Tank Reuse Policy in light of the Results of Analysis of Water in Tanks to be repurposed

July 30, 2020

TEPCO

Tokyo Electric Power Company Holdings, Inc.

1. Background

- Repurposing welded tanks
  - Approximately 1,370,000 m³ of tank storage space has been secured (as of December 2020), and tanks previously used to store Sr-treated water that have been drained will be repurposed for the storage of ALPS-treated water.

    (repurposed tanks: 93, approximately 97,000 m³)

  - When repurposing tanks, the water and sludge remaining in the bottom of the tanks shall be recovered as a measure to prevent the generation of hydrogen sulfide, which occurred in October 2018.
  - However, sludge on the inside walls of the tank shall only be removed in areas that can be reached.

⇒Since it is assumed that the radioactive concentrations of water in the tanks that will be repurposed for ALPS-treated storage shall exceed that of water from the ALPS outlet due to the impact of radioactive substances that still remain inside of the repurposed tanks, after the tanks have been filled the impact on the ratio of the concentrations required by law shall be examined.

【Explained during a secretariat meeting of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment on January 30, 2020】

- A radiation concentration analysis of water in the G3-H group and K2-B group tanks, which have been repurposed and are full already, shall be performed in order to examine the effect of remaining radioactive substances that were present in the tanks when they were repurposed.

2. Results of tank water analysis from the G3-H and K2-B tank groups

	G3-H group (approx. 6400m3)	K2-B group (approx. 6200m3)
Sum of the ratios of the concentrations required by law for tank water when Sr-treated water was being stored※1	**2914.41**	Not measured. Results for the K2-D group which has a similar storage history was **6349.11**
Sum of the ratios of the concentrations required by law from existing ALPS outlet※2	**0.05**	**0.05**
Sum of the ratios of the concentrations required by law for tank water after filling the tanks with treated water from existing ALPS equipment※2	G3-H1 tank : **8.87** G3-H4 tank : **113.24**	K2-B1 tank : **2.31** K2-B6 tank : **1.07**
Tank usage history	After the tank was built it was used to store RO concentrated brine. After the RO concentrated brine was drained, the tank was filled with treated water from SARRY and KURION (Sr-treated water)	After the tank was built it was used to store water treated with RO concentrated water treatment equipment※3 (Sr-treated water)

※1 : Six nuclides: Cs-134/137, Sr-90, Co-60, Sb-125, Ru-106
※2 : Seven nuclides: Cs-134/137, Sr-90, Co-60, Sb-125, Ru-106, I-129
※3 : Equipment removing Cs and SR, etc. from RO concentrated brine

- The sum of the ratios of the concentrations required by law at the existing ALPS outlet is very low at 0.05 thereby showing that **existing ALPS is performing sufficiently**. Furthermore, risks are lower compared to when Sr-treated water was being stored.
- The sum of the ratios of the concentrations required by law for the G3-H and K2-B tank groups exceeds 1 to the impact of radioactive substances, such as sludge, etc., that were still present in the tank after it was washed.
  - The G3-H group has been used to store RO concentrated brine and it is assumed that the sum of the ratios of the concentrations required by law will be higher than that of the K2-B group as a result.
- **ALPS-treated water in the G3-H and K2-B tank groups** for which the sum of the ratios of the concentrations required by law exceeds 1 **shall be subjected to purification**.

