*Provisional Translation

TEPCO's Fukushima Daiichi NPS
Review Meeting on the Implementation Plan on Handling ALPS Treated Water
Minutes of the 5th meeting

Date: January 20,2022 (Thursday) 13:30-15:39
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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Tomoki Shibutani, Director for the TEPCO's Fukushima Daiichi NPS Accident Measures Office
Kohei Iwanaga, Director for the TEPCO's Fukushima Daiichi NPS Accident Measures Office
Hideaki Masaoka, Deputy Director for the TEPCO's Fukushima Daiichi NPS Accident Measures Office
Ayako Otsuji, Deputy Director of the TEPCO's Fukushima Daiichi NPS Accident Measures Office
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〇Kaneko (S/NRA) :
We will start the fifth Review Meeting on the Implementation Plan on Handling ALPS Treated Water.
The meeting will be conducted as video conference to prevent COVID-19 just as before.
Continuing from the last time, Kaneko of the Secretariat of NRA will work on the progress.
Thank you in advance.
Today, as on the previous meeting, TEPCO has prepared materials over four major issues. First, I would like TEPCO to explain each issue and then confirmations, comments and discussions will be conducted. Major points will be dilution of the treated water and evaluation of the radiation dose in regard to the installation of facilities for discharge into the sea.
Now we are moving to explanation part. With material 1, up to page 15 or so, would you explain control and monitoring of mixing/dilution ratio of ALPS treated water?

〇Matsumoto Director (TEPCO HD) :
Do you hear me well?

〇Kaneko (S/NRA):
Yes, hear well.

〇Matsumoto Director (TEPCO HD) :
Now, would you take a look at material 1, that Mr. Kaneko has touched upon?
I would like to explain today’s table of contents. As mentioned earlier, I would like to discuss and explain the following four of the major issues presented at the Review Meeting on December 24:

Control and monitoring of mixing/dilution ratio of ALPS treated water with seawater, Homogenization of radioactive concentration in ALPS treated water in tanks before discharging into the sea, Effective dose assessment at site boundaries due to the discharge of ALPS treated water into the sea, and Annual release of tritium. These are the four issues today.

First issue is" Control and monitoring of mixing/dilution ratio of ALPS treated water with seawater". See page 2. In the meeting held on December 24, it was presented as a main discussion point how to ensure that ALPS treated water would be discharged in a way that would satisfy the requirement of the annual effective dose of 1 mSv or less at site boundaries, which has been designated as an item against which measures should be taken, explanations regarding the following points shall be provided: the mixing/dilution ratio with seawater that meets the tritium concentration limit, mixing/dilution method and monitoring, and their validity. Today, I would like to explain this.

See page 3. I will explain how the capacity was set for ALPS treated water transfer pump and seawater transfer pumps, which are two major equipment of ALPS treated water dilution/discharge facility. The concentration of tritium in ALPS treated water stored in Fukushima Daiichi varies depending on the timing of storage. As shown in page 3, it varies from 150k Bq/l to 2.16 mil. Bq/l. So, in any case, TEPCO believes that it is necessary to dilute ALPS treated water by seawater since the concentration is over 60kBq/l.

For this reason, TEPCO summarized the design principle of each pump and set capacity as shown in the table below (in page 3) to discharge ALPS treated water into the sea.

First, for the transfer pump for ALPS treated water from Measurement/confirmation facility to seawater pipe, the capacity is set at 500 cubic meters per day at maximum.

And for seawater transfer pump, the capacity is set at 170k cubic meters per day, per unit. I will talk about the rationale for this.

Let us proceed to page 4. I would like to explain the principle for designing the ALPS treated water transfer pump. As I showed in a chart, tritium concentration in ALPS treated water varies from 150k to 2.16mil. Bq/l as of Apr.1 last year. Therefore, it is necessary for TEPCO to discharge the treated water taking the variation in mind.

On the other hand, maximum discharge of tritium is limited at 22 trillion Bq per year.

Considering these conditions, annual days of discharge considering maintenance and system change and the concentration of tritium, the capacity of transfer pump is decided.

Let me explain the calculation formula. At 80 % operating rate, number of discharge days will be 292 days per year (365x0.8). Daily amount of Tritium discharge will be 75.3 billion Bq/day (22 trillion/292 days).

The concentration of tritium varies from 150k to 2.16mil. Bq/l. In case of diluting the thinnest treated water, it needs to transfer 500 cubic meters of treated water per day to meet 75.3 billion Bq of daily discharge (75.3 billion Bq/day/150 k Bq/l).

Now, proceed to page 5. I will talk about the principle for designing the seawater transfer pump. As mentioned before, tritium concentration exceeds legally required limit, seawater dilution is necessary. TEPCO would like to ensure flexibility in pump operation i.e. continuous discharge, while ensuring that the tritium concentration after dilution with seawater is less than 1,500 Bq/l and that the annual release of tritium is below 22 trillion Bq. TEPCO proceeded with design work that in mind.

There are three points to consider in the course.

First, pumps must be capable of flexibly responding to the discharge of ALPS treated water with various tritium concentrations ranging from approximately 150k to 2,16mil. Bq/l.

Second, the amount of ALPS treated water to be discharged is up to approximately 500 cubic meters per day, but pumps must be capable of flexibly responding to increases in ALPS treated water due to heavy rains, etc., and to the progress of tank dismantling for the construction of facilities necessary for decommissioning.

And third, Seawater transfer pumps must be capable of flexibly responding to operation and maintenance inspections.

These are the three points to be considered.

Go to page 6. From the perspective of this design, TEPCO assumed three critical cases to fix the pump capacity.

Critical case 1 is discharge of highly contaminated ALPS treated water.

This case assumes an inevitable and temporal discharge of ALPS treated water with a tritium concentration of about 2,16 mil. Bq/L at a rate of 150 cubic meters per day, a value equivalent to the amount of contaminated water generated per day (in order not to increase the total inventory). This case, seawater required to lower the tritium concentration after dilution to less than 1,500 Bq/L is 220k cubic meters per day (2.16mil. Bq/L/1500 Bq/L x 150 cubic meters).

Critical case 2 is discharge of a large amount of ALPS treated water.

Considering the fact that approximately 400 cubic meters of contaminated water is generated per day during the rainy season (maximum data in 2020), this case assumes an inevitable and temporal discharge of ALPS treated water at an average of about 620k Bq/L at a rate of 400 cubic meters per day.

Move on to Page 7.

Critical case 3 is decline in operation rate.

This case assumes a discharge of ALPS treated water with an annual tritium release of 22 trillion Bq (220 billion Bq/day) when the number of discharge days is 100 days per year because the operation rate dropped due to a prolonged facility maintenance period and other reasons. When discharging treated water with a tritium release of 220 billion Bq/day, seawater required to lower the tritium concentration after dilution to less than 1,500 Bq/L is 150k cubic meters (220 billion Bq/L/1500 Bq/L).

In view of various critical cases as described above, a seawater flow rate of at least 220k cubic meters per day must be secured. Providing an allowance of 50%, the design flow rate of seawater is set to approximately 330k cubic meters per day.

Page 8 please. TEPCO would like to install three seawater transfer pumps to ensure stable discharge. In view of maintenance such as inspections and cases when one of the pumps goes out-of-service, three pumps will be installed to ensure stable discharge - one is kept on standby while the other two units are in operation.

For the above reasons, pumps with a capacity of 170k cubic meters per day each (approx. 330k cubic meters per day/2 units) were selected to secure the required flow rate.

In this case, even one pump operation can handle above mentioned critical cases 1 and 2 securing 1500 Bq/L condition.

Also, in order to confirm that ALPS treated water has been diluted with seawater to less than 1,500 Bq/L, it is important to precisely measure the tritium concentration in the ALPS treated water before dilution, and the flow rates of ALPS treated water and seawater. It has already been confirmed that there is a flowmeter (orifice type) available for the measurement even when pumps of a capacity of 170k cubic meters per day per unit are selected.

For the purpose of capacity calculation, only two pumps are operational, however, all three pumps can be operational in some cases. This opportunity can be utilized to minimize reputation damage as national policy says by discharging diluted ALPS treated water with tritium concentration as low as possible.

With an annual operation rate of 80% and annual tritium release of 22 trillion, TEPCO concluded that the tritium concentration after dilution with seawater be about 440 Bq/L, which is well below 1500 Bq/L, even with one pump operation. With two pumps operation, it will be 220 Bq/L.

Next, page 9. As to concentration of ALPS treated water after dilution, there is no way to directly and timely measure the value. As the concentration assessment formula shows, TEPCO is going to confirm the concentration be below 1500 Bq/L from (i) concentration of ALPS treated water before dilution, which is measured at Measurement/confirmation tanks, (ii) live flow rate of ALPS treated water and (iii) live flow rate of seawater on an as-needed basis. As the chart on page 9 shows, with concentration registered in monitoring and control device, the device calculates concentration after dilution using ALPS treated water flow rate and seawater flow rate.

Please see page 10, which explains how to control the mixing/dilution rate. The control will be made over the flow rate of ALPS treated water since seawater pumps will be in rated operation. To be more specific, the control will be made automatically over the opening degree of the valve (the ALPS treated water flow rate control valve) so that the predetermined mixing/dilution ratio (100 times or more) may be achieved.

