*Provisional Translation

TEPCO's Fukushima Daiichi NPS

Review Meeting on the Implementation Plan on Handling ALPS Treated Water

Minutes of the 6th meeting

Date: January 27,2022 (Thursday) 13:30-16:30

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

Participants:

The Nuclear Regulation Authority (NRA)

Nobuhiko Ban, Commissioner of the NRA

The Secretariat of Nuclear Regulation Authority (S/NRA)

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

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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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○Kaneko (S/NRA):

We will start the sixth meeting of Review on the Implementation Plan on Handling ALPS Treated Water.

The meeting will be conducted as video conference to prevent COVID-19 just as before. Thank you for your cooperation in the smooth progress.

Continuing from the last time, Kaneko of the Secretariat of NRA will work on the progress.

Thank you in advance.

Today, the agenda is in one form, but we will proceed with two broad discussions.
First of all, TEPCO will explain the radiological impact assessment on the surrounding environment due to discharge into the sea, and we will proceed with discussions on these issues.
After that, there is a slight change in the arrangement in the room, so we would like you to hold a break for about 10 minutes, and then proceed with discussions on structural strength and protection against natural phenomena in the discharge facilities. Meeting becomes a two-stage configuration.
I would like to start with a session to discuss the radiological impact assessment. Today, TEPCO summarizes the contents of the explanation in Material 1. TEPCO will first explain the contents of the section related to the radiological impact assessment, and NRA will confirm the issues.
Then, could you please explain it?

○Matsumoto (TEPCO HD):
Now, let me explain based on Material 1.
See page 1. As mentioned earlier by Mr. Kaneko, TEPCO today explains two of the main items to be confirmed regarding the government policy, namely, the first, the assessment of the effects of discharge into the sea on the surrounding environment, and the second, among the main points to be assessed under the Nuclear Reactor Regulation Law, the following is to be explained: ⑤ Structure and Strength of Equipment, Design Consideration for Natural Hazards such as Earthquake and Tsunami, Prevention of Incorrect Operation, Reliability
To begin with, we will explain the assessment of the effects of discharge into the sea on the surrounding environment.

See page 2. Seven items have been identified as major items to be checked in relation to the efforts to government's policy. There are seven items, including IAEA safety standards, setting source terms based on upper limits of discharge control, diffusion models, transfer models, exposure pathways, IAEA guides, etc., and assessing the effects of potential

exposure. The explanation should be explained in each.

Please next slide. First of all, I would like to discuss the outline of the radiological impact assessment.

See page 4. With regard to the background to the implementation of the radiological impact assessment, TEPCO announced on April 16 last year "TEPCO's Response Based on the Government's Basic Policy on the Discharge of Treated Water by Advanced Liquid Processing System, etc.". In order to release ALPS treated water into the sea, we not only comply with regulatory standards based on laws and regulations, but also comply with relevant international laws and practices, and ensure through further efforts that discharge water is safe.

To ensure this safety, the concentration of radioactive material of tritium and other than tritium in the discharge water will be assured to comply with Japan's regulatory standards and laws and regulations in accordance with international standards. In addition, the safety of the radiological effects on humans and the environment in the discharge under these conditions will be assessed by the commencement of the NRA's necessary approval procedures. The results were implemented from this point of view and were announced on November 17 last year. In addition, this time, the implementation plan document is also attached as a reference material, and in the future, we plan to receive the IAEA experts review, etc.

Go to page 5. As for the assessment methods, based on IAEA Safety Standards Document GSG-9, TEPCO assessed the radiological effects associated with the discharge of ALPS treated water into the sea. For specific assessment methods, we also follow IAEA's GSG-10 steps. We have also conducted assessments of potential exposures that are not covered by GSG-9, and environmental protection that is not regulated in Japan.

The documents of the referenced IAEA, ICRP are as described in the latter half.

See page 6. The composition of the Radiation Impact Assessment Report prepared by TEPCO is shown. In the main text, from the assessment of human exposure, the report was

prepared in the form of the purposes, concepts, water quality and methods of discharge of ALPS treated water, assessment methods, assessment of exposure, and summarization of the assessment. Reference materials A-I are the back data for each item.

See page 7. First is the evaluation of human exposure.

The steps shown in IAEA GSG-10 are listed on page8. The assessment for people is carried out in six steps from the selection of source terms. The selection of source term defines the type and amount of radioactive material by the discharge of treated water into the sea. Subsequently, we will examine how radioactive materials released into the sea, diffuse, migrate, and accumulate as modeling of direct irradiation, diffusion, and transfer in the environment.

Next, it identifies the exposure pathways, and examines the pathways by which people are exposed from radioactive materials that have spread or transferred in the environment. And then, it selects representative individuals, and assesses the dose to these representative individuals.

The assessment results of the dose are compared between the estimated dose and the dose constrain value and the dose limit.

In Japan, since no dose constraint values have been introduced under laws and regulations, we compare it with the dose targets for nuclear power stations, namely, the dose limits of 0.05 mSv/year and with the dose limits for general public (1 mSv/year).

Go to page 9. The discharge method, which is a prerequisite for the assessment, is the selection condition described in the Implementation Plan in addition to the basic policy of the government. That is, ALPS treated water to be discharged is purified until the Notification total concentration ratio of 62 nuclides other than tritium and carbon-14 is less than 1.

Next, we assume the annual release amount of tritium will be less than 22 trillion Bq, which is the discharge management target value of the Fukushima Dai-ichi NPS before the accident. However, we use 22 trillion Bq for assessment purposes.

In addition, the diluted ALPS treated water will be discharged from the seabed

approximately 1km offshore of the power plant to prevent the discharged water from being drawn up again.

For discharge, the treated water is diluted more than 100-fold with seawater, and the tritium density at the outlet is less than 1,500Bq/L. As the results, the sum of the Notification concentration ratios for 62 nuclides other than tritium and carbon 14 is diluted to less than one-100th.

The lowest tritium concentration in ALPS treated water is approximately 150,000 Bq/L. In order to dilute this to 1,500Bq/L, more than 100 times dilution is required. That is why we write a report as more than 100 times dilution is required.

Then go to page 10. About source term setting. TEPCO has prepared two cases of treated water as the source term setting for the release of ALPS treated water. The first is the source term based on actual measurements, and the second is the treated water that is hypothetical to maximize the amount of exposure.

First of all, with regard to the source term based on actual measurements of 64 nuclides, there are three tank groups of 64 nuclides in ALPS treated water currently stored at Fukushima Dai-ichi, all of which have been measured. There are three types listed below: the K4 tank group, J1-C tank group, and J1-G tank group. We use these measured values to assess.

In each case, the annual release of tritium is in the range of 22 trillion Bq.

Next, go to page 11. Another hypothetical source term for ALPS treated water. This is a very conservative assessment. Although such treated water does not actually exist, the exposure assessment was conducted using ALPS treated water, which is hypothesized to contain only nuclides with relatively large impacts of exposure, as it is diluted with seawater and then continuously discharged during the discharge period.

