*Provisional Translation

TEPCO's Fukushima Daiichi NPS

Review Meeting on the Implementation Plan for Handling ALPS Treated Water

Minutes of the 9th meeting

Date: February 15, 2022 (Tuesday) 13:30-16:15

Location: Conference room B, C and D on the 13th floor of the Nuclear Regulation Authority

Participants:

The Nuclear Regulation Authority (NRA)

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The Secretariat of Nuclear Regulation Authority (S/NRA)

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Jun Takeuchi, Director of the TEPCO's Fukushima Daiichi NPS Accident Measures Office

Tomoki Shibutani, Director for the TEPCO's Fukushima Daiichi NPS Accident Measures Office

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Hideaki Masaoka, Deputy Director of the TEPCO's Fukushima Daiichi NPS Accident Measures Office

Ayako Otsuji, Deputy Director of the TEPCO's Fukushima Daiichi NPS Accident Measures Office

Yasuhiro Chimi, Chief Safety Examiner of the TEPCO's Fukushima Daiichi NPS Accident Measures Office

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〇Kaneko (S/NRA):

Then, we will start the 9th Review Meeting on the Implementation Plan for the Disposal of ALPS Treated Water at the Fukushima Daiichi NPS.

Today, the meeting will be conducted as video conference to prevent COVID-19. Thank you for your cooperation in the smooth progress of the meeting.

The meeting will be moderated by myself, Kaneko of the Nuclear Regulatory Agency.

Today, TEPCO has prepared materials for three main issues, so we will proceed with these discussions.

The first issue is the concept of analysis and identification of radionuclides contained in ALPS treated water prior to dilution, and its future policy.

The second issue is the method of taking seawater in the facilities for discharge of ALPS treated water into the sea
The third issue is the facilities to discharge treated water to the sea.
First, according to the document 1-1, TEPCO will explain the first issue, that is, analysis methods and systems for radioactive concentration of nuclides.

○Matsumoto (TEPCO HD):
Today, I will participate online from the Fukushima Daiichi site. Thank you very much.
Do you hear this sound?

○Kaneko (S/NRA):
Yes, I am hearing it clearly.

○Matsumoto (TEPCO HD):
Please see the document you have, "(The 9th) Review Meeting on the ALPS-Treated Water Document 1-1". As Mr. Kaneko mentioned earlier, I will explain three issues today.

Please see page 1.
The first issue is the analysis methods and systems for radioactive concentration of nuclides in ALPS treated water, among the safety measures at the time of discharge into the sea.
At the last week's review meeting, I talked about the construction method, system, etc. Today, I would like to explain our policy of for selecting nuclides that may affect dose assessment, other than tritium, C-14, and 62 nuclides to be removed by ALPS.
I would also like to talk about two things regarding the facilities for discharge. The first one is the measure to prevent seawater with a high concentration of radioactive materials from mixing with seawater for dilution, such as the partition dike within the port.
The second one is the structural design of the discharge tunnel and outlet located on the downstream side of the discharge shaft.
Now, let me talk about the first issue. Please see page 2 of the document.

Here, I would like to explain the nuclides to be measured among the analysis methods and systems for radioactive concentration of nuclides in ALPS treated water.
From page 3, we provide an overview of its discussion.

Please see page 4.
As shown in the figure below, TEPCO currently uses the K4 tank group as the measurement and confirmation facilities for the discharge of the ALPS treated water into the sea. The K4 tank group is divided into the tank groups with 10 tanks, one of which is scheduled to be used as the process for measuring and confirming nuclides species in the treated water.
Here, the treated water is stirred, and then the quality of water in the tank group is homogenized by the circulation pump, and then the treated water is sampled. The sampled water is then analyzed to check whether it meets the discharge criteria.
We measure tritium, 62 radionuclides other than tritium, and C-14 as radionuclides.
However, in releasing the ALPS treated water into the ocean, we would like to select nuclides that need to be checked before the discharge by thorough verification based on the knowledge of decommissioning and burial
facilities.
Particularly in the selection process, it is expected that radionuclides that are difficult to be measured due to low energy radiation, having smaller effects on the human body, will be included in the target to be studied. In conducting this study, we would like to check whether these nuclides may affect the dose assessment of ALPS treated water or not.

Please see page 5. I would like to conduct the study using two approaches.
The first approach is nuclide analysis. Based on the past knowledge, regarding the nuclides to be assessed in the research of decommissioning and burial facilities, we will check whether or not they are significantly present in the stagnant water in buildings through actual analysis and confirm the results of previous nuclide analysis as well.
The second one is inventory assessment. We will assess the inventory of fission products as we did the study for the nuclides to be removed by ALPS. Further, referring to the

research on decommissioning and burial facilities, we will evaluate the inventory quantity generated by the activation of structures in the reactor pressure vessel.

In the assessment, considering that 12 years have passed from the time of the Earthquake to the time of the discharge, inventory volume reduction due to attenuation will be considered.

Based on the above evaluation results, taking into consideration the ease of transition to water, we will confirm the existence of nuclides that may be contained in the stagnant water in buildings.

Alpha nuclides have been measured with total alpha. In this study, the analysis and inventory assessment of each nuclide are carried out, and based on these results, the properties of alpha nuclides that may be contained in the stagnant water in buildings are checked. In actual operation, we would like to perform measurement with total alpha.

Please see page 6. This section illustrates the direction of the study.

First, as I mentioned earlier, we will investigate the past knowledge based on the studies of decommissioning and buried facilities in Japan. Based on this, the analysis plan will be planned by referring to the results of previous nuclide analyses.

In parallel, the inventory assessment is conducted, and based on these results, we will evaluate the transition to stagnant water in buildings and then select the nuclides to be measured.

Page 7 shows the nuclide analysis of contaminated water and treated water.

Page 8 shows the nuclides that have been analyzed for ALPS treated water.

Fifty-six fission products are shown on the left-hand side, and six corrosion products are shown on the right-hand side. These 62 nuclides are nuclides to be removed by ALPS.

In addition, in the upper right, as nuclides other than those, tritium and C-14 are shown. The existence of C-14 was found as a result of total β measurement.

In addition, there are 20 nuclides measured by JAEA shown in the lower right as nuclides other than 64.

Please see page 9.

This time, we have selected the nuclide to be analyzed by referring to the three kinds of materials as the previous knowledge.
The first one is the Joint Electric Power Research Project "Study on Decommissioning of BWR (Part 2)" (FY 1996). The second one is the Tokai low-level radioactive waste burial facility, Type II waste disposal business license application "Selection of major radionuclides" (February 2018, Japan Atomic Power Company). The third one is the Research materials obtained when JAEA studied the nuclides to be analyzed in order to understand the property of radioactive waste at the 1F. The third one contains four reports. These materials contained many nuclides that were identified at the time of the study for the nuclides to be removed by ALPS. However, TEPCO organized the content of these materials as the previous knowledge and made a new analysis plan again.
As a result, we have summarized on page 10 the nuclides that have not yet been evaluated among the nuclides extracted from the previous knowledge.
There is a number on the left side of the table. These are candidate nuclides for analysis, Cl-36, Se-79, Zr-93, Pd-107, Ca-41, Fe-55, Ni-59, Nb-93m, Mo-93, Sn-121m, Ba-133.
For these nuclides, the disintegration form, energy, regulatory concentration limit(s), measurement method, etc. are shown. The remarks column shows whether or not there are analysis results in the past.
Based on these results, we intend to narrow down the nuclides to be measured.
Page 11 shows the candidate of alpha-nuclides for analysis. Regarding these nuclides, it is difficult to measure them at TEPCO as of now, therefore, the measurement is planned to be implemented by external organizations. By analyzing these nuclides, we would like to confirm alpha nuclides that may be contained significantly in the stagnant water in buildings.

Then, please see page 12.
This section describes the actual samples to be analyzed. By preparing five kinds of samples and measuring these waters, we would like to identify the candidate nuclides to be analyzed.
The first sample [1] is water collected from the K4 tank group and it is the ALPS treated

water.

The second sample [2] is the water in the H4-E7 Tank, which is also the ALPS treated water, but it is chosen because the measured value of C-14 is the highest in the ALPS treated water.

By analyzing these two types of samples, we would like to check that the candidate nuclides to be analyzed are not significantly present in the ALPS-treated water.

Next, the third sample [3] is the water before the additional ALPS treatment. The fourth sample [4] is the water after the additional ALPS treatment.

The purpose of these samples is to check that the nuclides confirmed to be significantly present before the ALPS treatment have been removed after the ALPS treatment.

The fifth sample [5] is the stagnant water in the main process buildings. The purpose of this sample is to identify the nuclides significantly present in the stagnant water in buildings.

We intend to prepare five types of samples and determine the nuclides to be measured based on the results of these analyses.

Please go to page 13.

Now, let's talk about the overview of inventory assessment.

Please see page 14. In the inventory evaluation, in addition to the code evaluation of fission products in the safety evaluation of nuclear power plants, we would like to refer to the results of the activation calculation of equipment that has been carried out in the research on decommissioning and burial facilities. We would like to use the code ORIGEN as in the past evaluations.

First, we conduct the assessment of the fission products. In this assessment, referring to the safety evaluation of conventional nuclear power plants, we will evaluate the inventory quantity as of March 2011 based on the condition of the fuel loaded in the reactor pressure vessels of 1F-Units 1 to 3 as well as the condition of the burnup assumed from the loading period of each fuel. From March 2011 onwards, we will calculate the decrease in the 12-year inventory volume due to attenuation and add its results to the evaluation.

The other is the assessment of the activation products. In this evaluation, with reference to the research of decommissioning and burial facilities, about the 4 types of equipment and structures existing inside the reactor pressure vessel and the lower part of it, we will assess the inventory volume as of March 2011 based on the irradiation period from the reactor core. Here, the 4 types of equipment are the reactor internals, the fuel assembly excluding nuclear fuel material, the pressure vessel, the pedestals.

In addition, about the corrosion products to be generated due to the corrosion and activation of components of equipment comprising reactor coolant system, we will assess the inventory volume as of March 2011 with the data of feedwater metal at the time of operation.

In the assessment of the activation products, from March 2011 onwards, we will calculate the reduction in the inventory volume over a 12-year period due to attenuation and add its results to the evaluation

Please go to page 15. It shows the overview of the assessment of fission products in the inventory evaluation.

This figure shows the mass distribution of fission products when nuclear fissions occur. We would like to evaluate this inventory volume based on the code ORIGEN I mentioned earlier.

Please go to page 16.

It shoes the assessment of the activation products.

The assessment targets are indicated by red frames. The targets include SUS316L, Zircaloy 4, and materials of control rods among the reactor internals.

Such information will be input data of the code ORIGEN for the assessment.

Please go to page 17.

The fuel and reactor internals has been eventually melted down as debris.

Finally, we conduct the transition assessment to see if the radionuclides contained in the debris dissolve in water and come out in the stagnant water.

Currently, we have the results of previous analysis of stagnant water in buildings and the results of analysis of stagnant water in main process buildings located in the Concentrated Rw. We would like to conduct the transition assessment based on these data.