In case that the mixing/dilution ratio does not satisfy the predetermined limit, the emergency isolation valves provided in the ALPS treated water transfer line are designed to be automatically closed by an interlock.

Page 11 shows the specific way to register tritium concentration to the monitoring and control device.

In the process of the discharge operation, the results (tritium concentration) obtained through analyzing the ALPS treated water sampled by the measurement/confirmation facilities are registered to the monitoring and control device. In order to prevent human errors throughout this operation, a method of mechanically importing the tritium concentration into the monitoring and control device is planned to be adopted. The specific method will be examined. Since the above tritium concentration registration system uses an input support function, two or more persons will check if the values registered to the monitoring and control device are correct or not before discharging the water in the same way as they do when handling the subdrains and underground bypass.

Next page 12. How to mix/dilute ALPS treated water with seawater.

To mix and dilute ALPS treated water with seawater, the treated water is injected into the seawater piping header through which diluted seawater is running. The ALPS treated water injected into the seawater piping header flows down through the seawater pipe and is mixed with surrounding seawater to reduce the concentration of radioactive materials.

In order to check the mixing and dilution condition of ALPS treated water in the seawater pipe, the effect of dilution was estimated by performing a numerical simulation.

Upon completion of the facility installation, a verification test using a tracer for filtered water will be conducted.

There is a model for above mentioned numerical simulation on page 12. There are three mainstream pipes coming from seawater transfer pumps with diameter of 1800A* each. Seawater piping header is 2200A in diameter at the thickest portion. Transfer pipe from ALPS treated water pump is 100A in diameter. (1800A denotes nominal diameter in millimeter)

This simulation model also assumes two seawater transfer pumps in operation and maximum flow rate of ALPS treated water at 500 cubic meters per day.

Analysis code called STAR-CCM+(ver.11) was used in the simulation. This tool is widely used in energy, automobile, and other industrial fields. TEPCO has also used it for thermal analysis and

sloshing evaluation for the PCV pressure relief device of unit 7 at the Kashiwazaki-Kariwa NPS.
The result of the simulation is on page 13. As mentioned before, results of diffusion and mixing analysis in seawater piping when dilution is simulated with an ALPS treated water flow rate of 500 cubic meters per day and seawater flow rate of 340k cubic meters per day.
On scale bar chart down below of page 13, red shows 95% or more ALPS treated water contained and blue shows 5% or less ALPS treated water contained.
As you see in the enlarged view of the section near the injection pipe, ALPS treated water coming in through transfer pipe in red becomes blue in the vicinity of the inlet of transfer pipe. Since linear scale chart can't show the dilution rate of 5% or less, the result expressed using the logarithmic scale is posted again on the next slide.
See the logarithmic scale chart on page 14. 1/100,000 is on the extreme left, and 1 on extreme right. This case, mass ratio of ALPS treated water is 0.23% at maximum or 1/430 around outlet of straight pipe (position v). If ALPS treated water of 150k Bq/L is discharged, concentration after dilution will be 350 Bq/L at maximum, 220 Bq/L average.
See page 15. You can see how the dilution moves ahead depending on the distance(position). As the right chart shows, a dilution effect of 100 times or more is achieved "(3) immediately after the down elbow (inlet of straight piping)".
This is it for the explanation of mixing/dilution method.

〇Kaneko (S/NRA):
Thank you very much. There are a variety of perspectives, so I would like to confirm them sequentially from the NRA side.
Anyone is fine. Arai-san, please.

〇Arai (S/NRA):
Please open page 9. What I understand in your explanation is how to monitor the tritium concentration after dilution with seawater using the evaluation formula, or its concept. However, with regards to the explanation and the contents of the materials today, I think it is a little bit difficult to judge the feasibility of this concept. Specifically, I think it is impossible to judge whether it can be diluted properly or monitored correctly unless the specifications of the equipment are made clear and how they are laid out in order to realize this concept, and to what extent to grasp the error, and to what extent to weave it and how to set the interlock set-point in anticipation of the error of tritium concentration after dilution. In this sense, I would like to confirm one thing. Could you open page 10? There are three items on the 10th page, and regarding the note written in the second one. As I mentioned earlier, it is written as "Take into consideration the accuracy of the instrument, etc." and it is natural to consider the accuracy of the instrument. After all, what

errors of two flowmeters are assumed and how the opening of the FCV should be set, being combined two errors? I understand that it will be set as to keep the concentration of the diluted water within 1,500Bq. Could you explain?

○Kaneko (S/NRA):
First of all, how about this point, TEPCO?
Mr. Matsumoto, please.

○Matsumoto (TEPCO HD):
I apologize that the materials have not been sufficiently matured yet. As you pointed out, in this case, the flowmeter for the ALPS treated water and the flowmeter for seawater become key points. Therefore, we would like to explain the specifications of these instruments and their accuracy at a next review meeting. I think it is largely related to the set-point of emergency isolation or troubleshooting.
It should be noted that as for the tritium concentration after dilution, as you said in your question, we would like to set it conservatively. Do you hear me?

○Kaneko (S/NRA):
Yes, the sound is heard. It's okay.

○Matsumoto (TEPCO HD):
Yes. The error of the flow meter for the ALPS treated water is anticipated conservatively as the flow rate increases. Regarding the error of seawater flowmeters, it is assumed based on the assumption that the flow rate decreases. After that, we judge whether the specified mixed dilution rate has been secured and determine the alarm set-points, etc.
That’s all for my answer.

○Kaneko (S/NRA):
Mr. Arai, do you continue?

○Arai (S/NRA):
Yes, I do. I understand you will continue to explain in the future. So let me confirm the basic things next. The same part on the same page. The second item. It is written that the FCV will be automatically adjusted. At a first glance, I think that if you know the concentration, you don't need automatic adjustment for the FCV after you set the valve opening at a pre-set value. Could you explain why you choose automatic adjustment capability for the FCV, while recognizing such a

concept which I explained?

〇Kaneko (S/NRA):
Yes, TEPCO, is that all right with you?

〇Matsumoto (TEPCO HD):
First, we already know the concentration of tritium in the tank for measurement and evaluation. In addition, since the seawater transfer pump operates at the rated flow, it is almost unnecessary to adjust the flow rate of the FCV in fact. On the other hand, if this is the case, it would be better to adjust the constant flow rate and concentration. Therefore, we decided that it would be better to adopt a valve that can be automatically controlled rather than the fixed opening valve.
That's all.

〇Arai (S/NRA):
Yes, I understand.
I will ask next questions. As I mentioned earlier, I believe that registration of this flowmeter and tritium concentration is an important key point. For example, I would like to ask about the reliability of this flowmeter. How do you confirm whether the flowmeter is alive? Is there alternative measurements to check the validity? Please explain.

〇Kaneko (S/NRA):
TEPCO, please explain.

〇Matsumoto (TEPCO HD):
First of all, with regard to the flowmeter, it is necessary to conduct an acceptance inspection to confirm that the instrument is properly manufactured. After that, although ALPS treated water itself cannot be flowed in the pre-service inspection, we would like to confirm that the actual flow rate can be correctly measured by flowing the imitated water. I think that the purpose of the question is that we check whether or not the value is correct, and we would like to deal with it separately by checking the flowmeter.
That's all.

〇Arai (S/NRA):
I think it is natural to inspect the flowmeter, but I believe that it is possible to judge for example, by the water level of the tank and the flow rate, and it was an intention of my question.

〇Kaneko (S/NRA):
Yes, go ahead, TEPCO.

〇Matsumoto (TEPCO HD):
I understand the purpose of the question. After all, I understand that we should confirm there were no discrepancy between the level of the tank and the amount of treated water discharged or the amount of discharge really measured. As you said, we will study how to confirm in various ways.

〇Kaneko (S/NRA):
I am sorry for asking you a little bit. I would like to ask you to consider the issue that Arai has just mentioned, as the image of the operation has not been finalized yet. For example, do you intend to adjust the flow rate of seawater? In addition, the concentration does not rise above a certain level if the amount of ALPS treated water enters into the area where its flow is constant at or under a certain level, I think it is one way to operate. In this sense, I think that whether or not the flow meter should be monitored at all times and the fluctuation should be checked is also connected with the question of how the flow rate should be validated in the previous discussion.
More specifically, if you are more concerned about whether the flowmeter is operating properly depending on the operation, it may be necessary to think about various things, such as flowmeters are multiplied or redundant, and what kind of operation you consider concretely.
I understand that the actual amount of flow will be observed and then measured. However, I could not see when the actual operation is carried out, what kind of procedures will be planned. Could you let me know if you have any idea at this moment?

〇Matsumoto (TEPCO HD):
First of all, for the seawater transfer pump, this operates at rating, so the flow rate will be measured, but the flow rate will not be adjusted. TEPCO selects only the number of pumps in operation. Therefore, the selection is about 170000 m^3 per day for a single operation, 340000 m^3 for two-pump operation, and 510000 m^3 for three-pump operation. However, it may not be exactly constant, so I wonder if there will be some difference in flow rate within the range of normal condition, so-called fluctuation. This is a situation in which the flow meter monitors.
Also, in the unlikely event that the pump does not achieve the specified performance, i.e., the pump is running, but the flow is insufficient, this means that the flow meter detects that the flow rate is below rating and the emergency isolation valves should be closed.
In addition, the flow control valve of the ALPS treated water and the flow meter are set according to the concentration of tritium. Therefore, if we know the tritium concentration and set the target

of the tritium concentration after dilution as 440Bq/L, for example, as I mentioned earlier, we will automatically know the flow rate of the treated water we need, so we set it with that. As Mr. Arai asked earlier, I believe that this flow control valve does not need to adjust the flow rate, but rather be maintained at a level of almost constant opening than controlled. In the unlikely event that the flow control valve should fail and the flow rate control valve should have a larger flow than was planned, we will provide an interlock such as closing the emergency isolation valve. In any case, we would like to determine the set-points in consideration of the conservativeness of the seawater side, the treated water side, and the flow meter.
That’s all.

