NRA JAPAN
Nuclear Regulation Authority

NRA presentation

C2 Revised REIA

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2nd IAEA Regulatory Review Mission on ALPS Treated Water Handling
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1. Results of revised REIA with selected nuclides

- In TEPCO's Application submitted in Nov. 2022, only the source term is revised. The assumption and methodology of the REIA is not changed.

- Therefore, the NRA only reviewed ① the revised source term and ② assessment result revised with this source term. The other parts of the NRA's Review Results published in July 2022 are still valid.

- Considering above, the NRA's Review Results document for this Application will cover ① & ②.

1. Results of revised REIA with selected nuclides

TEPCO selected nuclides (30 nuclides) @ Dec. 2022

H-3	C-14	Mn-54	Fe-55	Co-60	Ni-63	Se-79	Sr-90	Y-90	Tc-99
Ru-106	Sb-125	Te-125m	I-129	Cs-134	Cs-137	Ce-144	Pm-147	Sm-151	Eu-154
Eu-155	Pu-238	Pu-239	Pu-240	Pu-241	Am-241	Cm-244	U-234	U-238	Np-237

Results with the source term above

		Assessment Result (April 2022)	Assessment Result (This time)	The Criteria
Exposure to humans		0.4 μSv/year	0.03 μSv/year	50 μSv/year
Potential Exposure		0.3 mSv/case	0.01 mSv/case	5 mSv/case
Exposure to animals and plants in the sea	flat fish	6×10^{-5} mGy/day	7×10^{-7} mGy/day	1-10 mGy/day
	crab	6×10^{-5} mGy/day	7×10^{-7} mGy/day	10-10 mGy/day
	seaweed	6×10^{-5} mGy/day	8×10^{-7} mGy/day	1-10 mGy/day

NRA

confirmed that the assessment results are below the criteria that the NRA commission decided

2. Review results as of July 2022 approval

Six items as being relevant to the design and operation of the Discharge Facility as well as the radiological impact of discharge within the Government Policy:

(Measures relevant to the design and operation of the Discharge Facility)

1. Necessary procedures and the construction of the facility for starting the discharge in around spring 2023
2. Involvement of a third party with expertise in analysis of radioactive materials
3. Extensive dilution of ALPS treated water
4. Total amount of tritium discharged per year
5. Starting with a small amount of discharge, and discharge suspension when unusual values are observed by marine monitoring

(Measures to assess impact on the marine environment)

6. Radiological impact assessment of discharge

Chapter 2
2-1

reviewed along with the examination based on the Reactor Regulation Act.

2. Review results as of July 2022 approval

2-1. Radiological impact assessment of discharge

1. Assessment of radiation dose to humans
   >*Criterion: dose constraint 50 μSv/year*
2. Assessment of radiation dose to humans in potential exposures
   >*Criterion: 5 mSv per event which is shown in GSG-10 as a typical criterion for radioactive material and sources with a low capacity for a radioactive release in an accident*
3. Assessment of radiation dose to marine animals and plants in normal operation
   >*Criterion: the lowest values of the Derived Consideration Reference Levels*
4. Consideration of uncertainty

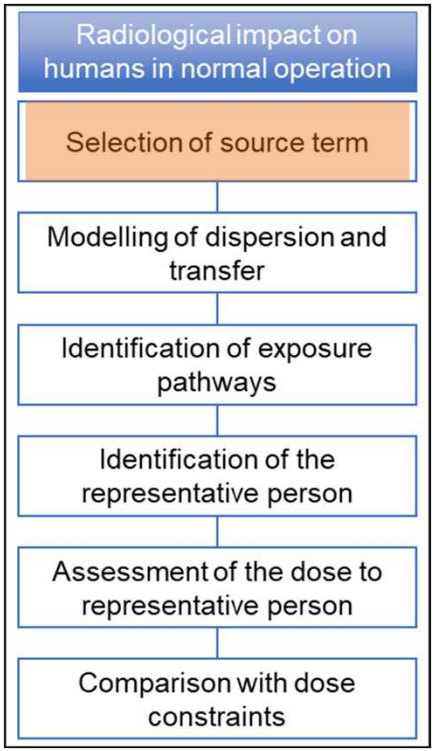
the NRA confirmed and concluded that the Radiological Impact Assessment is conducted with reference to the relevant IAEA Safety Standards' Requirements and Guides (GSR-Part3, GSG-9, GSG-10), and that the assessment results are below the criteria and thus the impact both on humans and the environment is sufficiently small.