The concept of selecting the nuclides to be measured is shown on page 18.
Based on the above considerations, TEPCO intends to select the nuclides to be measured for ALPS treated water according to the flowchart shown on page 19.
First, there are about 1000 nuclides in the libraries used for ORIGEN. As the step 1, it is determined whether the nuclide exists in terms of assessment from the inventory assessment results based on the cooling period of 12 years using the code.
Next, as the step 2, we will check if the nuclide falls under the category of rare gas. Rare gases volatilize and diffuse into the atmosphere. So, after the step 2, nuclides other than noble gases remain.
In the step 3, we will check if the "relative importance" of the nuclide is equal to 1/10nn.
The relative importance is the ratio of the value obtained by dividing the inventory volume of each nuclide by the regulatory concentration limit(s) to the sum. We would like to confirm the nuclides that affect the dose assessment based on this value. If this setting value is too large, the target nuclide is biased toward Se or St, which have a large relative importance value. On the other hand, if this setting value is too small, it is expected that nuclides that do not affect the dose assessment will be selected. Therefore, we think this judgment will be important.
In the step 4, we would like to evaluate how much nuclides are transferred into the water as the evaluation of transition to stagnant water in buildings.
The steps 3 and 4 are currently under consideration, but I would like to show them as soon as they are finalized.
Finally, as the step 5, based on whether the concentration evaluated in the step 4 exceed 1/100 relative to the regulatory concentration limit(s), we would like to select nuclides that exceed such value as the nuclides to be measured.

As shown at the second square, in this selection of nuclides to be measured, even if 62 nuclides currently selected as the nuclides to be removed with ALPS are excluded, in order

to check the fact that they have been removed with ALPS, TEPCO plans to check these nuclides voluntarily.
That is all for the first explanation of the issue.

〇Kaneko (S/NRA):
Thank you very much. So, if you have any questions or concerns from the NRA regarding the explanation from TEPCO, please let us know. Anyone is fine.
Mr. Iwanaga, please.

〇Iwanaga (S/NRA):
I have something to say throughout.
The first point concerns page 19, which you just talked about. Considering the composition of this document, I think that the flowchart shown on page 19 shows a zero-based start that first measures what is in the tank. And regarding the top of this flowchart, that is, starting the selection after clarifying the type and inventory of each nuclide to some extent, I feel that you have also stood at the starting line.

On that basis, I would like to ask a few specific questions.
On page 5, the direction of the study, it is shown that when conducting this analysis, you will confirm the nuclides to be assessed through actual analysis. That is, it is written that the nuclides on pages 10 and 11 are measured. In other words, I understood that each step on page 19 is explained on the previous pages.
Page 6 emphasizes the evaluation of transition to stagnant water about the nuclides existing in the stagnant water in buildings. In this regard, how many data are currently available for reference regarding the nuclides in the stagnant water? This is the first question.
On page 8, 20 nuclides are shown as nuclides other than the 64 nuclides that have been measured in the past. Did TEPCO itself confirm these nuclides, or did you simply receive the information from JAEA and then verify that by yourselves? This is the second question.
First, I would like to ask you about these two questions.

〇Matsumoto (TEPCO HD):

Regarding the first question, I will have Mr. Yamane answer it.

Regarding the second question, as shown in the column of "Remarks" of the table on page 10, nuclides with the description "External analysis results available" in this column are nuclides measured not by TEPCO but by asking JAEA to measure them.

To be able to measure these nuclides in-house, we intend to prepare necessary equipment and acquire analytical skills, etc. in the future.

In addition, we believe that Cl-36 and Se-79, which are No. 1 and No. 2, are at a level that can be detected by measuring total β. Therefore, we believe that these two nuclides can be confirmed by measuring total β.

Mr. Yamane, please give me a supplement.

〇Yamane (TEPCO HD):

I would like to answer your first question.

I believe it is certainly very difficult to prepare the data on the transition of nuclides to the stagnant water.

Regarding the transition of nuclides to the stagnant water,

we would like to proceed with the assessment based on the results of the previous analyses, i.e., the results of our analyses of the 62 nuclides, the analysis data by JAEA, and the results of our new analyses. For example, we would like to proceed with the assessment from elements of the same family or elements that show similar behavior.

〇Iwanaga (S/NRA):

I will sort out the answers I have just received from you.

To begin with, the target nuclides for nuclide analysis are described separately on pages 8 and 10, but TEPCO wants to adopt these nuclides based on the results measured by external organizations and JAEA. In other words, I understand that you would like to adopt the nuclides based on the results of the analysis rather than the ability of the analysis.

Next, it is a well-known fact that there is a possibility of the transition of nuclides into water under various conditions regarding the stagnant, which Mr. Yamane responded.

The process of the transition of nuclides to the stagnant water in the past decade immediately after the accident varies depending on the respective environment. Therefore, there is a difficulty that it cannot be said unconditionally. Based on the above, I think that if you refer to the accumulated results in the past, you should conduct the assessment based on many databases. As described above, the steps 1 and 2 are important in the flowchart on page 19. In other words, I think it is very important to confirm the nuclides based on the fact that 12 years have passed since the accident. In addition, I think it would be better if the steps 3 and 4 could be developed.

We would also like to first take a selection process that considers the physical behavior of nuclides with half-lives. This is because I think that the evaluation result on the downstream side of the flowchart will be determined by how much nuclide remains according to such behavior. We do not deny the evaluation of the transition of the nuclides to the stagnant water in buildings, but it is very difficult to grasp the nature of the stagnant water or the relative importance of a nuclide based on such databases, I understand that you will calculate the effectiveness of a certain nuclide against the regulatory concentration limit and exclude the nuclides with small results. Since there are nuclides that are measured and those not done in this process, I would like you to take a viewpoint of whether your evaluation results are consistent with the results of the analysis in the past.

〇Matsumoto (TEPCO HD):

I understand. It's just like what you said.

In the flowchart on page 19, the step 2 simply checks if the nuclide falls under the category of rare gas. Therefore, as Mr. Iwanaga said, regarding reevaluating the nuclides to be measured this time, we will once again firmly evaluate from the beginning, that is, at the first step 1, how much inventory will exist 12 years after the accident. With that as a starting point, we would like to proceed to the step 3 and 4.

On the other hand, as Mr. Yamane and I explained earlier, regarding the step 4, we would like to re-measure the five types of samples this time and evaluate them based on the results, while considering the data we have measured in the past and the data measured by JAEA.

〇Iwanaga (S/NRA):

The step 4 is the most worrisome in this flowchart.

As for the future discussions, the phrase "Consider when it is actually detected" is too limited. Here, I think it is necessary to consider the accumulation of past knowledge and the results of the steps upstream from the step 4 as you just mentioned. It seems that the step 4 and the steps on the upstream side from the step 4 are separated, but I think that both must be considered together. What are your thoughts on this?

〇Matsumoto (TEPCO HD):

I understand.

Regarding "Consider when it is actually detected", there are cases where nuclides are detected and those where they are not detected, so we wrote it to show that we would think about that exactly.

As Mr. Iwanaga pointed out earlier, I think it is important that the evaluation results of the step 4 do not contradict the previous explanations.

〇Iwanaga (S/NRA):

Again, once again, plainly speaking, if you proceed steps 1, 2, and 3, there are some nuclides that always emit the β-ray spectrum or γ-ray spectrum. However, as previously pointed out in the NRA's survey, there are cases in which some spectrum cannot be explained depending on the combination of nuclides. Therefore, if it is possible, we would like you to identify exactly what it is.

The identified process is closely related to the next process. I understand that this is obvious, and in short, it describes that you will analyze it because there is an unexplainable spectrum coming out, but you cannot go there as it is. Am I correct in understanding?

〇Matsumoto (TEPCO HD):

Yes, that's fine.

〇Kaneko (S/NRA):
Then, Mr. Takeuchi.

〇Takeuchi (S/NRA):
The concept of nuclide selection is as Iwanaga said today. Originally, we were asking for consideration of the effects other than 64 nuclides in the Pre-Application Monitoring Review Meeting. At the Monitoring Review Meeting, as Iwanaga said, there was an inconsistency between the total β-rays and that of accumulation of other nuclides, and C-14 and Technetium-99 came out. Other than that, we are also confirming that there are no other nuclides that would seem to exist.

Consequently, at this point in time, there are virtually no other nuclides that may have a significant impact on dose assessment. In the meantime, I raised a point of discussion with the intention of having the applicant confirm, just in mind, how much the impact is for the nuclides of which the energy is low and not so much impact on the whole, including relatively minor ones.

Therefore, in the future, please evaluate and analyze again what kind of nuclides are contained in the ALPS treated water as a whole prior to the commencement of the discharge, and then, if it influences and is necessary to change the assessment so far, please reflect it again.

That’s all.

〇Matsumoto (TEPCO HD):
I understand. Repeatedly, in the figure on page 19, with step 1 as the starting point, we will select the nuclides to be investigated without doubling and without fail, and we will keep in mind that there will be no cases which cannot be explained, repeatedly pointed out by Mr. Iwanaga, and we intend to compile the data so that we can discuss thoroughly.

That’s all.

〇Kaneko (S/NRA):
Commissioner Ban, please.

〇Ban (NRA):
I would like to reconfirm the meaning of organizing the discussions so far, but the important point is the positioning of which nuclide needs to be grasped. I think it is important for you to clarify that.
In other words, TEPCO is thinking that there will probably be no other than 64 nuclides that could contribute to the dose as you have considered 64 nuclides so far. Is that right?

〇Matsumoto (TEPCO HD):
Yes, that's right.

〇Ban (NRA)
I agree with you.
The reason for this is that, as I said earlier, the β spectrum, for example, cannot discriminate between nuclides, so it is only seen as a quantitative contribution. Among them, it can be concluded that, because there is no inconsistency in seeing such things, empirically, perhaps what should be measured and what should be seen are almost complete. That is why, in the environmental impact assessment, you are doing it under the premise of 64 nuclides, is that correct?

〇Matsumoto (TEPCO HD):
Yes, that's right.

〇Ban (NRA)
Nevertheless, this assures that when discharging the ALPS treated water, the sum of the Notification concentration ratio of radioactive materials other than tritium is all below the limit. you have promised it, so you are saying that you will do something close to the proof of absence.

However, it is scientifically impossible to prove the absence. Therefore, as an approach as through as possible, the inventory evaluation is carried out, all theoretically derived ones are picked up, the half-life for all nuclides are considered, and the analysis is carried out, after eliminating such nuclides of short half-life, as a final step. You're going to analyze a representative sample, check if it exists in fact, and get a final conclusion.

Therefore, I understand that this is just a methodology for confirming the fact that, when discharging the treated water, you promised that other than tritium, the concentration ratio is below the limit. Is that correct?

〇Matsumoto (TEPCO HD):

We also believe in that way. At this time, 62 nuclides were originally selected from the starting points of the ALPS treated water as what nuclide is to be removed by the ALPS. Afterwards, since the results of all β-ray data were inconsistent, C-14 was added.

Therefore, as a starting point, we believe that the term "nuclides to be measured" originally is sufficient as stated by Commissioner Ban. However, this time, we promised to reduce the sum of the Notification concentration ratio of radioactive materials other than tritium is less than 1 when discharging the ALPS treated water to the environment.

As Commissioner Ban says, it is impossible to prove the absence. However, as shown on page 19, if we can evaluate the inventory, exclude those that do not need to be considered from the half-life, and ultimately show that it is not technologically or logically inconsistent in the transition assessment, we are thinking about fulfilling the promise in such a way.

〇Ban (NRA):

Perhaps with that understanding, I think it matches our understanding.

〇Kaneko (S/NRA):

Is there anything else?

