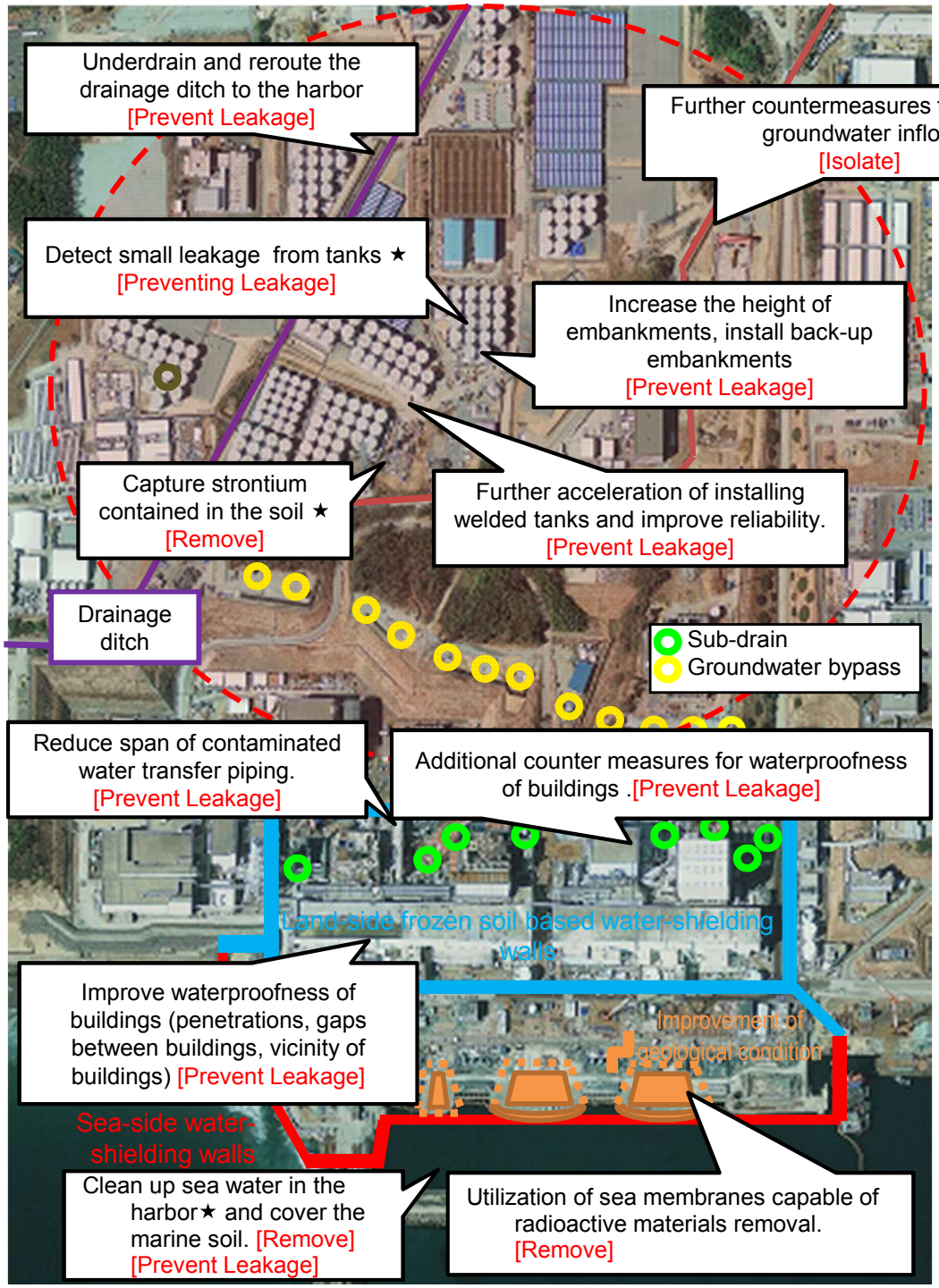
Source: TEPCO website
Analysis results on nuclides of radioactive materials around Fukushima Daiichi Nuclear Power Station
http://www.tepco.co.jp/nu/fukushima-np/f1/smp/index-j.html