3. Future tank repurposed policy

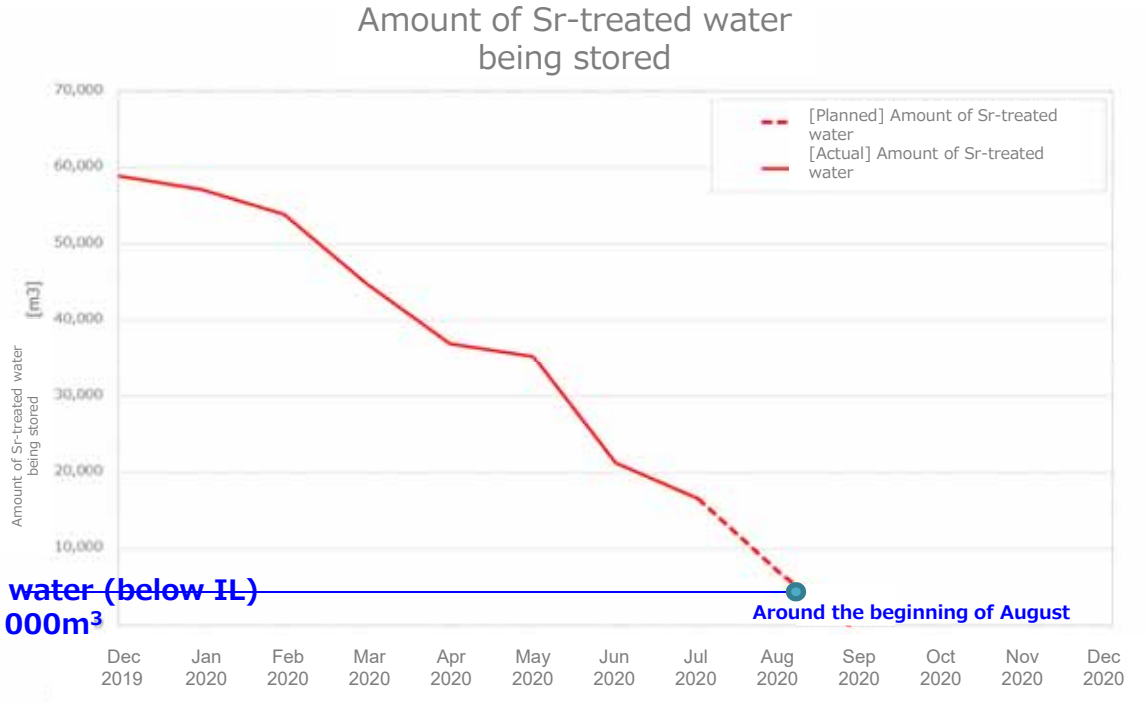
- The sum of the ratios of the concentrations required by law for ALPS-treated water is very low at 0.05 thereby showing that existing ALPS is performing sufficiently.
- Going forward, measures, such as reducing the impact of sludge, etc., shall be deliberated in order to prevent radiation concentrations of ALPS-treated water being stored from greatly increasing after which the tanks will be repurposed in order to secure tank space for storing ALPS-treated water.
  - In order to quickly reduce the risks associated with storage of Sr-treated water, we will use new tanks as well as the K2-C and D tank groups (approximately 13,000 m³), which were used to store water of a similar nature as the K2-B tank group (low levels of contamination), as we aim to complete treatment of Sr-treated water during August 2020.

    ※If the sum of the ratios of the concentrations required by law for ALPS-treated water stored in repurposed tanks exceeds 1, it will be subjected to secondary treatment.
  - If and when welded tanks other than the tanks in the K2-C and D tank groups (approximately 71,000 m³) are to be repurposed, measures for reducing the impact of sludge shall be deliberated and the timing for the repurposing of these welded tanks shall be carefully examined based on the results.

If ALPS-treated water for which the sum of the ratios of the concentrations required by law exceeds 1 is to be discharged into the environment, **it shall be subject to treatment until the sum of the ratios of the concentrations required by law is below 1**.

Reference 1: Plans for after the treatment of Sr-treated water has been completed