I think it's very important for me as well, so I'll change my words a little and check it while rephrasing. In a sense, what is written on page 19 is that when you apply logic to the

measurement you have done so far, you want to make sure that there is no difference between what comes out of that logic and what has actually been analyzed.
The point is that although it is supposed to exist logically, it is not visible in analysis, and when analyzing there is a gap in the spectrum. I think that you would like to make sure that whether something have happened and that such things have not happened properly. Therefore, I understand in my own mind that it is the effectiveness of the accumulation of various data that you have analyzed so far, and that you want to thoroughly confirm that you can consider things within that scope. I think the meaning of that is the same. Is that fine?
Do you hear me, Mr. Matsumoto?

〇Matsumoto (TEPCO HD):
TEPCO, Matsumoto.

〇Kaneko (S/NRA):
Yes, I can hear you. It's okay.

〇Matsumoto (TEPCO HD):
We also believe that way.

〇Kaneko (S/NRA):
In that sense, the first half shows 64, namely 56+6+2, nuclides and the page 8 shows 20 nuclides that have been measured. In addition, you have added some candidate nuclides on pages 10 and 11. Regarding this, when the results of measurement and analysis have come out, you are going to check whether the results are well matched with those selected in the previous flow on page 19.
So you will make sure what nuclides are in the pre-dilution ALPS treated water, and how much they are concentrated and contributed to, after the original treatment with the ALPS. So far, I think you should analyze the water before discharging it.
It is not directly related to the current explanation, but it is regarding the analysis of water

when discharging and before discharging. This is another way of thinking, but rather than doing all of this one, it is an analysis to confirm that there is a base like this and that it is almost the same, and I understand that in the next step, it will be an object to be explained by you separately. Is that correct?

〇Matsumoto (TEPCO HD):

First of all, about the story of the first half, that is true. The data will be used on page 8 for 20 nuclides that have previously been measured in addition to 64 nuclides.

On pages 10 and 11, we have extracted that there might be such candidates based on our previous knowledge.

By actually analyzing the five samples shown on page 12, I think that we should clarify whether the nuclides on pages 8, 10, and 11 actually exist or how much they exist, and then put them on the flow on page 19.

〇Kaneko(S/NRA):

I understand this point. It's okay. The perceptions are consistent.

〇Matsumoto (TEPCO HD):

Regarding the latter, we need to consider various nuclides to be measured in accordance with this flow in the future. However, as shown in the square box on page 19, we guess that some of the 64 nuclides that we are measuring now have a short half-life and will be excluded.

On the other hand, as to whether or not to confirm this, we are thinking of making voluntary measurements at the present time. As Mr. Kaneko said, how we can surely measure this point is an issue to be considered in the future.

That’s all.

〇Kaneko (S/NRA):

I understand. In that sense, it is okay to think about whether it is best to measure with 64 nuclides, whether there is no leakage in selection, or whether there is more narrowing down, or whether there is something that needs to be added, after looking at this whole picture, and then setting it up again, isn’t it?

〇Matsumoto (TEPCO HD):
That's right. We are thinking so.

〇Kaneko (S/NRA):
I understand.
Now, there is a point that we are able to confirm exactly how far in our review, so when TEPCO's work progress shows the results of the analysis, we would like to confirm how far we were able to verify by sharing the information.

〇Matsumoto (TEPCO HD):
I understand.
Currently, the five samples shown on page 12 are being prepared for measurement. Some nuclides are difficult to measure, so it will take some time, but as Mr. Kaneko says, we would like to share the results and discuss them with you.
That’s all.

〇Kaneko (S/NRA):
So, I look forward to your continued support regarding that as well.
Would you like to hear about the analysis of nuclides in other respects?
Would you mind? Now, we have had a lot of fundamental discussions, so if you want to check something like more technical details, if you have, is that okay with you?
Mr. Arai.

〇Arai (S/NRA):
The first entry point on page 19, starting with the library used for ORIGEN, and starting with this as the starting point, is an explanation on page 14 that all the material was spread over the table. It is described on page 14 that this ORIGEN can be used to assess

the formation, nuclear decay, and impairment of radioactive material, and classification of No. 1 Fission Product Assessment and No. 2 Activation Product Assessment. Maybe it's a matter of how to make documents, but which of these heavy nuclides, such as transuranic elements and minor actinoids, should I look at?
Please explain.

〇Matsumoto (TEPCO HD):
TEPCO, Matsumoto.
This is a product of activation, Mr. Yamane, as confirmation? It is a type of neutron absorption.

〇Yamane (TEPCO HD):
We see the decay series of uranium-based neutron absorption at No. 1.

〇Matsumoto (TEPCO HD):
No. 1 for decay?

〇Yamane (TEPCO HD):
I am sorry. Transuranium elements are classified as No. 1 for those that absorb neutrons and gradually increase in the mass number.
We are looking at the fission product evaluation in No. 1.

〇Matsumoto (TEPCO HD):
No, not the activation product in No. 2?

〇Iwanaga (S/NRA):
We just wanted to confirm that. No. 1 and 2 did not talk about that. The so-called minor actinoids are always analyzed in the analysis of Fukushima Daiichi NPS using ORIGEN, so I think you already have that.
In addition, at the time of the accident, only the FP (Fission Product) that could be

disrupted in the core fuel was targeted, and some of the CP (Corrosion Products) were not included because of no activation. Therefore, I think that what is assumed as a new activation product was added to compensate for the claimed portion that would melt down from the structure or so-called transferred to the water. You don't write about minor actinoids here anymore, but I think it is already included in decay series. It's okay, isn't it?

〇Yamane (TEPCO HD):
TEPCO, Yamane. It is all right as Mr. Iwanaga pointed out.

〇Kaneko (S/NRA):
The answer is, therefore, that those are not expressed in this expression, but they are included in the No.1 category that we are originally doing.

〇Yamane (TEPCO HD):
That's right.

〇Matsumoto (TEPCO HD):
Excuse me. It was my misunderstanding.

〇Kaneko (S/NRA):
In any case, if we can confirm that they are even included, as Arai pointed out earlier, it may be a matter of expressions in the materials, so I understand that they are included in the results as well as objects of ORIGEN properly. Do you have anything else?
Now, I think we need to conduct a thorough examination of the results of specific evaluations, analysis, and so on. Thank you very much.
So, please explain about the relation of water intake in the second point from page 20

〇Matsumoto (TEPCO HD):
Now, I will explain how to take water, in particular, how to assess the impact of taking seawater in a port up to 41 pages.

See page 20.

Of the methods of taking seawater and the methods of discharging the ALPS treated water after dilution, the setting of the mixing and diluting ratio and the effective dose assessment at the site boundary are cited as the points of discussion. In addition to considering the effects of radioactive materials that may exist in the water intake sites of seawater, if the effects cannot be neglected, measures to prevent the transfer of radioactive materials in the harbor to the water intake sites should be explained.

See page 21.

As shown in the lower left and left side of the plan view, this water intake will be carried out by modifying the breakwater on the north side to take seawater from outside the port and harbor. It will be guided to the water intake channel of Unit 5 and taken from the dilution facility.

On the other hand, as indicated by red bands, the partition dike will be built as the seawater in the harbor and the intake facility shall be designed so that the seawater in the harbor does not mix with the seawater for dilution taken from outside the harbor.

The partition dike prevents water from moving back and forth by placing a sheet on a sloping dike stacked with approximately 65 meters of riprap.

Based on this, from page 23, I will explain the results of confirmation of water quality, including the concentration of radioactive substances in seawater at the water intake side.

Go to page 24.

The radioactivity concentration of seawater in the current harbor is illustrated. The water intake point is "north side of Units 5 and 6 discharge outlet" on the north side of the north side breakwater. As for Cs-137 at this point, the figures are 0.16Bq/L for FY 2019, 0.14 Bq/L for FY 2020, and 0.42 for FY 2021.

On the other hand, in the harbor, although the value is high at the open channel, the value at the entrance of the harbor or in front of the unloading wharf in the harbor is higher than the value at the north side of the discharge outlet, although it is slightly low.

Accordingly, TEPCO would like to reduce the effects of radiation by taking water from the outside at north of the harbor as much as possible, rather than taking water inside the harbor.

Please see page 25.
Here, we assessed the effects of radioactivity when water in a port and water outside a port were taken in, and used respective data on the reactivity concentration of seawater used for the assessment.
As shown in the plan view on page 25, the "North side of the water outlet of Units 5 and 6" indicates that seawater to be taken for dilution and the other is "North side of harbor". However, the concentration is slightly higher than that of the north side of Units 5 and 6. Using this actual data, the impact assessment was conducted this time.

Proceed to page 26.
The inventory of nuclides contained in seawater for dilution is shown in the table. The annual discharge rate is calculated by taking in 340,000 m3 seawater per day and multiplying the seawater concentration for assessment shown on page 25 by 80% of the 365 days as availability. This is listed as the source term for the exposure assessment on page 26.
On the other hand, the measured value of the K4 tank group used for the radiological impact assessment and the hypothetical value of ALPS treated water, these two value are used to evaluate the amount of radioactivity by adding this transfer reactivity.

Go to page 27.
The results of the exposure assessment are shown in the table. Table 1 is classified as results of human exposure assessment, and Table 2 as results of internal exposures assessment by age. Both assessments using actual measurements of the K4 tank group and assessments using the hypothetical ALPS treated water show that the K4 tank group is originally cleaner in terms of water intake north of the port, i.e., that of north of the water outlet of No. 5 and No. 6. However, the effect of the K4 tank group has increased by about

one order of magnitude, but the assessment for the hypothetical ALPS treated water has been almost the same.

Then go to page 28.
In light of these factors, we are assessing the impact of these activities. This time, we will establish a partition dike to separate the seawater for dilution from the seawater in the harbor. As shown on page 28, explanations of the water discharge relationship of water intake facilities, undersea tunnels, etc. show the concept of this partition dike and the concept of transition rate to seawater intake points as the points of discussion.

Regarding the design, although repeating what I told you earlier, please see page 29.
Intake seawater from outside the port flows along the blue arrow. After remodeling work to remove the permeation prevention work that exists on the north side breakwater, the water is drawn into the intake open channel. Partition dikes are 65 meters long and 10 meters wide. By dividing with this dike, the water of the intake channel of Units 1-4 is not taken.

On page 30, the status of the removal of the permeation prevention work is illustrated with an image of the current and the after completion of construction. There is a permeation prevention work at the breakwater in the figure on the left, which will be remodeled to allow seawater to pass through.

As for page 31, there are currently existing doubled silt fences that separate the port sides of Unit 1 thru 4 and the port sides of Units 5 and 6. We will install a partition dike on the south side of that area so that the seawater in the harbor on the side of Units 1-4 will not be taken in.

Page 32 shows the comparison before and after the construction of this partition dike.

See page 33.

This section explains the radioactive material concentration in the seabed soil after the construction of the partition dike. Currently, as shown in the photo, the radioactive material concentration in the seabed soil of the three places A, B, and C in the harbor is measured. As shown in the table, values of the order of several Bq to several hundred Bq have been detected for Cs.

Therefore, it will become a problem to ask whether or not to wind up the seabed soil by carrying out the construction work in the vicinity of the silt fence this time. As shown on page 34, however, the seabed soil and sand are covered with two layers of bentonite or cement as the covering material.

At present, about 1.5 meters depth of sand is deposited on the insulation material, so we intend to implement this work so as not the sand to be rolled up in line with this work.

Then see page 35.

I will explain how to construct a partition dike. As explained earlier, the partition dike is laid with riprap, and a soft vinyl chloride sheet is placed on it to prevent water from moving back and forth. Some methods of partitioning are to arrange concrete retaining walls and to lay sheet piles of earth retaining steel. However, considering workability and the concern on radioactive material rolling up, TEPCO concluded that the riprap sloping dike is more appropriate.

The design is shown on page 36.

