NRA's Regulatory Activities related to ALPS treated water

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Nuclear Regulation Authority JAPAN
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1. Background and Purpose of Independent Analysis

- NRA conducts its independent analysis to complement operational safety inspection on TEPCO's organizational framework for analyzing "nuclides to be measured and assessed" and their quality assurance activities with objectivity and transparency.

- This activity roots in several IAEA safety requirements and guides (ex. GSG-9, 5.92) stating "The regulatory body should verify compliance with the regulatory requirements and the operational limits and conditions of the authorization for discharges".

- NRA has completed total three NRA's analysis on ALPS treated water.

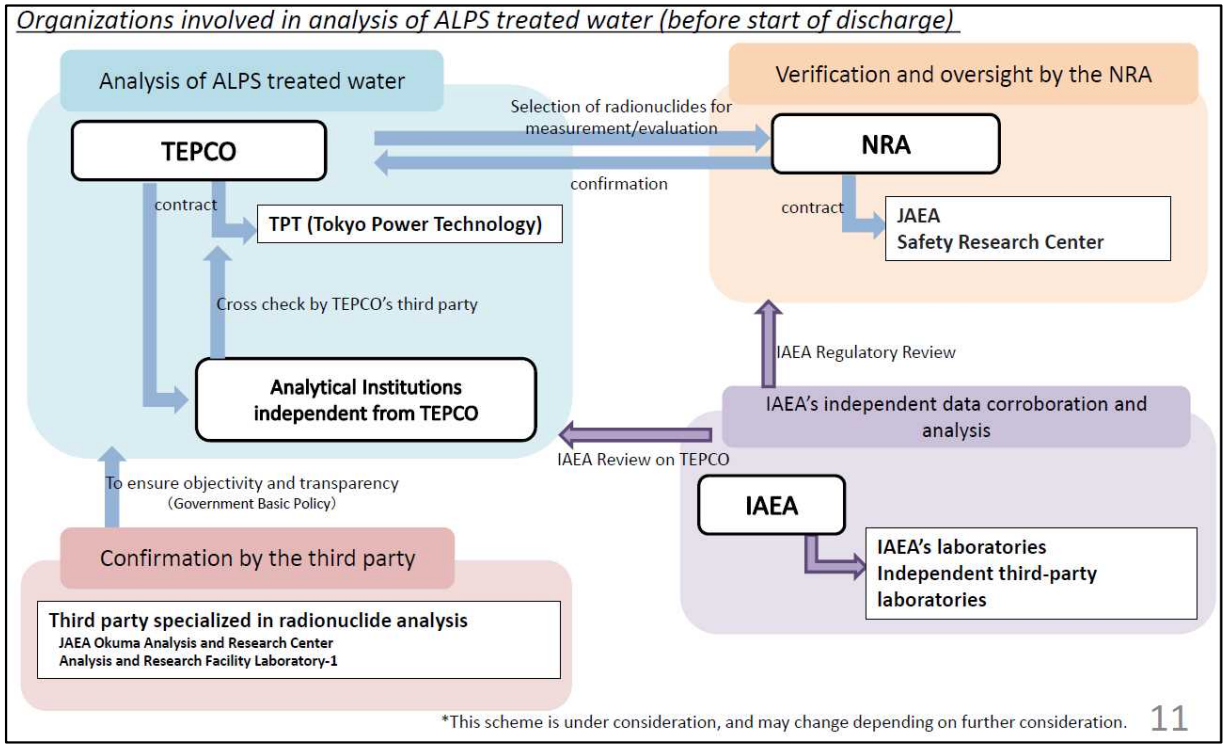
- So far, based on the results, Tepco's analysis were valid.

- Today, this presentation covers details of the latest NRA's analysis.

1. Background and Purposeof Independent Analysis

- NRA's independent analysis was conducted for the release on 17 October 2024 (the tenth batch.) This is the report on the results.

- JAEA NSRC analyzed radionuclides in ALPS treated water under the contract from the NRA in the same framework as one conducted the previous year.