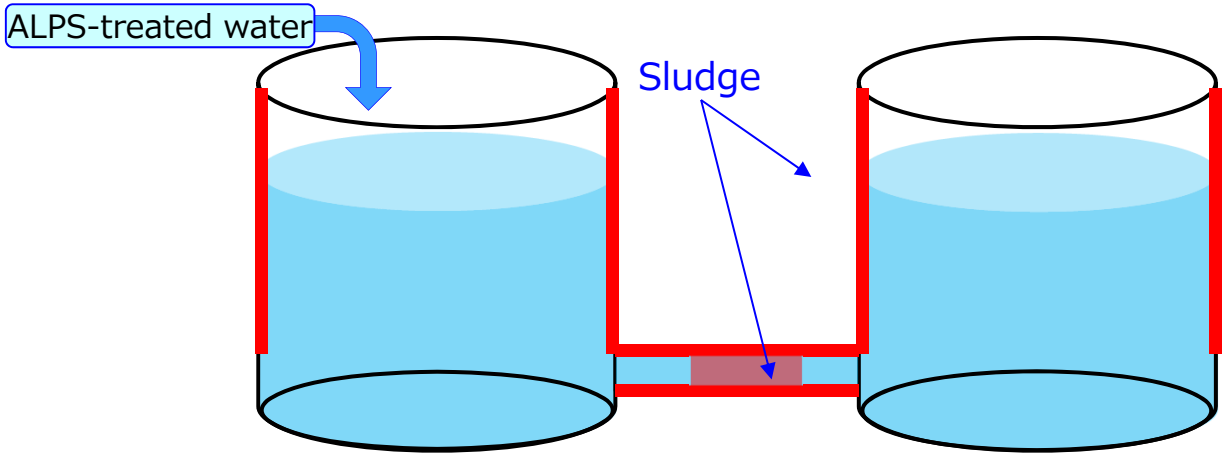
- The treatment of Sr-treated water should be completed by the beginning of August 2020 with the exception of approximately 4,000 m³ of the remaining water that is lower than pump interlock (pump automatic shut down) levels.



- After completing the treatment of Sr-treated water, after September 2020 we shall begin to examine the performance of secondary treatment of highly concentrated ALPS-treated water (sum of the ratios of the concentrations required by law exceeds 100) (approximately 2,000m³ treated) as put forth in the "TEPCO Draft Study Responding to the Subcommittee Report on Handling ALPS Treated Water" (released by TEPCO on March 24, 2020). We do this to examine if we can reduce the sum of the ratios of the concentrations required by law of radioactive substances, with the exception of tritium, to below 1 using ALPS. (Analysis and assessment should be completed around January 2021)
- ALPS-treated water that has been subjected to secondary treatment shall be stored in newly constructed tanks.

Reference 2: Assumed causes of the increase in the sum of the ratios of the concentrations required by law (1/2)

- High pressure washers were used to clean the inside of the tanks after they were drained of water to the extent that they could reach
- Since concentration levels increased after filling the empty tanks with ALPS-treated water, it is assumed that sludge on the tank walls and inside the connection pipes caused the increase.
- We will examine new methods for cleaning the tanks and employ these methods when repurposing tanks in the future

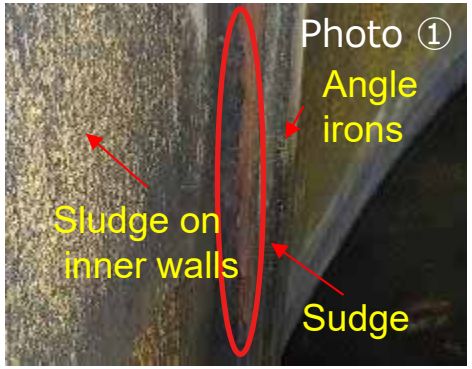


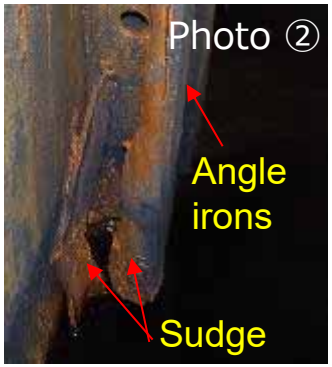
: Uncleaned areas

※The sludge on the bottoms and on the inner walls up to a height of approximately 2 m (height that could be reached) was removed.

G3-H tank bottom (after cleaning)

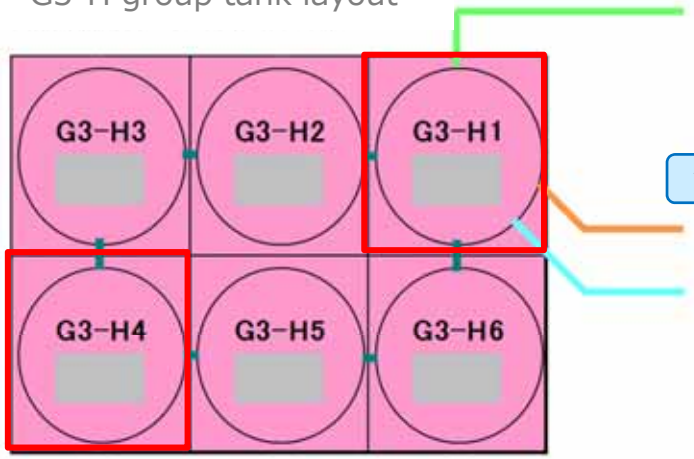
G3-H tank inner wall sludge (uncleaned)