The riprap is approximately 65 meters in length and is connecting the north breakwater and the yard side of Units 5 and 6. The area above the sea surface is approximately 10 meters wide, and the bottom in the sea is approximately 22 meters to 33 meters wide. The height of the top end of the partition dike is T.P.+2.2 m, so we do not think that the wave will overflow the dike even at high tide.

Go to page 37.

After loading the riprap, we lay a mat made of a soft vinyl chloride sheet on the dike. This suppresses the movement of water coming back and forth. We will cover a thick sheet with a thickness of 5mm, but we would like to prevent water from passing through by either the method of overlaying the sheets or the method of welding the sheets. We will study the details in the future.

Go to page 38.
This section explains the status of removal of permeation prevention work. Currently, there is a permeation prevention work in the north side breakwater, but as shown in the photo on page 38, this permeation prevention work will be partially removed. For the water intake from Units 1-4 during this removal, please note the description of the mark with asterisk. During the removal work, there will be almost no supply of seawater from intake channel of Units 1-4 and from the open channel, but since there is seawater supply from the north breakwater side, we believe that it does not become problem with the intake of emergency cooling water for Units 5 and 6.

See page 39.
I will explain about the radioactive material concentration in seawater during the construction of the partition dike. In the last three years, by using working crafts and backhoes within the port, we have put materials such as riprap into the sea as shown ①, ② and ③. At that time, we installed construction fences to prevent pollution, etc., and carefully constructed them with work speed slower than usual, thereby suppressing the swirling and spread of the seabed soil and sand.

Page 40 shows the radioactive material concentration in seawater in the harbor during that construction periods, but we believe that there were no significant impacts from the construction works.

The summary is written on page 41.
TEPCO considers that the amount of intake of diluted water will be larger than that of the auxiliary component cooling water for Units 5 and 6. However, the construction of a partition dike will prevent the intake of seawater, which has a relatively high concentration

of radioactive material, from within the port of Units 1-4. Moreover, the construction of the partition dike prevented the soil and sand brought in from the port of Unit 1-4, which had been prevented by the silt fence so far, and prevented the risk of an increase in the radioactive material concentration in the dilution seawater due to the transfer of those soil and sand into the water intake of Units 5 and 6. Finally, seawater with a lower radioactive material concentration can be taken from outside the harbor as seawater for dilution. From the above three points, we believe that by constructing a partition dike, the transfer of radioactive materials to the seawater for dilution of the ALPS treated water can be suppressed.

That's all for my explanation on this case.

〇Kaneko (S/NRA):
Thank you very much.
So, regarding the points that have been explained so far, please ask questions and make confirmations from the regulatory side. Mr. Masaoka.

〇Masaoka (S/NRA):
I have a detailed question about asterisked portion on page 38. This time, a partition dike is constructed, and then the permeation prevention work is removed. On the other hand, I think that the auxiliary system is working for the water unit 5/6 inlets and the cooling of the pool. Why doesn't this construction affect water intake? Is it based on the quantitative evaluation the amount of seawater flowing from the north side breakwater or the qualitative understanding that there is no obstacle to the inflow?

〇Matsumoto (TEPCO HD):
Basically, the latter. As you can see, the North Breakwater is in a state of piling up tetrapods, so you can get seawater going inside. Therefore, I think that water can be taken from there.
Mr. Furukawasono, please make supplemental remarks.

〇Furukawasono (TEPCO HD):

In addition to the explanation, we also internally verified by numerical analyses that the water intake at Units 5 and 6 was not affected.

〇Masaoka (S/NRA):

I understand.

When I visited the site, I couldn't see the foot of the pile of tetrapods, so I just confirmed it.

Also, I would like you to show me the details, such as the structure, next time. I understand.

〇Kaneko (S/NRA):

Anything else? Commissioner Ban.

〇Ban (NRA)

One more detailed question. Laying a soft vinyl chloride sheet as described on page 37 seems to me a very primitive method. How long will the durable life be?

〇Matsumoto (TEPCO HD):

Mr. Furukawasono, please.

〇Furukawasono (TEPCO HD):

This time, we believe that this sheet has a durable life of about 30 to 40 years, based on experiences with Fukushima Dai-ichi and Fukushima Dai-ni.

On the other hand, we place a sheet on top of the rubble stones, and we will monitor the sheet after it is built, verify it on a daily basis, and if there are any problems, we can modify it while conducting long-term inspections, so we would like to firmly maintain and use it even after operation, while making repairs and repairs.

〇Ban (NRA)

Understood.

〇Kaneko (S/NRA):

Mr. Arai.

〇Arai (S/NRA):

On pages 26 to 27, you have confirmed the contribution to the results of the evaluation of the radiological environmental impact of water withdrawal from seawater in the harbor. The results show that all the cases satisfy 1mSv and 50μSv. In this sense, what is the meaning of this partition bank?

〇Matsumoto (TEPCO HD):

As you say, on pages 26 and 27, when seawater from the north side of the water outlet of Units 5 and 6 and outside of the port was taken in, and when the north side of the port was taken in as it is and used as diluted seawater for discharge, as based on the results of this evaluation, we see that almost no effect will be exerted on the effect.

This is attributable to the fact that, although the seawater in the harbor is originally higher than that outside the harbor, it is not extremely high.

On the other hand, this time, since it is preferable for us to have as little radioactive material as possible, I think it is meaningful to provide a partition bank.

In addition, as I mentioned on page 41, it may also contribute to measures to control sand, so I think there is an advantage to constructing this partition bank.

〇 Arai (S/NRA):

Rather than attempting a transition prevention rate through quantitative evaluation, target dose is satisfied without the bank in the first place. Therefore, I understand that this partition bank should be constructed in order to mitigate the impact of sand transfer and sea water transfer as much as possible.

〇Kaneko (S/NRA):

Anything else?

Mr. Iwanaga.

○ Iwanaga (S/NRA):

The point that commissioner Ban made is very important. In the past, water from the underground storage tank leaked from this similar welded sheet in 1F. From these experiences, it is understood that understanding the durable life would be important. However, it was difficult to maintain the sheet and to detect the leakage.

By adopting such a structure this time, this probably does not significantly change the condition and environment before 5 and 6. Even when there is a large typhoon or a tidal wave, it is hoped that the provision of such a partition will not bring about a large change in this part. By managing this, I think that concentration control and condition of the sheet with or without durable life can be monitored by periodical maintenance. Are such reflections being taken into account?

○Matsumoto (TEPCO HD):

As you said, in the case of the underground water storage tank, these sheets were used by welding, but as a result, there were some parts that were not sufficient, and repair was not possible, so I think that the people in the region were greatly worried about it.

With regard to this case, since the partition is meant to separate the water intake in the harbor and water intake from outside the harbor, we are aiming for such an effect, although I do not think there will be any movement of seawater between inside and outside.

On the other hand, as Commissioner Ban and Mr. Iwanaga say, this is visible on the surface, we intend to conduct visual inspections in a planned manner and maintain this facility appropriately, besides durable life.

○Kaneko (S/NRA):

Thank you very much. Do you have anything else?

Let me make a small question or two.

I was looking at the picture on page 29, and this time, the partitions that that we are talking about are shown in the red part. There is a part of the existing work which is shown in yellow and green on both sides of it. The names suggest dikes, but I think both are places where stones are placed as far as I remember. Whether or not a vinyl sheet for preventing permeation is stretched on the partition, and whether or not the dikes are structured so as not to be passed through. I would like you to explain what the relationship is.

〇Matsumoto (TEPCO HD):

Mr. Furukawasono, please.

〇Furukawasono (TEPCO HD):

First of all, with regard to the green and yellow connections on both sides, we are also considering the connections so as to prevent impervious water and the passage of seawater by laying the sheets explained this time.

On the other hand, as for this yellow part, where the north breakwater is indicated is a pile of tetrapods, seawater and sand will come in from here, so the sand may accumulate in this open channel. The yellow part is an inclined dike mainly made of stones, but we are proceeding with the construction of a sheet that prevents sediment from entering. I would like to thoroughly observe the environment of the No. 5 and No. 6 open channels, while checking this matter every day.

〇Kaneko (S/NRA):

Thank you. Then, the red arrow comes from the right to the cross mark, as shown in the picture on page 29. Does that mean that yellow and green portion connected to red area is also covered with this vinyl, and in fact the flow indicated by this red arrow is effectively suppressed?

〇Furukawasono (TEPCO HD):

That is correct. With regard to the details, I would like to explain once again when we are finalizing the design and starting the construction. That is all.

○Kaneko (S/NRA):

Then, I understand that it will be a construction that produces such a function or performance.

Also, regarding the evaluation of the exposure dose on page 27, which Mr. Arai checked earlier, I would like to confirm the details just in case. The right and left halves of this table, the K4 tank water with thinner concentration, and the average ALPS water, I suppose. The original source term was evaluated for two, plus the portion of radioactive material that is added in the seawater diluent that results in yearly releases, and the total amount was evaluated. The number at the bottom, which was originally 6.3 × 10-5, was 8.5 × 10-5, so I wrote that the total amount would be this instead of the additional amount. That's OK, but that's OK. It's just a confirmation for my understanding.

○Matsumoto (TEPCO HD):

That is correct.

The hypothetical ALPS treated water is water produced by choosing eight types of nuclides that are most consistent with the definition of ALPS treated water with the sum of ratios of legally required concentrations limit exactly one. Therefore, in the original report, the treated water hypothetically used for the K4 tank group has two digits different. The K4 tank group was strongly influenced by that.

Consequently, increased value from 6.3 x 10-5 to 8.5 x 10-5 is contributed by moving the original diluent seawater.

○Kaneko (S/NRA):

I understand. For hypothetic treated water, you increased the amount of nuclides that contribute well, such as zinc, didn't you?

Therefore, the difference is eventually the same, and in the right half and the left half, when the north side of the fountain outlet of Units 5 and 6 is taken into account by approximately 2.2 × 10-5, and when the north side of the port is taken into account, approximately 0.5 × 10-5 is taken into account. Simply speaking, that's the result, isn't it?

〇Matsumoto (TEPCO HD):
That is correct.

〇Kaneko (S/NRA):
That is all from me. Anything else?
Then, regarding the intake of water, I would like to confirm the actual state of construction of permeation prevention work and what kind of inspection should we refer to, and how this sort of thing will be done.
Then, we have a change of members, let us break 10 minutes or so.

〇Matsumoto (TEPCO HD):
OK

(Break)

〇Kaneko (S/NRA):
So we will resume the 9th meeting of ALPS Treatment Water Review Conference.
Page 42 of document 1-1, we would like to ask you to explain the design of the water discharge equipment, the water discharge tunnel, and the water discharge outlet, etc.,

〇Matsumoto (TEPCO HD):
Now, let me explain about the method of discharge. Today, I would like to explain three points regarding discharge.
First of all, I explained the shape of the water discharge shaft in the matters listed at the review meeting the other day. I have evaluated the fact that the sea water in the vertical shaft is surely discharged from the water discharge outlet 1km ahead of the shaft in consideration of the back-flow due to the overall arrangement and the difference in height, based on the hydraulic calculation. I would like to explain this.
The second point is design and architecture of the discharge tunnel, and the third point is the design and structure of the discharge outlet.

Page 43 please.

First of all, I would like to talk about the results of hydraulic calculation. Page 43 shows the situation when three sea water transfer pumps are operated, and page 44 shows the situation when two sea water transfer pumps are operated.