〇Kaneko (S/NRA):
Yes, thank you. Then, can I roughly understand like this? The seawater, although it may be fluctuated, is constant flow and the water of a certain concentration is mixed with it, then the diluted water concentration is kept at a certain level. If it is observed that fluctuations exceeding those assumptions have occurred, you might have to reduce the flow rate of the ALPS treated water, and if it changes greatly, you will stop the operation at once.

〇Matsumoto (TEPCO HD):
Yes, Mr. Kaneko, your understanding is fine.

〇Kaneko (S/NRA):
Now I got the point. Then, if the above-mentioned flowmeter does not aim at achieving the target control, the design or the specification will be such that it should accurately measure, or a certain value can be accurately measured rather than pursuing such target control. Or in terms of the credibility that I mentioned earlier, I don't know if you need more than one, but do you consider that sort of things?

〇Matsumoto (TEPCO HD):
As you said, although there is no doubt that accuracy is important for each of these flowmeters, I think the role is not to pursue accuracy and properly control the concentration, but to confirm that there is no problem in terms of accuracy with respect to ensuring a prescribed flow rate.
That’s all.

〇Kaneko (S/NRA):
Yes, I understand the situation of the operation well. In that sense, I took the idea that the operation would be based on such a concept that the above limit should be held firmly and that

regarding the control to prevent it from going beyond it should be closely monitored and observed. So my doubts have been almost disappeared, thank you.
How about other points from you all?
Ms. Otsuji.

〇Otsuji (S/NRA):
Regarding the current discussion, I think that in slide page 10 it also relates to the role of the FCV for the ALPS treated water and the accuracy of the flow meter. Could you explain why the flow meter for the ALPS treated water is installed upstream of the FCV?

〇Matsumoto (TEPCO HD):
Are you intend to ask whether a flowmeter may be located downstream of the FCV?

〇Otsuji(S/NRA):
That's right.

〇Matsumoto (TEPCO HD):
Regarding the flow meter, it is possible to install either before or after the FCV, because there is no particular branch piping. In this case, we installed it upstream of the FCV and there is no particular reason of installing upstream or downstream.

〇Otsuji (S/NRA):
By your explanation, could I understand that there is no influence on the accuracy of the measurement, regardless of whether the flowmeter is installed on either side?

〇Matsumoto (TEPCO HD):
Yes, your understanding is fine. However, as long as a flow meter is installed, the required length of straight piping has to be secured, or the conditions for installing the flow meter on the upstream side or downstream side should satisfy the requirements.

〇Otsuji (S/NRA):
I understand. Thank you very much.

〇Kaneko (S/NRA):
Yes, thank you. Perhaps the current point is that it may be somewhat in relation with how it will measure or detect unusual situations. So, I feel that it had better to check with the actual design

of the system in relation to the layout of the piping. I would also like to confirm this when you show us the various specs afterwards.

〇Matsumoto (TEPCO HD):
The FCVs and the flow meters will be installed in the so-called ALPS electrical equipment room, which was presented at the review meeting the other day, and we will show the layout of the valves and the flowmeters later.
That’s all.

〇Kaneko (S/NRA):
Yes. What other points do you think?
Yes, Mr. Arai, please.

〇Arai (S/NRA):
Arai of the NRA.
Please see page 11. On page 11, an operation (plan) to prevent the misregistration of tritium concentration on the system is indicated. And the first explanation says that TEPCO will study it in the future. Please explain when this is to be materialized or if there is any better idea, do you think it will be adopted?

〇Kaneko (S/NRA):
Yes, please.

〇Matsumoto (TEPCO HD):
Matsumoto of TEPCO.
We will prepare to explain how to register this information in the explanation of abnormal situations and the description of how to deal with troubleshooting. As we have experienced some mistakes in transcribing or inputting until now, we are currently thinking of eliminating such risks as much as possible.
In addition, basically, we intend to materialize this operation (plan). In the future, if a better method will be available, we would like to adopt the new method after again explaining it at the review meetings.
That’s all.

〇Kaneko (S/NRA):
Mr. Arai.

〇Arai (S/NRA):
Arai of the NRA.
I understand that there will be a detailed explanation at a future review meeting. In doing so, I would like you to make clear the frequency of registration and the extent to which people's hands are involved.
That’s all.

〇Kaneko (S/NRA):
Yes, please.

〇Matsumoto (TEPCO HD):
Regarding the frequency, basically, I think it will be the timing when the concentration of tritium is determined in the measurement/confirmation facilities. Therefore, it is about at every release timing, so I think the input work is not so frequent.
In addition, as you pointed out, I will show the process and explain where people are involved.
That’s all.

〇Kaneko (S/NRA):
Please allow me to confirm just two points. The previous frequency story is basically to measure once for each batch of ten tanks’ discharge, once before discharge. I don't know if it's once or twice. If you register that value and it is basically all right, you don't need to update any more.

〇Matsumoto (TEPCO HD):
We are thinking of 10000 m^3 in one batch at the beginning of the discharge, but we are thinking of dividing it into several small quantities and discharging it in several steps, in this case we need to register it each time. On the other hand, if it has been confirmed that the operation of the ocean discharge can be stabilized, and one batch of 10000 m^3 is continuously discharged, the input will be carried out once at the beginning of the discharge, and the concentration of tritium will be checked by the flow meter while continuously discharging.
That’s all.

〇Kaneko (S/NRA):
Yes, I understand. Then, if it becomes a stable steady state, it will be operated as you explained. And even though it is better that there are no troubles, it needs to be adjusted depending on situations in the early stages or anything happened.

Another question concerns about the prevention of input mistake. Maybe it is better to say the failsafe consideration on the mechanical side, namely to set at or below the designated set point. If you put it thinner, it will come out thicker. Therefore, if you input the value below the designated lower limit, it will be alerted or if you do not check it, you cannot move forward. I think you will probably put this kind of failsafe mechanism apart from the man involved area. Could you please let us know in this regard in the future?

〇Matsumoto (TEPCO HD):
I understand. We would like to incorporate such functions as fool proof, or so-called poka-yoke, into this the measurement/confirmation facilities, and then conduct verification tests before actual operation.
That’s all.

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

〇Ban (NRA):
This is Ban of the NRA. It is important to prevent such an input mistake. However, I think it is also necessary to comprehensively consider where errors can tend to occur. Considering these points, you should explain measures you prepare. Some people think that it is better not to be intervened by a mankind as much as possible. However, there is a possibility that you will not be aware of the error by making it a black box, and that you may bring another risk. In this sense, I would like you to overview the whole picture relating mistakes and explain the measures to prevent them.
That’s all.

〇Kaneko (S/NRA):
Yes, Mr. Matsumoto, please.

〇Matsumoto (TEPCO HD):
I understand. I will prepare to explain some process where a machine judges and other processed where a worker involves in each job flow handling data.
That’s all.

〇Kaneko (S/NRA):
Yes, thank you. I think that the same kind of thinking can probably be applied to the confirmation of the flow rate, which was the topic of discussion just before, so I would like you to take such considerations into account in that as well.

If it is okay, someone else, on another point. Are there any?
Yes, Mr. Masaoka.

〇Masaoka (S/NRA):
Masaoka of the NRA.
I hope you will take a look at page 14. Here simulation results are presented, and I think there are two criteria or judgement basis for the discharge. These are 100 times of the dilution coefficient and 1500 Bq. The simulation this time is done by the flow rate of ALPS treated water is 500 m^3 /day, so I think the necessary action is to confirm more properly that the dilution coefficient is 100 times. On the other hand, in relation to 1,500Bq/L, the current simulation is done by the condition that the ALPS treated water is low concentration of 150,000 Bq. But if it is high concentration of 2.16 million Bq, it will rise by more than one order, therefore If 2.16 million Bq is included in the simulation with 150m^3/day, which is also the basis for the flow rate of the seawater transfer pump in page 6, I think it is also necessary to confirm that the flow rate is exactly below 1500Bq at around ⑤ or about 13m downstream, at around 20m, or about 20m downstream. Please explain how you confirm this point.

〇Kaneko (S/NRA):
TEPCO, please.

〇Yamane (TEPCO HD):
I'm Yamane from TEPCO. Thanks for your question.
As you have pointed out, if 2.16 million Bq is entered for example, the highest value at the fifth position would be more than 1,500Bq/L as the result of simulation. The average cross section is a theoretical mixing ratio, so unless the effect of diffusion downstream is taken into consideration, we cannot say whether it is below 1500 Bq/L. As we haven't examine it in detail, we can't answer at present.