- In light of the concentration levels in tank H1 (sum: approx. 10), which is at the front of the G3-H tank group, and tank H4, which is at the back of the group (sum: approx. 100), it is possible that sludge that has accumulated in the connecting pipes gradually gets pushed to the tanks in the back depending on the degree to which the tanks are in service.

G3-H group tank layout

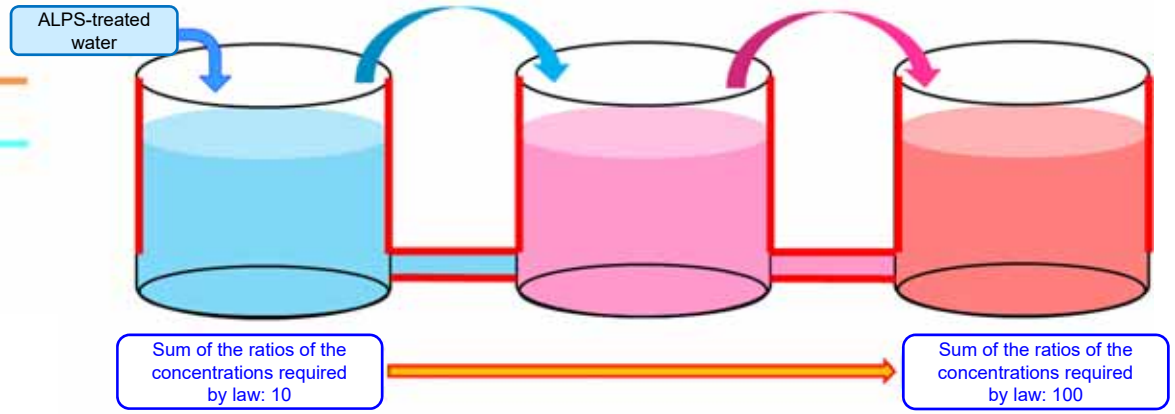


ALPS-treated water receiving pipe

RO concentrated water receiving pipe

Drainage pipe

Analyzed tank



Reference 3: Analysis results (G3-H group)

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【G3-H tank concentrations when storing Sr-treated water (H4 analyzed) 】

Group	Radiation concentration for each nuclide									Sum of the ratios of the concentrations required by law (6 nuclides) [-]
	Cesium (Cs)-137 Concentration required by law **9.00E+01** [Bq/L]	Cesium (Cs)-134 Concentration required by law 6.00E+01 [Bq/L]	Cobalt (Co)-60 Concentration required by law **2.00E+02** [Bq/L]	Antimony (Sb)-125 Concentration required by law **8.00E+02** [Bq/L]	Ruthenium (Ru)-106 Concentration required by law **1.00E+02** [Bq/L]	Strontium (Sr)-90 Concentration required by law **3.00E+01** [Bq/L]	Iodine (I)-129 Concentration required by law 9.00E+00 [Bq/L]	Tritium (H)-3 Concentration required by law **6.00E+04** [Bq/L]	Gross beta (β) [Bq/L]	
H4	1.73E+03	3.54E+02	1.82E+02	2.40E+03	2.04E+02	8.65E+04	–	–	–	2914.41

【ALPS-treated water stored in the G3-H group (ALPS outlet analysis) 】

Group	Radiation concentration for each nuclide									Sum of the ratios of the concentrations required by law (7 nuclides) [-]
	Cesium (Cs)-137 Concentration required by law **9.00E+01** [Bq/L]	Cesium (Cs)-134 Concentration required by law 6.00E+01 [Bq/L]	Cobalt (Co)-60 Concentration required by law **2.00E+02** [Bq/L]	Antimony (Sb)-125 Concentration required by law **8.00E+02** [Bq/L]	Ruthenium (Ru)-106 Concentration required by law **1.00E+02** [Bq/L]	Strontium (Sr)-90 Concentration required by law **3.00E+01** [Bq/L]	Iodine (I)-129 Concentration required by law 9.00E+00 [Bq/L]	Tritium (H)-3 Concentration required by law **6.00E+04** [Bq/L]	Gross beta (β) [Bq/L]	
AL outlet	3.52E-01	1.84E-01	4.35E-01	5.47E-01	1.33E+00	9.37E-02	2.22E-01	–	6.22E+00	0.05