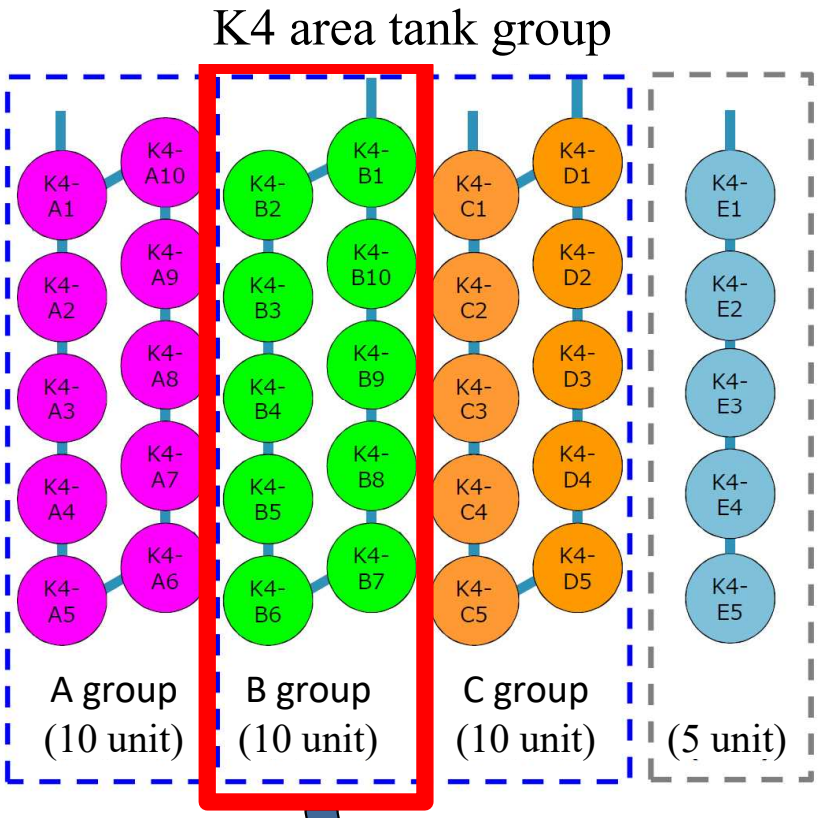


"Update Material" explained in 2nd IAEA review mission for NRA

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

2. Analysis Sample

Sampled on September 4, 2024 at 8:29 AM
“ALPS treated water measurement/confirmation tank water (K4 tank B group)”



JAEA
Received at the Nuclear Science Research Institute
(September 11, 2024)

3. Analyzed Nuclides

- Analyzed 7 radionuclides (compared with TEPCO's result)

- Among nuclides mainly detected in ALPS treated water :
  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. 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

5. 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 NSRC

U_{TEPCO} : Uncertainty of TEPCO's value

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

5. Comparison of the results with Tepco's ones (En number)

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

Nuclides	JAEA NSRC (Bq/L)	TEPCO* (Bq/L)	Regulatory concentration limit (Bq/L)
Ru-106	<0.49	<0.23	100
Sb-125	<0.17	0.13±0.062	800
Cs-134	<0.15	<0.029	60
Cs-137	<0.067	0.054±0.020	90

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

＊：https://www.tepco.co.jp/decommission/data/analysis/pdf_csv/2024/4q/measurement_confirmation_241015-j.pdf

5. Comparison of the results with Tepco's ones (En number)

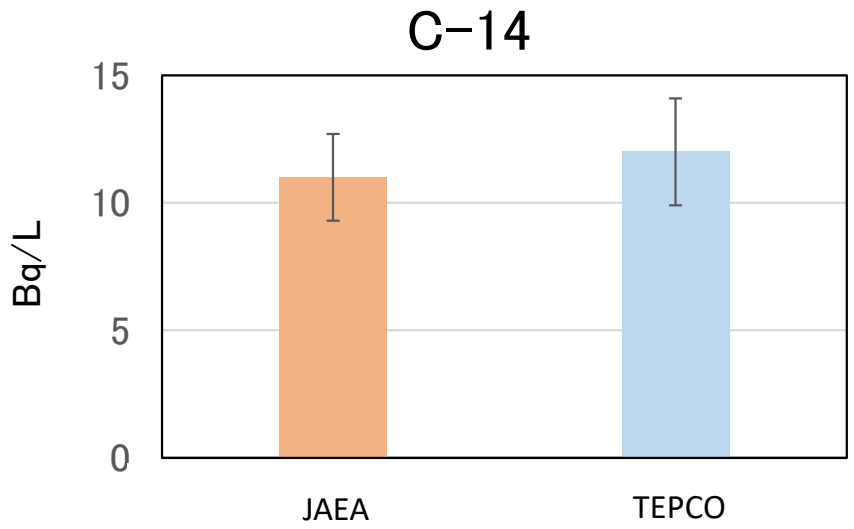
- Nuclides which were detected in the analysis of JAEA NSRC