I will explain the chart from the left side. After the diluted treated water flows into the upstream water tank, water flows into the downstream water tank in a waterfall-like manner. The downstream water tank is structured so that water is discharged from the discharge outlet utilizing the head difference from the sea surface.

Regarding downstream water tank, the depth is about 16 meters. From there, water goes through the discharge tunnel to discharge outlet, of which location is 13m below the sea level and one kilometer away from the tank.

Sea level varies depending on tide. At high tide, sea level is HWL:T.P.+0.76m and at low tide, it is LWL:T.P.-0.78m.

HWL has a smaller head difference, making it difficult to extrude water. In this case, when going from the left, water statically stays in the upstream tank at T.P.+3.11m, and then flows into the downstream tank. The downstream water tank is T.P.+2.40m, and the head difference is 1.64m at this time. This 1.64m gravity force is used to extrude the water from the discharge tunnel and the discharge outlet from the downstream water tank.

Page 44 shows the case when two pumps are operated. This case, T.P.+2.79m at the upstream tank, 1.49m at the downstream water tank, and the head difference is 0.73m.

The actual calculation status is shown from page 45. The hydraulic calculation results show that the flow velocity in the tunnel, is 0.89m/s for two-unit operation and 1.34m/s for three-unit operation, approximately one meter per second through the discharge tunnel considering the water level of the vertical shaft and the downstream tank.

The detailed hydraulic calculation results are shown on page 46. The important point in the graph below is the red line. The flow of seawater follows the dynamic water gradient.

This calculation assumes that there are shellfish of about 10cm in diameter stuck inside the sea water discharge tunnel with a thickness of 10cm at high tide. In short, it simulates that the flow path is narrowed by this.

In addition, page 47 presents a formula based on the hydraulic calculation. It is basically based on a hydraulic formulae by the Japan Society of Civil Engineers.

Please go to page 48.

Since there is a concern that an abnormal shutdown of a pump (earthquake, tsunami, etc.) may cause surging (back-flow) in the water tank and tunnel, the water level fluctuations in the event of an abnormality was calculated. As third arrow shows, calculation was carried out by reflecting the conditions of the wave and storm surge (HHWL (highest sea level in the past): T.P+1.15 m) corresponding to the design wave height (50-year-probability significant wave height: 7.0 m) in the analysis. As a result, the maximum water level in the upstream water tank was T.P.+2.50 m, and the maximum water level in the downstream water tank was T.P. 2.40 m. So, it was confirmed that there will be no inundation.

On page 49, effect of water level fluctuation in a discharge shaft (upstream water tank) is shown. We are examining this based on the T.P.+3.11m of the water discharge shaft. As shown in the drawing at the bottom right, the seawater piping and the seawater piping header, which is a mixture of seawater for dilution and treated water, are finally bent downward by this elbow and are headed toward the upstream water tank.

At this time, the discharge end of the seawater pipe is released to the atmosphere, so the discharge shaft is designed not to be submerged. Therefore, even if the pump trips, it is designed so that backflow does not occur.

As you can see on the right side of page 49, the air has been released to the atmosphere at T.P.+4.5m, near the top of the tank. The water level is 4.00m, so there is a gap of about 50cm.

In this figure, it appears that a gray pipe is attached to a seawater pipe like a cylinder, however, this is not a cylinder, but a steel support, or a structure. Therefore, I would like you to keep in mind that we are opening the air to the atmosphere.

Also, as shown in the figure on the left, as for the upstream water tank explained the other day, the seawater piping will be joined at the upper right of this picture. At the middle wall, there are two upper and two lower stages. In this picture, water flows in a U-shaped route counterclockwise, and from the lower right, it falls from the upper water tank to the downstream water tank.

Also, this time, the upper water tank will be covered with a top plate, so in this case, it will be bonded to the side wall and the partition wall, making it advantageous to the structure.

Then, please proceed to page 50. From here, I will explain the discharge tunnel and discharge outlet.
From page 51, we will explain the design structure of the water discharge tunnel and facility overview/design. First, we will discuss the overview of the facility from page 52.
On page 53, you see the overview of the ALPS treated water dilution/discharge facilities as explained in previous Review Committee and other meetings. This water discharge tunnel is the part that leads from the downstream tank of the discharge shaft to the discharge outlet.
As shown on page 54, this tunnel will be constructed using the shield method. By creating reinforced concrete segments on the back side while digging the tunnel, both excavation and tunnel construction are carried out together.
Since there are many tunnels constructed by the shield method, so this method is safety and secured, and it is unlikely that any trouble happens. Slurry shield method is adopted this time.
Specified dimensions are shown on page 55. The outer diameter of the tunnel is 2950mm. We are considering a structure that connects segments with a thickness of 180mm.
Segments with a length of 1.0m will be connected together to build the tunnel. In addition, the maximum covering, which is the deepest part of the tunnel, is approximately 14 meters from the seafloor.
Segment pieces and dimensions are explained on page 56. One ring consists of six segments. Each of the six segments will be appropriately chosen from types A, B or K.

Then go to page 57. This is the selection of the alignment of the discharge tunnel, which means where the tunnel passes.
Page 58 is the reason for selecting the horizontal alignment. The orange part shows seafloor with rocks, and in order to allign this water discharge outlet in this part, the water discharge outlet is shifted to the north side by about 20m, rather than about 1km direct

east. Therefore, there are a bend in the middle, but in reality, we are considering a alignment such as a gentle bend at R=500m.

Go to page 59.

This is longitudinal alignment of discharge tunnel. We performed geological boring, so please see the structure of the tunnel along with geological data of three borings.

The red line shows where the tunnel passes. The entrance side is sandy mudstone, and the exit side is sandstone. Both are member of Tomioka formation T3, and we confirmed very solid rock.

We have shown the results of this boring on page 60. As I mentioned earlier, the geology has been confirmed to be the T3 layer of the Tomioka layer, and the standard penetration test value (N-value) has been confirmed to be over 50.

In addition, grain size analysis was conducted and we found mainly sandy fine-grained soil, so we would like to reflect the results as soon as possible in the design of mud production during mud discharge.

From page 61, the results of the boring survey and the passing position of the tunnel are shown.

Page 61 is the farthest, 1km ahead, there is a caisson at the outlet of the sandstone. A caisson at the outlet to be explained later.

Page 62 shows middle of the water discharge tunnel, where a slight bend to the north appears. Blue circle shows location where the tunnel passes, 12.0 meters to 15.0 meters from the seafloor.

In the geological survey (3) on page 63, about 400 meters offshore from the site, we are now proceeding with the design by passing the water discharge tunnel around 15.0 meters from the seafloor.

Geological survey data near the Units 5/6 revetment are shown on page64. Except for buried earth and beach sand, the geology consists of an alternate layers of sandstone and mudstone, and it is confirmed to be very hard.

Page 65 confirms the consistency between past geological survey data and current geological survey data. It is still true to pass through the T3 layer of the Tomioka layer, however, the layer of sand was found thinner than assumed previously.

Then go to page 67.
This is the selection of the method of the discharge tunnel. At the start of the meeting, I explained that we would like to adopt a shield tunnel by shield machines. As shown on page 68, there are two types of tunnels: mountain tunnels and shield tunnels. This time, we adopt a shield tunnel instead of a mountain tunnel.
Regarding this matter, both methods can be used because the rocks are hard. However, as shown on page 69, in order to execute the seabed tunnel work more safely, we will employ the shield tunnel method.

Page 70 provides an overview of the shielding machine, and on left side, there is an image of the actual shielding machine to be used. The purple portion is the rotating part at the front of the shielding machine. After the soil is scraped in the cutter chamber on the right of the shielding machine, it becomes muddy and feeds it back through the brown pipe. Behind this, it is the construction work to fit the pieces of the segment.

"Report of the Council for the Improvement of Safety of Shield Tunnel Construction Technology (the Ministry of Land, Infrastructure, Transport and Tourism)" suggests considerations based on the experience of accidents and troubles that have occurred so far, and from pages 71 to 73, it is described how we will take measures this time referring this report.

Page 75 shows the design, structure, and strength of the discharge tunnels. This time, we are proceeding with the design in accordance with civil engineering-related codes and standards, and these red words of codes and standards such as Concrete Standard Specifications have been applied to the design of tunnels.

From page 76, this is TEPCO’s design considerations. As for the earthquake, the facilities are classified as Seismic Class “C” as I have mentioned, so it will be designed conforming to the guidelines for joint ditch design, guidelines and explanations for earthquake-resistant sewerage facilities, etc.

On page 77, this is consideration for the natural phenomena other than earthquakes, such as tsunami and typhoon. Sea level rise due to tsunami that is equivalent to Japan Trench Tsunami, and waves corresponding to the design wave height (50-year-probability significant wave height: 7.0m, period: 15.0 seconds) are taken into account.

On page 78, this is about fire considerations, but since it is an RC structure, we believe there is no fire concern.

On page 79, there are design considerations for the reliability of the structure. We intend to construct a highly reliable discharge tunnels by taking the structure such that discharge facilities are grounded to bedrock, it will not be easily affected by earthquake, and by using a shield tunnel.
In addition, we will explain the considerations for the soundness later, but we will also consider that stationary load, wave load and earthquake load is within the allowable stresses and that measures against salt damage, etc. will be taken into account.

Subsequently, from page 80, these are the examination items and results.
We examined the discharge tunnels in relation to the structure, the wave, cracks, and salt injury at all times as well as earthquake.

The actual results are on page 81. With regard to examination on the stress intensity, we confirm that the stresses of materials caused by differences in loads are within Allowable Stress Intensity by using rebars of SD345 with 42N/mm2 specified design strengths.

On page 82 is the results of examination on the stress intensity. As the result of consideration on the combination of loads at all times and at the time of earthquake, as shown in the lower right corner of page 82, Operating Stress/Allowable Stress are all below 1.

On page 83 shows the results of examination on the stress intensity for each part. The maximum value at the red point is 0.46, which is all below 1, indicating that it has passed.

Then, page 84 shows the result of examining the displacement during earthquake. Based on the results of the boring survey, we will install the discharge tunnel in the N50, it is a very hard rock, so the results of examining the horizontal displacement shown on page 84 are also about 3mm. Consequently, as a whole, we can say in another words, there will be displacements such as "not moving," so we believe that there will be no significant impact, particularly on starting part of the tunnel and discharge shaft connections. On page 85, we have listed the case studies.

On page 86. Regarding the concept of the load on the discharge tunnel, there is a picture on the left side, we examined it by the design under the condition that the rock of two tunnel volumes above the tunnel has collapsed.

Page 87 shows the relationship between segment thickness and outside diameter. We plan to have a segment thickness of 180mm with a shield tunnel of outer diameter 2950 mm this time. As for the dimensions of this segment, the relationship between the height/outer diameter and the segment outer diameter of ring is shown in the graph on the right. We prepare segments with a quality of 6.1%.

From page 88, these are the results of examination on crack. This examination is based on the formula.
Page 89 shows the results of examination on salt injury.
As a result of calculation based on the formula, the examination results are shown on page 90.
The generated bending crack width / allowable bending crack width is 0.76 and 0.84 for the starting point and the deepest point of the lining plate. Both bending crack widths are less than 1 for the allowable bending crack width. Regarding salt injury, the concentration of chloride ions at the position of rebars / Corrosion limiting concentration of rebars is

0.90 and 098.

Regarding the segment, this time, there are joints. Water leakage from the joint portion will be stopped by applying more seals. Seal material is rubber that expands in contact with water. When assembling segments, expansion sealing material will be placed and joined shown in the picture on lower left. In the unlikely event of water leakage, as shown in the lower right of page 91, the water expansion seal cuts off the water flow to downstream. We plan to use chloroprene synthetic rubber seal with a thickness of 4mm and a width of 17mm.