〇Masaoka (S/NRA):
Masaoka of the NRA.
I asked this question because I expected the result from my hand calculations. As for the criteria of 1,500 Bq/L, we should clarify the point where it is satisfied generally to some extent, even not always necessary at every local point. Then we should be able to get out of such concerns if the point where satisfies the requirement is made clear.

〇Kaneko (S/NRA):

Yes, please answer.

〇Matsumoto (TEPCO HD):

I understand. First of all, it is a major premise to satisfy the criteria of less than 1,500Bq/L, so I would like to be able to explain in terms of how to give it credit in the design.

On the other hand, there are several selectable parameters for the dilution and discharge of the treated water. As for the concentration of tritium, the most concentrated portion are the most stringent. Considering this point, we can choose which tank is most suitable for discharge. And another point is the amount of ALPS treated water to discharge per day. It means that when we choose to discharge more concentrated portion, we can reduce the amount of ALPS treated water such that below 150 m^3 per day. In addition, although there is water of 2.16 million Bq tritium for most concentrated portion, TEPCO is currently considering that water will be discharged from that of less concentration of tritium. In other words, we manage to delay the highest class of concentration such as 2.16 million Bq/L, as later as possible. Around 2050, the 2.16 million Bq will naturally attenuate to about 400,000 Bq by calculation. I think that this is also possible from the viewpoint of operation.

That’s all.

〇Masaoka (S/NRA):

Specific procedures will be discussed later, but you may be able to explain that there is one more seawater transfer pump, or more concentrated water will be discharged later stage in order that tritium will attenuate. On the other hand, I think what we are discussing here is about design, and I think you will not conduct such simulation every time. Regarding design, I have asked a few questions about how far we should check as a whole.

〇Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

I understand that point.

〇Kaneko (S/NRA):

Yes, Mr. Shibutani.

〇Shibutani (S/NRA):

I am Shibutani, S/NRA.

In relation to the current discussion, I don't understand much about the simulation because it doesn't mention parameters. How much margin do you have in this calculation? Is it evaluated through some realistic calculations? For example, are very conservative parameters input in some calculations? I would like you to explain the rough picture of the evaluation.

〇Kaneko (S/NRA):
TEPCO, please.

〇Yamane (TEPCO HD):
My name is Yamane, TEPCO.
Regarding the conservativeness of this evaluation, differences in density of the ALPS treated water and the seawater are taken into account as pure water and seawater respectively. In this evaluation, due to the density difference, buoyancy acts on the fluid, but this has an effect on drifting in a specific direction. Therefore, it is effective to reduce the diffusion effect, so that it contributes to conservativeness of evaluation. Regarding the effect of diffusion, as there is a dimensionless number that shows the effect of diffusion, which is called as Schmidt number, we used a conservative value by conducting parametric study.

〇Shibutani (S/NRA):
I am Shibutani, S/NRA.
What about the conservativeness of this figure, the highest of the realistic figures in the literature, or the one added a bit to the figure listed in the literature, for example?

〇Yamane (TEPCO HD):
We do not use values from reference materials which are conservative. Considering the actual density simply, we give conservativeness of the effect of turbulent diffusion by giving conservativeness in Schmidt number, physical properties, density, etc. of turbulent flow.

〇Shibutani (S/NRA):
I understand. So, may I understand that it is evaluated with relatively realistic figures, though they are relatively conservative?

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

〇Kaneko (S/NRA):
Mr. Iwanaga, please.

〇Iwanaga (S/NRA):
I am Iwanaga, S/NRA.
I feel that the conversation is somehow not on the same page. Looking at page 12, I think what TEPCO wants to explain with this material here this time is probably how the ALPS treated water flows away in such structure shown on page 14, while enabling it to be diluted to this extent when using such structure, rather than the reliability of this STAR-CCM code. It is obvious that, for example, if you flow a lot of ALPS treated water in it, it will be impossible to be diluted, or it will only be diluted to this extent due to the spatial constraint like this. Instead, it will be diluted to this extent by using such structure. For example, looking at ②, ③, and ④, it is very important to say how the concentration in this figure on page 15 will be diluted in such a manner in terms of the property of the ALPS treated water from the upstream and how this property will change along the pipe. In conclusion, I think it is not rather than the discussion about 1500 Bq or non-conservative, but the first point to be confirmed is whether it is possible to say that the property at these lines (sections) could change steadily and gradually along this shape of the pipe. If you will explain like this, it will be an appropriate answer to our question here instead of your answer to the previous two questions which have been somehow not on the same page. What do you think, Mr. Matsumoto?

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
That's right. Please see page 15. This figure shows that a 10cm diameter pipe of ALPS treated water joins the so-called 2.2m diameter pipe header of seawater at a right angle. When the seawater and the ALPS treated water are flowed at a given flow rate, as the ALPS treated water gets diffused and diluted along the shape of pipe composed of elbows and straight pipes through section zero as an injection position to sections ①, ②, ③, ④, and ⑤, we can see that the mass concentration of the injected ALPS treated water is diffused and diluted in this way as shown in the graph at the lower right. I assume that this will be the point that the ALPS treated water could be diluted by more than 1/100 just after the falling elbow of section ③. As Mr. Iwanaga mentioned, we should consider in design in the future what will happen when the concentration or flow rate of ALPS treated water increase or decrease, or for the cases of the flow rate of seawater pump with one unit, two unite and three units, respectively.

〇Iwanaga (S/NRA):
I am Iwanaga, S/NRA.
For this reason, looking at the figure on page 15, the degree of dilution varies along these lines (sections), and the relations between input and output are correlated in that variation, and the

discussion on the relation will proceed with a focus on this function, so I think it is important to use this device while adjusting the input. May I understand that way?

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
That's fine. Therefore, as Mr. Iwanaga mentioned on page 15, I would like to explain again that there are several possible input conditions and how the graph on the right side will be as a reply to the question at this review meeting.

〇Kaneko (S/NRA):
It seems like the talk will be back a little, I'm sorry, but please allow me to confirm the very basic design mattes properly.
One of them is on the structure diagram on page 12. It says "Modeling Conditions." First of all, are those nominal diameters written in millimeters?

〇Matsumoto (TEPCO HD):
It is okay to see the inner diameter in millimeter.

〇Kaneko (S/NRA):
Inner diameter in millimeter, isn't it? Have you almost fixed the design of the shape of piping like this configuration now?

〇Matsumoto (TEPCO HD):
I am thinking of this kind at this time. However, it is not impossible to modify it depending on the situation of the field or interference objects when actually constructing it. In such a case, I would like to conduct an analysis again.

〇Kaneko (S/NRA):
Yes, I understand.
So, I would like to ask you a little bit more specifically about the present structure, for just an image in my head. Do three pipes coming from the seawater transfer pumps join at the middle of this header? Does “join at the middle” mean entering straight into the line that passes through the center?

〇Matsumoto (TEPCO HD):
Yes, that's right. The seawater piping header has a diameter of 2.2m, and they are welded to the

so-called centerline so that they just enter it.

〇Kaneko (S/NRA):
So. may I understand that you have not given particular consideration that it would be better to put them in the lower part from the viewpoint of facilitating diffusion and mixing?

〇Matsumoto (TEPCO HD):
Yes, mixing would not particularly be facilitated by gravity, etc., and seawater volume is in a certain sense significantly larger than ALPS treated water or diluted water. These so-called mainstream pipes deliver seawater to the seawater piping header from seawater transfer pumps located at the intake channel of Unit 5, and mostly supported on the ground. So they look like piercing straight from the side.

〇Kaneko (S/NRA):
Yes, I understand that this simulation is conducted on that premise. And, this is not written here, but we may need to be confirm at another time. Since this is supposed to be used for a long period of time, have you already evaluated so-called erosion due to flow?

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
Since they are seawater piping, we take general countermeasures against seawater corrosion. In addition to coating inner surface with paint for corrosion prevention, we will consider to inspect the inner surface regularly and measure the thickness in the inspection program. Inspection holes are also provided.

〇Kaneko (S/NRA):
Then, I would like you to explain the concept separately how you use and operate this for a long time in detail. I'm sorry, but I got back to the basic structure.
Is there anything else?
Regarding mixing and diluting, adjusting, and monitoring the situation, if you have something you have forgotten to confirm, I don’t mind you go back to them. Is it all right?
Yes, then, I would like to close the first point once as discussed so far and go on to the next point.
Regarding homogenization of the concentration of radioactivity, there were discussions about the batch of tanks earlier. I would like TEPCO to explain the measures to homogenize the ALPS treated water as uniform as possible by agitating in the tanks.

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
Then see page 16. This is the homogenization of concentration of radioactivity of ALPS treated water in tanks before discharging into the sea. The main issue is to explain the method and validity for homogenizing the radioactive concentration in ALPS treated water in the K4 area tanks before discharging into the sea.
See page 17. First of all, among the dilution/discharge facilities, TEPCO considers that measurement/confirmation facilities handle 10 tanks in the K4 area as one group in the discharge operation. For this purpose, in order to homogenize radioactive concentration by this measurement/confirmation facilities composed of the 10 tanks as one group, agitators are built in each tank, and circulation pumps are installed for each one set of 5 tanks. As shown in the figure below, 10 tanks in the K4 area are provided with an agitator in each tank, and temporary circulation pumps are installed. By installing a pump with 5 tanks as a set, and connecting each tank, circulation through these 10 tanks will be operated. I will explain the test results of the agitation operation later. Regarding the circulation/agitation operation with installed circulation pumps (A) and (B), I would like to explain at the review meeting in next February that the concentration will be homogenized by the said facilities after the circulation/agitation operation is conducted actually.