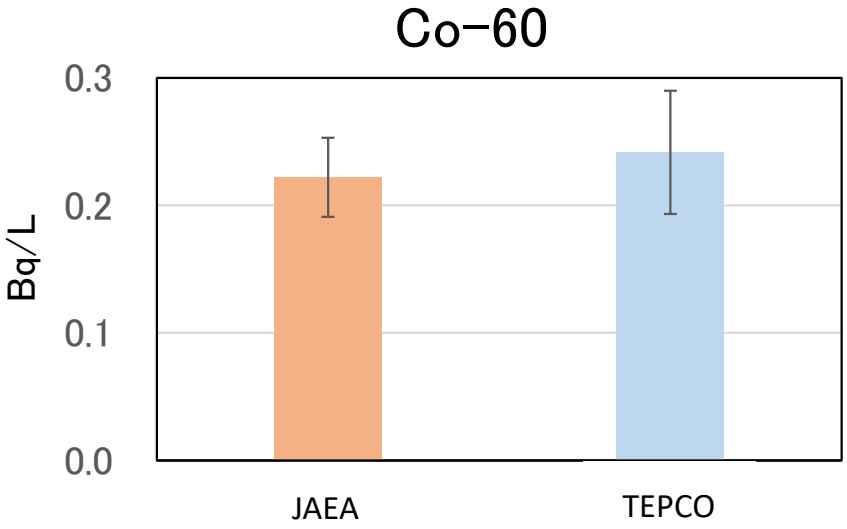
Nuclides	JAEA NSRC (Bq/L)	TEPCO* (Bq/L)	Concentration limit (Bq/L)	|En|
C-14	11.0±1.7	12±2.1	2,000	0.37
Co-60	0.222±0.031	0.24±0.048	200	0.32
I-129	0.1273±0.0089	0.11±0.021	9	0.76

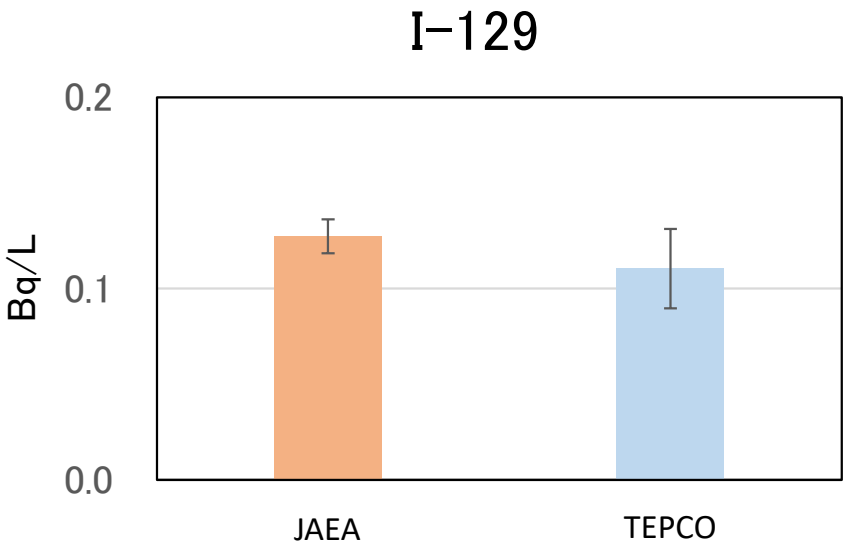
・All of the values of |*E*n| were below 1.

