

- Prior to the discharge of ALPS treated water into the sea, we confirm that discharge standards have been met (sum of the ratios of the regulatory concentrations limits of radioactive nuclides, with the exception of tritium, is less than 1). 29 nuclides that have been found in contaminated water in significant concentrations (concentrations that exceed 1/100 of the regulatory concentration limit) during past analysis have been selected/targeted for measurement and assessment.
- However, since it is possible that the concentrations of radioactive substances in contaminated water may fluctuate in conjunction with the progress of decommissioning, once a year we conduct an investigative analysis of six nuclides (nuclides to be monitored*¹) that may theoretically be present in contaminated water, even though no significant concentrations have been found during past analysis, in order to confirm that they do not exist at significant levels.

*1: : Chlorine 36, Niobium 93, Niobium 94, Molybdenum 93, Cadmium 113m, Barium 133

< Announced by April 24, 2023 >

- In February of this year **we conducted our FY2023 investigative analysis of the six nuclides to be monitored in contaminated water prior to ALPS treatment (water sampled from the ALPS inlet).**
- Results of the analysis showed the concentration of cadmium 113m to be 2.9Bq/liter, which is above 1/100 of the regulatory concentration limit (40Bq/liter) (The concentrations of the other five nuclides were below 1/100 of the legally required concentration).
- In light of the investigative analysis results, **we will add cadmium 113m to the nuclides to be measured/assessed starting from the fourth sea discharge of ALPS treated water in FY2024.**
- Water in which cadmium 113m was detected was contaminated water prior to ALPS treatment. Cadmium 113m is a nuclide that can be removed by ALPS. **We have been voluntarily measuring 39 nuclides including cadmium 113m prior to the discharge of ALPS treated water into the sea. Since we have been confirming during each discharge that concentration of cadmium 113m is less than approximately 1/500 of the regulatory concentration limit (40Bq/liter), there are no issues with the safety of ALPS treated water discharged.** Moreover, since the contribution of cadmium 113m to sum of the ratios of the regulatory concentrations limits is very small, **there is no impact from adding cadmium 113m to the nuclides targeted for measurement and assessment.**
- We will continue to remain vigilant to ensure the safe and stable discharge of ALPS treated water into the sea.

1. Nuclides to be measured/assessed to date

- When discharging ALPS treated water into the sea, **the 29 nuclides shown in the charts below have been targeted for measurement/assessment when analyzing ALPS treated water prior to sea discharge.**
- Apart from 29 nuclides aforementioned, we have been voluntarily analyzing **39 nuclides including cadmium 113m** among the nuclides that are removed by ALPS, to confirm that they do not exist in significant concentration (1/100 of the regulatory concentration limit).

[Nuclides to be measured/assessed(29 nuclides)]

C-14 Carbon	Sr-90 Strontium	I-129 Iodine	Eu-154 Europium	Pu-239 Plutonium
Mn-54 Manganese	Y-90 Yttrium	Cs-134 Cesium	Eu-155 Europium	Pu-240 Plutonium
Fe-55 Iron	Tc-99 technetium	Cs-137 Cesium	U-234 Uranium	Pu-241 Plutonium
Co-60 Cobalt	Ru-106 Ruthenium	Ce-144 Cerium	U-238 Uranium	Am-241 Americium
Ni-63 Nickel	Sb-125 Antimony	Pm-147 Promethium	Np-237 Neptunium	Cm-244 Curium
Se-79 Selenium	Te-125m Tellurium	Sm-151 Samarium	Pu-238 Plutonium	

[Nuclides to be measured/assessed voluntarily(39 nuclides)]