From page 92, segment joints are described. The segments will be divided into six in the peripheral direction. These are joined using corn connectors. In addition, joints in extension direction is designed to be joined with screw bolts.

The structural features of the joints are shown on page 93. Each of joints have characteristic features such that it is not exposed in the tunnel when fastened, and that they resist against drawing force by frictional force.

From page 94, these are the explanation about outline and design of the facility, so-called discharge outlet caisson, namely the outlet of discharge diluted treated water.

Shown on page 96, this is a cross-sectional view of the discharge outlet. The green line is the parts where the so-called shield machine is dug as a tunnel at the exit of the tunnel. The light blue square is a concrete box called a caisson, and the yellow one is the shape of the upper lid of this caisson. On page 96, an enlarged view of the box is shown. After passing through the tunnel, there is a box with a height of 10m at the outlet of 9m×12m in width and length. The outlet of the box is 3m×3m, a height of 2m, for example, a chimney, and the diluted seawater is spouted directly above the box.

Also, on page 97, it is under construction. discharge outlet caisson is fabricated as combined form of this blue turret-like structure and is brought it to the site. The turret is shaped so that it protrudes from the sea surface on the blue top, and, it has the role of preventing the arrival of the shield machine from being misaligned by measuring from the premises.

From page 98, the structure and design of the discharge outlet caisson.

As shown on page 99. this is designed in accordance with four types of cords and standards, such as the concrete standard specification which was applied to the discharge outlet.

On page 100. The discharge outlet caisson was designed as seismic class C, and the horizontal design seismic coefficient of kh=0.2 will be used for examination as same as in the case of tunnels,

On page 101. Like tunnels, the wave pressure resistance against tsunami equivalent to the Japan Trench tsunami and the waves corresponding to the design wave height are taken into consideration.

On page 102.

Regarding consideration on a fire, we concluded that there are no concerns about it, because this is an underwater facility.

From page 103, the structure and integrity against the impact of the earthquake are described. With regard to discharge facilities and discharge outlet caissons, the structure is such that they are less susceptible to earthquakes by landing on the rock. As for consideration on soundness of the facility, similar to discharge tunnels, it is confirmed that generated stress for stationary load, wave load and earthquake load are within the allowable stress intensity, and also evaluated the uplift of structures, salt injury, cracks, etc.

Go to page 104. Regarding discharge outlets among the examination items for discharge facilities, the same way applies to high waves, so that the structure at all times is within the allowable stress intensity. We confirmed that cracks and salt injury are within the allowable range, and there should be no uplift, and that they are within the allowable stress against earthquakes.

From page 105, we have examined the stress intensity. The data used is as shown in the table.

The result is page 106. For the base plates and sidewalls, the applied stress/allowable stress is 0.46 and 0.48, respectively, which are lower than 1.

The areas where stress is generated are shown on page 107. The opening joints at the outlet of the tunnel is reinforced as shown in the section force diagram. The location where the stress is generated is written with a cross mark at the box, and the shear stress is less than 1.

Page 108 is a standard that applies crack examination.
Page 109 is an examination formula for salt injury.
As shown on page 110, both the width of the crack and the salt injury are below 1, and we think there is no problem.

On pages 111 and 112, these are examination of uplift of the discharge outlet caisson. Even if the safety factor is expected to be 1.20, the calculated value is 1.99. We confirmed that the durability against uplift is secured.
These are the design and structure of the discharge outlet and the discharge tunnel.

From page 113, I would like to give a few answers to the points raised at the 8th review meeting last week. We explained countermeasures against natural disaster because of changing the upper water tank of the discharge shaft into a wide shallow water tank. At that time, NRA pointed out that TEPCO should explain a little bit more about the actual layout regarding the reduction of the risk of earthquake, and to explain the calculation for ensuring the shearing strength by arranging shear reinforcement for the discharge shaft (downstream water tank).

Page 114 shows the planning view when the actual equipment is placed. The right side is the intake of Unit 5, and we will take in the seawater for dilution from here. The newly installed seawater transfer pump will be set at the red circle and the blue pipe for dilution is led to seawater pipe header. The picture shows the circulating pump of Unit 5, but we will install a new seawater pump after removing it. Place the orifice flowmeter set on the yellow square in the center of the straight pipe. In addition, a red and thick pipe is the seawater pipe header. This is headed toward the upstream tank in a straight line, but it runs underground at the crossing of the road. The transfer pipe of ALPS treated water system is a thin red pipe on figure, which is connected to the seawater pipe header through an emergency isolation valve. Then, the vertical and horizontal sizes of the upstream tank are shown in this figure. When a tsunami attacked from the front, this upstream water tank also serves as a seawall. In the lower part of this photo, although the seawater pipe headers in west side, seawater transfer pipes, and orifice flowmeters will be flooded, we believe that these important parts will be kept in order with stable discharge.

Then, on page 115.
It is at the outlet of the downstream tank of the discharge shaft. It is called the exit or the hole. As you mentioned earlier, this is to ensure shear strength by arranging shear reinforcement. There is a result in the lower right. The required cross-sectional area/gross-area sectional area is 0.68 and 0.57, which is considered to be satisfactory for examination.

It becomes a little longer, but my explanation on the discharge facilities is over.

○Kaneko (S/NRA)::
Thank you very much.
Although the explanation is one summary, there are some points to discuss, so I think it's okay if the order is unchanged, but I think it's easier for everyone to understand according to the order of the materials number as much as possible. Thank you for your questions and confirmation by dividing them in this way.
Mr. Esaki, please.

〇Esaki (S/NRA)::

I would like to confirm the facts. On page 45, it is hydraulic calculation of the discharge method. You have been calculated this time due to the consideration of 10cm of shellfish adhesion. Please tell us how the rationale for setting this 10cm was decided.

〇Matsumoto (TEPCO HD):

Mr. Furukawasono, please.

〇Furukawasono (TEPCO HD):

I would like to answer from Furukawasono.

With regard to this, TEPCO decided to use 10cm from the viewpoint of the past design of water intake and discharge at TEPCO's nuclear and thermal power stations. On the other hand, although I have not shown it in today's materials, I have also confirmed that there is no problem with the case of up to 20cm, and as I have calculated it based on the experience up to now, that it is 10cm. So, I have explained it as 10cm in the materials.

〇Esaki (S/NRA):

Next question is the same story. When considering the so-called shellfish adhesion, the calculation on page 46 indicates that the so-called water flow area is reduced due to the shellfish adhesion allowance. However, the friction coefficient is slightly different for the water channel, which is 0.04. Is the coefficient of friction loss determined by the roughness coefficient evaluated by the shellfish margin or something? In a commercial reactor, shellfish thickness is about 10cm, which varies from company to company, but it is sometimes examined by roughness coefficient. What about this area?

〇Furukawasono (TEPCO HD):

Thickness of shellfish adhesion 10cm, as Mr. Ezaki pointed out, decreases cross section of waterway. On the other hand, we have calculated using the roughness coefficient under shellfish conditions.

〇Esaki (S/NRA):

I understood well with the explanation just now. I would appreciate it if you could submit a careful explanation about that in the application or other documents.

〇Furukawasono (TEPCO HD):

I understand.

〇Kaneko (S/NRA):

Thank you very much. Is there anything else?

I have a question. I would like to confirm that I may not be able to properly understand your explanation that water heads flow well in this structure, rather than calculations. Looking at the pictures on page 44, I would like to ask you to explain again what kind of assessment has been made　about the head difference of 0.73m in the downstream water tank, and about the head loss that corresponds to the so-called pressure loss at the highest sea level of the highest tide under the operating conditions of two seawater transfer pumps.

〇Furukawasono (TEPCO HD):

Page 43 is a bit easier to explain. Just in the conceptual diagram, the head difference is written as 1.64m. For details, see page 46. There are a variety of exit losses and friction losses in "loss". I apologize for the small letter, but the "Summary of Loss" is written on the lower right side of page 46. Of the 1.64m, the loss due to rapid expansion and contraction is 0.14m, the friction loss is 1.44m, and the exit loss is 0.06m. The total loss is 1.64m. As Matsumoto explained earlier, I would like you to understand that the breakdown of the calculation in which water flows along the hydraulic gradient on page 46 is ultimately the figure for this summary of loss.

〇Kaneko (S/NRA):

Then, in the calculation on page 46, loss 1.64 means that there is a difference of 1.64, and in effect, the pressure is 0?

〇Furukawasono (TEPCO HD):

I would like to answer from TEPCO.

I will explain practically 0 a little more carefully on page 43. Finally, the water level when entering from the seawater header pipe from the upstream side is 3.11. As a precondition, when high water is calculated at 0.76m, the water level on the downstream side is 2.4m, and if we calculate the loss from it, we will eventually lose 1.64m of energy. Considering this loss of 1.64m, a difference in water level of 1.64m will occur. As this water level difference means that the water flows naturally, as pointed out by Mr. Kaneko, there is no mistake in understanding that the water outlet or the end is zero. In the end, the water flows toward the outlet can be understood in such way.

The easiest thing to understand is that the water gradient on page 46 has the energy of the downstream water tank of 2.4m, so the water level in the ocean is written as 0.76, but the difference is 1.76, so I would like you to understand that water flows with this hydraulic gradient.

〇Matsumoto (TEPCO HD):

Rather than 0, you could understand that it is balancing at the height of 1.4m. On the right side of page 46, there is a summary of losses. This may mean "resistance" in a sense. This resistance is pushed out with a 1.4m drop, so I think it is a balance.

〇Kaneko (S/NRA):

I can't understand what you're saying. Doesn't it mean there's no flow when it is balancing?

〇Matsumoto (TEPCO HD):

With a 1.64m head difference, I think this is going to overcome the so-called loss, or it is being pushed out in a balanced manner. Did I make any strange explanation?

Mr. Furukawasono, please give me a little supplement.

〇Furukawasono (TEPCO HD):

To put it very briefly, I would like you to understand that on page 46, the energy we have at 2.4m in the downstream tank will be pushed down by its gravity and will flow down naturally.

〇Kaneko (S/NRA):

I am sorry. 2.4m,,,. Please wait for a moment. T.P.2.4 is the picture on page 43. 2.4m is the actual water level.

〇Furukawasono (TEPCO HD):

That's right.

〇Kaneko (S/NRA):

Is this the level that it will be delivered to that point when downstream tank is the highest level, right?

〇Furukawasono (TEPCO HD):

Yes

〇Kaneko (S/NRA):

Then, in short, if it is 2.4m, it will exactly balance each other, you mean that the amount of water more than 2.4m will flow as an actual operation?

〇Matsumoto (TEPCO HD):

That's right. Water enters from the upstream tank to the next, but the water level remains constant at 2.4m. Therefore, the incoming portion is pushed out accordingly.

〇Kaneko (S/NRA):

That's what you mean. So, if we consider it dynamically, water can be stored or raised up to 2.5m at the top of the bulkhead, so water can be flowed away by 10cm.

〇Furukawasono (TEPCO HD):

You could understand that the height of the weir is 2.5m, so eventually it will flow at a difference of 10cm between the height of the downstream water tank and the weir. This is in the state of high water. I would like you to see page 43 in the case of low water, the water level declines as a whole, and the head difference does not change, so it is T.P. 0.86m, so if you think it is about 0.9. There is a head from a weir of 1.6m with a difference of 2.5 and 0.9, so you could understand that it will flow like a waterfall.

