

Issues pointed out in the implementation plan concerning the change in the operation structure and the selection of nuclides to be measured and assessed for the discharge of ALPS treated water into the sea

No.	Category	Issues pointed out	Answer	Updated in	Page number
1	Operation framework	The number of member for Operation Shift Team (Water Treatment System) will be increased by 2 persons per team to 10 persons per team. Regarding the current Operation Shift Team, please add the division of roles and the number of shifts per day to the supplementary explanation material.	In the supplementary explanation material, the division of roles of the members of Operation Shift Team (Water Treatment System) and the number of shifts per day were added. With additional members of 2 persons per team, 10 persons per team will be assigned to Operation Shift Team (Water Treatment System). With this number, we plan to manage the operation of facilities related to the discharge of ALPS treated water into the sea, in addition to the operation management of facilities they are currently in charge of.	[Material 1-1-1] Supplementary explanation Attachment-1 Reference-1	P 17-18
2	Nuclide analysis	Regarding this additional analysis, there is a description indicating "less than 1/100 of the regulatory concentration limit and less than the lower limit of detection." However, this additional analysis includes some difficult-to-measure nuclides. Is it correct to understand that the lower limit of detection is less than 1/100 of the regulatory concentration limit for all nuclides?	In this additional analysis, we asked each external analysis organization to conduct an analysis, aiming for 1/100 or less of the regulatory concentration limit as much as possible. As a result, the targets were achieved in all nuclides. With this, the analysis result for the lower detection limit value was 1/100 or less of the regulatory concentration limit.	[Material 1-1-1] Supplementary explanation Attachment-2 2.5	P 24-33
3	Nuclide analysis	The regulatory concentration limit of iron 55 is 17 Bq/L, which can be interpreted as being below 1/100 of the regulatory concentration limit of 2000 Bq/L. However, the value of the filtrate is < 4.1 Bq/L, and the sum of the residue and the filtrate is 21.1 Bq/L, exceeding 20 Bq/L, i.e., 1/100 of the regulatory concentration limit. We understand TEPCO's view that just adding values is not enough, but it is also difficult to discuss the analytical values presented here without indicating how fluctuating the range is, so this should be explained in the future.	See No.18. In the external analysis, uncertainties were calculated only for the detected values. It was confirmed that there were uncertainties of ± 1 Bq/L for the residue of Fe-55 in the stagnant water, ± 0.7 Bq/L for the filtrate of the stagnant water in Ni-59, and ± 0.3 Bq/L for the strontium-treated water.	[Material 1-1-1] Supplementary explanation Attachment-2 2.5	P25-27 P29-33
4	Inventory assessment	The reactor internals have been activated based on the knowledge of decommissioning and burial in Japan. For these results, an explanation of the degree of uncertainty should also be added to the supplementary explanatory material.	As input conditions for the evaluation of activation products in the inventory assessment, uncertainties exist in the target equipment to be assessed and equipment weights, element concentration conditions, setting of the amount of irradiation/neutron flux, and irradiation period. These conditions are set so that the inventory assessment can be conservative. For example, as other structural materials, core support plates and upper grid plates are evaluated by neutron flux at the center of the equipment. Compared with neutron flux at a point 1/2 in the radial direction, the inventory amount of radioactive materials generated by (n, γ) per unit weight is approximately 1.3 times more conservative. Regarding the other conditions (especially the element concentration), it is difficult to quantify the extent of conservativeness as a whole because the actual equipment condition is unknown. However, by setting these assumptions, there is uncertainty on the conservative	[Material 1-1-1] Supplementary explanation Attachment-3 2.4	P 51-52
5	Inventory assessment	We believe the inventory assessment results are somewhat reliable as a relative trend. However, regarding activation products, we believe there is a great deal of uncertainty about the total amount of activation materials. When the results of the calculations include both fuel-derived activation materials and activation products, we cannot tell the degree of uncertainty, leading to a vague discussion with inconclusive results. When considering Step 4, it is necessary to understand how that uncertainty spreads.	As described in No. 4, in the inventory assessment, there is uncertainty on the conservative side in the activation calculation of structural materials compared with the calculation of fuel. This works conservatively until Step 3. On the other hand, in the transfer assessment in Step 4, regarding the nuclides without analysis results, nuclides with the same properties (isotopes, radioactive equilibrium, etc.) are grouped to calculate the ease of transfer to contaminated water (analysis value/inventory amount) of representative nuclides in the group. When FPs and APs are mixed in the group, and if AP nuclides are treated as representative nuclides, FP nuclides may be unconservative. Because of this, FP nuclides were identified in the assessment method as representative nuclides for groups with a mixture of FPs and APs. Regarding the nuclides that may result in unconservative assessment, there are no nuclides to be measured and evaluated. Thus, we consider there is little actual effect.	[Material 1-1-1] Supplementary explanation Attachment-4 2.4	P81,87
