Regulatory Updates since the 3rd mission

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Nuclear Regulation Authority JAPAN
16th Dec 2025

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1. Results of Regulatory Inspection

Status of Operational Safety Inspection and Periodic Safety Inspection

➢ **No safety concerns were identified so far.**

Results of Operational Safety Inspection

1. ***Operation management (approx. once/week)***
   - ✓ Operation status at each step (1. receiving, 2. measurement/confirmation, 3. discharge), decisions made by a responsible person at the holding points
   - ✓ Maintenance status, the facilities management
   - ✓ Dismantling plan for storage tanks for ALPS treated water
2. ***Quality assurance (approx. once/month)***
   - ✓ Checking condition reports related to the discharge facilities
3. ***Project management (approx. twice/week)***
   - ✓ Hearing of the status of project management
   - ✓ Status of establishing the annual discharge plan
4. ***Trouble management (each time)***
   - ✓ Status of discharge suspension by usual or emergency process in response to unusual events
   - ✓ Status of countermeasures and corrective actions to troubles such as equipment failure or leakage

1. Results of Regulatory Inspection

Results of Periodic Safety Inspection (26th Feb 2025 , 22nd Oct 2024, 25th Sep 2024)

1. ***The measurement/confirmation facility:***
   - ✓ Circulation performance
   - ✓ Agitation performance
   - ✓ Operation status
   - ✓ Alarm device performance
2. ***The emergency shutdown valve:***
   - ✓ Operation test with actuation signal

2. Review on TEPCO's REIA updated in Dec 2024

Background

- Based on the Japanese government policy, NRA reviewed radiological environmental impact assessment (REIA) for the discharge of ALPS treated water conducted by TEPCO whether the REIA was conducted following on the international standards.

- TEPCO has conducted the REIA several times from designing, construction and operational phase of the discharge facility of ALPS.

- So far, **no safety issue has been confirmed through NRA's reviews.**

- Today, we would share overview of NRA's review on the latest REIA (operational phase).

2. Review on TEPCO's REIA updated in Dec 2024

Major updates from the previous REIA (construction phase)

- Update of the source terms
- Use of actual data and parameters

2. Review on TEPCO's REIA updated in Dec 2024

Update of the source terms

- NRA verified appropriateness for each coefficient (conversion factors) of newly added Cd-133m

TEPCO's selection according to the scheme

C-14	Sr-90	Te-125m	Sm-151	Pu-238	Cl-36
Mn-54	Y-90	I-129	Eu-154	Pu-239	Nb-93m
Fe-55	Tc-99	Cs-134	Eu-155	Pu-240	Nb-94
Co-60	Ru-106	Cs-137	U-234	Pu-241	Mo-93
Ni-63	**Cd-113m**	Ce-144	U-238	Am-241	Cd-113m
Se-79	Sb-125	Pm-147	Np-237	Cm-244	Ba-133

Nuclides to be measured and evaluated (except H3): ***29 nuclides → 30 nuclides (explained in the 3rd mission)***