# Contaminated Water Treatment System

## ＜Overview of the System＞



# Overview of Measures for Contaminated Water Management




**Three principles**

1. Remove source of contamination
2. Isolate water from contamination
3. Prevent leakage of contaminated water

**Immediate measures**

1. Remove highly-contaminated water in the trenches【Remove】
2. Soil improvement with sodium silicate (liquid glass) , rainproof pavement, and pumping out 【Isolate】【Prevent leakage】
3. **Pump up groundwater for by-passing【Isolate】**

**Fundamental measures**

1. Pump up groundwater from sub-drains near buildings【Isolate】
2. Install sea-side impermeable walls【Prevent leakage】
3. Install land-side frozen soil impermeable walls【Isolate】
4. Install more efficient water treatment equipment【Remove】

etc.

**Preventive and Multi-layered Measures**

(★:measure to be studied on its feasibility)

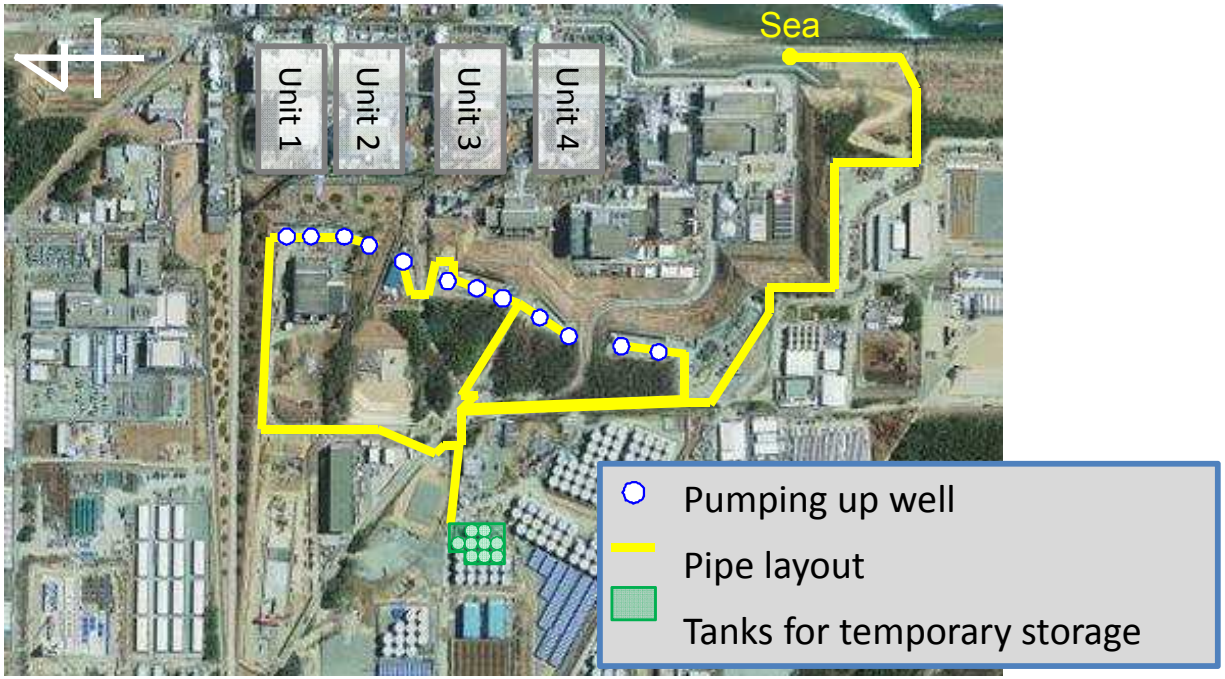
1. Further countermeasures for prevent groundwater inflow【Isolate】
2. Increase height of embankments, install back-up embankments【Prevent leakage】
3. Further acceleration of installing welded tanks and improve reliability【Prevent leakage】
4. Underdrain and reroute the drainage ditch to the plant port【Prevent leakage】
5. Detect small leakage from tanks.★【Prevent leakage】
6. Capture strontium in contained water in soil.★[Remove]
7. Reduce span of contaminated water transfer piping. [Prevent Leakage]
8. Improve waterproofness of buildings(penetrations, gaps between buildings, vicinity of buildings), etc. [Prevent Leakage]
9. Counter measures for great tsunami (consideration on additional counter measures for waterproofness of buildings, wave breakers, etc.)[Prevent Leakage]
10. Clean up sea water in the harbor★ and cover the marine soil. [Remove] [Prevent Leakage]
11. Utilization of sea membranes capable of radioactive materials removal. [Remove]