6	Nuclides to be measured and assessed	Regarding the criteria used in Steps 3 and 4, which are 1/100 of the regulatory concentration limits, it is difficult to judge whether they are valid based on the current description. Thus, first, the sum of the ratios to regulatory concentrations limits for the nuclides to be excluded in each step should be indicated before discussing whether it is valid.	In Step 3 and Step 4, we added the sum of the ratios to regulatory concentrations limits for the nuclides that proceed to the next step and for those to be excluded and explained that the criteria are valid.	[Material 1-1-1] Supplementary explanation Attachment-4 2.3, 2.4.1	P60,63
7	Nuclides to be measured and assessed	In setting the transfer coefficient, the past maximum is used for the analysis value, and the minimum of the detection limit is used for those that have not been detected before. Please explain the reason for this.	Using the maximum value among analyzed values, the detected nuclides are evaluated based on the concentration when they are most transferred to the contaminated water. On the other hand, as an approach to the lower detection limit, it indicates that there is a possibility that the nuclide exists at a concentration lower than that value but guarantees that the concentration is not higher than that value. Therefore, we consider it sufficiently conservative if we assess nuclides that have never been detected in the past with the smallest detection limit value in the analysis results.	[Material 1-1-1] Supplementary explanation Attachment-4 2.4.2	P65

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8	Nuclides to be measured and assessed	Regarding the grouping of nuclides with similar properties, such as isotopes, you should first explain that the grouping is valid and then explain that the representative nuclides are to be measured. In addition, you should explain the nuclides that could not be grouped by the process of measurement based on individual properties.	In the previous supplementary explanation material, there was no description of isotopes in the grouping of nuclides. Therefore, after explaining four nuclides: (1) radioactive equilibrium, (2) decay series, (3) isotopes, and (4) nuclides with similar underwater characteristics, nuclides were grouped, and then the representative nuclides of the group and the measured values of nuclides that are individually measured were explained. For Sn, the result of Sn-121 m, which has been confirmed to have the lowest analysis result among these groups, is applied. For the platinum group and Cf, etc., the similarity was explained in (4), and only the ease of transfer of other nuclides to contaminated water (transfer coefficient) was evaluated by referring to other nuclides. However, as a result of examining these results, it was determined that grouping is possible, and because of this, we reviewed the assessment again. In particular, since Cf behaves in the same way as Am and Cm, as a result of grouping them, it is valid to exclude Cm-243, which had been included in the nuclides to be measured and	[Material 1-1-1] Supplementary explanation Attachment-4 2.4.3	P 69 – 86
9	Nuclides to be measured and assessed	In the nuclide grouping, Cs and Tl are classified as the same, but Tl is on the right side of the periodic table, so it seems the intent is to make the transfer coefficient the same, but the reason for the same grouping should be explained.	Cs belongs to Group 1, and Tl belongs to Group 13. As a result of literature research this time, we confirmed that Tl is a monovalent cation like Cs, that the ionic radius is the same as that of the alkali metals Cs and K, and that the feature of adsorption to other zeolites and other materials are the same as those of the alkali metals. Based on this result, Tl is handled as part of the same group as Cs.	[Material 1-1-1] Supplementary explanation Attachment-4 2.4.3	P78
10	Nuclides to be measured and assessed	Please provide details of the analytical results used in the assessment of transfer to contaminated water in Step 4.	The details of the analysis used to evaluate the transfer to contaminated water are described in Reference 1 of Attachment-4.	[Material 1-1-1] Supplementary explanation Attachment-4 Reference-1	P 98–108