The plan is on page 18. As shown in this table, the circulation/agitation operation in which 10 tanks are connected is scheduled for testing for 140 hours from February 7 to February 13, next month, 2022, that is for 6 days. As a reagent, tribasic sodium phosphate will be used. As shown on page 17, tribasic sodium phosphate will be charged into K4-B6 tank at the outlet of the circulation pump (A). During circulation operation, we will check the concentration of tribasic sodium phosphate in each group of the 10 tanks and confirm in sequence that homogenization can be achieved.
Regarding sampling, the points to be sampled before, during, and after the test are shown respectively. We would like to show how the concentration will get homogenized after the circulation operation by sampling at each point according to the lapse of time. Also, after the test, we would like to confirm that the tritium as well as the tribasic sodium phosphate injected as reagent has been homogenized by measuring it.
Then, go back to the second bullet in the lead, we see that it will take two months to analyze ALPS treated water in the current plan. Therefore, we would like to check whether the concentration distribution of the reagent after stopping the circulation and agitation will change afterwards, and then utilize the data in the actual operation after that. The intent is like this, the circulation operation will be conducted for a certain period before sampling, but basically these agitators

and circulation pumps will stop at the end of sampling. While there is more than a month before the start of discharge, we would like to confirm again whether or not concentration differences may occur in these tanks during that time.

Go to page 19. This is the condition and the results of the experiment conducted in November last year on the agitation test for one tank. As you see the picture, it was conducted on November 23 last year. The test was conducted to check the distribution of concentration at three points of upper, middle and lower part of the tank with an agitator built in on the bottom of it after injecting tribasic sodium phosphate. With regard to sampling, concentration was measured every 30 minutes by sampling water at each point.
The status of the demonstration test is shown on page 20. From 8:00 on the day, we started sampling before the agitation test. At 8:00, approximately 2.6L of tribasic sodium phosphate was injected, and then the agitator device was started, and the concentration was measured every 30 minutes.
As for the test results, see page 21. Tribasic sodium phosphate charged into the tank is approximately 2.6L 30g/L, and the theoretical concentration when diluted with approximately 970m^3 of water in the tank is approximately 80ppb. Therefore, we have confirmed the situation that it is approaching this 80ppb this time. As you can see in the graph below, when 30 minutes have passed, the concentrations of upper, middle and lower part converged the theoretical value of approximately 80ppb, so we believe that we can achieve homogenization in one tank by installing this agitator device and conducting agitation operation.
As I mentioned, we have confirmed that such agitation and homogenization in one tank could be achieved, so we would like to conduct circulation operation with connected 10 tanks next month and confirm them in the demonstration test.
This is all about this matter.

○Kaneko (S/NRA):
Thank you very much.
So, if there are any matters to be confirmed regarding the content of the explanation, please go ahead.
Mr. Chimi, please.

○Chimi (S/NRA):
I am Chimi, S/NRA.
First, please go to page 17. First of all, I would like to confirm the purpose of homogenizing the radioactive concentration. As mentioned in the second square on page 17, may I understand that

agitation and circulation will be needed to homogenize the concentration of the radioactive materials in order to obtain a representative sample during sampling, because the original concentration of the radioactive materials in the tank is not homogeneous?

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
This is basically the process of accepting the ALPS water treated sequentially, and the tanks are filled with the water. Therefore, basically, we believe that there are treated water of almost the same concentration. While they come sequentially, the time of acceptance in the group of 10 tanks will deviate a little. In this sense, we think that there will be some difference in the degree of homogenization. So, we decided this time that it would be better to incorporate the work of homogenizing it properly in sampling this water and measuring the concentration of tritium and other radioactive materials.

〇Chimi (S/NRA):
Yes, I understand the purpose. I understand that assuming the concentration varies depending on the tank, circulation and agitation are needed for the purpose of homogenizing it so that homogenized concentration can be measured wherever the representative sample for measurement is taken.
In addition, this is just a confirmation. The circulation and agitation demonstration test is mentioned on pages 17 to 18. The temporary circulation pumps (A) and (B) are prepared as described on page 17. I would like you to explain how this demonstration test simulates the actual situation in terms of equipment.

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
The temporary circulation pumps (A) and (B) are prepared as the same type of the actual model. Since the capacity, head, etc. are exactly the same, they will be used for this test. I am sorry, but the equipment will be installed after the so-called approval, so we will consider about it further at the stage of demonstration test.

〇Chimi (S/NRA):
Could I understand the agitation equipment in the same way?

〇Matsumoto (TEPCO HD):
Yes, you can think of the agitator in the same way.

〇Chimi (S/NRA):
I mean the similarity of the equipment placed temporarily for this demonstration test.

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

〇Chimi (S/NRA):
Yes, I understand.
Also, how do you think about the applicability to the actual operation with respect to the test conditions, etc.?

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
First, in this demonstration test, there is a difference between the reagent of tribasic sodium phosphate and radioactive materials. But the biggest difference in this demonstration test, as shown in the diagram on p. 17, is to see that the reagent which is charged into the tank at the top left called K4-B6, the tank closest to the outlet of the temporary circulation pump (A) can be mixed, agitated and diffused in the 10 tanks and homogenized in concentration.
On the other hand, in terms of actual operation, assuming that there are already a certain amount of tritium and other radioactive materials in each tank, we will confirm that it will be homogenized after the agitation operation, though we do not think that there is not so much concentration difference. So, I think that this demonstration test is more biased in a sense.

〇Chimi (S/NRA):
Yes, I understand. As a condition, I understand that more conservatively, you intend to set a biased condition as an initial condition and confirm that agitation can be achieved.
Regarding the sampling points, will the location of the sampling points for measurement in the actual discharge be like such two sampling points on page 17?

〇Matsumoto (TEPCO HD):
Yes, We are thinking of those points.

〇Chimi (S/NRA):
Yes, I understand.
Finally, I have one more question. Could you tell me what is the criteria for judging when you

confirm that this agitation has actually been achieved, concretely, what is the situation where agitation and homogenization are judged to have been achieved?

〇Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
As you can see on page 21, 2.6L of tribasic sodium phosphate at a concentration of 30g/L was injected this time. In that case, considering the water contained in the tank is 970m^3, the concentration of sodium phosphate is theoretically about 80ppb. Therefore, we would like to judge that homogenization has been achieved when the concentration at the upper, middle and lower part reached that value respectively.
According to the results of the experiment, as shown in the graph below and the table below, there are certainly variations in the last digit, but the standard deviation for the reference sample is 3.0ppb, so I see they are within this range.

〇Chimi (S/NRA):
I understand that if you obtain equivalent results as shown on page 21, you will judge that it has been homogenized. Is that right isn't it?

〇Matsumoto (TEPCO HD):
As you said, regarding the circulation and agitation demonstration test to be conducted in this February, we compare the amount of sodium phosphate and tribasic sodium phosphate to be charged with the theoretical value if it is uniformly diluted and diffused into 10 tanks.

〇Chimi (S/NRA):
Yes, I understand that the purpose is to confirm that water is mixed well by making the concentration of radioactive material homogeneous, and that the test will be conducted for that purpose.

〇Kaneko (S/NRA):
Any other comments?
Then from Kaneko, just a supplement.
In the circulation and agitation demonstration test to be conducted in February, the amount of tribasic sodium phosphate to be charged is 10 times because of the amount of tribasic sodium phosphate to be agitated in 10 tanks, and you will confirm the same concentration. Is that the plan?

〇Matsumoto (TEPCO HD):
Your understanding is correct.

〇Kaneko (S/NRA):
OK, then, if you make 80ppb a target and see if it will be uniform for 10 tanks, that's your plan, isn't it?

〇Matsumoto (TEPCO HD):
Yes, it is.

〇Kaneko (S/NRA):
Yes, I understand.
Sorry for more question a little bit. I have a question just to give us a concrete image of something very basic. The image of the agitator is shown on page 20, which looks like a screw. Could you tell me if you have any idea about where it's attached to the bottom of the tank with this screw facing up and the approximate diameter?

〇Matsumoto (TEPCO HD):
As shown in the picture on page 20, sink the propellers / impellers facing up with the bottom table facing down from above to the bottom of the tank. The power cable may hang, but this is the case.
There is a picture on page 19, and there is a manhole to check in the tank. In this case, the reagent is charged through the manhole on the top plate, so the agitator goes down through the manhole, and is placed closer to the side than the center. Therefore, this agitation pump is not located in the middle, but it is located on the side off the center.
Also, please allow me to confirm a little bit about the size.

〇Kaneko (S/NRA):
Yes, it's okay later. It may not mean that it is especially related to something. Yes, thank you.
Would you like anything else? Ms. Otsuji, do you want to go ahead?

〇Otsuji (S/NRA):
I believe that homogenization of the concentration of radioactivity in this tank is very important in ensuring the representation of the samples for the analysis before discharge. I would like to understand that this explanation is that the results of the agitation test in February, which was connected to the ten tanks, will be explained at the Review Meeting in the future as the basis for

homogenization.