Nuclides to be monitored

2. Review on TEPCO's REIA updated in Dec 2024

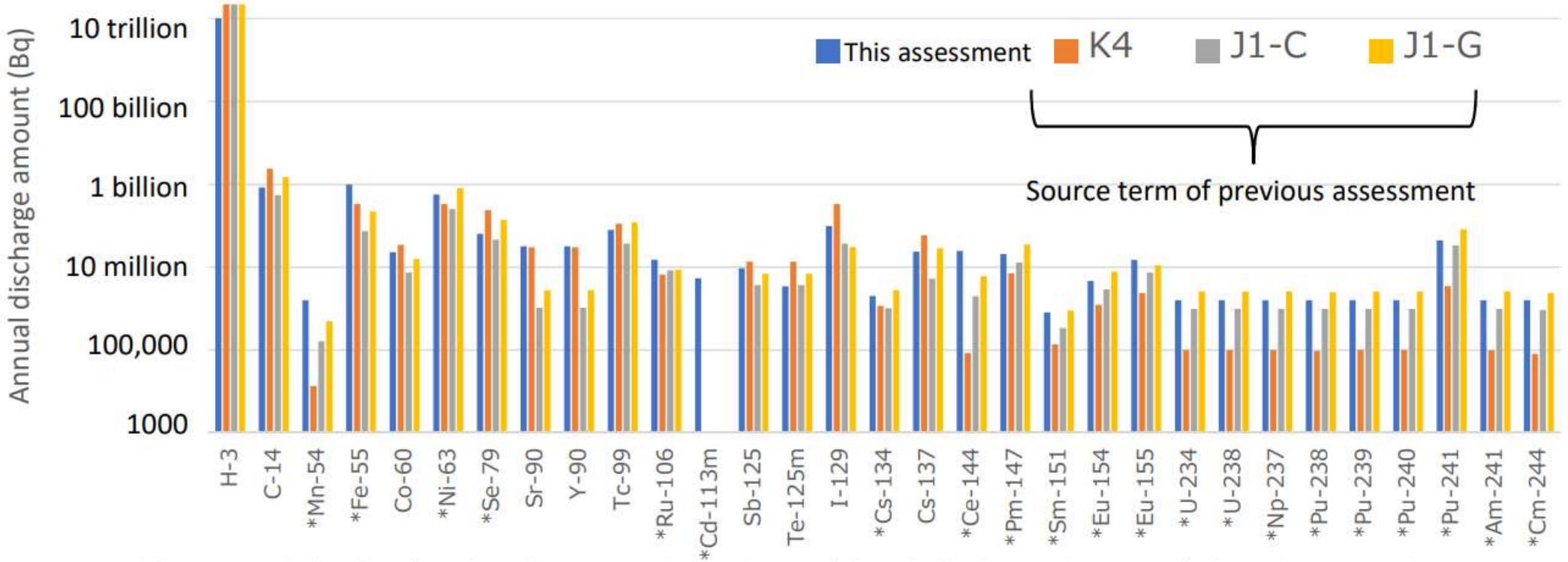
Use of actual amount data of tritium

Target discharge (The number on the right is the total number)	Discharge period	Tritium concentration (Bq/liter)	Discharged water volume (m^3)	Discharged tritium volume (Bq)
FY2023 1st-1	Aug 24, 2023～Sep 11, 2023	Approx. 140,000	7,788	Approx. 1.1 trillion
FY2023 2nd-2	Oct 5, 2023～Oct 23, 2023	Approx. 140,000	7,810	Approx. 1.1 trillion
FY2023 3rd-3	Nov 2, 2023～Nov 20, 2023	Approx. 130,000	7,753	Approx. 1.0 trillion
FY2023 4th-4	Feb 28, 2024～Mar 17, 2024	Approx. 170,000	7,794	Approx. 1.3 trillion
FY2024 1st-5	Apr 19, 2024～May 7, 2024	Approx. 190,000	7,851	Approx. 1.5 trillion
FY2024 2nd-6	May 17, 2024～Jun 4, 2024	Approx. 170,000	7,892	Approx. 1.3 trillion
FY2024 3rd-7	Jun 28, 2024～Jul 16, 2024	Approx. 170,000	7,846	Approx. 1.3 trillion
FY2024 4th-8	Aug 7, 2024～Aug 25, 2024	Approx. 200,000	7,897	Approx. 1.6 trillion
Total			62,631	Approx. 10 trillion

https://www.tepco.co.jp/en/hd/newsroom/announcements/archives/2024/pdf/241209e0102.pdf

2. Review on TEPCO's REIA updated in Dec 2024

Use of actual amount data of the nuclides (some parts are still conservative)



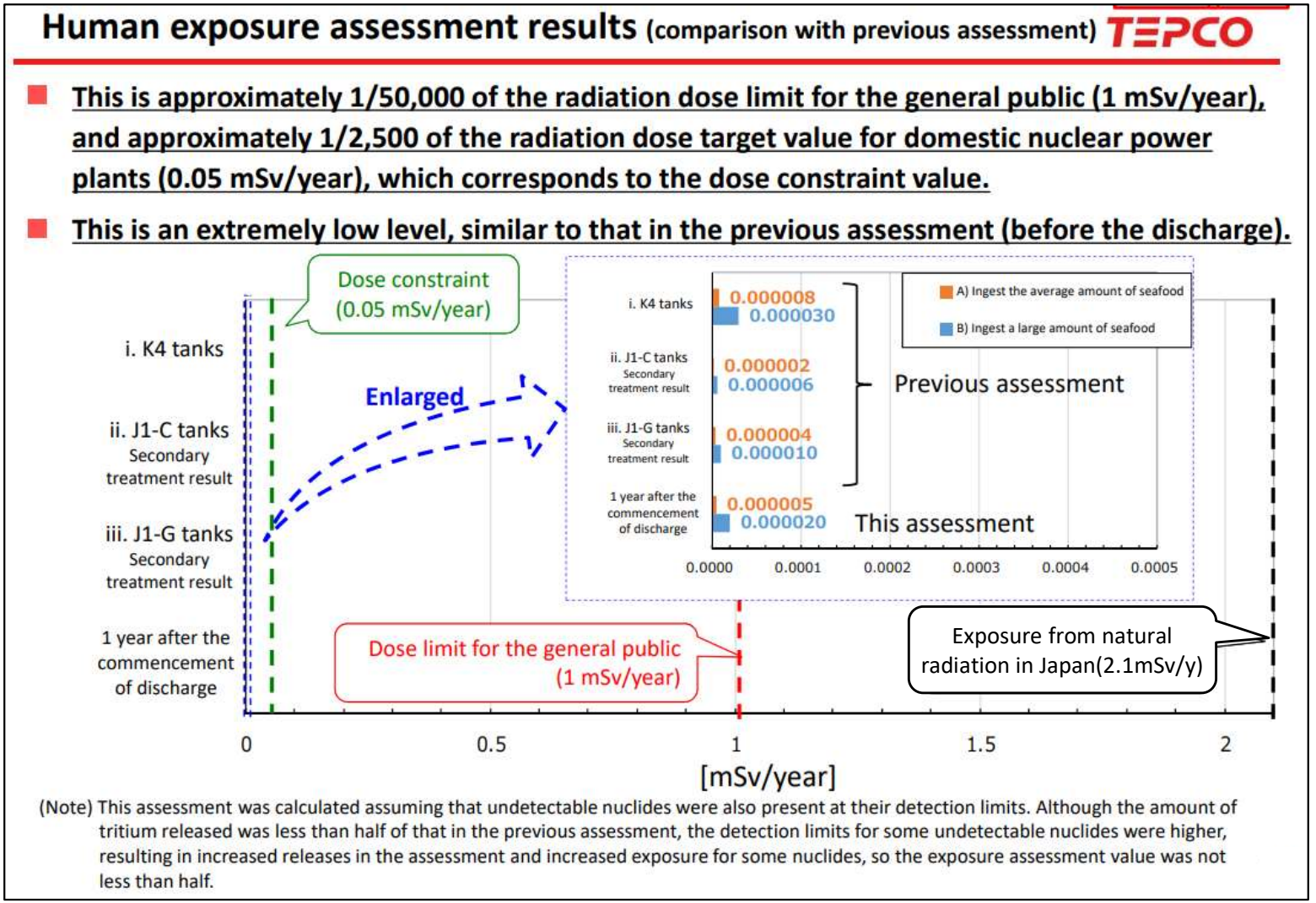
Note: Nuclide names marked with an * are those that were not detected in any of the eight discharges. The amount discharged was assessed assuming that the nuclide was present at the detection limit concentration.

Comparison of source terms with the previous assessment (before discharge)

https://www.tepco.co.jp/en/hd/newsroom/announcements/archives/2024/pdf/241209e0102.pdf

2. Review on TEPCO's REIA updated in Dec 2024

- NRA verified that still the exposure was quite small and its effect to human and the environmental was negligible.