Main measures taken or to be taken after decision of basic policy on Sep. 3

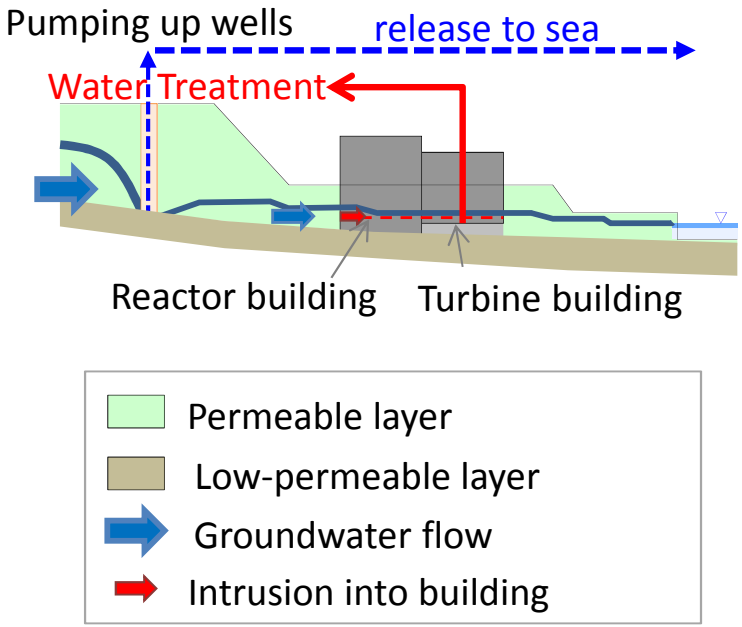
# Groundwater Bypassing

- In order to reduce the volume of groundwater flowing into the buildings, several hundred tons of groundwater will be pumped up on the mountain side of the buildings, and will be released into the sea (bypassing). It is expected to reduce the volume of the groundwater inflow to the buildings. The expected reduction ranges from several tens to hundred tons.
- The groundwater pumped up is released after confirming that the level of radio activities is lower than operational targets.
- Following implementation of explanation to stakeholders such as fishermen's union and detailed analysis of groundwater pumped up, Groundwater bypassing has been operated since May 21.

<Layout of groundwater bypassing system>




<Cross-sectional image>



# Groundwater Bypassing: detailed analysis of groundwater

**The radioactive levels of sampled water are substantially below the operational targets**

| | For 1st Release | | | For 2nd Release | | Reference | | |
|---|---|---|---|---|---|---|---|---|
| | JAEA | Japan Chemical Analysis Center | TEPCO | Japan Chemical Analysis Center | TEPCO | Operational targets | Legal discharge limit | WHO Guidelines for Drinking Water Quality |
| **CS-134** | 0.015 | 0.022 | 0.016 | ND (0.49) | ND (0.67) | 1 | 60 | 10 |
| **Cs-137** | 0.044 | 0.039 | 0.047 | ND (0.38) | ND (0.51) | 1 | 90 | 10 |
| **Gross β** | ND (0.1) | ND (0.61) | ND (0.88) | ND (0.89) | ND (0.55) | 5(1)* | 30 | 10 |
| **H-3** | 240 | 230 | 220 | 150 | 150 | 1,500 | 60,000 | 10,000 |