〇Matsumoto (TEPCO HD):
As per your question, we would like to explain that homogenization can be achieved based on the results of the circulation and agitation demonstration test in which these 10 units are connected. Data can be obtained at this time. Especially time to homogenize. After all, when TEPCO measures the actual radioactivity concentration in the future, the K4 tank group is divided into three tanks, A, B, C, and will be operated on a rotational basis, as shown in the previous Review Meeting. Therefore, we step into the measurement and confirmation stage after the ALPS treated water has been completed to be received. However, we do not suddenly conduct sampling for measurement and confirmation. Based on the results of this demonstration test, we can confirm how long agitation and circulation operations are to be continued so that the water is uniform. Based on this time, we would like to decide when to sample considering some conservativeness.

〇Otsuji, (S/ NRA):
Thank you very much.
I understand that the agitation and circulation demonstration test in February will serve as the basis for homogenization. In this explanation on page 18, I believe that the reagent for confirming homogenization is phosphoric acid, however in fact, the target for homogenization is the radioactivity concentration of 64 nuclear species. I understand that there is no precipitation nor movement that differs from phosphoric acid depending on the shape. I would confirm this understanding is correct and it is sufficient to confirm using phosphoric acid as the reagent?

〇Matsumoto (TEPCO HD):
I think it is basically ionic condition in the treated water, so I'm considering that this demonstration test for tribasic sodium phosphate is enough to confirm. After the test, we would like to confirm that the seven major nuclides written on *4, as well as tribasic sodium phosphate and tritium, can be measured and homogenized.
As the first question, shown in *2, after stopping the agitation and circulation, for example, it is conceivable that heavy nuclides are still below. Therefore, I would like to confirm additionally whether or not such concentration bias occurs or how long it takes to occur after stopping the agitation if occur. After that, based on the data, we would like to determine on operation whether it would be better to agitate again until the start of the release.

〇Otsuji (S/NRA):

Thank you. That's all from me.

〇Kaneko (S/NRA):
Then, Mr. Arai, please.

〇Arai (S/NRA):
Detail question. I think that 10 agitators in the 10 tanks will be installed one by one. Should each agitator be always operated? How do you detect if there is some trouble with agitators and how will you deal with the equipment with trouble?

〇Matsumoto (TEPCO HD):
This agitator and the circulating pump must be operated continuously for a period until the radioactivity concentration of the ALPS treated water by sampling is measured. As Ms. Otsuji's question earlier, I would like to set the operation time from the result of the demonstration test in anticipation of a certain conservative level in terms of how much time it takes to homogenize by agitating and circulating. The agitator and the circulating pump need to operate during that time.
In addition, because we can check the operation status by switches when a failure is detected or stopped, and if a failure occurs, spare parts are available. Therefore, we would like to replace them with new ones, or to restart agitation and circulation by replacing them.

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

〇Kaneko (S/NRA):
Yes, Mr. Shibutani.

〇Shibutani (S/NRA):
I'm sorry, maybe you've answered it earlier, but I might have missed it a bit. On page 17, the pumps used in this demonstration test have installed as the form of a temporary one, and permanent circulation pumps will be prepared separately in the application for the Implementation Plan. I would appreciate it if you could explain the relationship between these two types of pumps and whether or not you could do something like a demonstration test when you set up the later pumps at the real construction stage.

〇Matsumoto (TEPCO HD):

As for the temporary circulation pump, the same type of circulation pump as described in the Implementation Plan is also used. Therefore, in terms of the verification test, I think it is no inferior. After the approval, I would like to carry out installation work of a pump and then make a trial run of course. However, we have not yet decided on whether to re-demonstrate the circulation and agitation operation.

〇Kaneko (S/NRA):
Yes, thank you.
Other than that, yes, Mr. Takeuchi.

〇Takeuchi (S/NRA):
In response to the question from Otsuji, Mr. Matsumoto explained that you think there may not be any subsidence, but just in case, you will check whether there is any such material. I think today's document you explained do not mention that point. Specifically, which level of tank do you check, what kind of area or how close to the bottom do you take, if you have any specific ideas, please let us know.

〇Matsumoto (TEPCO HD):
The explanation in this document may be inadequate. At the second dot on page 18, it takes two months to analyze the data, so we also check the concentration distribution of the reagent after stopping the circulation and agitation. This is the case. Basically, we would like to measure the same points as this time, at the top, middle, bottom. Then, I would like to confirm whether there is a difference in concentration in the vertical direction.
Until now, I have been checking the existence of sludge inside of the tank when it is opened. However, I have not found that there is a so-called particulate or sludge that has accumulated on the bottom of the tank except in the early stages of ALPS treatment, so I think there is no need to check it in the bottom of the tank.

〇Takeuchi (S/NRA):
Thank you for your reply.
Basically, you answered that measuring points are the top, middle, and bottom shown on page 18, and the level of bottom point is 1.5m, but I think the outlet of the piping when releasing it from here is probably about 50cm from the bottom. I think it would be better to confirm that it would be okay if you could do so. If there is any reason why you could represent it at 1.5m from the bottom, I would appreciate it if you could tell us again.
Also, when the release begins in the future, I understand that the piping height I mentioned earlier

is about 50cm, and so it is not all discharged and remains about 50cm from the bottom. I am wondering that it would be about 500 tons, because amount of 50 centimeters out of 1,000 tons becomes 50 tons, so it would be about 500 tons for 10 units in total. If the ALPS treated water of different concentration comes in, even if there is no sediment in any tank, I think that something like this relationship may happen to cause accumulation. You mentioned that homogenization time could be identified from the results of demonstration this time. However, considering the amount of remaining water, I just comment that it is better to have some margin for it.

〇Matsumoto (TEPCO HD):
As you pointed out, we will measure 1.5m from the bottom of the tank by the demonstration test. As for under 1.5m, we would like to consider additionally how we check the concentration around the tank take-out piping, or so-called connecting pipe.
In addition, regarding the latter question and comment, as you said, the area below the connecting pipe will remain water. Therefore, we will take the process to check the concentration by sampling of the homogenized water after agitating and circulating again in which the next treated water was accepted in a condition with the remaining water. Therefore, since we are confirming the concentration, I think there is no problem with each release. However, as you pointed out, there are some areas below 50cm or very few of them subsidence considered, I would like to discuss whether or not we will conduct regular cleaning during maintenance and inspection for this tank group in the future.

〇Takeuchi (S/NRA):
I understand that you will check it by operations in the future.

〇Kaneko (S/NRA):
Do you have any other?
Just from Kaneko to check the facts.
Looking at the figure on page 17, I believe that the piping for circulation at the sampling point seems coming out from the bottom. Is this piping the same height of about 50cm as the remaining water level? In short, ALPS treated water goes through via this pipe? Is it correct to understand that this is lowest level to be sampled?

〇Matsumoto (TEPCO HD):
Yes, the position is right. Therefore, the lower part of the tank is the take-out piping of each tank, so the concept is that an agitator is installed in each tank.

〇Kaneko(S/NRA):
Yes, I understand. Thank you very much.
Are there any other question related to agitation, circulation and homogenization?
Is that okay with you? Then, there were also points that should be checked in detail or in concrete terms. I would like to confirm it from next time onwards.
Now, I will move on to the next slides on page 22 or later. I would appreciate it if you could explain what you expect in this operation regarding the effective dose evaluation at the boundary of the site.

〇Matsumoto (TEPCO HD):
Please see page 22 of the document. Now, I will explain how to evaluate the effective dose at the site boundary due to the discharge of ALPS treated water into the sea.
As shown on page 23, surrounded by a square, the requirements are the dose around the site should be reduced as much as achievable by implementing appropriate control measures for radioactive materials released from the Specified Nuclear Facilities into the environment, such as the atmosphere and the sea. Especially, it is a requirement that the effective dose (effective dose including additional release of radioactive material from the whole facility) at the site boundary caused by debris, contaminated water, etc., stored in the facility after Disaster, should be less than 1 mSv/year by March 2013.
For more information, see the table on page 24. In order to achieve 1 mSv/year at the site boundary, various doses have contributed from the Fukushima Daiichi NPS. For example, in the case of gaseous waste emissions, 0.03 mSv/year, and in the case of discharge from radioactive liquid waste, 0.22 mSv/year, which has been discussed informer meetings about sub-drainage and groundwater bypass. Therefore, we have decided to compare the discharge of ALPS treated water into the sea with the 0.22 mSv/year for the discharge of radioactive liquid waste.

Please return to page 23. In conclusion, we will confirm before discharge that the sum of Notification concentration ratios for radionuclides other than H-3 is less than 1 for ALPS treated water by measurement. When it is discharged, since the wastewater is diluted with seawater (100 times or more), we control such as the level of H-3 in the liquid waste to be less than 1500Bq/L. Therefore, we got the evaluation results of which the effective dose is 0.035 mSv/year, even if other radionuclides are included in the liquid waste.
The calculation method is as follows. First, as for H-3, it is diluted to be less than 1, 500Bq/L by seawater, then this contribution becomes 0.025 comparing the upper limit 1, 500Bq/L with the Notified Concentration Limit of 60, 000Bq/L of H-3. In addition, we confirmed that the sum of Notification concentration ratio other than H-3 should be less than 1. Therefore, when it is diluted

more than 100 times, we thought that the total concentration ratio other than H-3 would be 0.01 because it is 1/100. Therefore, including the contribution 0.025 of H-3 and the contribution 0.01 of radioactive materials other than H-3, we have decided 0.035.
The real concentration of H-3 is not full of the 1,500Bq upper limit, and as for the sum of Notification concentration ratio, the K4 tank group currently has around 0.3. Then, we think the actual effect on the site boundary is smaller than 0.035.
On page 24, in conclusion, according to the evaluation results up to the present time, we think that it is not necessary to change the effective dose evaluation value of 0.22 mSv/year due to the discharge of liquid radioactive waste.