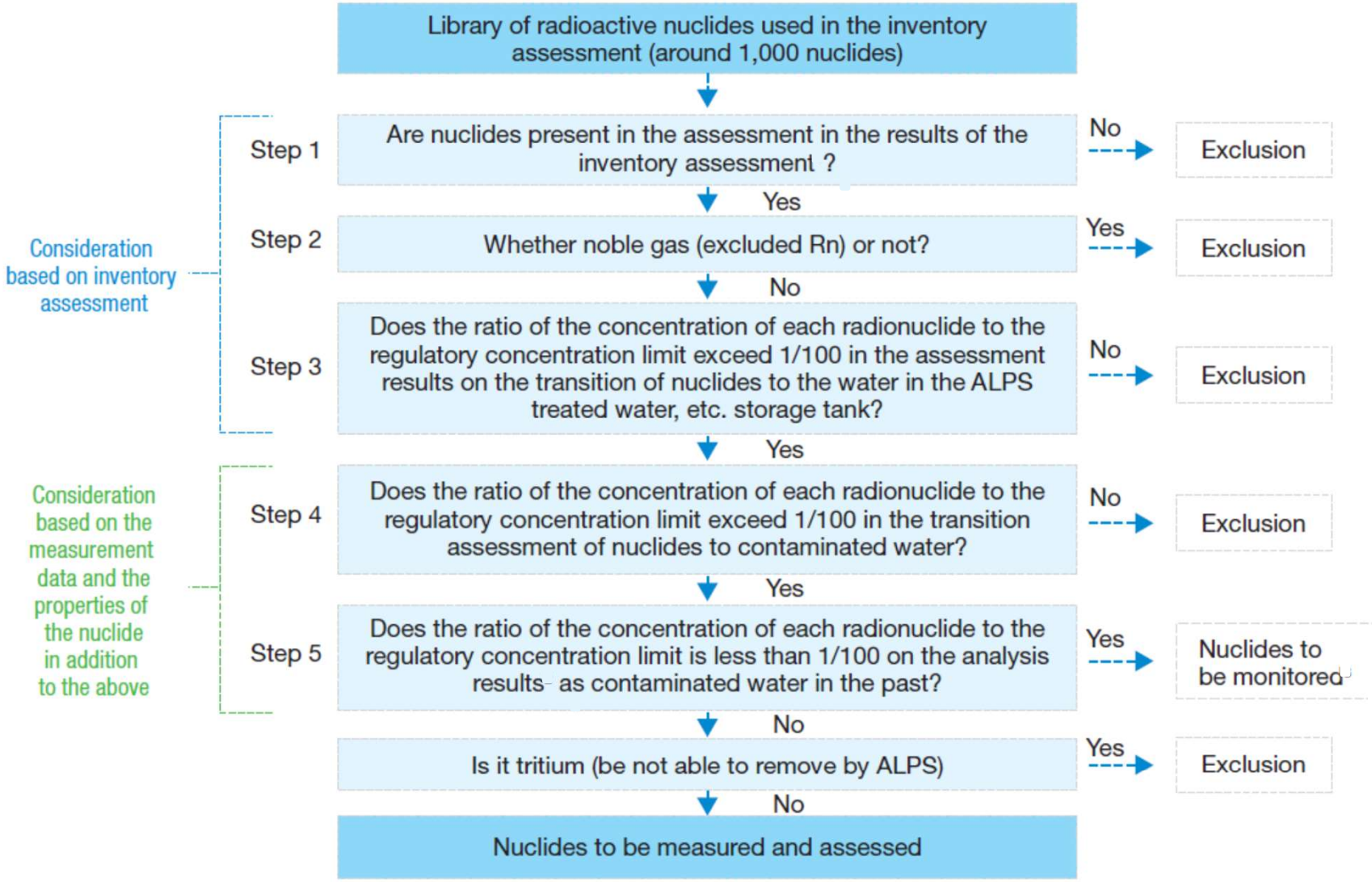


https://www.tepco.co.jp/en/hd/newsroom/announcements/archives/2024/pdf/241209e0102.pdf

3. Updates of "Nuclides to be measured and assessed"

- NRA approved TEPCO's flowchart to screen "Nuclides to be measured and assessed", those are nuclides to be measured at every discharge of ALPS treated water.
- This year, TEPCO re-assessed the "Nuclides to be measured and assessed" based on the flowchart, and as a result, Ce-144 was excluded from "Nuclides to be measured and assessed" due to its short half life (285days).
- So far, Ce144 has not been detected in ALPS treated water since the 1st discharge.
- Therefore, NRA verified there was no safety concern on this update.

3. Updates of "Nuclides to be measured and assessed"



Overview of methodology used by TEPCO to select radionuclides to be measures and assessed prior to discharge

3. Updates of "Nuclides to be measured and assessed"

C-14	Sr-90	Te-125m	Sm-151	Pu-238	Cl-36
Mn-54	Y-90	I-129	Eu-154	Pu-239	Nb-93m
Fe-55	Tc-99	Cs-134	Eu-155	Pu-240	Nb-94
Co-60	Ru-106	Cs-137	U-234	Pu-241	Mo-93
Ni-63	**Cd-113m**	Ce-144	U-238	Am-241	Cd-113m
Se-79	Sb-125	Pm-147	Np-237	Cm-244	Ba-133

Nuclides to be measured and evaluated (except H3): ***29 nuclides → 30 nuclides (explained in the 3rd mission)***