Please see page 12 for more information on these nuclides. TEPCO first assessed the dose of internal exposure to each nuclide in the case of discharge with the Notification concentration limit, and selected the top eight nuclides this time.

The selection flowchart is described on page 13. First, regarding 64 nuclides and C-14, we judge whether or not the exposure assessment value exceeds 0.001 mSv/year for each nuclide one by one, when the treated water, in which each nuclide is full of the Notification concentration limit, is discharged. Nuclide exceeding above is designated as the nuclide for operation management as the source term of the hypothetical treated water set forth in ② this time. Other nuclide will be out of operation management, but we will explain this point later.

Regarding the nuclides of operation management, depending on whether or not they have been detected in ALPS treated water until now. First of all, those detected, C-14, we will have the twice the maximum concentration of operation management. Next, those that are not detected as less than the detection lower limit, we will have the operation management of the concentration obtained by adding 20% of the error to the maximum value of the detection lower limit.

The results are on page 12, and the top of the selection items is from tin 126 to silver 110m as the target nuclide. For the sixth nuclide in which carbon 14 was detected, and for the remaining seven nuclides, we assume that the radioactive material with detection lower limit is present.

When the sum of the concentration ratios of the eight nuclides is calculated, it is 0.32. Therefore, for the other part of 0.68, it is assumed that the 9th nuclide of zinc 65 contains the amount of radioactivity equivalent to the concentration ratio of the remaining part of 0.68.

The tritium concentration is lower than 22 trillion Bq/year. However, the lower the diluting ratio, the higher the total concentration. We set 100,000 Bq/L as the source term for the hypothetical ALPS treated water ②, which is lower than the minimum concentration.

Go to page 14. As I mentioned earlier, the top eight nuclides in the results of internal exposure assessment were used as the target discharge management nuclides. From the viewpoint of the external exposure assessment and environmental protection, we have confirmed whether there are any additional nuclides or if they are released to each nuclide

within the Notification concentration limit.
In the case of external exposure, Te-127, Eu-155, Gd-153 exceeds 0.001 mSv/year. However, since both of them are nuclides that use Co-60 factors conservatively as dose conversion factors, and the exposure assessment value is slightly more than 0.001 mSv/year, it is judged that there is no need to add them to the target discharge management nuclides.
Regarding environmental protection, since the value for animals and plants are below the standard values even in Fe-59 with the greatest exposure effects, and they are the target discharge management nuclides, and other nuclides have a dose rate that is more than one order of magnitude smaller than Fe-59, we have determined that there are no nuclides that need to be added to the target discharge management nuclides.

Next, go to page 15. This is a modeling of diffusion and transfer after discharge. The assessment used a model that was found to be reproducible based on the repeatability calculations for the cesium concentration in seawater after the accident at the Fukushima Daiichi Nuclear Power Station.
In this calculation, the resolution has been improved so that the sea area near the power plant can be simulated in detail.
As for the model used, ROMS was applied off the coast of Fukushima Prefecture. The sea flow data of the area is as described.
The model scope is a map area on the left. With regard to the intersection of the blue band and the red band in particular, mesh resolution is step by step increased so that the mesh is about 200m, where the mesh is 1 km in other places.
The depth, vertical direction from horizontal planes is divided into 30 layers throughout. As for meteorological and sea condition data, we used the data for 2014 and two years for 2019.

See page 16. As for modeling of diffusion and transfer after discharge, we tested reproducibility for the cesium concentration in seawater as a reasonable model and compare it with actual data.
In Figure 1 on the left, you can see that the results of monitoring and simulation are

generally consistent. In addition, as shown in the map on the right side of Fig. 2, we see that the simulation results of the annual average concentration roughly agree with the actual measurement. In both figures, the measured values tend to exceed the simulated results at concentrations below 10 Bq/m^3 (0.01Bq/L), but this is estimated to be the effect of external inflow not included in the simulation.

See page 17. As for the transfer pathway, there is the transfer pathway shown in this table which was selected with reference to the previous cases in Japan. In addition, external exposure was targeted at exposure of gamma-rays, which have a large contribution to the dose.

Direct radiation from the facilities shown in ① above was not selected because ALPS treated water handled by the facilities has removed radioactive materials other than tritium to a level that can be discharged and because direct radiation exposure should not be taken into account.

Also, it's the lowest and the eighth on the table. There are advection, diffusion, and transfer to the atmosphere due to ocean currents, etc. However, we did not select this because the amount of radioactive materials that are transferred to the atmosphere due to evaporation, scattering, etc. is small, and similar evaluation cases have not been taken into consideration.

Next, see page 18. The exposure pathway is set in the transfer model. We show six pathways of exposure, including external exposure during work on the sea (exposure from seawater), external exposure during work on the sea (exposure from ship bodies), external exposure during swimming and undersea work, external exposure at beaches (exposure from sandy beaches), external exposure from fishing nets, internal exposure from ingestion of seafood.

See Page 19. As for the calculation method of external exposure, the radiation exposure from seawater when moving by boat or working underwater is obtained by multiplying the effective dose conversion coefficient by the concentration of radioactive materials in

seawater. Radiation exposure from radioactive materials transferred from sea water to the hull, sand on beaches, and fishing nets is also “an effective dose conversion factor x transfer factor x concentration of radioactive materials in sea water”.
The conversion factor and transfer factor used here are from the handbook as shown in the footnote below.

As for the model, as shown on page 20, the simple shielding calculation code is used, and the external exposure during swimming were calculated using the submersion model.

See page 21. The following is the route of internal exposure. Regarding internal exposure, as indicated by hatching, the exposure dose is calculated as the effective dose coefficient x the ingestion rate, and the intake rate is calculated as concentration of radioactive materials in seawater x concentration coefficient x amount of seafood ingested annually. Similarly, dose coefficient, concentration coefficient, etc. are based on data from IAEA, ICRP.

Next, go to page 22. Regarding the selection of representative individuals, it is difficult to establish lifestyles in areas surrounding the Fukushima Daiichi Nuclear Power Plant, which is currently being reconstructed. Therefore, based on the case studies of other companies, we assume the following individuals to receive a large amount of exposure.
Reside in the vicinity of the Fukushima Dai-ichi NPS and use the coast for leisure and other purposes. Engage in fisheries in the surrounding sea areas. They eat sea products sampled in the surrounding sea. More specifically, based on the " Dose assessment for the general public in the safety review for light-water nuclear power reactor facilities General Public" they engage in 2880-hour fisheries annually, of which 1920 hours work in the vicinity of fishing nets. We also assume a lifestyle habit of staying on the shore for 500 hours a year and swimming for 96 hours.
Regarding the exposure of humans this time, as shown later, it is known that the contribution of internal exposure is large.
As for the third square on page 22, the ingestion of seafood, two cases were set on the assumption: intake of the average amount and intake of a larger amount.