＊：https://www.tepco.co.jp/decommission/data/analysis/pdf_csv/2024/4q/measurement_confirmation_241015-j.pdf

5. Comparison of the results with Tepco's ones (En number)







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6. Inspection

Resident inspectors verify, as necessary, whether the operation is adequately conducted according to the approved IP, including the check points below.

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 based on the plan
   - ✓ Status of education and training
2. ***Quality assurance (approx. once/month)***
   - ✓ Quality assurance activities on analysis of ALPS treated water, ex. analysis methods for γ-lay nuclides and Cd-113
3. ***Project management (approx. twice/week)***
   - ✓ Hearing of the status of project management
   - ✓ Observing at the operator's relevant meetings (e.g., safety risk management meeting, ALPS treated water program team meeting)
   - ✓ 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

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

- ✓ The measurement/confirmation facility:
  - Circulation performance
  - Agitation performance
  - Operation Status
  - Alarm device performance
- ✓ The emergency shutdown valve:
  - Operation test with actuation signal

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

Thank you for your attention.

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

Analysis result(1/2)

➢ **Nuclides which were not detected in the analysis of JAEA NSRC**

Nuclides	JAEA NSRC (Bq/L)	TEPCO* (Bq/L)	Concentration limit (Bq/L)
Ru-106	<0.81	<0.21	100
Sb-125	<0.26	<0.088	800
Cs-134	<0.17	<0.03	60

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

＊：https://www.tepco.co.jp/decommission/data/analysis/pdf_csv/2023/3q/measurement_confirmation_230921-j.pdf

Analysis result(2/2)

➢ **Nuclides which were detected in the analysis of JAEA NSRC**

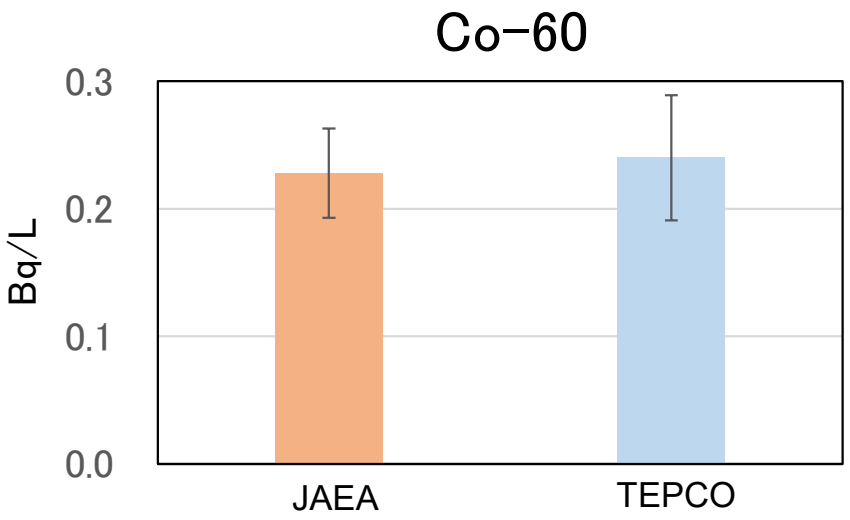
Nuclides	JAEA NSRC (Bq/L)	TEPCO* (Bq/L)	Concentration limit (Bq/L)	|En|
Co-60	0.228±0.035	0.24±0.049	200	0.20
I-129	1.70±0.12	1.8±0.092	9	0.66
Cs-137	0.445±0.064	0.45±0.080	90	0.05
C-14	13.19±0.65	13±2.3	2,000	0.08