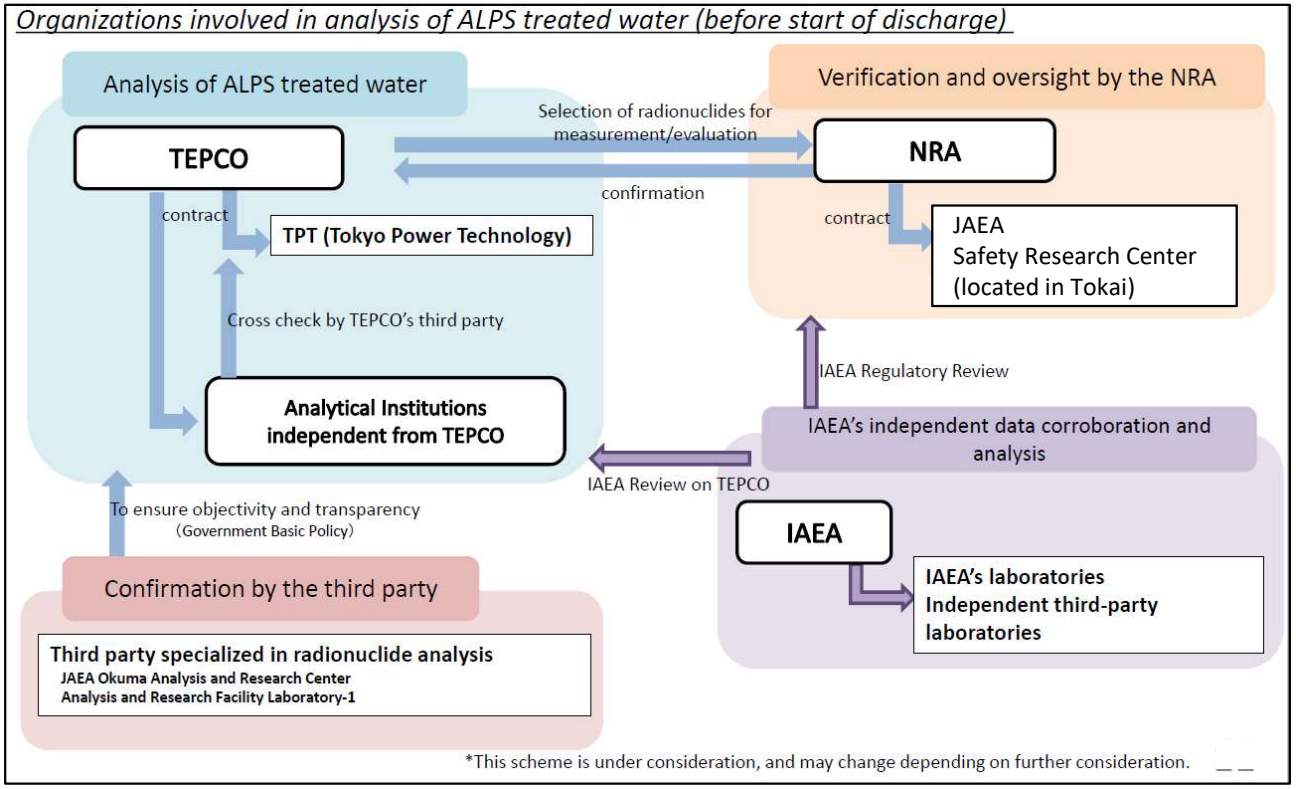
Nuclides to be monitored

Nuclides to be excluded from measurement of the discharge from Aug 2025

4. Result of NRA's Independent Analysis

- NRA's independent analysis was conducted for the release on 30 Oct 2025 (the 16th batch). This is the report on the results.

- JAEA Safety Research Center (SRC) analyzed radionuclides in ALPS treated water under the contract from the NRA in the same framework as one conducted the previous year.

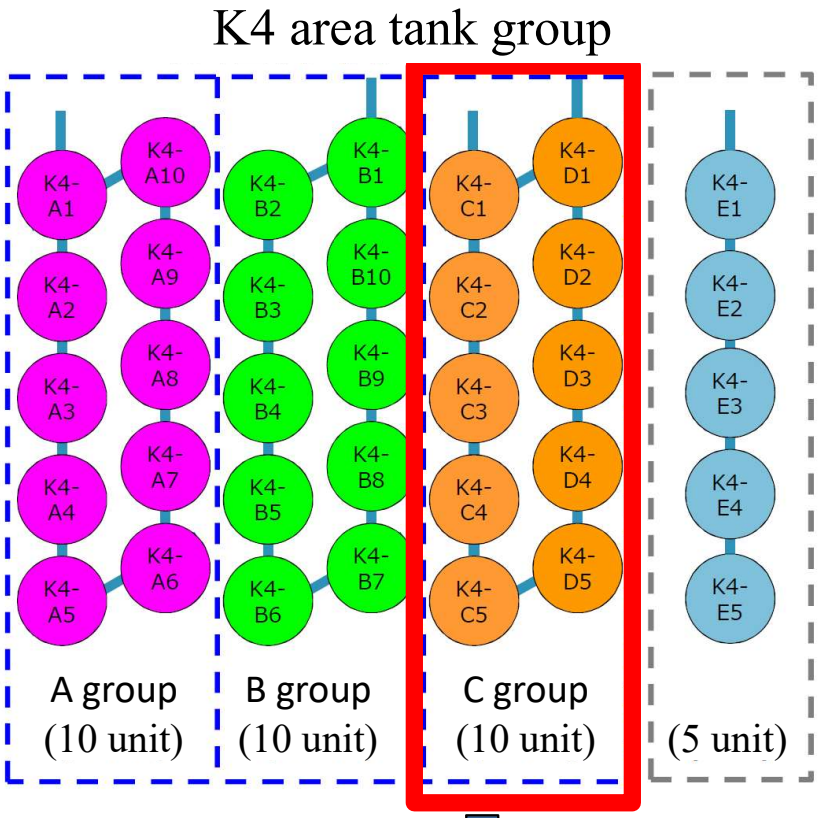


"Update Material" explained in 2nd IAEA review mission for NRA

Compare the analytical results (radionuclide concentration) by JAEA SRC and TEPCO with consideration of uncertainty ranges, for supporting the overall oversight by the NRA.

4. Result of NRA's Independent Analysis

Sampled on September 12, 2025 at 9:24 AM
"ALPS treated water measurement/confirmation tank water (K4 tank C group)"



JAEA
Received at the Safety Research Center
(September 16, 2025)

4. Result of NRA's Independent Analysis

Analyzed Nuclides

- Analyzed 7 radionuclides (compared with TEPCO's result)
  C-14, Co-60, Ru-106, Sb-125, I-129, Cs-134, Cs-137

*Reason for selecting those nuclides

Based on the analysis results obtained in 2023, for the purpose of more effectively and efficiently confirming the validity of the analysis, NRA selected the nuclides with major contributors to the REIA (I-129 and C-14) excluding tritium, and gamma-ray emitting nuclides (Ge semiconductor measurement) that can be targeted in one measurement.

Tritium is excluded from NRA's analysis because the level of Tritium is easy to measure and that does not contribute significantly to radiation exposure.