Table 1 shows the average intake of sea food based on data from the Ministry of Health, Labour and Welfare. The table is evaluated that adults take 58g of fish, 10g of invertebrates, and 11g of seaweeds.
Also, in Table 2, the average +2σ value is taken as the intake of individuals who consume a large amount of sea foods. In other words, it is assumed that adults consume 190g of fish, 62g of invertebrates, and 52g of seaweeds.
The intake of young children and babies is 1/2 and 1/5 of that of adults, respectively.

Go to page 23. As I mentioned earlier, we have calculated for three types of sauce terms based on actual measurements and four types of sauce terms based on hypothetical ALPS treated water. The external exposure is calculated for adults only, and the internal exposure is calculated for adults, children and babies respectively, when they take in average and when they take in larger amount. For this reason, the estimated exposure dose of representative person is the sum of external exposure and internal exposure.
This is a prerequisite. The results of diffusion calculation are from page 24.

First, page 24 is the result of the tritium diffusion calculation and shows the distribution of annual average concentration on the sea surface. As can be seen in the figure on the right, the dilution can be seen such as the range of 1 to 2Bq/L is finally known by the magnified image of the vicinity of the power plant. 1Bq/L is exceeded in the area between 2 km and 3 km. Looking at the magnified image on the left side, off the coast of Fukushima Prefecture, we can see that the area from 0.1 to 1Bq/L is more than 30 km south and 20 km north, but we think in reality that it is difficult to distinguish it from the concentration of tritium in nature.

Next, see page 25. This is the distribution of concentration in the vertical direction around the discharge outlet and outlet of the tunnel. The figure on the left shows the east-west section, that is, the site on the west side. The right side is the north-south section which shows around 30Bq/L just above the tunnel outlet, but it shows that the density is rapidly decreasing in the vicinity of the tunnel outlet.

Next, go to page 26. This is a calculation method of the radioactive materials concentration used for exposure assessment. Considering the areas subject to external exposure and the areas for the intake of sea foods that cause internal exposure, we decided to use the annual average concentration of radioactive materials as the exposure assessment in the seawater area of 10km in the east and west and 10km in the north and south, where it is closest to the nuclear power plant.

Individuals targeted for exposure assessment are individuals engaged in fisheries and eating sea foods in the vicinity of power station. Although the external exposure associated with the work is determined by the concentration of radioactive materials in the sea water at the work site and the work time, we believe that we can evaluate it by the average concentration of the entire work area throughout the year.

Since operations will be carried out over a wide area around the fishing port, external exposures from seawater, etc. should be calculated from the concentrations of radioactive materials in seawater in a wider area. The assessment this time conservatively assumed that the operations are carried out only within an area of 10 km x 10 km around the power station, and the annual average concentrations in seawater within this area were used.

In the same way, we have made a conservative assumption that seafood will only be taken within this 10km square.

The assessment results of the exposure dose are shown on pages 27 and 28.

On page 27, we have prepared tables: on the horizontal axis, the source term based on the actual measurement and the source term based on hypothetical ALPS treated water on the right, and two types of intake of seafoods such as the average and the more than average in each. Looking at the external exposure and the internal exposure, as I mentioned earlier, it can be seen that the contribution of the internal exposure to the exposure dose assessment is significant. The total of assessment results shows 10^{-4}～10^{-5}mSv/ year for the source term with real measurements and 10^{-3}～10^{-4} mSv/ year for the source term with hypothetical treated water. It is significantly lower than not only the dose limit of 1 mSv/year but also the dose target of 0.05 mSv/year.

Page 28 shows the assessment results of the internal exposure by different age group. Though the internal exposure of young children and babies with large effective dose coefficients exceeds that of adults, it is significantly lower than the dose limit of 1 mSv/year and the target dose of 0.05 mSv/year even in the cases where large amounts of sea foods are taken using conservatively hypothetical sauce terms with ALPS treated water.

Then go to page 29. This is assessment for environmental protection of non-human organisms, which can be found on page 30 and is being assessed for animals and plants in accordance with the procedure in IAEA GSG-10 Annex I. These procedures are similar to those for human assessments, including selection of source terms, modelling of environmental diffusion and transfer, identification of exposure pathway, selection of standard animals and plants, assessment of dose rates to standard animals and plants, and comparison of estimated dose rates and derived consideration reference levels.
Regarding the derived consideration reference level, it is a band of dose rates with a single-digit range defined by the ICRP for each species of organisms. If an assessment result falls within the range of the DCRL, the impacts must be taken into account.

On page 31, the source term is set. This is the same concept as the human exposure assessment, and we have set two types: a source term using actual measurements and a source term for hypothetical ALPS treated water.
The water is adjusted in such a manner that the sum of the concentration ratios is exactly equal to 1, while assuming that the two radionuclides subject to management, Fe-59 and Sn-126, which have relatively large impacts on the exposures and selected for the assessment for environmental protection, are contained at their target discharge management values, and as the radionuclide representing the other 62 nuclides, promethium-148m is contained at 499 Bq/L (Notification concentration ratio: 0.9975).

Page 32 shows the modeling of diffusion and transfer after discharge, and selection of exposure pathways. As for the modeling, we used the same model as human exposure,

but we selected a transfer pathway as the transfer of seabed sediment, which are important in assessing the exposure of marine animals and plants as well as advection and diffusion due to ocean currents.

The exposure pathways are the two from among the pathways indicated in the dose assessment of animals and plants in IAEA GSG-10. One is the external exposure from radioactive materials in sea water and sediments, another is the internal exposure from radioactive materials taken into the body by sea animals and plants.

The concentrations of the other 63 radioactive materials in seawater used for the assessment were calculated using the calculated tritium concentration and the proportions of each nuclide in the annual discharged treated water.

Area of 100km^2, i.e., 10km×10km square, is the assessment area for the 100 to 400km^2 shown in GSG-10. In addition, the annual average concentration in seawater within that area was used for the exposure assessment.

Finally, although the decrease of radioactive materials due to the transfer to sediments and animals and plants is not considered in the assessment of the diffusion of seawater, the ratio of the concentration of organisms to the transfer to sediments is considered to be in equilibrium in the assessment of exposure.

Shown on page 33, flatfishes, crab, and brown seaweeds have been selected as the target nuclides for the selection of reference animals and plants according to ICRP Pub 136. Since these plants and animals live near the seabed, the annual average concentrations of radioactive materials in the undermost layer of seawater were used for the exposure assessment.

Page 34 is the evaluation method. The internal exposure and external exposure are as described in the hatching. Factors such as ICRP, IAEA are used for conversion factors as same as human exposure. As for assessment criteria, the results are compared with the Derived Consideration Reference Levels published by the ICRP in Pub.124.

See page 35. This is the assessment results for non-human. Derived consideration

reference levels (DCRL) are shown at the bottom of the table. Flat fish is 1-10mGy/ date, crab is 10-100mGy/ date, and brown alga is 1-10mGy/ date. Comparing with the lower limit of DCRL, both the actual measurement from the source term and the hypothetical assessment of the source term of ALPS treated water were lower than one 100th.