2. Review results as of July 2022 approval

1. Assessment of radiation dose to humans

(1) Selection of the source term

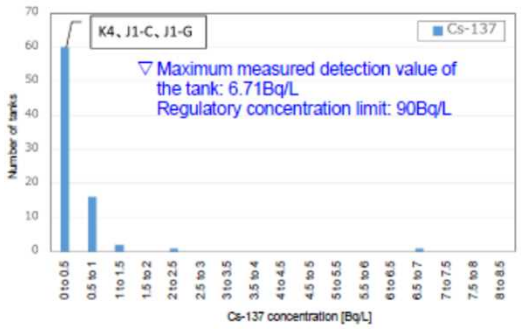
- The NRA confirmed mainly whether the selected source term is the composition and amount of relevant radionuclides typical to the activity subject to the assessment.

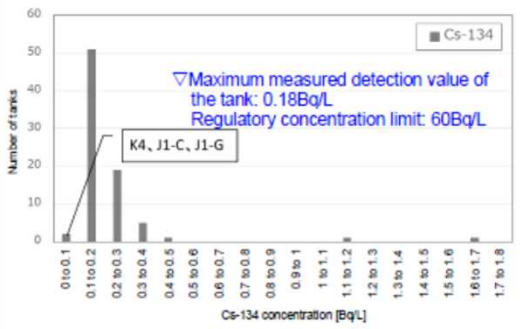


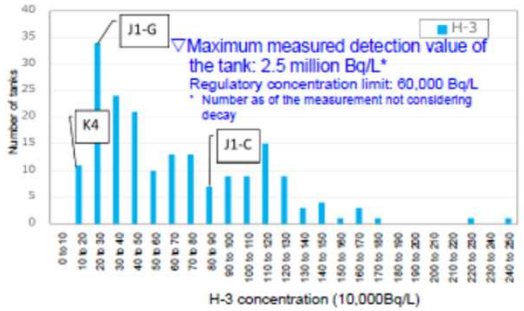
【NRA confirmation result】

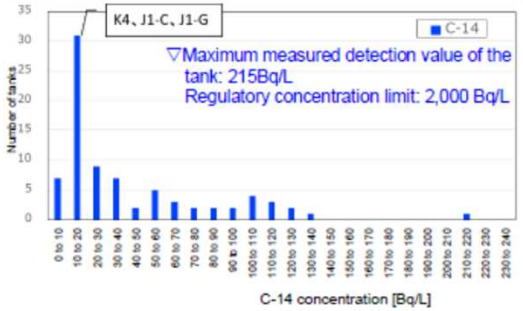
- Using the data of ALPS treated water in the three tank groups for which 64 radionuclides have been measured and evaluated.
- There is no substantial difference in radionuclide composition between ALPS treated water in the three tank groups and the water in the other tank groups of which the sum of the ratios of radionuclides other than tritium to each concentration limit is less than 1.
- Even if there exists any other radionuclide than ALPS removal target 62 radionuclides and carbon14, the impact to humans is considered small because of low-energy radiation, and thus the impact of the revisit of the source term to the assessment would be small.