4. Result of NRA's Independent Analysis

Analytical Methods

Nuclides	Principal radiation emitted	Analytical equipment	Analytical method (pretreatment)	Basis for analytical method
C-14	β	LSC	1.5 M HNO_3 was added into sample solution and N_2 gas was insufflated to the solution to evaporate CO_2. CO_2 was tapped by absorbent and absorbent was mixed with scintillator.	JAEA-Technology 2009-051
Co-60	βγ	Ge	without pretreatment	The Series of Environmental Radioactivity Measuring Methods (SERMM) No.7
Ru-106	β	Ge (Measure Rh-106)	without pretreatment	SERMM No.7
Sb-125	βγ	Ge	without pretreatment	SERMM No.7
I-129	βγ	ICP-MS	I was purified with Anion-SR	SERMM No.32
Cs-134	βγ	Ge	without pretreatment	SERMM No.7
Cs-137	βγ	Ge	without pretreatment	SERMM No.7

Ge : Ge Semiconductor Detector
LSC : Liquid Scintillation Counter
ICP-MS : Inductively Coupled Plasma Mass Spectrometry

4. Result of NRA's Independent Analysis

Comparison of the results with TEPCO's ones (En number)

Evaluated analytical results by using *E*n number shown in B.3 of ISO/IEC17043：2010(JIS Q 17043:2011), with consideration of uncertainty in analytical results

>> If the absolute value of *E*n number exceed 1 ($|En|>1$), the cause of discrepancy will be investigated.

$$En = \frac{X_{TEPCO} - X_{JAEA}}{\sqrt{U_{TEPCO}^2 + U_{JAEA}^2}}$$

X_{TEPCO} : Measured value (radionuclide concentration) by TEPCO

X_{JAEA} : Measured value (radionuclide concentration) by JAEA SRC

U_{TEPCO} : Uncertainty of TEPCO's value

U_{JAEA} : Uncertainty of JAEA NSRC's value

4. Result of NRA's Independent Analysis

Comparison of the results with TEPCO's ones (En number)

- Nuclides which were not detected in the analysis of JAEA SRC

Nuclides	JAEA SRC (Bq/L)	TEPCO* (Bq/L)	Regulatory concentration limit (Bq/L)
Ru-106	<0.69	<0.22	100
Sb-125	<0.26	0.17±0.063	800
Cs-134	<0.21	<0.027	60

- Any detection limit is lower than 1/100 of regulatory concentration limit

＊：https://www.tepco.co.jp/decommission/data/analysis/pdf_csv/2025/4q/measurement_confirmation_251028-j.pdf

4. Result of NRA's Independent Analysis

Comparison of the results with TEPCO's ones (En number)

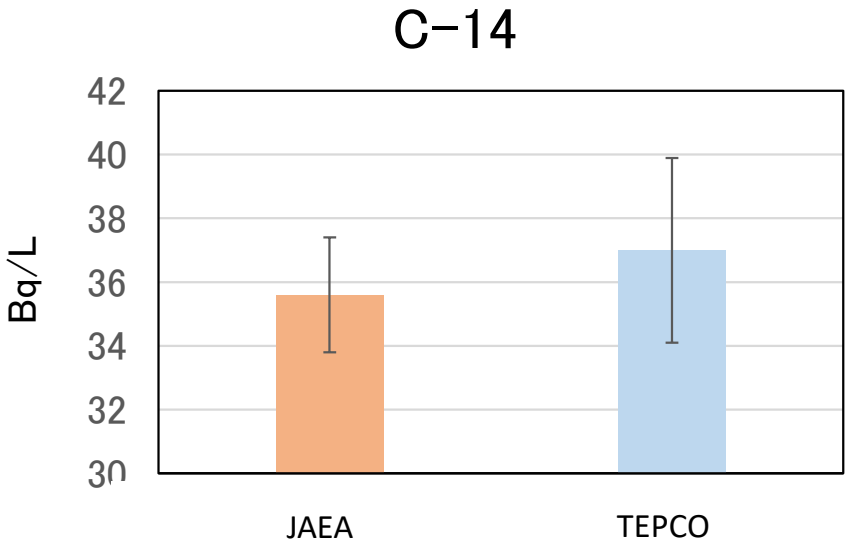
- Nuclides which were detected in the analysis of JAEA SRC

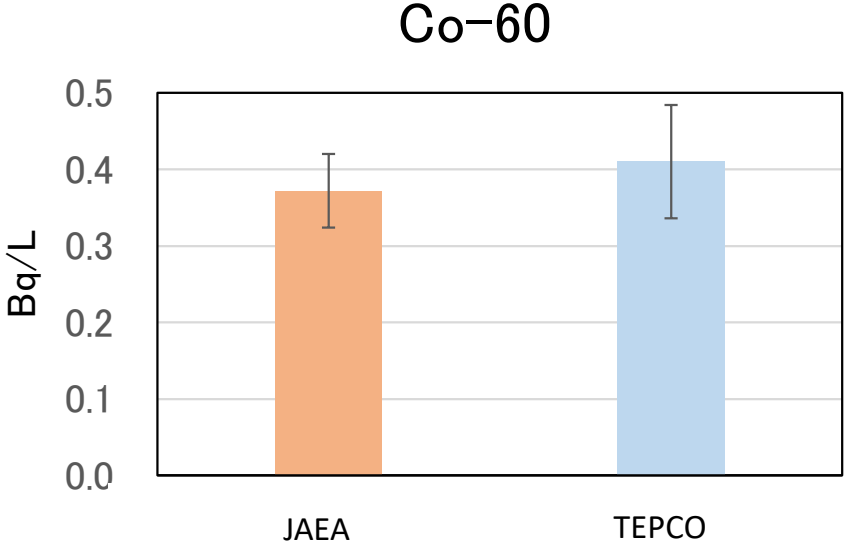
Nuclides	JAEA SRC (Bq/L)	TEPCO* (Bq/L)	Concentration limit (Bq/L)	|En|
C-14	35.6±1.8	37±2.9	2,000	0.41
Co-60	0.372±0.048	0.41±0.074	200	0.43
I-129	0.306±0.0067	0.37±0.031	9	0.87
Cs-137	0.234±0.048	0.21±0.042	90	0.38

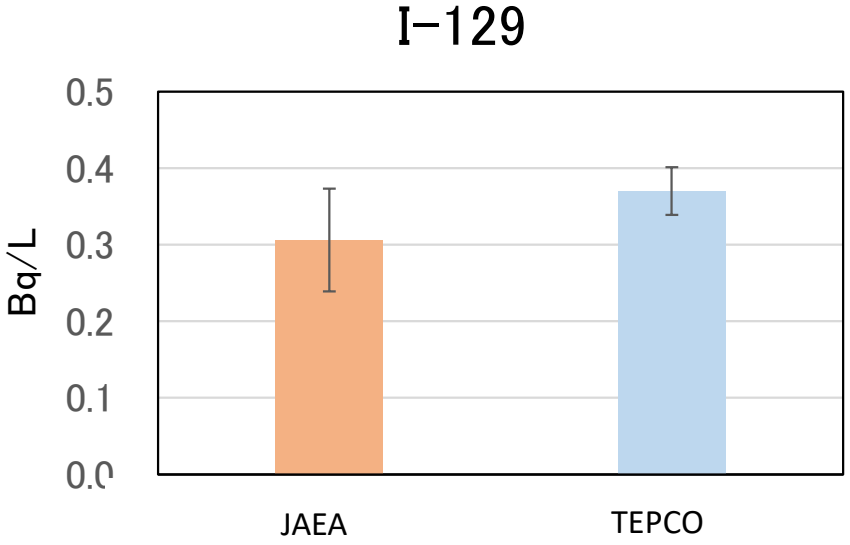
・All of the values of $|En|$ were below 1.