Go to page 36. This is an assessment of potential exposure. The description of the flowchart in IAEA GSG-10 has been omitted in the report, but the potential exposure has been assessed in the same manner.
The facilities covered in the study of potential exposure scenarios are shown in the figure on page 37.

The assessment procedures for evaluating potential exposures on page 38 as shown in IAEA GSG-10 are described. At the beginning, there are identification and selection of potential exposure scenarios, but the remaining six items are the same as the human exposure assessment mentioned so far. We will start by identifying and selecting events that may lead to potential exposure.

See page 39. As for the scenario of potential exposure, various events can be considered first of all as unusual events in facilities related to the release of ALPS treated water into the sea, such as pipe rupture or the shutdown of diluted seawater pumps. In any event, the water eventually discharged is ALPS treated water or diluted treated water in which radioactive materials other than tritium ware removed until less than the total Notification concentration 1.
Of these, ALPS treated water after dilution is subject to discharge. Therefore, we chose the scenario of the event in which ALPS treated water is discharged without dilution. Furthermore, we considered that the most severe scenario was the direct discharge of ALPS treated water into the sea rather than the event that would occur after a leak in the premises at first such as a pipe rupture, then discharge into the sea. Therefor we selected the case where the seawater pump for dilution would be shut down and the emergency shut-down valve would not operate, resulting in the discharge of the ALPS treated water

from the offshore outlet without dilution. In addition, since ALPS treated water is not expected to be released for a long period of time due to the release by each tank group basis, external exposure, which has a short-term impact, were selected.

See page 40. With regards to the source term, as I mentioned earlier in the scenario of the event, we assessed the cases where the discharge rate of Te-127, which has the greatest impact on external exposures from sea surface, is maximized and the concentration of H-3 is 100,000 Bq/L.
It was assumed that the treated water contains 5,000Bq/L which is the concentration limit of the target nuclide, Te-127, and that the discharge rate was the flow rate of 5,100m^3/day of ALPS treated water when diluting H-3 of 100,000Bq/L to 1,500Bq/L (67fold dilution) with seawater of 340,000 m^3/day. Discharge rate was calculated as the radioactive material discharge of 2.6E+10Bq/day.
However, since discharge rate on design is 500m^3/day, 5,100m^3/day is extremely conservative setting.

See page 41. Diffusion assessment uses the same simulation model as normal discharge.
Transfer pathways, advection and diffusion due to ocean currents, etc. were selected.
Because of the short-term discharge, we did not consider following exposure: adhesion to ship bodies, beach sand and fishing nets and accumulation in marine organisms such as fish and shellfish.
The exposure pathways, from sea surface that could be for a long time, were selected.

See page 42. Representative individuals subject to the assessment of potential exposure are crew members of vessels engaged in fishing operations in the vicinity of power stations when the event of unusual discharge occurred. Considering that there is a large flow in the north-south direction in the vicinity of the power plant, it is assumed that the work is carried out outside the area where fisheries are not routinely carried out at the location closest to the north from the discharge outlet (approximately 1km north). In the event of unusual discharge, the work should be suspended and evacuated, and the period

of exposure should be one day (24 hours). The concentration of radioactive materials in seawater for assessment was calculated as the maximum daily average concentration at the distance of 1km from the outlet based on the calculation results of the two years, 2014 and 2019. The exposure assessment method was the same as that of the external exposure of humans from seawater during normal operation.

The assessment result is shown on page 43. First of all, the assessment criteria are as follows: Considering that ALPS treated water is the water from which radioactive materials have been removed until the sum of ratios of radionuclides other than tritium becomes less than 1, and that the discharge of ALPS treated water is performed on a tank group by tank group basis, radioactive materials to be released in the event of an accident is considered to be limited. Therefore, the standard value specified in GSG-10 as the value to be used generally, 5 mSv, was adopted as a
criterion with which the estimated doses in the event of an accident should be compared.
As the results of exposure assessment, estimated exposure dose was 7.3 E-05 mSv, which is much smaller than the criterion of 5 mSv in the event of an accident.
The above is the radiological impact assessment of discharge into the sea on the surrounding environment.

Go to page 44. TEPCO has heard the opinions of a large number of people so far and is planning to revise this report. Currently, we are considering revisions as shown on page 44, and we intend to continue to add and change items through explanations to the parties concerned.
There are four main points. As for the change of exposure pathways, it is the additional consideration of the exposure pathways based on IAEA TECDOC-1759. As I mentioned earlier, there are six types of exposure pathways. In addition, we think that we should consider reflecting the ingestion through drinking water during swimming on it.
Second, it is assessment using coefficients from other data sets. As there are another coefficient depending on the nuclide in addition to the dose conversion coefficients, distribution coefficients, and concentration coefficients used this time, we will consider the

extent to which these coefficients will affect the assessment results. There are coefficients such as the concentration ratio of sea water and marine organisms in IAEA TRS-479, and the human external exposure in United States EPAs and ICRP Pub 144. Therefore, we would like to use these coefficients to calculate them.

Additionally, TEPCO will assess the effects of the exposure dose again although we had judged that organic-bound tritium (OBT) is less affected by our experience so far. Also, we are thinking whether we should assess the effect to outer area with more fine layers of density, although the layers are the 0 to 0.1Bq/L levels of diffusion simulation model this time.

Third, it is the consideration about the selection of abnormal events and their counter measures.

Fourth, we would like to make further detailed explanations: Monitoring plans to be implemented by TEPCO (source monitoring, pre-release monitoring, sea area monitoring), Study on uncertainties in the assessments, Progress after the publication of this report which are made in the design and operation of facilities etc.

In addition to the changes in the exposure pathways, four points of revision above that are planned to be made next time. If necessary, we would like to make other descriptions more appropriate.

My explanation is over.

○Kaneko (S/NRA):

Thank you, Mr. Matsumoto.

Then, if NRA side has any comments to be confirmed, clarified, or questioned about the contents of the explanation, please.

Yes, Mr. Masaoka.

○Masaoka (S/NRA):

Thank you very much.

Before going into the content, I would like to ask you to look at the second page and confirm how you have responded to the main items of the review meeting. For example, in

the lower part of the third dot, I have asked you to indicate the appropriateness of the area to be modeled, or to show us by the concentration at the border. I have received a general response, but could you sort out the items that are not listed on the page 2?

○Kaneko (S/NRA):
At this point, do you have any answers from TEPCO?

○Matsumoto (TEPCO HD):
"Study impacts on the outside of the diffusion simulation model used this time" of second dot of "Additional assessment" in the "Revision that are planned to be made next time" on page 44. I believe this is a point that Mr. Masaoka said.
On page 15, we indicated the area of the overall simulation, however I think that we need to properly indicate that point of outside area or more diluted area in the revision.

○Masaoka (S/NRA):
I understand you will consider or study in the additional assessment that the boundary is well below the background and is well within the area of modeling as described on page 44.
In addition, there is no description about study process of exposure pathways at the third part from bottom on page 2, although 6 items clearly described this time. I understand that you will show us the assessment process about 6 items (plus alfa?) in future as stated on page 44. My understanding is correct?