【Results of analysis of G3-H tank group after being filled with ALPS-treated water】

Group	Radiation concentration for each nuclide									Sum of the ratios of the concentrations required by law (7 nuclides) [-]
	Cesium (Cs)-137 Concentration required by law **9.00E+01** [Bq/L]	Cesium (Cs)-134 Concentration required by law 6.00E+01 [Bq/L]	Cobalt (Co)-60 Concentration required by law **2.00E+02** [Bq/L]	Antimony (Sb)-125 Concentration required by law **8.00E+02** [Bq/L]	Ruthenium (Ru)-106 Concentration required by law **1.00E+02** [Bq/L]	Strontium (Sr)-90 Concentration required by law **3.00E+01** [Bq/L]	Iodine (I)-129 Concentration required by law 9.00E+00 [Bq/L]	Tritium (H)-3 Concentration required by law **6.00E+04** [Bq/L]	Gross beta (β) [Bq/L]	
H1	2.05E-00	<1.95E-01	6.96E-01	6.27E-01	<1.22E+00	2.64E+02	<2.39E-01	–	–	8.87
H4	4.01E+01	2.18E+00	4.62E+00	1.69E+00	<2.54E+00	3.38E+03	3.26E-01	–	–	113.24

Reference 3: Analysis results (K2-B group)

【Reference: concentrations in K2-D tank when storing Sr-treated water (D7 analyzed) 】

Group	Radiation concentration for each nuclide									Sum of the ratios of the concentrations required by law (6 nuclides) [-]
	Cesium (Cs)-137 Concentration required by law **9.00E+01** [Bq/L]	Cesium (Cs)-134 Concentration required by law 6.00E+01 [Bq/L]	Cobalt (Co)-60 Concentration required by law **2.00E+02** [Bq/L]	Antimony (Sb)-125 Concentration required by law **8.00E+02** [Bq/L]	Ruthenium (Ru)-106 Concentration required by law **1.00E+02** [Bq/L]	Strontium (Sr)-90 Concentration required by law **3.00E+01** [Bq/L]	Iodine (I)-129 Concentration required by law 9.00E+00 [Bq/L]	Tritium (H)-3 Concentration required by law **6.00E+04** [Bq/L]	Gross beta (β) [Bq/L]	
D7	1.206E+01	<3.168E+00	5.773E+02	2.055E+03	<1.354E+01	1.903E+05	–	–	–	6349.11

【ALPS-treated water in K2-B group (ALPS outlet analysis) 】

Group	Radiation concentration for each nuclide									Sum of the ratios of the concentrations required by law※ (7 nuclides) [-]
	Cesium (Cs)-137 Concentration required by law **9.00E+01** [Bq/L]	Cesium (Cs)-134 Concentration required by law 6.00E+01 [Bq/L]	Cobalt (Co)-60 Concentration required by law **2.00E+02** [Bq/L]	Antimony (Sb)-125 Concentration required by law **8.00E+02** [Bq/L]	Ruthenium (Ru)-106 Concentration required by law **1.00E+02** [Bq/L]	Strontium (Sr)-90 Concentration required by law **3.00E+01** [Bq/L]	Iodine (I)-129 Concentration required by law 9.00E+00 [Bq/L]	Tritium (H)-3 Concentration required by law **6.00E+04** [Bq/L]	Gross beta (β) [Bq/L]	
AL outlet	2.14E−01	6.81E−01	4.83E−01	1.17E+00	8.50E−02	2.23E−01	2.14E−01	–	–	0.05

【Results of analysis of K2-B tank group after filling the tanks with ALPS-treated water】