〇Kaneko (S/NRA):

I understand that there is the balanced water level. The flow rate will eventually be slow in actual operation when it is high tide, because the amount of discharge water per hour may be reduced. On the other hand, when low tide, I think, if you flush a lot, it will flow a lot rather, because the suspended water head differences are balancing. How do you assess the relationship with the velocity currently as a whole?

〇Furukawasono (TEPCO HD):

Regarding speed, the flow speed in the tunnel is determined by area and flow rate. Therefore, if two pumps of flow rate 4m3/s are operated as shown on page 45, the flow speed in the tunnel is 0.9m/s. On the other hand, as shown on page 46, it has velocity head of about 0.09m, so the flow speed in tunnel does not change at low tide level and high tide level.

〇Kaneko (S/NRA):

So does it mean that only the flow speed, which is almost balanced, comes out of the pump?

〇Matsumoto (TEPCO HD):

Pumps operate in constant, and basically only the sea level varies with time at low and high tide. Therefore, the water level of the downstream tank moves up and down here.

The water level of downstream tanks and sea surface change up and down, but the overall water balance is constant, and therefore, as Furukawasono said, the flow speed through them is almost constant, and then the amount of discharged water is constant.

〇Kaneko (S/NRA):
So you assessed it with the assumption that there is almost no dynamic state.

〇Matsumoto (TEPCO HD):
That's right.

〇Kaneko (S/NRA):
You assessed it with the balance condition only. That's what you mean.

〇Matsumoto (TEPCO HD):
Yes

〇Kaneko (S/NRA):
In balancing condition, for example, when two pumps are operating with discharge rate 4m3/sec, a capacity, or in other words specification, of discharge outlet is such that the outlet can push out water with flow speed of the pumps, therefore they are balanced. May I understand it in this way?

〇Matsumoto (TEPCO HD):
That's right.

〇Kaneko (S/NRA):
I understand. I am sorry. I'm afraid I didn't understand it.

〇Matsumoto (TEPCO HD):
It may be a bit confusing. If we decide on the caliber or length of these tunnels, it is

primarily determined. If there are some problems and you want to make the flow speed slower, you can increase the inner diameter of the tunnel to lower the flow speed. You can adjust these parameters in this way. We showed the balancing condition from the design of current tunnel and discharge outlet.

〇Kaneko (S/NRA):
It's okay. I understand that there is nothing to push out in particular, and in that sense, there is always a situation where the amount of unbalance will go out from the discharge outlet.
Do you have any questions about this point? Hisakawa-san.

〇Hisakawa (S/NRA):
You talked about shellfish adhesion now. During actual operation, I think, there are other problems that how much shellfish are attached, and how is the effect of algae, and sands which rolled up by ocean currents may flow into facilities from the water discharge outlet. Considering the service life of this facility, I would like you to explain the concept of long-term maintenance.

〇Matsumoto (TEPCO HD):
Regarding the shellfish adhesion, as Furukawasono explained earlier, we estimate it as 10cm thick based on our experience. Therefore, we operate facilities with assumption of this thickness of shellfish adhesion. We would like to plan to conduct periodical inspection to check inside using underwater ROV when the pumps are stopped and the discharge to the sea is stopped.

〇Hisakawa (S/NRA):
Thank you very much. That's all from me.

〇Kaneko (S/NRA):
Any other questions? Mr. Masaoka.

〇Masaoka (S/NRA):

I would also like to confirm the view on page 45. It is said that there is a margin of 3m and 2.1m for the top end on the third line and on the fifth line from the top respectively. So in terms of safety, that may be the case, am I correct in understanding that TEPCO's current design is based on the idea of dropping the water from the upstream water tank to the downstream water tank properly, as written on the third line from the bottom on page 45?

〇Matsumoto (TEPCO HD):

Yes, that's right.

〇Masaoka (S/NRA):

In that sense, the water level on the downstream water tank side will go up to 2.4m at the severest case of the high level on page 43, while the top end of the partition wall is 2.5m, so may I understand that the difference of 10cm means design margin?

〇Matsumoto (TEPCO HD):

Rather than a margin, it means the situation that a 10cm head will be produced could be realized when operating in this way.

〇Masaoka (S/NRA):

I understand.

That being the case, when you carried out hydraulic calculation this time, you said that you did it basically with theoretical formulas and that there was nothing else but shellfish adhesion that could be arbitrarily decided, and that you evaluated also for the case of 20cm. Am I correct in understanding that the level would still rise slightly higher than 2.4m, but it won't rise to the height of the top end 2.5m?

〇Furukawasono (TEPCO HD):

This is the same answer, but even if we carried out calculation with 20cm of shellfish adhesion, the height of the partition wall is still 2.5m, so the head from there will not particularly change. Besides, we evaluated that, for example, even if a very unusual event occurs, the water will not overflow the highest top end of the discharge shaft which is 4.5m high as shown on page 45. Therefore, we think that the flow of water from the upstream water tank to the downstream water tank through the partition wall will not particularly change so much, whether the shellfish adhesion is 10 cm or 20cm. In fact, we design to allow the shellfish adhesion to increase up to 20cm, so I would like to explain about it when there is time.

〇Masaoka (S/NRA)

Of course, I understand that it will not overflow. Now, in relation to the design, I have just confirmed whether it can be dropped properly from the upstream water tank to the downstream water tank. I understand about the matter of 20cm.

In that case, as Mr. Matsumoto explained, this High Water Level means high tide level. Let me confirm that this is not the high tide level probability for that kind of years, but the normal high tide level is 0.76m.

〇Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

It is the so-called high tide and low tide. To be precise, I will let Furukawasono explain this, but as an image, that is my understanding.

However, since we are designing under these conditions, as explained for the case of unusual situation when typhoon or storm surge is expected, we are considering to stop the discharge into the sea in advance.

〇Furukawasono (TEPCO HD):

If I were to add a little more, even if the shellfish adhesion is 20cm, it is OK in design. However, when storm surge or typhoon comes anyway, it would become severe if they are overlapped. As Mr. Matsumoto explained, in that case we will stop the operation of the facilities.

That’s all.

〇Masaoka (S/NRA):

I'd like to confirm the description at the bottom of page 45. According to your explanation last time, you mentioned that if a tsunami advisory or tornado advisory is issued, the operator will automatically stop the discharge. At the bottom of page 45, it is mentioned that you confirmed that the effect of the fluctuation of the open sea waves mentioned here is small for high tide or high wave as the waves for that kind of typhoon, I would like to ask what you confirmed specifically. And I'd like to confirm whether the discharge will be stopped even in the case of typhoon or high tide as mentioned earlier. I'd like to ask for your explanation to these two points.

〇Furukawasono (TEPCO HD):

First of all, regarding the first point, I would like to explain about the case of storm surge or typhoon. Please refer to page 48. This is also related to the result of surging analysis. For example, the pump stopped unusually due to an earthquake. If this happens, water will not be supplied to the upstream water tank immediately. Then, there is a concern that surging may occur in the tunnel of the water tank when water is flowing through the upstream water tank, the downstream water tank and the tunnel normally. As for the result of surging analysis, the calculation is described at the second arrow feather. However, when the operation is stopped urgently, even if a considerably large wave is overlapped, the water level of the water tank will eventually be below the height of about 2.5m in the upstream water tank as shown in the description here. In this sense, the top end is 4.5m, so the water will not overflow. That is what will happen, however we will stop the discharge in any unusual conditions as a matter of course. Even if surging occurs in case of stopping the discharge, the calculation will be made in such a way, so the water will not overflow both the upstream water tank and the downstream water tank. Accordingly, we believe that the calculation was made in conjunction with the unusual situation.

Regarding the second point, of course, the details of how to stop the operation in the event of the unusual situation will be finalized in the future. Of course, if a tsunami

warning is issued, the procedure to stop will be carried out. Regarding typhoon, it will be known by forecasts and other means whether the typhoon is approaching. So we will develop an appropriate method of operation.
That’s all.

〇Masaoka (S/NRA):
I understand.
As for the matter below on page 45 of the first point, I surely thought you explain that the water will flow properly or as designed, but as a result, I understand that even if backflow occurs due to surging on page 48, the water will not overflow the top end.
Regarding the second point, since it will be involved in the procedures of the operational safety program of the implementation plan, I would like you to declare at some stage, that you will stop the operation in such cases in concrete terms, considering them properly as natural phenomena.
Also, I'm sorry, I just want to confirm one more thing. On page 49, Mr. Matsumoto explained last time that this seawater pipe will be soaked in the pool or upstream water tank. As shown on page 49, it is actually cut off at the level of top end, and only support members are installed beyond it. That's my understanding, right?

〇Matsumoto (TEPCO HD):
I'm sorry. The design is just as you say.

〇Masaoka (S/NRA):
I understand. That's all from me.

〇Kaneko (S/NRA):
Thank you very much. Is there anything still left around here?

〇Chimi (S/NRA):
I would like to confirm about your explanation on pages 43 and 44. In the previous

meeting, you explained that less than 1,500Bq/L can be secured even when only one pump is in operation. May I understand that even if a single pump is in operation in such a case, gravity flow will be ensured, because the head only becomes small?

〇Matsumoto (TEPCO HD):
Your understanding is right

〇Chimi (S/NRA):
I understand that it can be achievable even in such an operation.
I am sorry. Just in case, that's all.

〇Kaneko (S/NRA):
Do you have anything else?
If you don't mind, we may come back again, but we will go to the next issue of the design of water discharge tunnel.
Mr. Esaki, please.

〇Ezaki (S/NRA):
My question is about the discharge tunnel on page 84. Regarding the result of the displacement examination in the event of an earthquake, in the calculation method and the calculation result shown here, I don’t know why you can consider the 3.2mm written in red as the displacement at the starting part in the event of an earthquake is safe, even though the number to be compared with is not provided. It is described that the connection portion of the downstream water tank and the discharge tunnel at the starting part was checked, but I can’t see this 3.2mm has safety margin for what connection portion. Could you please add some explanation to this?

〇Furukawasono (TEPCO HD):
Regarding the description on page 84, this examination was conducted based on the approach of the Joint Ditches Design Guideline or the Guideline for Sewerage or Tunnel

Standard Specifications issued by the Japan Society of Civil Engineers, etc.

First of all, it is assumed that the facilities will be installed at a ground with relatively high N-value of 50 or more, so this calculation was made on the assumption that the effect of the earthquake will be small.

Regarding the 3.2mm and 1.1 mm pointed out by Mr. Ezaki, I think that such displacements would be well acceptable, for example considering the joint structure of the tunnel itself. On the other hand, with regard to the influence on the structure, I would like to ask for a little more time to answer about whether there is any problem in terms of stress.

〇Ezaki (S/NRA):

I am Ezaki, S/NRA.

I still do not quite understand what you have mentioned now, unless you explain it with numbers. I understand the feeling that if it is 3.2mm, it may be vaguely OK from an engineering judgement point of view. However, since this is a place for examination, I would like you to explain it so that we can somehow understand based on reasonable criteria or some kind of scientific basis, even though those are Class C structure. For example, it would be OK, because there is such a clearance, or even if it moves about 3.2mm, the part has flexibility which would correspond to the allowable displacement. Is that okay with you?

〇Furukawasono (TEPCO HD):

Because it is about 3.2mm and 1.1mm, we judged that flexible segments will not be needed. Still, we would like to explain this point from you at the subsequent meeting after considering in more detail.