○Matsumoto (TEPCO HD):
As you said, we will show you the whole concept after assessing and study including ingestion by drinking water while swimming.

○Masaoka (S/NRA)
So, I would like to confirm points of contents. 8 types have been selected to be managed as target discharge management on page 12. The flow on page 13 is very easy to

understand.

On the other hand, you attached the Reference Material H of the Radiation Impact Report, “the contribution of each nuclide”. I understand the selection procedure itself, however iodine 129 was put on high contribution as the result of assessment for actual water. The reason why it is not included in management is that it is much smaller than total 50μ as a result. Is it correct?

○Matsumoto (TEPCO HD):

As you say, it is right. Iodine contribution certainly looks like high, but it was a result of which we have chosen nuclides with a large contribution, especially internal exposure, in accordance with the flow shown on page 13.

○Masaoka (S/NRA):

I understand.

I believe that it is important to confirm TEPCO policy in the sense of confirming the government policy, namely “ALPS treated water which contains nuclides at concentrations that exceed the target discharge management values will be treated again until the concentrations satisfy the discharge limits, even if the sum of the ratios of the 63 radionuclides is less than 1” described in the lower right corner of this report on page 12. Since these are not include in implementation plans or in the application, I would like to ask you to input it in management of implementation plan or at least management of the radiation impact.

○Matsumoto (TEPCO HD):

As you said, I would like to consider it within the company.

This time, hypothetical ALPS treated water that could not actually exist is intentionally considered. In particular, since only nuclides with a large effect of exposure are selected, and the total concentration ratio of 1 is not reached only by those, so that we assumed the water with zinc 65, the remaining 9th nuclide, until it reaches 1. Although we use this water for assessment, I am currently worried about whether there is a realistic meaning to

the implementation plan or to management in our manual. I would like to show you the results of the examination including it.

○Masaoka (S/NRA):

There is certainly one point that you mentioned, but on the other hand, it is also related to the operating procedures that becomes topics every time. Based on the results of the study, I think it will be related to the positioning of this assessment itself, so I hope you will consider it.

That's all from me.

○Matumoto (TEPCO HD):

I agree with you.

○Kaneko (S/NRA):

Thank you very much.

How about something else?

Mr. Sugiura, please.

○Sugiura (S/NRA):

I would like to ask two questions.

First, it is related to pages 19 and 21. With regards to dose conversion coefficients of daughter nuclides under radioactive equilibrium, which has different name between external exposure and internal exposure. From 4-1 to 4-5 in the table of the impact assessment report, I think, are for external exposure, and the 4-6 in the table are for internal exposure.

There are different expressions in the tables for external and internal exposures. Namely, the expression of “are included in the parent nuclide” for external exposures is appeared, on the other hand expression of "evaluated by" for internal exposures is appeared. Therefore, we would like you to explain what specific actions are being taken here.

I would like to ask you one more question. As you mentioned that you will implement an

additional assessment about OBT, organic bonded tritium, on page 44. Could you tell us your opinion or such data of the existing ratio of OBT when you start assessment?

○Kaneko (S/NRA):
It looks like some details, but how about it from TEPCO.

○Matsumoto (TEPCO HD):
To begin with, I would like to answer from the second question, OBT topic. There were discussions regarding OBT in ALPS subcommittees hosted by the Government. In the discussion, about a few percent of OBT exists in tritium and the degree of influence is about three times greater. Based on this discussion, we would like to implement some trial calculations and assess the impact of OBT.
The contribution of tritium is originally small in this impact assessment, so even if the OBT of about a few percent is considered, it is currently estimated that there is little effect.

○Kaneko (S/NRA):
As for the first point, do you have any answer at this moment?

○Okamura (TEPCO HD):
This is Okamura from TEPCO. I will answer the question.
With regard to external exposure, the radiation equilibrium is established at the source where the radiation was originally emitted. So, explanation “included in the conversion factor of the parent nuclide” is used to mean that the contribution of both nuclides is included in the parent nuclide.
Regarding internal exposure, it was written in the same way that it was "evaluated by the parents nuclide" for the same purpose. However, in the actual exposure evaluation, the calculation including the nuclear species that have become radiatively balanced outside is being carried out, and there is a slight inconsistency in the writing method in this part.
As I mentioned earlier, if you look at the results of the exposure assessment for each nuclide, there are numbers including those progeny nuclides, and there is a slight

inconsistency, so I would like to fix this at the time of revision.

○Sugiura (S/NRA):

I understand that the existing progeny nuclide at the time of internal exposure is being evaluated. Thank you.

○Kaneko (S/NRA):

Is it Ok with the OBT?

When you explain about OBT, I think that there is probably some kind of data that will serve as a basis for various references, so I would like you to share that information with us as well, so I would appreciate your cooperation.

○Matsumoto (TEPCO HD):

I would also like to specify those points at the next revision.

○Kaneko (TEPCO HD):

Thank you very much. Anything else?

Commissioner Ban, please.

○Ban (NRA):

I would like to ask you a few questions. The first is about the source term that Mr.Masaoka asked about earlier. This nuclide is the so-called 62 nuclides + C-14, could you tell us the reason why it is enough?

○Matsumoto (TEPCO HD):

At this moment, TEPCO has evaluated 62 nuclides, 62 nuclides of ALPS target species plus carbon-14 which has been confirmed to exist. However, as you pointed out, TEPCO is proceeding with the rearrangement of the way of thinking and the preparation for actual measurement to determine the necessity to consider other nuclides just in case.

So, depending on the results, I think this can be changed according to the ideas on pages

13 and 12.

○Ban (NRA):

Actually, I do not believe that other nuclear species would contribute a lot, however, assuming totally hypothetic water shown on page 12, unlikely water as you described, the logic behind your evaluation might break down unless you start to think what kind of species can exist theoretically first, then eliminate whatever species that can be eliminated, and make it a biggest set.

I believe that this will also affect the selection of nuclides to be checked in the monitoring in the future, so I would like to ask for a proper handling of that. That's the first point.

○Matsumoto (TEPCO HD):

I Understood.

○Ban (NRA):

Second point is the concentration in diluting seawater. You take in seawater from unit 5 intake channel for dilution whose concentration of radioactive substances derived from 1F (short for Fukushima-Daiichi Nuclear Power Station) are not zero. So, isn't it necessary to consider such concentration when you plan to discharge diluted water one kilometers away?

○Matsumoto (TEPCO HD):

As you pointed out, there exists certain amount of radioactive material, mainly cesium from the accident, in the seawater around unit 5 intake channel. However, at this moment, TEPCO construes discharged water one kilometers away as merely a product of location change, sorry to say. In view of this, the additional exposure derived from this location change may not necessarily be considered.