Fe-59 Iron	Rh-103m Rhodium	Sd-124 Antimony	Ba-137m Barium	Eu-152 Europium
Co-58 Cobalt	Rh-106 Rhodium	Te-123m tellurium	Ba-140 Barium	Gd-153 Gadolinium
Zn-65 Zinc	Ag-110m Silver	Te-127 tellurium	Ce-141 Cerium	Tb-160 Terbium
Rb-86 Rubidium	Cd-113m Cadmium	Te-127m tellurium	Pr-144 Praseodymium	Am-242m Americium
Sr-89 Strontium	Cd-115m Cadmium	Te-129 tellurium	Pr-144m Praseodymium	Am-243 Americium
Y-91 Yttrium	Sn-119m Tin	Te-129m tellurium	Pm-146 Promethium	Cm-242 Curium
Nb-95 Niobium	Sn-123 Tin	Cs-135 Cesium	Pm-148 Promethium	Cm-243 Curium
Ru-103 Ruthenium	Sn-126 Tin	Cs-136 Cesium	Pm-148m Promethium	

2. Regularly checking nuclides to be measured/assessed

- Since it is possible that the concentrations of radioactive substances in contaminated water may fluctuate in conjunction with the progress of decommissioning, once a year we conduct an investigative analysis to confirm that they do not exist at significant levels.
- Furthermore, if significant concentrations of nuclides to be monitored are found during the investigative analysis, the nuclides selected as targets for measurement/assessment are reevaluated.

【 Investigative analysis 】

We check once a year to confirm that there are no significant concentrations of nuclides to be monitored in contaminated water prior to ALPS treatment.

○Nuclides to be monitored (6 nuclides)

Although nuclides shown below are not detected in significant quantities in past analysis of contaminated and treated water, they are subject to continuous check since it is theoretically possible that they exist in contaminated water.

Cl-36 Chlorine	Nb-93m Niobium	Nb-94 Niobium	Mo-93 Molybdenum	Cd-113m Cadmium	Ba-133 Barium
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3. Investigative analysis (analysis of nuclides targeted for monitoring) results

- The results of investigative analysis of contaminated water prior to ALPS treatment in FY2023 are as shown in the chart below
- Five out of the six nuclides to be monitored(chlorine 36, niobium 93m, niobium 94, molybdenum 93, barium 133) were below detection limits. **Cadmium 113m was detected at concentration higher than 1/100 of regulatory concentration limit.**

<Analysis results for the nuclides targeted for monitoring>

Analyzed nuclide	Specimen sampling location	Specimen sampling date	Analysis results (becquerels/liter)	0.01 of regulatory concentration limit(becquerels/liter)
Cl-36 Chlorine	ALPS Inlet (contaminated water prior to ALPS treatment)	February 7, 2024	Below detection limits (detection limit: 1.7)	9
Nb-93m Niobium			Below detection limits (detection limit: 14)	70
Nb-94 Niobium			Below detection limits (detection limit: 0.88)	5
Mo-93 Molybdenum			Below detection limits (detection limit: 1.9)	3
Cd-113m Cadmium			2.9	0.4
Ba-133 Barium			Below detection limits (detection limit: 4.9)	5



More than 1/100 of the regulatory concentration limit



Cadmium 113m added to the nuclides to be measured/assessed

4. Changes to the nuclides to be measured/assessed

Nuclides to be measured/assessed : 2930 nuclides

C-14 Carbon	Sr-90 Strontium	I-129 Iodine	Eu-154 Europium	Pu-239 Plutonium
Mn-54 Manganese	Y-90 Yttrium	Cs-134 Cesium	Eu-155 Europium	Pu-240 Plutonium
Fe-55 Iron	Tc-99 Technetium	Cs-137 Cesium	U-234 Uranium	Pu-241 Plutonium
Co-60 Cobalt	Ru-106 Ruthenium	Ce-144 Cerium	U-238 Uranium	Am-241 Americium
Ni-63 Nickel	Sb-125 Antimony	Pm-147 Promethium	Np-237 Neptunium	Cm-244 Curium
Se-79 Selenium	Te-125m Tellurium	Sm-151 Samarium	Pu-238 Plutonium	Cd-113m Cadmium

: Newly selected nuclides

Assessed as the sum of the ratios of legally required concentrations to check that it is less than 1

H-3
Tritium

Measured in order to determine that the volume of water with which to dilute the treated water so that the tritium concentration after dilution is less than 1,500 Bq/liter