〇Kaneko (S/NRA):
Thank you for your explanation.
Any questions?
Yes, Ms. Otsuji.

〇Otsuji (S/NRA):
This is important, I would like to confirm the purpose of the explanation. As noted in the square above page 23, it is required that the additional effective dose at the site boundary should be less than 1 mSv/year in the Items Required for Measures. This is the concentration regulations for the discharge of waste liquid and gas. However, the ALPS treated water will be newly discharged this time. You explained in upper square on page 24 that the result of evaluation for ALPS treated water(0.035mSv/year) is lower than the value of 0.22, which is the maximum evaluation for other former discharge of liquid waste than ALPS treated water. Therefore, regarding the concentration regulation, the discharge of ALPS treated water is included in the maximum evaluation for other liquid waste and satisfy the 1mSv/year as regulatory standards in total. My understanding is correct?

〇Matsumoto (TEPCO HD):
Your understanding is correct, but I would like to supplement it a little. First of all, the requirement is to reduce the dose around the site as much as achievable by implementing appropriate reduce measures for radioactive materials released to the environment, such as the site and the sea. In my previous explanation, effective dose becomes 0.035mSv on the assumption that the concentration of tritium is 1,500Bq and the sum of Notification concentration ratio of other nuclides is less than 1. However, in practice, there may be options that the discharge concentration for tritium is more than 1,500 or that the sum of Notification concentration ratio is not necessarily less than 1 if assuming it is diluted. I think there may be a judgment that we will use the value of

0.22mSv as much as possible. However, we have chosen to use 1,500Bq and then less than 1 this time. We have decided that this is the best policy to reduce this as much as possible.
In the latter half of Ms. Otsuji' explanation, it is right because our evaluation result is 0.035 for 0.22mSv at present.

〇Otsuji (S/NRA):
Thank you for your explanation.
As you said, the evaluation for ALPS treated water by discharge may be made effort to reduce it less than the evaluated maximum value under current conditions of 0.035. I understand that 1mSv would be satisfied because the evaluated maximum value of 0.035 for the ALPS treated water is now sufficiently smaller than 0.22 allocated for liquid radioactive waste.
I would like to ask you to explain one more. What is "the discharge standard" on the second line in the sentence of *1, "when discharge is performed at the same concentration as the discharge standard", in the upper square on page 24?

〇Matsumoto (TEPCO HD):
1,500Bq/L is the discharge standards for tritium.

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

〇Kaneko (S/NRA):
Do you have any other comments? Is that okay with you?
The value discussed previously comes from the evaluation with various conservative conditions, so it is not the kind of actual value, i.e., so-called effective dose. In other words, we need to put some regulatory limits on activities by licensees, which is stipulated in the Items Required for Measures.
I understand that you confirmed the result of ALPS treated water discharge will not exceed the regulatory limit, even if the evaluation is conducted in conservative manners, and will be within the framework so far. It is such a mechanism, so I would like to share such understanding once again.
That is, **this value** does not actually come out, and as Mr. Matsumoto explained earlier, operationally, it is just that **this value** is the maximum, to say, **a value at a certain moment** may reach the maximum, but as you explained previously, **values** come out lower on average practically. So, in fact, of course, **values** will be at a level without problems. I would like to share such understanding just in case.

〇Matsumoto (TEPCO HD):
I understand.

〇Kaneko (S/NRA):
Are you okay with other matters?
Then, we finish the discussions on the dose evaluation.
Next, I would like to ask TEPCO to explain the issue of the annual discharge amount of tritium.

〇Matsumoto (TEPCO HD):
The fourth issue is the annual discharge amount of tritium, that is, explaining how to operate and confirm that the annual discharge of tritium in ALPS treated water does not exceed the annual discharge control of 22 trillion Bq.
Please see page 26. Regarding this issue, in the ALPS treated water dilution/discharge facilities the tritium concentration in ALPS treated water to be discharged is registered to the monitoring and control device each time before discharge. In addition, the monitoring and control device monitors the flow rate of ALPS treated water at discharge, then, counts and records the total flow rate.
Therefore, the monitoring and control device sums up the results obtained by multiplying the tritium concentration registered each time of discharge and the integrated flow rate, so the annual tritium discharge is given. In addition, we prepare the system such that the relevant data can be checked at any time.
In the monitoring and control device, the system which can set the upper limit of the annual discharge of tritium is installed. Therefore, the discharge operation can be disabled by equipping an interlock system that does not allow the system to shift to the discharge operation when there is a possibility that the annual release of tritium may exceed the upper limit. In this way, we would like to carry out the discharge operation not to exceed the limit for discharge per year (22 trillion Bq) or a certain upper limit if TEPCO manually set it.
At the bottom of page 26, we have illustrated the image of that way. After setting the upper limit of the annual discharge of tritium, we would like to establish a mechanism that enables us to constantly monitor the annual discharge of tritium by recording the tritium concentration and the flow rate of the ALPS treated water discharged as an integrated value every time the discharge operation of tritium is performed.
That’s all from me.

〇Kaneko (S/NRA):

Thank you.
Are there any items to be confirmed from the NRA?
Mr. Masaoka, please.

〇Masaoka (S/NRA):
Regarding the content in the page 26, I understand that in that way you can record and confirm the data in real time, but I would like to confirm a little bit about how to manage the discharge operation.
Concretely speaking, I think that you will not take a "real-time-management" for the discharge, e.g., you do some action after you found that the release of tritium will become almost more than 22 trillion Bq soon. I think that you will probably take an appropriate "batch-type-management" for the discharge. For example, you can confirm in advance how much tritium will be discharged in one batch under the normal condition because the concentrations of tritium in 10 tanks are known, so you can manage the discharge at each batch operation. So, let me confirm that you will take which type of management for the discharge.

〇Matsumoto (TEPCO HD):
As you said, the page 26 shows the method that allows us to manage how much tritium have been discharged in a real-time manner.
On the other hand, TEPCO would like to prepare a plan of the discharge at the beginning of the fiscal year.
For example, considering the inventory of tritium in a 1-batch 10000m^3 of the ALPS treated water with mean tritium concentration of 0.6 million Bq, it is 6 trillion Bq, so if we discharge 3-batches of the water with such tritium concentration, the amount of tritium discharged reaches 18 trillion Bq.
At the beginning of the fiscal year, it is scheduled that which tanks of ALPS treated water will be discharged, so, we can estimate that how many times we can discharge the water in the year when the sampling and discharge process are carried out in a planned manner.
Therefore, I think it is appropriate to have such a plan about the annual release of tritium at the beginning of the fiscal year in advance, and I think it is the premise that we will manage the discharge based on this plan.
That's all from me.

〇Masaoka (S/NRA):
In that sense, in my understanding, what you have shown in the page 26 is a confirmation just in case, and of course you do "batch-type-management" for the discharge properly through I don't

know whether it is planned at the beginning of fiscal years or before each discharge

〇Matsumoto (TEPCO HD):
Yes, that’s right. Today, we explained that the annual discharge of tritium will not exceed 22 trillion Bq or its upper limit when TEPCO set it, through showing the system that constantly confirms the concentration of tritium.
That’s all from me.

〇Masaoka (S/NRA):
I understand that.
I have one more comment regarding the interlock shown in the page 26.
Based on your explanation, in the case of “batch-type-management” I think that normally the interlock should work not to activate the discharge operation itself for a batch to prevent the discharge of a certain amount of treated water, e.g. the relevant pumps should not be started, the relevant valves should not be opened from the beginning.
However, the interlock system described here seems that if the total discharge of tritium exceeds 22 trillion Bq, emergency isolation valves are closed. If so, I think that such interlock system is basically not expected. Explain the mechanism of the interlock system.

〇Matsumoto (TEPCO HD):
First, we explained that the tank groups for measurement and confirmation are divided into A, B and C tanks by 10,000 tons, and each works in rotation.
At that time, an interlock will be provided to prevent the release of ALPS treated water that has not been measured by mistake or came from the group of tanks that should not discharge their water.

We are now considering that a mechanism not to release the ALPS treated water would be provided into the interlock on the relevant valves if there is a possibility of exceeding 22 trillion Bq.
As you asked, in the discharge operation, we do not shut the emergency isolation valves suddenly when almost exceeding the upper limit. We plan to prevent the discharge much earlier than that.
That’s all.

〇Masaoka (S/NRA):
From your answer it is as same as my understanding but let me confirm one thing. I think that the interlock, we are talking, works mechanically, e.g., not opening the valves mechanically or not

starting the pumps before discharge. Is that right?

〇Matsumoto (TEPCO HD):
Yes, that is.

〇Masaoka (NRA):
Okay.

〇Matsumoto (TEPCO HD):
Again, the interlock is not something like closing emergency isolation valves to stop the discharge because it reached 21.5 trillion Bq when its upper limit is 22 trillion Bq.