Group	Radiation concentration for each nuclide									Sum of the ratios of the concentrations required by law※ (7 nuclides) [-]
	Cesium (Cs)-137 Concentration required by law **9.00E+01** [Bq/L]	Cesium (Cs)-134 Concentration required by law 6.00E+01 [Bq/L]	Cobalt (Co)-60 Concentration required by law **2.00E+02** [Bq/L]	Antimony (Sb)-125 Concentration required by law **8.00E+02** [Bq/L]	Ruthenium (Ru)-106 Concentration required by law **1.00E+02** [Bq/L]	Strontium (Sr)-90 Concentration required by law **3.00E+01** [Bq/L]	Iodine (I)-129 Concentration required by law 9.00E+00 [Bq/L]	Tritium (H)-3 Concentration required by law **6.00E+04** [Bq/L]	Gross beta (β) [Bq/L]	
B1	7.72E-01	<2.51E-01	1.20E-01	7.32E-01	<1.81E+00	5.77E+01	3.16E+00	–	–	2.31
B6	4.68E-01	<4.55E-01	5.53E-01	2.28E+00	<2.57E+00	2.95E+01	3.77E-01	–	–	1.07

Reference 4: List of repurposed tank groups

Repurposed tank group	Tank capacity	Storage history
G3-H group	6, 427m³	RO concentrated brine ⇒SARRY/KURION-treated water (Sr-treated water)
K2-B group	6, 200m³	RO concentrated brine treatment equipment-treated water (Sr-treated water)
G3-E group	12, 171m³	RO concentrated brine ⇒ RO concentrated brine treatment equipment-treated water (Sr-treated water)⇒SARRY/KURION-treated water (Sr-treated water)
G3-F group	11, 156m³	
G3-G group	9, 128m³	
H8-B group	11, 782m³	
J1-B group	8, 569m³	RO concentrated brine ⇒SARRY/KURION-treated water (Sr-treated water)
K1-C group	6, 800m³	
K1-D group	4, 533m³	
K2-A group	7, 233m³	RO concentrated brine treatment equipment-treated water (Sr-treated water)
K2-C group	6, 200m³	
K2-D group	7, 233m³	

Repurposed

To be gradually repurposed from July 20, 2020

To be repurposed after revising cleaning methods

4-1. Plan for repurposing Strontium-treated water tanks for ALPS-treated water tanks

- Repurposing plan
  - In order to secure 1.37million m^3 of tank storage capacity by the end of December, 2020, we plan to drain Strontium-treated (Sr-treated) water tanks and repurpose them for ALPS-treated water with the aim of beginning the transfer of ALPS-treated water around March 2020. Before ALPS-treated water is transferred, the remaining Sr-treated water and sludge at the bottom will be removed and the bottom of tanks will be cleaned as a measure to prevent the generation of hydrogen sulfide like we experienced in October, 2018.
    (Repurposed tanks: 93 tanks, approx. 97,000m^3)
  - In FY2015, Sr-treated water tanks were repurposed for ALPS-treated water, however ALPS-treated water was transferred into the tanks without removing the remaining Sr-treated water and sludge.

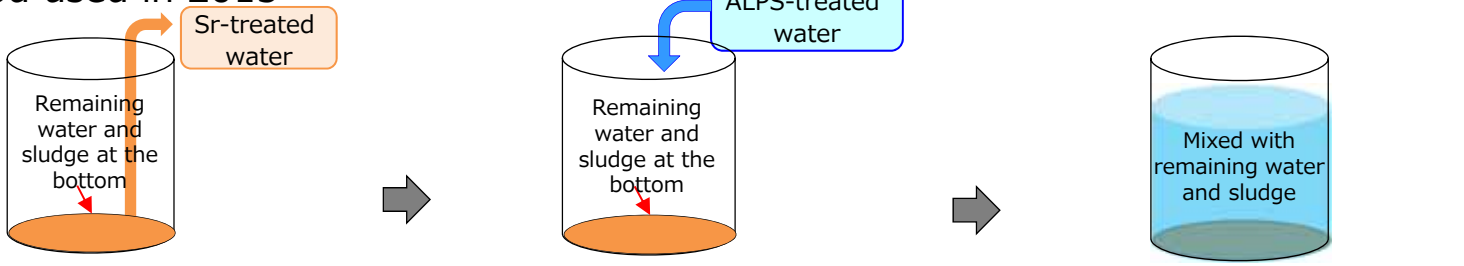
(※1 ALPS-treated water was transferred into tanks without draining the remaining water at the bottom of the tanks because the priority was to secure storage capacity. Therefore, the sum of the ratios of the concentrations required by law for water in tanks exceeded 100.)