Measured every time

Nuclides targeted for removal by ALPS that are not subject to be measured/assessed : 3938 nuclides

Fe-59 Iron	Rh-103m Rhodium	Sb-124 Antimony	Ba-137m Barium	Eu-152 Europium
Co-58 Cobalt	Rh-106 Rhodium	Te-123m Tellurium	Ba-140 Barium	Gd-153 Gadolinium
Zn-65 Zinc	Ag-110m Silver	Te-127 Tellurium	Ce-141 Cerium	Tb-160 Terbium
Rb-86 Rubidium	Cd-113m Cadmium	Te-127m Tellurium	Pr-144 Praseodymium	Am-242m Americium
Sr-89 Strontium	Cd-115m Cadmium	Te-129 Tellurium	Pr-144m Praseodymium	Am-243 Americium
Y-91 Yttrium	Sn-119m Tin	Te-129m Tellurium	Pm-146 Promethium	Cm-242 Curium
Nb-95 Niobium	Sn-123 Tin	Cs-135 Cesium	Pm-148 Promethium	Cm-243 Curium
Ru-103 Ruthenium	Sn-126 Tin	Cs-136 Cesium	Pm-148m Promethium	

Voluntarily measured to confirm that concentrations are below detectable levels

Nuclides to be monitored : 65 nuclides

Cl-36 Chlorine	Nb-93m Niobium	Nb-94 Niobium	Mo-93 Molybdenum
Cd-113m Cadmium	Ba-133 Barium		

Checked once a year to confirm that there are no significant concentrations

*Although Cd-113m will no longer be monitored, its trend will be checked voluntarily in regular basis.

5. Concentrations of cadmium 113m after ALPS treatment

- Even if cadmium 113m is contained in contaminated water, it can be removed with ALPS.
- Additionally, this nuclide is measured prior to the discharge of ALPS treated water into the sea, and we have confirmed that concentrations are less than approximately 1/500 of the regulatory concentration limit. Therefore, there are no impact on the safety of ALPS treated water discharged.
- Even if cadmium 113m was present in ALPS treated water at concentrations at detection limit, its ratio of the regulatory concentration limit is very small and would have no impact on the sum of the ratios of the regulatory concentrations limits.