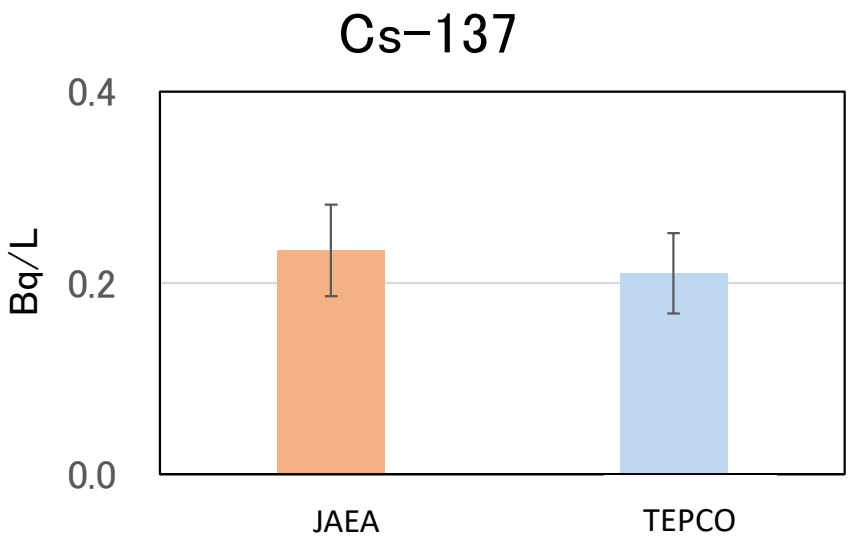
＊：https://www.tepco.co.jp/decommission/data/analysis/pdf_csv/2025/4q/measurement_confirmation_251028-j.pdf

4. Result of NRA's Independent Analysis









Error bar shows relative expanded uncertainty

Discussions about the discharge of ALPS treated water

An examples of the discussion at the Oversight and Review Meeting for Fukushima daiichi, which involves external experts and local stakeholders in addition to NRA Commissioners, NRA staff and TEPCO

At the meeting on 16th Dec, 2024,

- One representative of the local community (provisional translation)
  - *I think it is very good that the treated water is being processed smoothly without any trouble. First of all, from the perspective of providing reassurance to the local community by handling this as quickly as possible—even by one day—we currently have a system that processes 460 tons per day. One cycle is 7,800 tons; I understand that. However, will we continue with this system semi-permanently, or will we consider speeding up the process so that we can handle a larger volume? That is one point.*

Meeting record (Japanese only)

https://www.da.nra.go.jp/view/NRA100007024?contents=NRA100007024-004-001

Thank you for your attention.

Reference

Reference; descriptions from the IAEA report of 1st review mission after start of discharge (Oct. 2023)

The NRA explained the independent source monitoring that it is undertaking to complement the operational safety inspections and more broadly, the regulatory oversight of the discharge activities. A summary of the radionuclides included in NRA's independent source monitoring is shown in Table 1.

Table 1: Independent source monitoring by NRA

NRA Independent Source Monitoring	Frequency	Radionuclides
Before the start of discharge	-	Co-60, Sr-90, Ru-106, Sb-125, I-129, Cs-134, Cs-137 H-3, C-14, Tc-99 Cl-36, Fe-55, Se-79
After the start of discharge	Once a year (for year 1 (2023) – the 2nd batch of discharge)	C-14, I-129 (major contributors in the REIA) Co-60, Ru-106, Sb-125, Cs-134, Cs-137 (major gamma-emitting radionuclides)

https://www.iaea.org/sites/default/files/first_review_mission_report_after_start_of_alps_treated_water_discharge_oct_23.pdf

Reference; descriptions from the IAEA report of 1st review mission after start of discharge (Oct. 2023)

Before the start of discharges of ALPS treated water, the independent source monitoring confirmed that TEPCO's analysis for the first batch of ALPS treated water discharge was valid. The radionuclides assessed by NRA before the start of discharge are given in Table 1.

After beginning to discharge ALPS treated water, independent verification analyses will be undertaken by NRA or its contractor once a year but also, in the first year of discharges (2023), for the second batch of discharge (see Table 1).

The Task Force noted that not all 30 radionuclides in TEPCO's source term are included in NRA's independent source monitoring and, that in the case of future independent verification, ^{3}H will not be assessed (as shown in Table 1). The NRA explained that this had been decided on the basis that ^{3}H at the levels typically present in ALPS treated water is easy to measure and that this radionuclide does not contribute significantly to radiation exposures. The Task Force was satisfied that this approach was justified.

https://www.iaea.org/sites/default/files/first_review_mission_report_after_start_of_alps_treated_water_discharge_oct_23.pdf

Additional Parameters for Cd-113m (External Exposure Assessment)

Assessment Item	Conversion Coefficient	Unit	Source
External exposure from surface of the sea	7.4E-11	(mSv/h)/(Bq/L)	Decommissioning Environmental Impact Handbook
External exposure from ship hull	7.2E-12	(mSv/h)/(Bq/m^2)	Decommissioning Environmental Impact Handbook
External exposure during swimming/underwater work	4.2E-11	(mSv/h)/(Bq/L)	Decommissioning Environmental Impact Handbook
External exposure from beach sand	4.1E-11	(mSv/h)/(Bq/kg)	Decommissioning Environmental Impact Handbook
External exposure from fishing nets	5.9E-12	(mSv/h)/(Bq/kg)	Decommissioning Environmental Impact Handbook