11	Nuclides to be measured and assessed	Of the analytical data used in the assessment of transfer to contaminated water in Step 4, for nuclides with a small number of data, the validity of using that data should be explained. In addition, the validity of supplementing with data before treatment by ALPS should be explained.	Among the nuclides requiring individual evaluation, there are five nuclides that have been analyzed less than 10 times: Fe-55, Zr-93, Nb-93m, Mo-93, and Ba-133. All of these were not detected at 1/100 or less of the regulatory concentration limit in the stagnant water in the buildings and the strontium-treated water. Therefore, we believe the effect on the ALPS treated water is negligible. Of these, Fe-55, Nb-93 m, Mo-93, and Ba-133 were selected as the nuclides to be monitored to check changes with the progress of future decommissioning. On the other hand, since Zr-93 was measured by ICP-MS and had a long half-life, it was not detected in 2 samples of stagnant water in the building and strontium-treated water and 3 samples of ALPS treated water with measurements up to about 1/1000 of the regulatory concentration limit. With this, it is considered to have barely transferred to contaminated water. Moreover, even considering In Step 4, the data before treatment by ALPS was used to supplement the data. However, the concentration of Cs, etc., in the stagnant water in buildings is high, and the lower detection limit of the nuclides that can be measured with the Ge semiconductor detector is high, which cannot be said to be representative of the actual situation. In addition, considering the effects of the exposure of the analyzers, many individual nuclides have not been investigated. Therefore, some of these nuclides were verified before treatment by ALPS. Qualitatively, as for the performance of the cesium adsorption device, the device can remove the nuclides with the same chemical properties and ionic radii as Cs and Sr. However, the other nuclides are mostly unable to be removed. In fact, as shown in Figure 1.1.4-4, we have confirmed that there is no significant difference between the results of I-129, Co-60, Ni-63, and Tc-99, which are individually evaluated this time, and the results of the analysis of the stagnant water in buildings in the concentrated Rw, etc. Therefore, we believe there will be no problem using the device.	[Material 1-1-1] Supplementary explanation Attachment-4 2.5	P 92–93 P 64 – 65
12	Nuclides to be measured and assessed	Regarding trending in contaminated water, where and how often each nuclide is currently measured and confirmed should be added to the supplementary explanation material.	For the details of trending at least once a month, we added the following to the material. • In the centralized Rw, Cs, Sr, total β, total α, and H-3 were confirmed. • At the ALPS inlet, 7 major nuclides, Tc-99, total β, total α, and H-3 were confirmed.	[Material 1-1-1] Supplementary explanation Attachment-4 3.2	P96
13	Nuclides to be measured and assessed	The concentration of α nuclides in the stagnant water of the centralized Rw is expected to increase due to fuel debris retrieval and other operations. However, even in such a situation, it is stated that there is no effect on the nuclides to be measured and assessed, and the radioactive concentration of contaminated water before treatment by ALPS is checked. Please explain this in more detail.	We added an explanation of the state of alpha nuclide control we aim for at T.P. 33.5 m at 1F. Further, for that purpose, an alpha nuclide removal facility will be installed at T.P. 8.5 m. Therefore, we explained that we are considering monitoring contaminated water before treatment by ALPS as water that affects the ALPS treated water at T.P. 33.5 m.	[Material 1-1-1] Supplementary explanation Attachment-4 3.2	P 96–97
14	Nuclides to be measured and assessed	On the identified 37 nuclides, to grasp the degree of effect on dose assessment, the nuclides detected in ALPS treated water, alpha nuclides, and the nuclides other than alpha nuclides should be classified into those with a sufficient number of analytical data, and those with a small number of data. In each classification, they should be arranged so that the measured values or the detection limit value can be compared to the sum of the ratios to regulatory concentrations limits. In addition, low-energy β nuclides that are not counted in the total β measurement should be indicated.	We have prepared a document describing the classification method for the 35 nuclides identified (excluding H-3, and Cm-243 that was excluded from this selection) and comparing the sum of the ratios to regulatory concentrations limits.	[Material 1-1-2] Comparison of a sum of the ratios to regulatory concentrations limits at ALPS inlet/outlet	-

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15	Nuclides to be measured and assessed	Since the smallest regulatory concentration limit among α nuclides is 4 Bq/L, assuming that nuclide has an activity concentration of the lower detection limit value and the regulatory concentration is evaluated, isn't it unnecessary to substitute all alpha nuclides with gross alpha values?	With reference to the matters pointed out and the thinking behind the concentration limit in cases where the type of radioactive material is not clear (use the lowest concentration except for radioactive material that is clearly not in water) in Article 8 of the regulations, which defines dose limits, etc. (concentration limit outside the peripheral monitoring area, etc.), we made revisions as follows. Of the α nuclides selected for nuclides to be measured/evaluated, plutonium has the smallest regulatory concentration limit, and its regulatory concentration limit of 4 Bq/L will be used to divide the total- α value. This method will be used for assessment in actual operations. Regarding REIA, there is no method of assigning the gross α value to the concentration of each α -nuclide, as in the case of the sum of the ratios to regulatory concentration limits, and allocating the gross α value to only one α -nuclide is not explanatory. Therefore, regarding REIA, we plan to continue the evaluation by substituting the gross- α	[Material 1-1-2] Comparison of a sum of the ratios to regulatory concentrations limits at ALPS inlet/outlet [Material 1-1-1] Supplementary material Attachment-4 2.6	- P95