<Concentrations of cadmium 113m in ALPS treated water discharged to date>

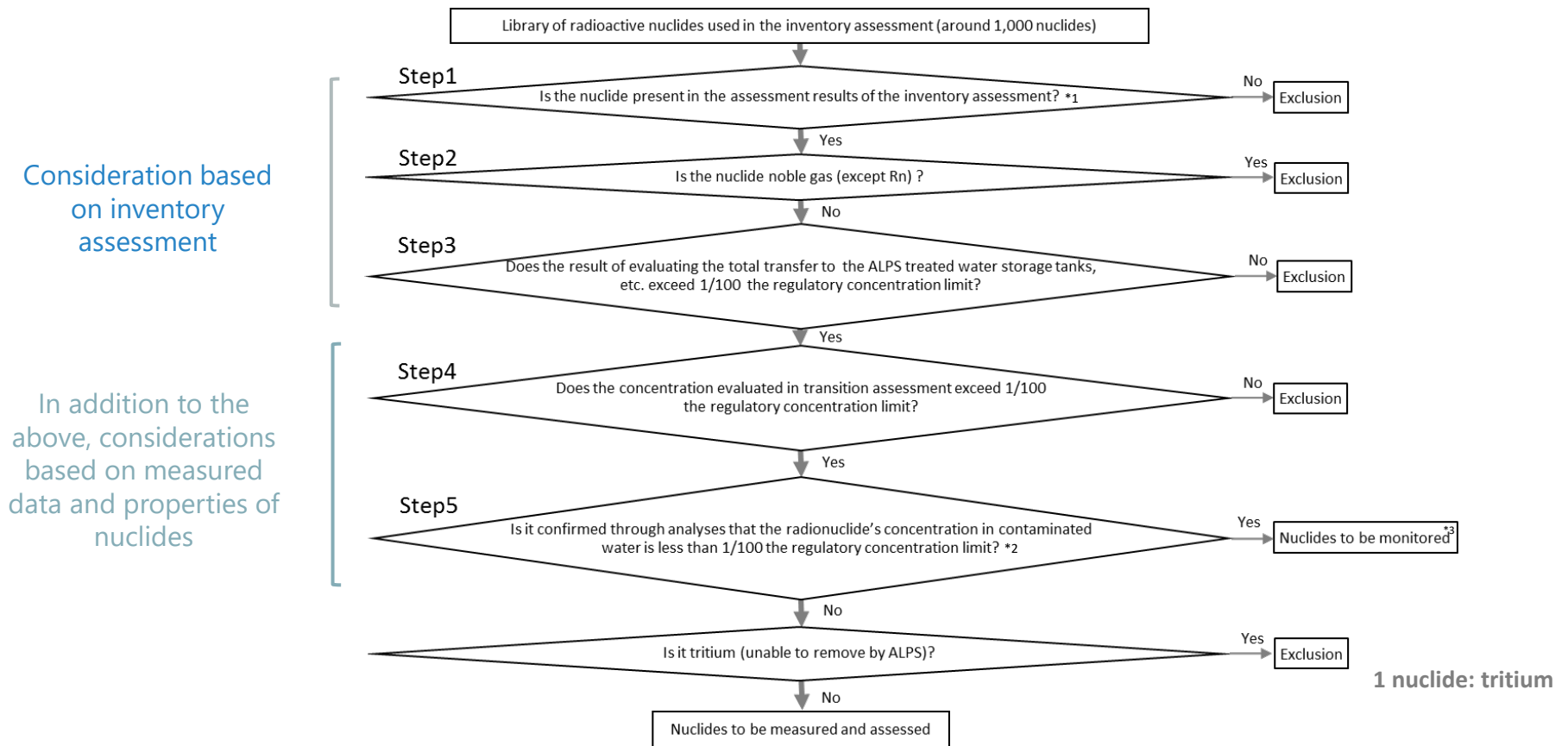
		Cadmium 113m regulatory concentration limit[Bq/liter]	Cadmium 113m analysis results [Bq/liter]	Cadmium 113m regulatory concentration limit (*)
FY2023	First discharge	40	Below detection limits (detection limit: 0.084)	0.0021
	Second discharge		Below detection limits (detection limit: 0.085)	0.0021
	Third discharge		Below detection limits (detection limit: 0.093)	0.0023
	Fourth discharge		Below detection limits (detection limit: 0.088)	0.0022
FY2024	First discharge		Below detection limits (detection limit: 0.085)	0.0021
	Second discharge		Below detection limits (detection limit: 0.086)	0.0021
	Third discharge		Below detection limits (detection limit: 0.086)	0.0021

*Ratio of the regulatory concentration limit is assessed assuming the nuclides are present at detection limit

[Reference] Flow chart for the selection of nuclides to be measured/assessed

- Nuclides to be measured/assessed are selected based on the following flowchart stated on implementation plan approved by the Nuclear Regulatory Agency (NRA).
- During the selection process, nuclides that could realistically exist considering their half-lives are selected based on guidance from the IAEA and the NRA. After that, a desktop analysis is conducted assuming* that the total amount of radioactive substances has migrated to the ALPS treated water, etc. storage tank. Furthermore, nuclides that could exist at significant concentrations in contaminated water are assessed based on actual measurement data from contaminated water stored for 12 years as well as the nature of the nuclides.

*Assumes that contaminated water that has been continually treated for the 12 years since the accident has been stored in the same tank



*1 : The inventory assessment decay period has been set properly in accordance with when the selection results are used (initially set to be 2023 (12 years after the accident))
 *2 : The maximum detection value is used for nuclides that have been detected in the past, and the minimum detection limit is used for nuclides that have never been detected
 *3 : Nuclides that are continually measured to confirm that there are no significant concentrations in contaminated water