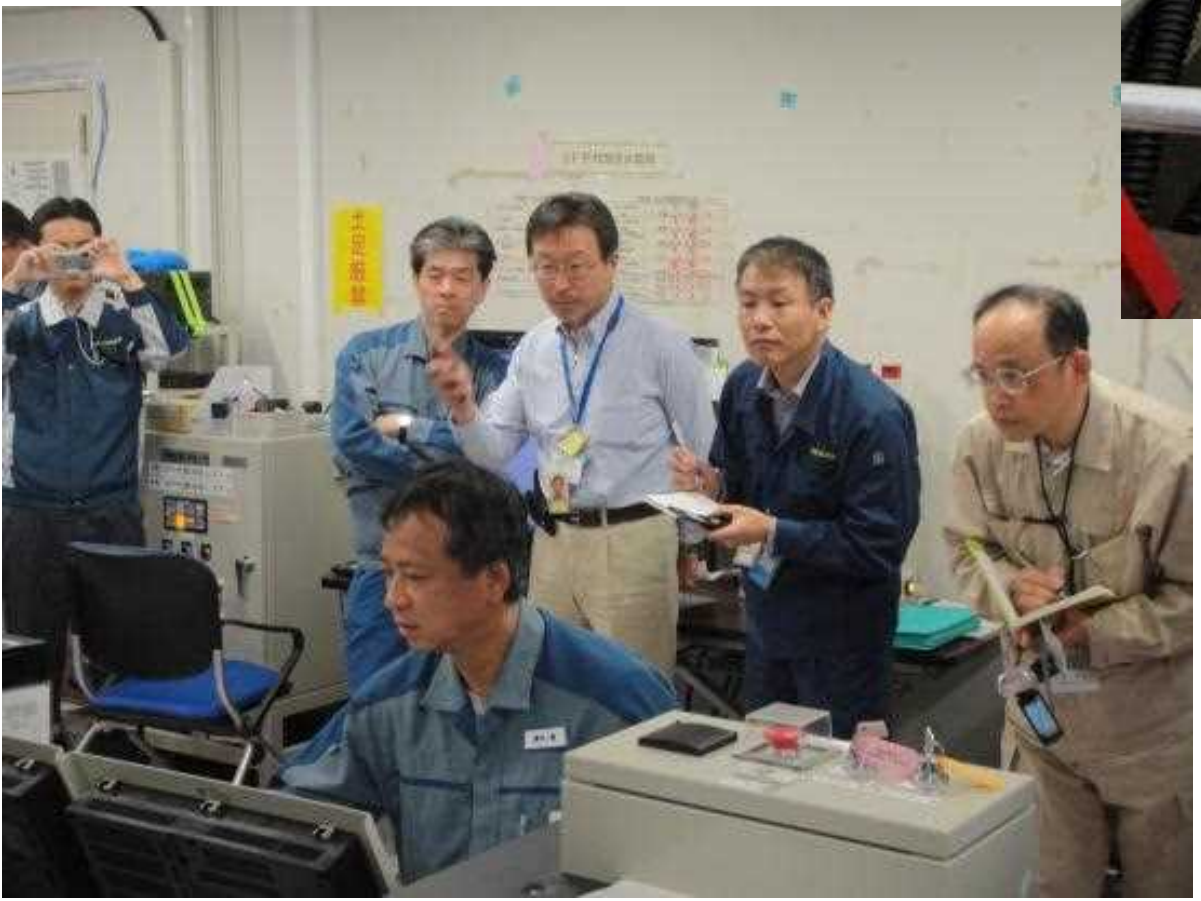
(Note)
Unit: Bq/L
ND represents a value below the detection limit; values in ( ) represent the detection limit

*The operational target of Gross β is 1 Bq/L in the survey which is conducted once every ten days.