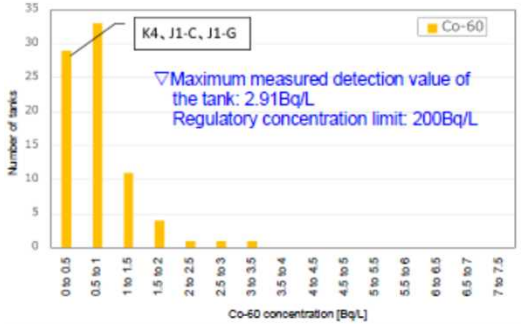
2. Review results as of July 2022 approval

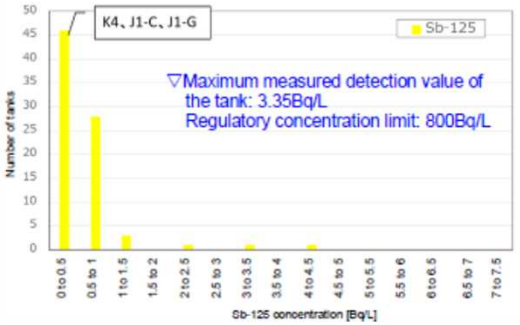


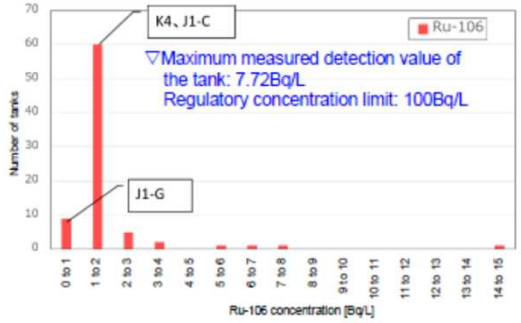


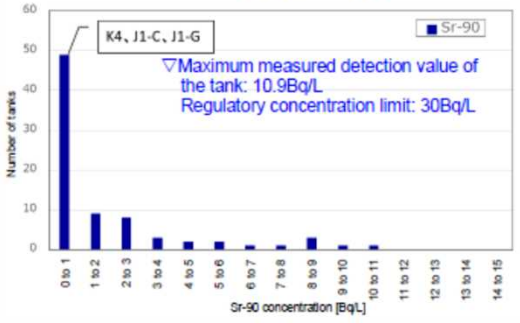


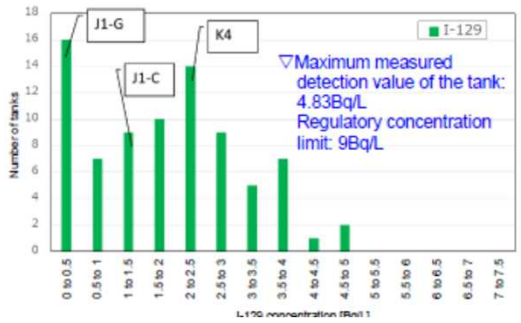












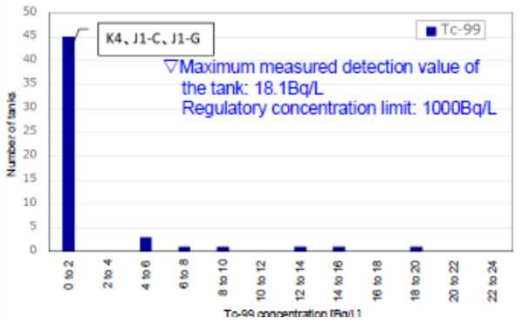


Figure 6-1-3 Concentration distribution of tritium and C-14 in the analysis result of ALPS treated water, etc. (as of the end of March 2021) and comparison among the three tank groups

* The analysis results of the tank group (189 tanks for tritium and 81 tanks for C-14) are plotted (excluding secondary treatment test water)
* The vertical axis indicates the number of tanks (counted as the detection limit if not detected)
* Values are measured values at the times and no half-life correction is considered.

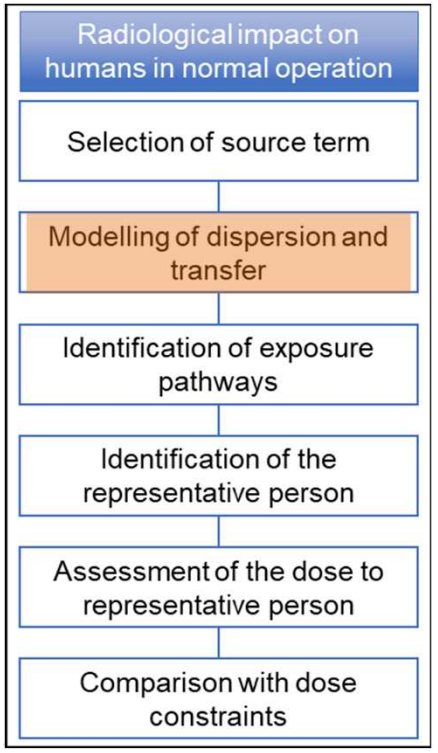
Source: TEPCO's Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea(Design stage /Revised version), April 2022
Application Documents for Approval to Amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station Specified Nuclear Facility [Partially revised] (tepco.co.jp)