16	Nuclides to be measured and assessed	Regarding the calculation method of the transfer coefficient for the nuclides of the lower detection limit, while understanding that the lower detection limit itself is conservative, in the current TEPCO evaluation in which the inventory evaluation result is different from the reference date of the analysis result, the assessment will be unconservative. Therefore, the nuclides of the lower detection limit in the calculation of the transfer coefficient should be reassessed in such a way that the inventory quantity used for the assessment match the reference date of the analysis result.	As you pointed out, we revised the inventory amount to match the reference date of the analysis. Since the half-life of Zn-65 and Ag-110m is short, and since the lower limit of detection is reached along the way, the minimum value of the analysis is not necessarily the minimum value of the transfer coefficient. Therefore, for these two nuclides, the results of the analysis with lower transfer coefficients are described in the References-3 and 4 of Attachment-4. (The same measures were taken for Ce-144 at the ALPS inlet.) Other nuclides that have never been detected are Cl-36, Nb-94, Cd-113m, Sn-126, and Eu-155. Since these nuclides have long half-lives, the minimum values of the analytical values are the minimum values of the transfer coefficients, and we confirmed the same measures as those for Zn-65 and Ag-110 m are not required. No changes were made in the nuclides to be measured/evaluated or to the nuclides to be monitored after this review. Specific example (Zn-65)	[Material 1-1-1] Supplementary explanation Attachment-4 Reference-1 Reference-2	P87~90 P 98~108 P109-122
17	Nuclides to be measured and assessed	In Step 5, when dividing into the nuclides to be measured/evaluated and the nuclides to be monitored, we do not think it is reasonable to select nuclides whose lower detection limit is below 1/100 of the regulatory concentration limit as nuclides to be monitored because there is no detected value, as is the case with Nb-94. In addition, as for Cd-113m, it has been measured to 1.7E-01 Bq/L, which is below 1/100 of the regulatory concentration limit, and considering that this value itself is an analytical value that was used when setting the transfer coefficient, we would like to ask again about your thinking behind including Cd-113m in the nuclides to be measured/evaluated, instead of the nuclides to be monitored.	In Step 5, regarding nuclides that have not been detected despite many analyses in the past, we thought that there would be no problem with designating them as the nuclides to be monitored. However, based on what you have pointed out, we specified this criteria: regardless of whether it has been detected, have we confirmed if it is at 1/100 of the regulatory concentration limit or less? The results of the detailed examination of Step 5 based on this thinking are as follows. With regard to Nb-94, now that it is possible to measure it with the Ge semiconductor detector in the 1F premises, we measured it again this time, and as a result, we found that it was < 6.8E-01Bq/L at the ALPS inlet, which is 1/700 of the regulatory concentration of 5.0E + 02Bq/L. Therefore, we determined that there is no problem in setting it as a nuclide to be monitored. For Cd-113m, although its solubility is high in the literature, due to the fact that it was not detected in the actual analytical results when measured to 1/100 of the regulatory concentration limit or less, and that after checking the conditions of this analysis, we confirmed there was no problem as the analysis result. Therefore, similar to the other nuclides, based on the idea of giving priority to the actually confirmed analytical results, this nuclide was selected as a nuclide subject to	[Material 1-1-1] Supplementary explanation Attachment-4 2.5	P92
18	Nuclides to be measured and assessed	Regarding No. 3, in cases where the sample is divided into the residue and the filtrate, and it is detected in one of these while in the other, it is at the minimum limit value of detection, since there is no established method on how to look at the radioactive concentration of the entire sample, wouldn't adding them together be a workable way to think conservatively? By doing so, we think it is possible to treat Fe-55 as a nuclide to be measured/evaluated in Step 5. Please let us know TEPCO's thoughts on this.	There is no established method for indicating the activity concentration of the entire sample when separating the residue from the filtrate. For Fe-55, as you pointed out, we will adopt the idea of adding the detected value of the residue to the lower detection limit of the filtrate in a conservative manner. As a result, Fe-55, a nuclide to be monitored, will be treated as a nuclide to be measured and evaluated.	[Material 1-1-1] Supplementary explanation Attachment-2 Attachment-4	P24, 28 P92, 95 P99, 110