Additional Parameters for Cd-113m (Internal Exposure Assessment)

Assessment Item	Adult	Child	Infant	Unit	Source
Effective dose coefficient for ingestion	2.3E-05	3.9E-05	1.2E-04	mSv/Bq	IAEA GSR Part 3
Effective dose coefficient for inhalation	1.1E-04	1.8E-04	3.0E-04	mSv/Bq	IAEA GSR Part 3

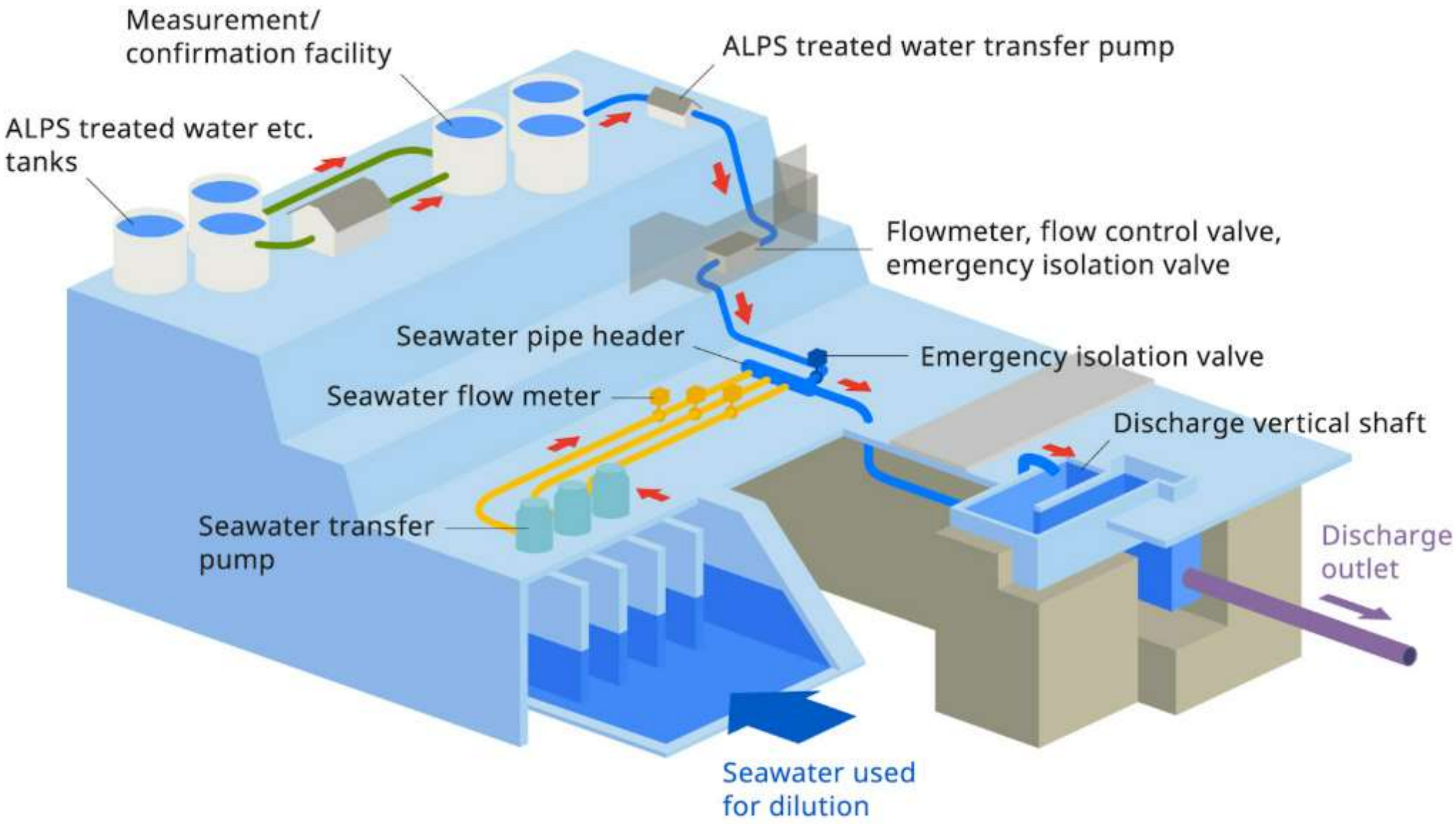
Assessment Item	Fish	Invertebrates	Seaweed	Unit	Source
Concentration factor for fish	5.0E+03	8.0E+04	2.0E+04	(Bq/kg)/(Bq/L)	IAEA TRS No.422

Additional Parameters for Cd-113m (Environmental Protection Assessment)

Assessment Item	Flatfish	Crab	Brown Algae	Unit	Source
Internal dose conversion coefficient	2.5E-06	2.5E-06	2.4E-06	(mGy/day)/(Bq/kg)	ICRP BiotaDC
External dose conversion coefficient	1.7E-08	1.6E-08	1.4E-07	(mGy/day)/(Bq/kg)	ICRP BiotaDC
Concentration ratio	2.9E+04	1.3E+05	1.6E+03	(Bq/kg)/(Bq/L)	TRS-479, ICRP Pub.114

Assessment Item	Distribution coefficient	Unit	Source
Distribution coefficient (From Seawater to Sediment)	3.0E+04	(Bq/kg)/(Bq/L)	IAEA TRS No.422