Plan for repurposing Sr-treated water tanks at the end of December, 2020

Water being currently stored	Purpose and number of tanks		Amount of water at the end of 2020	Storage capacity at the end of 2020
	Purpose	Number		
Strontium-treated water	Repurposed for ALPS-treated water	93	ALPS-treated water	Approx. 97,000m^3
	Continued Sr-treated water storage	24	Strontium-treated water	Approx. 25,000m^3

4-2. Repurposing of tanks for Strontium-treated water

Method used in 2015

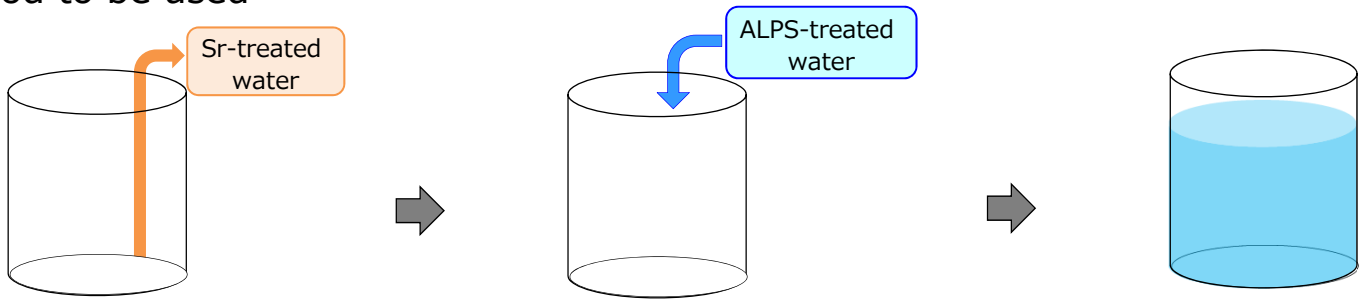


Draining Sr-treated water

ALPS-treated water was injected into the tanks where Sr-treated water and sludge remained.

ALPS-treated water was mixed with remaining Sr-treated water and sludge.
Sum of the ratios of the concentrations required by law exceeded 100.

Method to be used



Draining Sr-treated water, removing sludge and cleaning bottom

ALPS-treated water is injected.

Sum of the ratios of the concentrations required by law can be kept lower compared to the former method.

- Sludge will be removed and the bottoms of tanks will be cleaned before injecting ALPS-treated water. The sum of the ratios of the concentrations required by law are expected to be lower than when the tanks were repurposed previously. However, it is expected to be higher than concentrations at the ALPS outlet due to radioactive materials that remain in the tanks. The impact on the ratios of the concentrations required by law will be checked after ALPS-treated water is injected.
- When discharging ALPS-treated water into the environment, water for which the sum of the ratios of the concentrations required by law is confirmed by actual measurement to exceed 1 will be subject to secondary treatment.

Study on Disposal Details ⑦ (Secondary Treatment Implementation Schedule)

- For treated water, secondary treatment will be carried out to reduce the amount of radioactive substances released into the environment as much as possible.
  - Studies required for secondary treatment, including addition to the regular contaminated water treatment plan and preparation of tanks that will receive the secondary treated, have already started.
  - After the ALPS treatment of the strontium-removed water, which has a higher risk as compared to other treated water stored, the absorbents will be replaced, and a secondary treatment using ALPS will be conducted on a trial basis (in FY2020).
    - About 2,000 m^3 of water with high-concentration (regulatory concentration limit ratio of 100 times or above) will be treated, and the secondary treatment performance will be verified.
    - Thereafter, further secondary treatment will be continued while preparing for regular contaminated water treatment and installing receiving tanks.
  - Further secondary treatment prior to the start of disposal requires careful study of securing empty tanks, making arrangements for laying pipes and worker exposure and leakage risks involved in decontamination of receiving tanks for re-use.