2. Review results as of July 2022 approval

1. Assessment of radiation dose to humans

(2) Modelling of dispersion and transfer in the environment

- The NRA mainly confirmed whether the selected dispersion and transfer model is suitable for simulating dispersion, dilution, transfer, accumulation of radionuclides and their decay as necessary, taking into account the characteristics of discharge expected during normal operation.

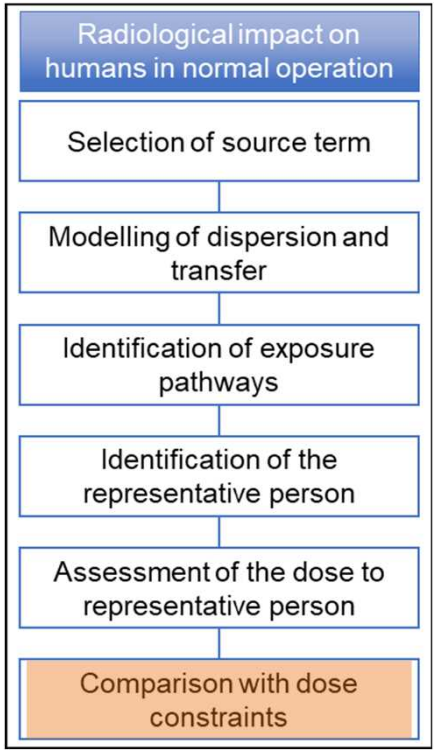


【NRA confirmation result】

- For radionuclides other than tritium, the dynamics does not necessarily coincide with tritium, which is a tracer in simulation, in the environment due to adsorption such as into seabed soil. However it is assumed in the estimation that the other radionuclides are advected and diffused in a state dissolved in seawater like tritium, and this assumption is conservative without account taken of decrease in concentration in seawater.
- On the other hand, the accumulation of radionuclides associated with transfer such as to beach sand, is assumed in equilibrium with the radioactive concentration in seawater from the start of discharge, which means the assessment is conducted in a state where the radioactive concentrations in the environment are considered to become the highest during the long-term discharge.

2. Review results as of July 2022 approval

1. Assessment of radiation dose to humans
(6) Comparison of estimated doses with dose constraint

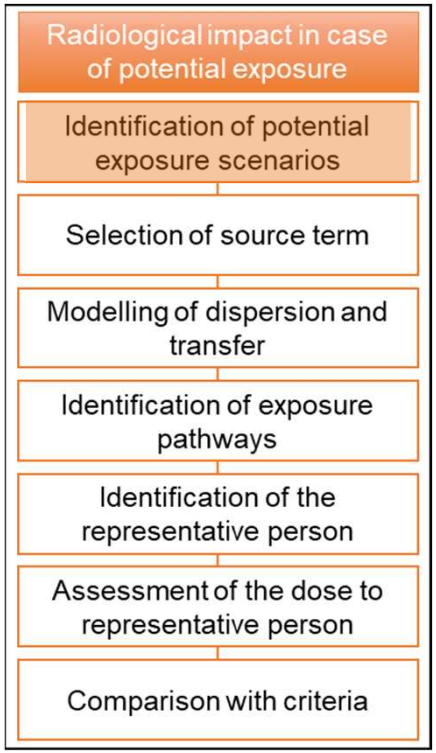


【NRA confirmation result】

- As a result of the above assessment, the estimated dose to the representative person is approximately 10^{-2} to 10^{-1} μSv/year, which is considerably small compared to 50 μSv/year, the criterion approved by the NRA Commission.
- With the above result in mind, recognizing that, in the process of deciding the Government Policy, consideration was given to factors for optimization of protection and safety associated with ALPS treated water discharge such as the planning of the entire decommissioning, the effect of decay, the risk of accidental discharge during storage, occupational exposure, and societal impacts, TEPCO has decided that the annual amount of tritium to be discharged is controlled at a level lower than 22 tera Bq.
- TEPCO plans to periodically revisit the annual amount of tritium to be discharged within the range of the dose constraint taking into account factors to be considered in the optimization process.