-Overview of the discharge facility-

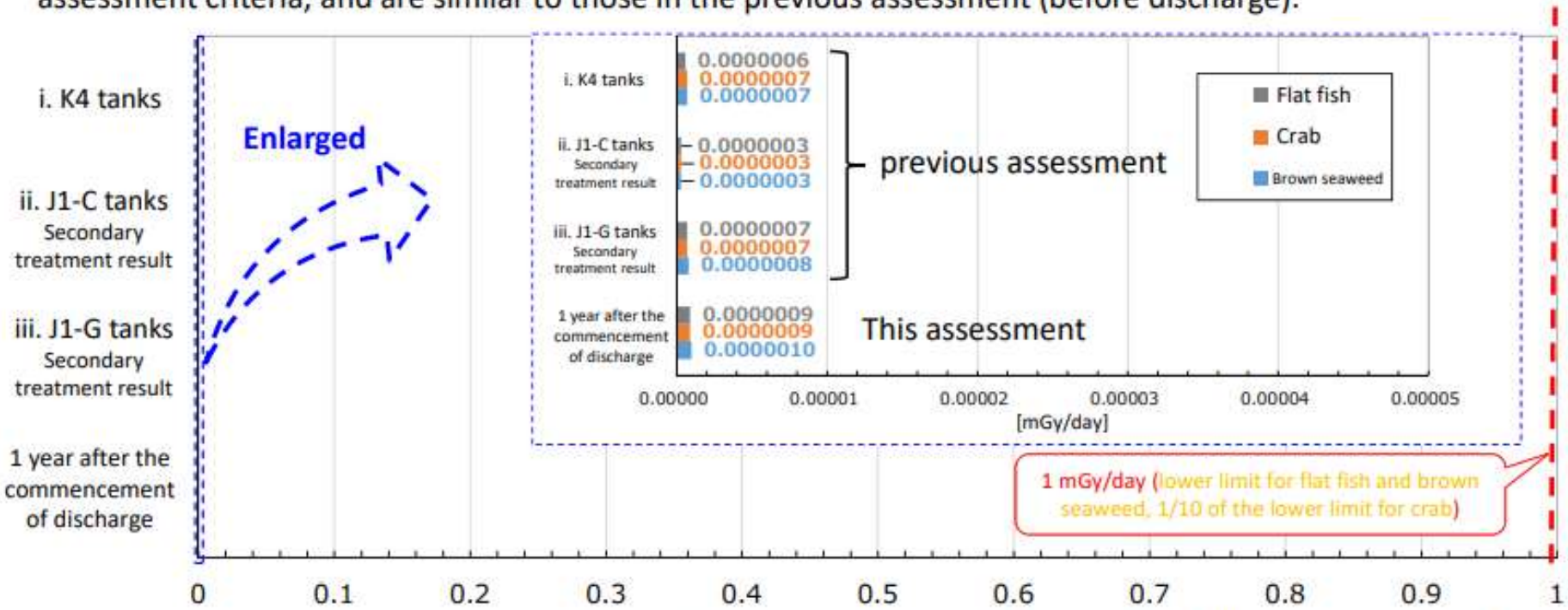


Exposure assessment results for animals and plants
(comparison with previous assessment)

changed

TEPCO

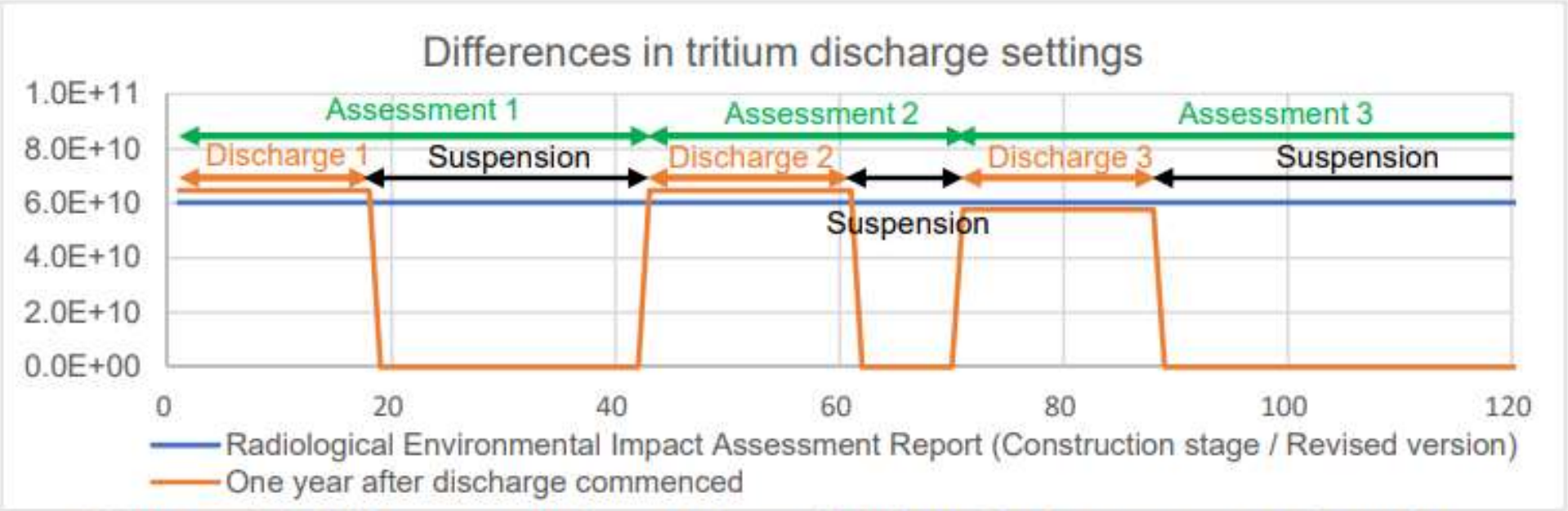
- The levels are extremely low, ranging from approximately 1 part in 1 million (brown seaweed) to approximately 1 part in 11 million (crab), which is the lower limit of the induced reference levels* (1-10 mGy**/day for flat fish, 10-100 mGy/day for crabs, and 1-10 mGy/day for brown seaweed), which are the assessment criteria, and are similar to those in the previous assessment (before discharge).



Note) This assessment was calculated assuming that undetectable nuclides were also present at their detection limits. Although the amount of tritium released was less than half that of the previous assessment, the detection limits for some undetectable nuclides were raised, increasing the amount released in the assessment and increasing exposure to some nuclides, so the exposure assessment value has increased slightly.

* Derived Consideration Reference Level (DCRL): A range of dose rates with a one-digit width established for each biological species proposed by the ICRP. This is the dose rate level above which effects must be considered.

** Gray: A unit showing the absorbed dose (amount of absorbed energy) of a substance, while Sievert is a unit showing the magnitude of the effects of radiation on the human body.
To be precise, Sievert = Correction Factor × Gray, but it is roughly equivalent for gamma rays and beta rays.



Differences in the settings of tritium discharge amount input into dispersion simulation

[Radiological Environmental Impact Assessment Report for One Year after the Commencement of Discharge Regarding the Discharge of ALPS Treated Water into the Sea]