# Groundwater Bypassing: checked by government officials


(At the  groundwater releasing point)

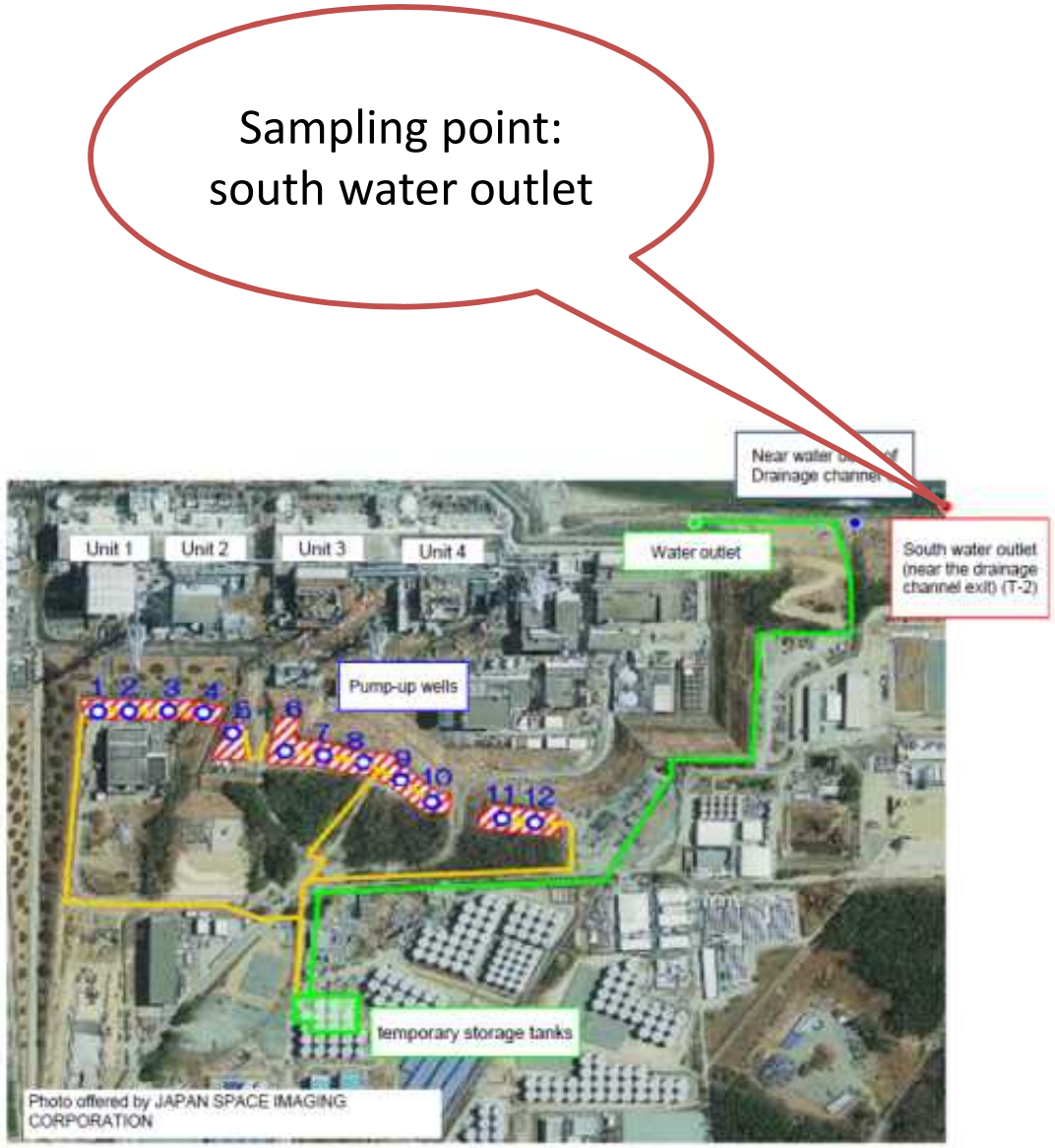
(At the operating room)