○Ban (NRA):

Well, I think it depends on the way of thinking. We also discussed it internally. First, the

radiation dose at the site boundary meets our review criterion. The water out of site, intentional or not, is out of our review. However, what we are trying to do right now is an environmental impact assessment. In this view, with controlled discharge, this is a kind of planned exposure. If that's the case, the committee thinks that intentional change of distribution of the sources should be included in the evaluation.

○Matsumoto (TEPCO HD):
I can't answer it right now. So, allow me to discuss internally.

○Ban (NRA):
OK, please discuss and make appropriate responses.
Last point is about uncertainty of overall evaluation under the circumstance of various source terms with extreme composition of nuclear species. There should be various kind of uncertainties, however, what would be the most dominant factor for the evaluation? For instance, if you find a certain composition of nuclear species might be most dominant, there should be some kind of explanation about your evaluation, including the assessment of uncertainties at that point.

○Matsumoto (TEPCO HD):
Understood. I will address it with assessments of uncertainties here and uncertainties there. However, in the overall evaluation as you mentioned, there are many conservative factors in many places. So, the uncertainties could be blurred due to the conservativeness. Anyway, I will prepare so that I can explain the conservativeness and uncertainties.

○Ban (NRA):
I know that, if you manipulate, say, concentration factor to extreme value, you can come up with outrageous result. But I am not asking for that kind of things. I am asking you to add a little bit of explanation of uncertainties and conservativeness.

○Matsumoto (TEPCO HD):

Let me make sure about your question. Is that something like sensitivity for concentration setting?

○Ban (NRA):

When you say uncertainties, there may be uncertainties due to lack of our knowledge like concentration factor, some may be due to variation or variability. You may want to consider generation difference about that. Something like that.

So, describe what kind of things exist and what kind of measures are being taken for each.

○Matsumoto (TEPCO HD):

Understood, Thank you.

○Kaneko (S/NRA):

I would like you to prepare and explain for the next meeting or later.

Any other comment?

Mr. Niisoe, please.

○Niisoe (S/NRA):

This is Niisoe from NRA.

I have some comments on the diffusion simulation on page 15. This time, you made evaluation using the result of numerical simulation with the model called “Regional Ocean Modeling System (ROMS)”. I think you need to make a little bit more explanation on the adequacy to utilize this model. Explanation of adequacy on page 16 looks more like an explanation to connoisseurs. This may be apparent for the connoisseurs, however, for common people, I think some politeness is needed. What do you think?

○Matsumoto (TEPCO HD):

Regarding ROMS, this model has been used many times in simulations like dispersion of warm water discharge by electric power companies. So, TEPCO adopted this as proven model. As shown on page 16, TEPCO also confirmed high reproductivity using cesium

dispersion.

For the explanation to common people, TEPCO asked some third parties to review the explicitness and some other things of this simulation. TEPCO would like to consider this with comments from third parties.

I know this is not a clear answer. TEPCO is somewhat worried about the fact that it can prove that it is getting the right results by calculating with this model, or that it will be communicating the results in an easy-to-understand manner.

○Niisoe (S/NRA):

Regarding that, I also have a comment on the area of simulation on page 15. I think you need to address the adequacy of the defined area like Mr. Masaoka pointed out, some explanations are needed to show the defined area is broad enough.

○Matsumoto (TEPCO HD):

I understand. In the main report, seasonal variations and other geometrical variations already exist. So, I think TEPCO can explain using the variations with some additional notes. As Mr. Masaoka stated in his question, it is true that the boundary will expand if we try to decompose it to a thinner level by expanding its scope. Therefore, I would like to present it as one of the contents of this next revision.

○Niisoe (S/NRA):

The other comment is on vertical distribution on page 25. ROMS adopts hydrostatic balance as hypothesis. In a simple term, it is a hypothesis that seawater doesn't move vertically much. Actually, seawater acts that way and it is a general hypothesis in oceanic models. As shown in the vertical distribution on page 25, it is true that tritium stays around bed and does not move toward surface if discharged around bed.

However, I am concerned that tritium to be stirred up upon the discharge of ALPS treated water. If that happens, local turbulence may occur in vicinity of outlet of discharge tunnel to activate the vertical blending. What do you think about the possibility and effect of that?

○Matsumoto (TEPCO HD):

As you say, it is true that the model has such a characteristic, hydrostatic balance. The simulation result shown on page 25 is kind of annual average of the distribution. It does not mean the distribution stays all year long.

So, the vertical distribution changes or fluctuates from time to time just like horizontal distribution. Expression should be modest enough.

On the other hand, as in the latter part of your question, there is a stream of seawater around one meter per second. This stream goes up vertically, so rather than stirring up, you may want to call ceaseless blowing up. Including that, charts on page 25 is drawn that way. What TEPCO wants to show is, even treated water with high concentration (maximum of 1500 Bq/l) goes dispersed quickly around the outlet of discharge tunnel with this simulation. That's all.

○Niisoe (S/NRA):

Let me confirm one thing. The result of the simulation this time looks to me that concentration is thicker around bed and thinner toward surface since discharge is performed around bed. Do I understand right?

○Matsumoto (TEPCO HD):

Right.

○Niisoe (S/NRA):

Well, if you look into the Impact Assessment Report, actual numbers used in exposure assessment are shown. On table 5-5 on page 56, concentration at uppermost layer was 1.2×10^{-1} Bq/l in 2019. On table B-7 on page 87, concentration at lowermost layer is shown, which is 6.0×10^{-2} Bq/l. Concentration at uppermost layer is double of lowermost layer. How should I comprehend this?

○Matsumoto (TEPCO HD):

I need to go back to the data to find the precise answer, but for now I guess it's because the data are average value of 10kilometer square area in front of the power station. Let me come back to you for the right answer.

○Niisoe (S/NRA):

Thank you very much. That's all from me.

○Kaneko (S/NRA):

I'd like to make some comments. Regarding the adequacy of the simulation model, as Mr. Matsumoto explained, the model has been used many times by power companies and you may want to add explanation about adaptive flexibility and ability of expression using actual examples to convince those who may concern.

About charts of annual average concentration on page 24 and 25, it is kind of hard to image the relationship between actual movement of water and the concentration. For instance, if you look at the charts on page 24, other than the point of discharge one kilometers away, there is an area with a little thicker color shoreward. Since this chart shows annual average, I can't tell chronical changes, however, I wonder if the concentration grows as time passes or goes diluted. I wonder what relationship with the design to discharge one kilometer away not to re-take in the water. Do you have any additional explanation?

○Matsumoto (TEPCO HD):

For the first point, I would like to fill in the gaps in the explanation of adequacy of simulation.

Second point, this is beyond the limit of this dispersion simulation in a sense. As you said, this uses 2019 meteorological and oceanographic data, so if the 2019 meteorological and oceanographic data are repeated every year in the same way, the charts on pages 24 and 25 will stay the same. However in reality, meteorological and oceanographic data do not stay the same so is the annual average concentration.