〇Masaoka, (S/NRA)
That is as same as my understanding. Thank you very much.

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

〇Ban (NRA):
In relation to the previous question, at the beginning of the fiscal year you have a plan on how to discharge the ALPS treated water from the tank groups, and I think that the plan includes not only the concentration matters but also probably the priority of which tank you want to discharge the water in it.
So, I think that you of course would face the situation such that the actual release would be less or more than expected. If that is the case, would you give its feedback and review the plan again?

〇Matsumoto (TEPCO HD)
As you said, there are naturally cases in which things do not go well as planned, so in such cases, I believe we will review our plans. However, in such case we will satisfy the prescribed conditions, e.g., we do not exceed 22 trillion Bq. That is all.

〇Ban (NRA):
So, as in the previous question from Mr. Masaoka, the interlock gives the impression that you discharge the ALPS treated water as much as possible at the last minute. However, I have the image that the discharge is not carried out that way, but more systematically and steadily on the batch-by-batch basis. Is that right?

〇Matsumoto (TEPCO HD):

That's right. Regarding this matter, we have only stated that we will check the annual discharge of tritium using the on-line system as a reference material of how to check it. However, we would like to be able to explain this matter to you again, including the annual discharge plan.

That’s all from me.

〇Kaneko (S/NRA):

Yes, thank you.

I think it would be better to clarify a viewpoint as well in relation to the previous discussions. As you have already stated, you plan to discharge from the ALPS treated water with low tritium concentration so that you will empty the tanks as soon as possible.

Then, to put it other way around, as you have written the critical cases on the page 6 and 7 of the today’s document, but I think that when something goes wrong due to some other factors, the flexibility of discharge operation will gradually increase.

Therefore, for example, I think that the discharge operation not to exceed the annual limit, that is, 22 trillion Bq now, is completely synonymous with the systematic approach to the operation in the previous discussions.

Therefore, I think it would be better to clarify the policy of implementing the discharge plan that would keep the limits through such operation. Of course, it should be appropriate to stop the discharge mechanically, but I have the impression that such policy will be more important rather than that.

〇Matsumoto (TEPCO HD):

I understand. Today, I have mainly explained that the discharge is stopped mechanically. On the other hand, as you said, we would like to be able to explain what kind of management will be done from the point of formulating the discharge plan, and how to review the plan when it does not go according to the plan or when we have the flexibility of the operation. That’s all from me.

〇Kaneko (S/NRA):

Yes, thank you. Do you have any other comments about this matter? Okay, yes.

Then, the issues in this document were explained as a whole and we discussed them.

The rest of the material is a bit detailed for reference. Dose TEPCO have anything that should be explained in supplementary terms?

〇Matsumoto (TEPCO HD):

The slides for reference from the page 27 in the document were included in the material for the 3rd review meeting. We prepared them if there is something to be quoted in today's explanation, so. I do not think it is necessary to explain them at this moment. That's all from me.

〇Kaneko, (S/NRA):
Yes, thank you.
Are there any comments from the NRA regarding the reference slides?
Now, if you have anything to ask about all discussions today such as something you have missed to confirm and you want to check, you can ask about that at this moment.
Yes, Mr. Masaoka.

〇Masaoka (S/NRA):
I have one point. It was also discussed today, and it is about the concreate procedure.
I think that the procedure manual describing from the treated water's acceptance, discharge and stop of its discharge will be reviewed later. I think that this time you explain the Implementation Plan including all activities about the installation permit, design and construction approvals and operational safety programs.
I think that it would be better if you could explain the outline of the procedure to a certain extent once in a proper manner. Then, I think that the review will go more efficiently in relation to the each activities relating discharge.
Specifically, for example, first regarding the acceptance of the ALPS treated water in the tanks, as mentioned earlier you put more and more water into each tank, and after that, you agitate it.
Regarding the agitating time, probably while looking at the test results at this time, 144 hours, I think that you will probably stop the agitation a little before that time. After such agitation, you will analyze the ALPS treated water and register its results.
In parallel with that, considering the situation of the tanks, e.g., are they in a connected state? As you mentioned previously, are they left for 2 months without agitating?
After that when the ALPS treated water should be discharged, you probably run the seawater transfer pumps and the treated water transfer pumps. At that time, then, how do you set the flow rate control valves including how to handle the error?
In addition, you will of course monitor the discharge, and then, when it is stopped, I think that of course due to the pump cavitation, you will probably stop the discharge property in relation to the NPSH (Net Positive Suction Head) when the water level in the tanks reach a certain level.
I think that if we understand the outline of procedure manuals on series of operations as shown in the examples previously, our understanding will be improved, and the review will go easier. What do you think?

〇Matsumoto (TEPCO HD):
I understand. As you said, basically, focusing on the flow of how to operate equipment and that of how to handle the data, I would like to explain such procedures. At the same time, for such processes I would like to clarify where people are involved and where machines perform and, as Mr. Ban mentioned, do where the risks are likely to exist. Then, I would like to discuss them. That's all from me.

〇Masaoka (S/NRA):
Thank you in advance.

〇Kaneko (S/NRA):
I would like to thank you for your cooperation in that point.
Do you have any other comments? Is that okay with you?
Mr. Shibutani, please.

〇Shibutani (S/NRA):
This is Shibutani from the NRA.
I would also like to hear your opinions on the overall approach.
This is the fifth review meeting, but practically the third review one for the main application of the Implementation Plan.
Some issues are going as expected, such as the radiation dose evaluation in the discharge as discussed previously, but regarding the facilities we have no facility that look satisfactory at this moment. I have an impression that the discussions about the facilities are somewhat postponed.
So, I think that neither listeners of the meetings nor us will probably know what kinds of issues will come and how they will do after this. Therefore, I would like you to show us something like the overall schedule, for example, how many times you intend to have the meetings, what kind of issues you plan to explain, and how you explain them. First, what do you think about this point?

〇Matsumoto (TEPCO HD):
I understand that. At the review meeting held on December 24, the NRA provided us the document showing major issues. At the next review meeting, regarding facilities TEPCO would like to show what kind of issues we have and what kinds of subjects to be reviewed, although we can't specify the date. That's all from me.

〇Shibutani (S/NRA):

This is Shibutani from the NRA.

So, on top of that, for example, there are various comments like this meeting, and I think that things like homework will increase more and more. Therefore, after showing the schedule, I would like TEPCO to proceed with preparations so that, for example, if some contents are supposed to be provided after the next meeting in the schedule, they can be explained ahead of the schedule if possible.

For questions, i.e., the previous one about the concept of corrosion countermeasures of the dilution facilities for long-term use, what kinds of materials are used and what kinds of countermeasures are done are written in the Implementation Plan.

Of course, we do not review the details at the review meeting, but I would like you to explain it in the main part of the review meeting documents to such extent that, for example, you will take the same measures as those for the Transfer Facilities of the contaminated water in the turbine buildings. After you show that in the main part, I would like you to attach the explanations of measures to prevent the leakage, the spread of contamination, and the corrosion to the reference part of the meeting documents.

I think it will be troublesome to make new documents. If so, I think it would be alright such that you could add the relevant parts of the Implementation Plan. Anyway, I would like you to expand the documents a little more.

I have just mentioned the above two points.

〇Matsumoto (TEPCO HD):

Yes, first, I accepted the former comment. Since the third meeting, we have some homework and leftovers, etc., so we will prepare to be able to reply them one by one.

Regarding the latter comment, since the documents were made with the PowerPoint, there are some parts that are not fully described. However, we will describe the important points, e.g., the materials of components necessary to be shown, how basic design concepts are, in the meeting documents to submit, or if they cannot be written on a single slide, we would like to attach them in the form of reference slides at the last of the documents. That's all from me.

〇Shibutani (S/NRA):

Thank you for your cooperation.

So, for example, when answering a question, if the answer is not described in the main part of the documents, you can explain it by showing it is written here in a reference part. I think that such materials are ideal. Thank you for your cooperation.

〇Matsumoto (TEPCO HD):
I accepted that.

〇Kaneko (S/NRA):
Regarding the first schedule that Mr. Shibutani just mentioned, rather than making a very detailed schedule, it is fine that we can roughly share a plan of when the homework items can be prepared and in what order we can discuss the issues. If we can understand such plan, we will do our best to discuss in the review meeting assuming what will be the detailed issues in the meetings, so I would be very grateful if you could show such plan to us.

〇Matsumoto (TEPCO HD):
I accepted that. We will prepare to show it at the next review meeting.

〇Kaneko (S/NRA):
Thank you for your cooperation.
Do you have anything else to say? Is that okay for you?
Well, now we have talked about how to proceed the meetings in the future, so I would like to close the meeting today. Essentially, it may be better to summarize today's points as a list, but we would like to proceed with that listing after confirming them property on both sides through the interviews etc. in the sense of making the meeting itself more efficient. So, today I would like to skip to summarize today's points.
Then, if you don't mind, is there anything more from TEPCO in particular?

〇Matsumoto (TEPCO HD):
Nothing from TEPCO.

〇Kaneko (S/NRA):
Then, the 5th review meeting on the Implementation Plan will be completed.
Thank you for your cooperation.

〇Matsumoto (TEPCO HD):
Thank you very much.