# Groundwater Bypassing: effect to seawater

**No significant change of radioactivity was observed according to the radioactive analysis conducted by TEPCO.**

| Sampling date | May 21, 2014 | | | |
|---|---|---|---|---|
| **Status** | Before release | During release | Shortly after release | 1 hour after release |
| **Time of sampling** | 10:05 | 12:10 | 13:15 | 14:05 |
| **CS-134** | ND (0.45) | ND (0.62) | ND (0.64) | ND (0.57) |
| **Cs-137** | ND (0.60) | 0.84 | ND (0.76) | ND (0.68) |
| **Gross β** | 12 | 12 | 11 | 13 |
| **H-3** | 3.9 | 2.1 | 2.2 | 2.7 |



# Working with global wisdoms

| **RFI: Request For Information for Contaminated Water Issues (closed)** | |
|---|---|
| Period: Sep 20 to Oct 23 | Status: 780 proposals were received |

**Request for Proposal for entities to implement with subsidies the "Verification of technologies for contaminated water management**

| 4 RFP topics (closed)<br>- Demonstration Project for Seawater Purification Technologies<br>- Demonstration Project for Technologies for Capturing Radioactive Substances from Soil<br>- Demonstration Project of Technologies for the Decontamination of Contaminated Water Tanks<br>- Demonstration Project for Unmanned Boring Technologies | |
|---|---|
| Period: March 24 to May 19 | Status: Under examination |

| **1 RFP topic (open)**<br>**- Demonstration Project for Verification Tests of Tritium Separation Technologies** | |
|---|---|
| Period: May 15 to July 17 | Status: Requesting proposals |
| **Information session is schedule on June 3, 2014 (Tuesday), 13:30-15:30**<br>**Further information is available at**<br>http://www.mri.co.jp/english/news/if20140526_e.html | |

# Outline of RFP for "Validation of technologies for contaminated water management project"

## 1. Purpose of this project

- ✓ "The Additional Measures for Decommissioning and Contaminated Water Issues" are expected to be highly effective but among the technologies which require confirmation and validation for their application.
- ✓ It was decided to carry out the validation of technologies which are expected to be highly effective, but with a high degree of technical difficulty. In this project, we intend to implement validation of the technologies listed in "RFP Topics."

## 2. RFP topics and Procedure of the project

Time limit of 4 topics below was from "March 24, 2014" to "May 19, 2014(Mon), 12:00 Noon (Japan time)". Now Mitsubishi Research Institute (project management office of these project) are evaluating each proposal.

(1) Demonstration Project for Seawater Purification Technologies

(2) Demonstration Project for Technologies for Capturing Radioactive Substances from Soil

(3) Demonstration Project of Technologies for the Decontamination of Contaminated Water Tanks

(4) Demonstration Project for Unmanned Boring Technologies

Time limit of another RPF topic, verification test of tritium separation technologies, is from "May 15, 2014 (Thu)" to "July 17, 2014 (Thu), 12:00 Noon (Japan time)".

(1)Demonstration Project for Verification Tests of Tritium Separation Technologies

- ➢The purpose of this project is
  - (i) to verify separation performance of tritium separation technology
  - (ii) to assess construction costs and operating costs needed for installing the equipment in the Fukushima Daiichi Nuclear Power Station and for treating water remaining after treatment through the multi-nuclide removal equipment.
- ➢However, the decision whether or not to conduct tritium separation treatment has not yet been made.

# Thank you for your attention!

Agency for Natural Resources and Energy, METI

Please visit the following website for further information.
http://www.meti.go.jp/english/earthquake/nuclear/decommissioning/