So. as disclosed in TEPCO's website in a form of so called flip book animation, you will see

horizontal simulation result with area stretch out to north and south several times a year in time lapse image. If you summarize the 365 images into one chart, you will see the annual average chart and based on that average concentration of radioactive materials were calculated for 10 kilometers square.
Therefore, the result of the simulation does not show that the tritium stays long or that same situation next year.

○Kaneko (S/NRA):
I think I understood your answer, but let me ask you in a little different way. This simulation assumes that diluted water with certain concentration is discharged from the outlet of tunnel for one year period into cleared water, water with zero contamination. And then the annual average is calculated. Is this OK?

○Matsumoto (TEPCO HD):
Right.

○Kaneko (S/NRA):
Then, if you continue discharging year by year, the result will be different for calculation purpose.

○Matsumoto (TEPCO HD):
Yes, the calculation should go like that. However, year 2019 does not seem to be particular in meteorological and oceanographic data, after all, fluctuation of meteorological and oceanographic data may not affect much on the sensitivity of exposure. Or, even after the accumulated annual fluctuation, exposure stays much lower than 1mSv, 0.05 mSv. These things must be discussed and shown. It just came up to my mind.
Is that what you wanted to ask?

○Kaneko (S/NRA):
It's a lay opinion, but perhaps if you keep simulating for years, concentration may be

accumulated year by year and then be saturated at certain point. I wonder, at the point of saturation, how thick will the concentration be? No big deal? a little thicker or what? Do you have anything like gut feeling?

○Matsumoto (TEPCO HD):
We will examine it. For our viewpoint, saturation point may be around the value of annual average. I will try multi year simulation, which I don't know possible or not, and find out what happens. We will examine it.

○Kaneko (S/NRA):
Maybe even in this single year simulation, if I could see the degree of changes, I may be able to get the better picture. Annual average does not mean enough. I need to know the movement.

○Matsumoto (TEPCO HD):
I understand. I would like to examine the contents of the model and inform you of the results of the examination.

○Kaneko (S/NRA):
Thank you very much. I think that the content is not likely to have a significant effect on the results. However, I was also concerned about how I should understand it in the explanation.
Anything else?
Mr. Hisakawa.

○Hisakawa (S/NRA):
This is Hisakawa from NRA. I would like to check two points, transition model and exposure route.
First, transition model. Accumulation of tritium over years were discussed about seawater, I think it is also necessary to discuss about bodies of ships, fish nets, and beaches.

○Matsumoto (TEPCO HD).

I can't answer right now. Let me bring it back. Period.

○Hisakawa (S/NRA).

OK, I understand.

Next is exposure routes. As described on page 44, additional studies will be made on exposure routes from now on. Do you have anything like general policy such as completeness of the exposure routes or particular routes that can be excluded this case that you can share at this moment?

○Matsumoto (TEPCO HD):

At this moment, what I can share with you is hypothetical definition of representative persons as on page 22. Assumption of what representative residents tend to do and what kind of daily habit do they have. These representative residents may have exposure routes listed on page 18.

On the other hand, as described on page 44, the representative persons could swim in the ocean and might drink water so TEPCO added the case in the study.

○Hisakawa (S/NRA):

Thank you very much.

However, if you refer to the procedure of evaluation, before identifying representative persons, you have transition model, identification of exposure routes and then identification of representative persons. So, first you set the transition model like listed on page 17. For instance, you choose no. (2) advection by ocean current, the source term advected by advection or diffusion by ocean current leads to, say, external exposure due to operation on the sea or external exposure due to swimming or operation under the sea. Or it could lead to exposure due to drinking water, the case that you are going to add on the coming revision. This way, deriving exposure routes from transition model comprehensively, you start sorting out unfit routes. Then you can make suasive

explanation about completeness. What do you think?

○Matsumoto (TEPCO HD):

Thank you. Deriving exposure routes from transition model is the correct approach. As you said, I would like to calculate the concentration from the advection and diffusion of ocean currents and so on, and carefully explain this.

○Hisakawa (S/NRA):

Thank you. That's all from me.

○Kaneko (S/NRA):

Thank you, Mr. Hisakawa.

Mr. Matsumoto, please.

○Matsumoto (TEPCO HD):

A little bit of comment on transit factor. I decided that accumulation effect is already included in the concentration factor. Period.

○Kaneko (S/NRA):

Thank you.

Mr. Ogino, please.

○Ogino (S/NRA):

Ogino of the Nuclear Regulation Authority. I would like to confirm several points regarding the setting of representative person. This is a confirmation from the viewpoint of whether the TEPCO's radiation impact assessment has made assumptions with sufficient representation.

First, how is the representative person defined this time? In your explanations, you mentioned that the assessment was conducted in line with the international standards of IAEA and ICRP. Could you explain more specifically about the definitions of representative person?

○Matsumoto (TEPCO HD):

In case of usual site for nuclear power plants, it is possible to assume general residents or general area and pick up and set certain representative residents. However, there is nobody living in the vicinity of Fukushima Dai-ichi NPS, TEPCO assumed representative residents on page 22. Are the representative residents really representative? Is that what you asked?

○Ogino (S/NRA):

Right. In terms of your explanation at the moment, is it correct to understand that the evaluation of doses was based on the assumption that the residents were living in the surrounding areas under the conditions that they were not actually living in?

○Matsumoto (TEPCO HD):

Yes. The Hypothetical residents live there, go to the coast for fun, work on fishing and eat sea product there.

○Ogino (S/NRA):

On slide 8, on the right side of the representative person settings, the definition refers to the person who is most exposed from the above exposure route in the population to be evaluated. ICRP recommendations 101 and 103 define individuals within a population who have received typical doses among those exposed to higher doses.

In TEPCO's assessment this time, is it correct to understand that dose assessment is being carried out in accordance with the content of ICRP Pub 101, which is a publication titled Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public?

○Matsumoto (TEPCO HD):

Since the setting of residents and so on is different, TEPCO had to take a different approach, however, by identifying the most exposed individuals, TEPCO’s purpose is in line

with ICRP's.

○Ogino (S/NRA):

I understand. Subsequently, I mentioned earlier that ICRP has published Pub 101 on representative person, and there is a little more important statement. There is a reference to the public's role in identifying and characterizing representative person for the purposes of radiological protection. These recommendations suggest that stakeholders provide inputs on specific habit data and use them to assess data rationality and sustainability, and that collaboration with stakeholders can improve the quality and importance of representative person' characteristics and enhance stakeholder support in the decision-making process.

If TEPCO has worked on these points in setting up a representative person, please explain.

○Matsumoto (TEPCO HD):

As mentioned before, since there is nobody living there, It is impossible to collect information like daily habit, going to beaches or how much to eat. It is definitely a hypothesis of TEPCO about individuals who get exposure within 10 kilometers square from the power plant.

○Ogino (S/NRA):

I believe that it is important to use realistic parameters as much as possible in the assessment of radiation exposure for the representative person. As you mentioned earlier, there are situations around the current 1F and there are prospects for the future. Based on the current situation and the future outlook, I felt that it would be necessary to discuss a little about the extent to which this time's representation is possible.