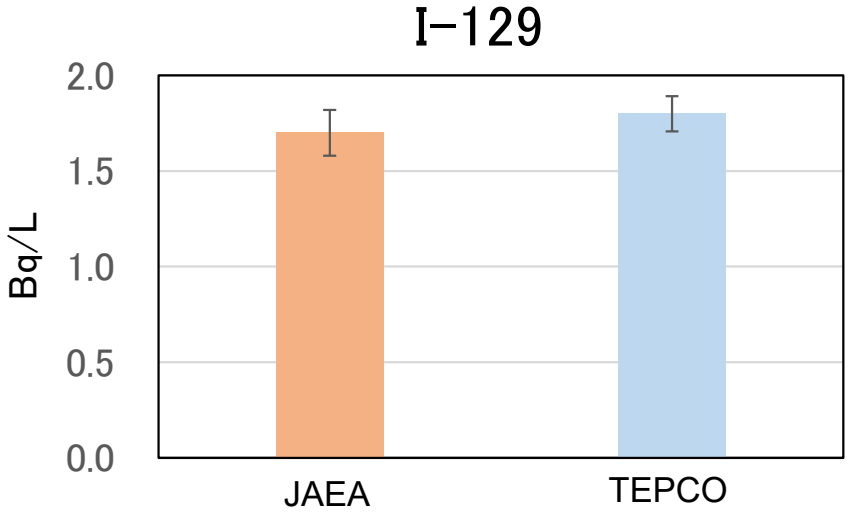
・All of the values of |*E*n| were below 1.

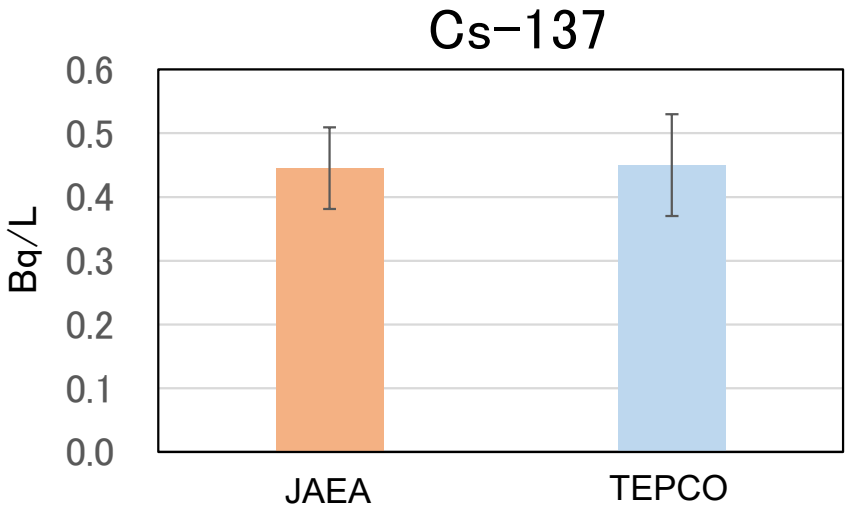
＊：https://www.tepco.co.jp/decommission/data/analysis/pdf_csv/2023/3q/measurement_confirmation_230921-j.pdf

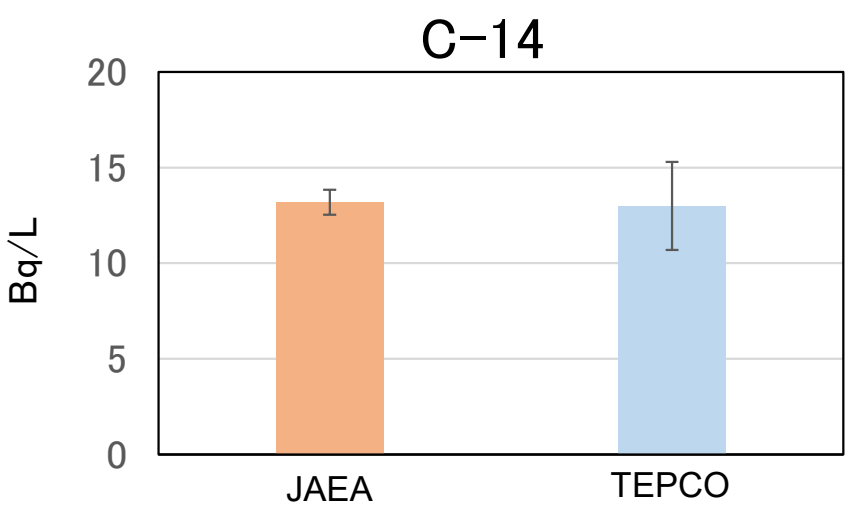
Reference; results of previous independent analysis from material of 1st review mission after start of discharge (Oct. 2023)

Analysis result(2/2)









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