〇Ezaki (S/NRA):

As for the second point, while ground displacement becomes 3.2mm as the so-called relative displacement calculated in case of earthquake, sectional forces on the segment as a result of the sectional design are shown on page 83, which says that the operating stress is basically severe in terms of safety margin from the viewpoint of the allowable limit. However, in case of earthquake, only inertial force of the structure is considered in the calculation of cross section. As I mentioned earlier, if the ground displacement is 3.2mm, which would correspond to the displacement between the top portion and the bottom portion of the tunnel, so-called the crown and the invert respectively, I think that a certain level of stress could be generated considering the stiffness of concrete. Even considering this, I think the result will basically remain the same, because the ratio of the operating stress intensity to the allowable stress intensity is now 0.5, which means that the safety margin is double. Furthermore, the allowable stress intensity at the time of earthquake is 1.5 times of that at the normal time, so in this design the tunnel could withstand up to three times of the stress calculated here. Therefore, this tunnel could not be damaged unless the load at the time of earthquake reaches about three times of the load at the long term. I think that the stress will never exceed the allowable limit, rather than damage it. I think it would be a matter of course, considering the standard coefficient of 0.2 as 1.0Ci. While it seems that deformation will not be produced so much in the bedrock, once the number of 3.2mm appears on page 84, I think that consideration of the cross-sectional aspects should be needed as well. What do you think of it?

〇Furukawasono (TEPCO HD):
Thank you for pointing it out. page 83 is for cross section, but I think you pointed out the consideration of longitudinal direction is needed. Regarding the longitudinal direction of the alignment itself, we...

〇Ezaki (S/NRA):
Excuse me for interrupting for a moment, but I have not mentioned the longitudinal direction, but the design of cross section for relative displacement in the ground. In the image on page 86, for example, if the seismic force is placed from right to left in such a cross-sectional state, relative displacement of the ground will cause a displacement between the upper and lower ends of the structure. So-called shear strain of the ground will be produced, and the ground pressure will be generated associated with it. From the

viewpoint of a seismic deformation method, I wonder if you have taken that into account. I am asking whether the so-called displacement of the ground of about 3mm is a negligible amount.

〇Furukawasono (TEPCO HD):

I apologize for my lack of understanding.

In fact, the results shown on page 83 are obtained using a different method which was applied to the calculation shown on page 84. They were the check results of the calculation at the time of earthquake, in which the tunnel itself was analyzed using a beam-spring model, and the stress generated at each portion were simulated in a similar manner with the seismic deformation model.

This time, the section force diagram at the time of earthquake was not shown, because the severest case was at all times. However, I would like to explain later how the section force will be generated when analyzed using a beam-spring model at the time of earthquake.

That's all.

〇Ezaki (S/NRA):

Thank you. That's all from me.

〇Matsumoto (TEPCO HD):

I am very sorry for the internal talk within TEPCO.

Mr. Furukawasono, in the standards and criteria on page 75 that we referred to, how did we deal with the 3.2mm horizontal displacement on page 84 that Mr. Esaki just pointed out?

〇Furukawasono (TEPCO HD):

As for the index on page 75, the calculation on page 84 was based on the Seismic Countermeasure Guideline and Explanation for the Sewerage Facilities on the fourth line from the bottom and analyzed using model. This is a kind of common way to evaluate the connection portion of the discharge shaft and the tunnel. On the other hand, on page 83, the tunnel is modelled as a circular shape and calculated using the beam-spring model. Therefore, the calculation methods of stress and displacement are different.

〇Matsumoto (TEPCO HD):
I understand.

〇Kaneko (S/NRA):
How about other points? Is it okay?
Sorry again, I feel like I just don't know the basics, but on page 56, there are three shapes of piece for each segment when building tunnels using the shield method. I wonder if the trapezoidal K-shaped segment is the top ceiling as a location for placement. I'm sorry, but could you explain what kind of design philosophy this is based on, and how are these three kinds of piece assembled?

〇Furukawasono (TEPCO HD):
If all segments are the same shape of rectangle like the rectangles on page 56, they will not be fit in well, so when assembling the segments with the shield machine, the K segment will be pushed in finally and assembled so that the segments will eventually be fit in properly.
That's all.

〇Kaneko (S/NRA):
Sorry for a while. I've been briefed aside.
In the end, I heard that when we build from A, then B of both sides, and finally the ceiling part, it would not be fit well if its shape is A. So from the workability point of view, its shape is trapezoidal so as to be easily fit in. Am I correct in understanding in this way?

〇Furukawasono (TEPCO HD):
That's right.

〇Kaneko (S/NRA):

I understand. Thank you very much. I'm sorry for an elementary question.

It does not mean that something is particularly beneficial in terms of structure. In terms of structure or strength, something is not advantageous, isn’t it?.

〇Matsumoto (TEPCO HD):

Yes, that's right.

〇Kaneko (S/NRA):

I understand.

Do you have anything else to confirm? Is it okay with you?

Then, we may come back again at the end, but as for the structure, I feel that we have almost discussed about it, so if there is anything to confirm about the discharge outlet, please go ahead, including other items as well.

Mr. Masaoka.

〇Masaoka (S/NRA):

Just one point. Please see on page 96. Normally, when installing a caisson, I think that it would be a construction work of a considerable scale to be carried out by digging a considerable amount of soil around it, placing it and then filling it with concrete. When the partition dike was explained about earlier, entrainment of sea-bottom soil during the construction work was mentioned I would like you to explain about the measures against entrainment during the construction work in the sea including those for the partition dike, such as how to prevent or mitigate the entrainment, how to monitor it, how to respond in case significant change is identified, and the forecasted amount of entrainment.

〇Matsumoto (TEPCO HD):

I understand the purpose and content of the question. The details are currently under consideration regarding the construction method, etc., so I would like to explain about this separately.

〇Masaoka (S/NRA):

Thank you very much.

〇Kaneko (S/NRA):

Do you have anything else? Is that okay with you?

This is just a confirmation from Kaneko. I understand about the structure as is written, and fire is evaluated. Since there is no particular active component, there is nothing to do with the electric wire, and there is nothing in particular to do with such work. It is a construction work that only the tunnel structure goes offshore, isn't it? May I understand that there is no availability of electricity for something?

〇Matsumoto (TEPCO HD):

Your understanding is right. It's just a box of concrete.

〇Kaneko (S/NRA):

You mean that there is no other extra thing attached to it. I understand.

Do you have anything else? Is that okay with you? If you missed a chance to confirm something also in the earlier topics, it's okay to talk about it. Is that okay with you?

So, I think that most of the explanations have been over, and reference materials are being attached there. Is that okay with you?

I would like to ask TEPCO to share something supplementarily or additionally within the scope of your explanation, if any. Is it okay with you?

〇Matsumoto (TEPCO HD):

We don't have anything from TEPCO.

〇Kaneko (S/NRA):

Thank you. I think that the points of discussion you presented today, the explanation on them and the confirmation on them are mostly over.

Now in the document 1-2 you prepared, where you have listed today's issues and the issues for the next meeting. With regard to the homogenization of radioactive concentration of ALPS treated water in tanks before discharging into the sea. We heard about a month ago that the agitation demonstration testing was planned. So, in the next meeting, the test result will be summarized and explained, and if the responses to the findings in the previous meetings are prepared, we will hear them in the same manner as today. Do you have some additional explanations?

〇Matsumoto (TEPCO HD):
Explanation contents we are preparing are as listed. As Mr. Kaneko mentioned earlier, regarding comments we received so far and examination items for deliberation, we will explain them on a basis of what is already available.

〇Kaneko (S/NRA):
I understand. Do you have any remarks for the future schedule, from the S/NRA?
Mr. Masaoka.

〇Masaoka (S/NRA):
In the document 1-2, you plan to respond the comments or findings pointed out in the previous meetings sequentially. At the Commission on Supervision and Evaluation of the Specified Nuclear Facilities on yesterday, we presented the status of responses to the major comments pointed out in the previous meetings in the reference document 4. In addition to the major comments, there are comments such as "to describe properly in the material" or "to let us see the specific calculation". We would like you to sort those comments pointed out so far in the form of a comment list according to the action categories such as examining at the review meeting or incorporating in the application document so that we can proceed with settlement of the responses to the comments systematically. So we would like you to prepare the comment list at the tenth review meeting. What do you think of it?

〇Matsumoto (TEPCO HD):

I understand. We will prepare it.

〇Masaoka (S/NRA):

Thank you very much.

〇Kaneko (S/NRA):

Then, as you've talked about the issues as scheduled next time, and then, so far......

〇Matsumoto (TEPCO HD):

Mr. Kaneko.

〇Kaneko (S/NRA):

I am sorry. Yes

〇Matsumoto (TEPCO HD):

We will prepare for this, but I would like to consult you to avoid discrepancies between the contents to be confirmed each other.

〇Kaneko (S/NRA):

I would like to share information, because we will be confused each other when something is missing, or the point is different. We could also have a chance to confirm at the meeting, but there may be some actions to settle those comments, such as to incorporate detailed information in the application document, to confirm at the meeting, or to add description because of too technical aspect, so I would like you to prepare the comment list for sorting those comments as a draft at the next meeting so that we can share the recognition of the sorting. Thank you for your preparation.

〇Matsumoto (TEPCO HD):

I understand.

〇Kaneko (S/NRA):

Then, I think we have almost finished confirmation. Is there any other comment from TEPCO for the subsequent meetings?

〇Matsumoto (TEPCO HD):

No, there's nothing in particular.

〇Kaneko (S/NRA):

Then, Mr. Takeuchi.

〇Takeuchi (S/NRA):

I am Takeuchi, S/NRA.

I would like to confirm that the explanations on the points of issues and applications presented by TEPCO have been generally completed with the explanations today, except for the result of the demonstration testing to be presented next week, and that you have also recognized that a series of explanations has been completed as a whole.

〇Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

In terms of the issues you presented to us in December last year, I believe we have finished it generally. On the other hand, as shown in the list of items pointed out mentioned earlier, there are some important matters, so in that sense, I would like you to provide us with opportunities to explain them.

〇Takeuchi (S/NRA):

As for the items pointed out, we will confirm them at the meeting as a matter of course. We would like to ask you to provide us with your preparations, the future arrangement, and the order in which they will be explained so that we can proceed with examination more efficiently. I think that your explanation will be scheduled on a basis of what is already available at this time, but if it is difficult for you to provide us at this time, we would like you to provide us next time including the arrangement.

〇Matsumoto (TEPCO HD):
Since I do not have it at hand at the moment, as Mr. Masaoka pointed out earlier, we will prepare it including the items such as what kind of comments we received, how we are going to deal with them, and by what categories we are going to settle them, for example incorporating in materials.

〇Takeuchi (S/NRA):
I understand. Additionally, if you already prepared basis materials or kinds of evidence materials required at the review meetings, which do not necessarily have to be confirmed at the meeting, I would like you to provide us with them one after another without waiting for an opportunity of explanation. In short, those are the kinds of compiled materials, please provide us with them on the basis of what is already available.

〇Matsumoto (TEPCO HD):
I understand.

〇Kaneko (S/NRA):
Maybe it's related to the previous point, and I don't think you have many items now, but as Mr. Arai pointed out previously, if you have some change in design or specifications or small change in contents rather than the design or specifications, I think it's better for us to confirm them early so as to reduce reworks, So please keep that point in mind. If not, that would be fine, though.

〇Matsumoto (TEPCO HD):
I understand that point as well.

〇Kaneko (S/NRA):

Then, if you don't mind, I would like to close.

Now, I would like to conclude the 9th review meeting on the disposal of ALPS treatment water.

Thank you very much for your cooperation on the smooth progress. Thank you for your hard work.