2. Review results as of July 2022 approval

2.Assessment of radiation dose to humans in potential exposures



The NRA mainly confirmed:

- Whether scenarios for potential exposures are identified on the basis of the safety assessment for the facility and activities;
- Whether radiation dose to the representative person is estimated after identifying source term, dispersion and transfer model, exposure pathways and the representative person appropriate to the identified scenarios; and
- Whether the estimated dose is below the criteria for potential exposure.

【NRA confirmation result】

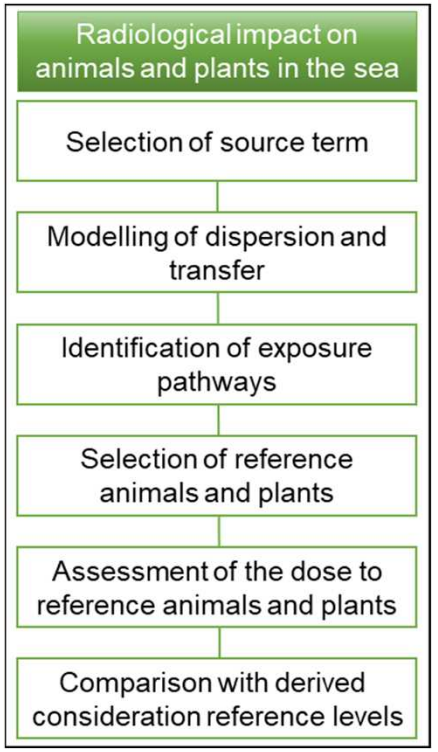
Conservative scenarios are assumed for two cases identified as damages which could lead to an unintended discharge, beyond equipment malfunctions postulated for the assessment of the design of the Discharge Facility:
(1)rupture of ALPS treated water transfer pipe, and (2)breakage to the tank groups for measurement and confirmation.

2. Review results as of July 2022 approval

3. Assessment of radiation dose to marine animals and plants in normal operation

The NRA mainly confirmed:

- Whether dose rates are estimated for the reference animals and plants selected according to the marine ecosystem in the sea area near the FDNPS, with the same source term and modelling of dispersion and transfer as used in 1. as well as the exposure pathways to be considered for marine animals and plants; and
- Whether the estimated dose rates are below the lowest values of the Derived Consideration Reference Levels.



【NRA confirmation result】

- The transfer models are selected from the ones identified in 1. with account taken of the habitat environment of marine animals and plants.
- According to the marine ecosystem in the sea area near the FDNPS, reference flatfish, reference crab and reference brown seaweed are selected.
- Dose coefficients based on GSG-10 are used for external and internal exposures.

2. Review results as of July 2022 approval

4. Consideration of uncertainty

The NRA mainly confirmed:

- Whether the level of uncertainty is understood with the nature of uncertainty included in the assessment being comprehended; and
- Whether consideration is given to identify sources of uncertainty contributing most to the assessment result.

【NRA confirmation result】

- Understanding the nature of uncertainty, such as random uncertainty with statistical distribution and uncertainty arising from incomplete knowledge, sources of uncertainty contributing largely to the assessment result are identified as the radionuclide composition of the source term and concentration factors in sea animals.
- As the estimated dose to the representative person in 1.(6) is considerably small compared to the criterion, there is no need to give detailed consideration to uncertainty. Even if the main source of uncertainty identified as above is considered in the assessment, the variance would be one order of magnitude and therefore the conclusion that the estimated dose is below the criterion remains the same.