○Matsumoto (TEPCO HD):

Identification of representative persons in the future, when people start coming back to the vicinity of the power plant at which point, is rather a long term agenda, rather than the next revision since discharge continues to year 2040, maybe 2050. What do you think?

○Ogino (S/NRA):

I think it is important to think about the future even in areas where the people are not currently living, and to set up individuals with such representation.

○Matsumoto (TEPCO HD):

Yes. I'll take this under consideration.

○Ogino (S/NRA):

As for the third point, I am sorry for the slight fineness, but I think that the annual effective dose due to external exposure and the committed effective dose due to internal exposure have been evaluated for the representative person in the impact assessment this time. Please explain how significant figures were handled in the process of this calculation.

○Okamura (TEPCO HD):

This time, I used two significant digits, as many parameters are. I think this is precise enough.

○Ogino (S/NRA):

In terms of the committed effective dose assessment of internal exposure to humans, for example, a concentration factor for marine products is used. In the Technical Report TRS-422 of IAEA, which is the source of the data citation, a concentration factor is given with a single significant digit. As long as the committed effective dose of internal exposure is calculated using this concentration factor, it is scientific to also express the committed effective dose of internal exposure in single digit. What is this point?

○Matsumoto, (TEPCO HD):

In that sense, the first digit has the biggest error. I understand what you mean and let me consider if it be included in the revision.

○Ogino, (S/NRA)

Thank you. Similarly, in the assessment of the reference animals and plants, the absorbed dose per day, the distribution coefficient or Kd from the liquid phase to the solid phase are also used. Similarly, since TRS-422 has only a single-digit precision, I think that the same indication can be made for the absorbed dose rate of reference animals and plants.

○Matsumoto (TEPCO HD):
Understood.

○Ogino (S/NRA):
With regard to the representative person, that's all I have to point out.

○Kaneko (S/NRA):
I would like to make a comment on the first discussion of representative persons in addition to the point from Mr. Ogino.
You may want interview some fisheries workers about the way they used to live before the accident and the way they wish to live when they come home and start stable living. Since TEPCO should have some communication lines with fisheries workers, it may be helpful to see if your assumption about the representative persons missing the point. What do you think about this?

○Matsumoto (TEPCO HD):
The representative persons that TEPCO set on page 22 are kind of eccentric individuals with eccentric habit. If you make realistic assumption, the evaluation may go safe side. Anyway, along with the definition of ICRP, TEPCO will consider the representative persons again.

○Kaneko (S/NRA):
Commissioner Ban.

○Ban (NRA):

This discussion may be related to the uncertainty or variability that I mentioned. After all, the philosophy is, as effective dose varies depending on living habit of each individual and distribution forms, to select persons from the higher skirt of the distribution as representative persons. However, do not assume extreme case, but assume reasonably higher skirt of actual distribution. That is the philosophy. So, it would be sufficient if you could explain how the evaluation was done. In the explanation, that I discussed a while ago, what kind of uncertainties and deviations are taken in the consideration, what kind of measures are taken for each of them, you may touch upon this.

○Matsumoto (TEPCO HD):
I understand. In the part of evaluation of exposure, I will be prepared to explain it by listing hypotheses and uncertainties and showing the range.

○Kaneko (S/NRA):
Thank you very much.
Anything else?
Mr. Shibutani.

○Shibutani (S/NRA):
This is Mr. Shibutani from NRA.
I have a question about potential exposure.
This time, you do not evaluate the radioactive materials adherent to fishing nets, etc. since the flow of undiluted water is in short term.
On the other hand, exposure from fishing nets is two to three digits higher than that from surface of sea in usual time as shown on page 27. Didn't you consider other cases like people close to fishing nets get more exposure even without materials with high inventory coming?

○Okamura (TEPCO HD):
Okamura is going to answer. As to the assumption of fishing net, we received comments

about accumulation and transition factor. However, the transition factor used here is the one for nets repeatedly used, so this time transition via fishing nets, etc. is out of consideration for one time discharge.

○Shibutani (S/NRA):
Understood. Although this may not be discussed in the review meeting, it would be helpful if you could provide us some list of premises of detailed settings attached to document.

○Matsumoto (TEPCO HD):
We listed the contents of revision on page 44, I would like to include the opinions and answers to the questions today into it to make the report self-explanatory.

○Kaneko (S/NRA):
Anyone?
Mr. Iwanaga.

○Iwanaga (S/NRA):
On page 24, I would like to come back to the discussion before. You use meteorological and oceanographic data of year 2019. However, as commissioner Ban pointed out, there are variations year to year. I would like you to collect such data, say, for ten years and show us which year is typical and which year is extraordinary. Then, we can discuss uncertainties and other things. Can you help us like that?

○Matsumoto (TEPCO HD):
If I rephrase Mr. Iwanaga's question, is it something like this? "Why use 2019 data at all? We need explanation."

○Iwanaga (S/NRA):
A little bit different. When I see data, I want to see the distribution, too. And in that

distribution, I want to see where the 2019 data sits. There may be reasons why 2019 is selected, like it is rather high or it is stable. It would be very nice if I could see the chronical positioning of the data. Is that quite tough?
In the case of the examination of installation of nuclear power plants in general, we have been considering the degree of stability of weather. So how far can we express such a point in this story? Do you understand?

○Matsumoto (TEPCO HD):
I got your point. At present, TEPCO conducted the radiological impact assessment mainly because meteorological and oceanographic data for 2014 and 2019 were all set. TEPCO uses the data of 2019 because that 2019 data are more effected than 2014 data. If we show the 2014 and 2019 data at the same time, you will get the feeling. I would like to revise the assessment.

○Kaneko (S/NRA):
So, please be a little creative in providing information so that we can see the positioning of a set of data.
Anyone?
Mr. Ogino.

○Ogino (S/NRA):
Ogino of the Nuclear Regulation Authority.
I would like to ask you one more question regarding the potential exposure.
As a scenario of the potential exposure this time, the sea water pump is stopped and the emergency shut-off valve is not operating, and the treated water is released directly to the ocean to calculate the external exposure for 24 hours a day. I have a question about the validity of this.
You have explained that the assessment was conducted in accordance with GSG-10 this time. Looking at paragraph 3.11 of GSG-10, for example, there is a statement that not only the exposure dose, but also the likelihood of exposure, the frequency of occurrence, and

the number of persons that may be affected by it need to be evaluated. Please explain the validity of this scenario and whether it is only necessary to evaluate the dose this time.

○Matsumoto (TEPCO HD):

Basically, if we imagine a situation in which the ocean release of treated water is about to, patrols will be conducted regularly by patrol personnel. However, basically, there are not many people in the vicinity of this situation. I usually see that regular patrols are held once a day for an hour or two. Of course, when we start regular maintenance and inspection, we check the seawater pump or the electrical equipment room with a reasonable number of people. However, conversely, there is no discharge of treated water at that time. In that sense, the script TEPCO assumes is not the effect from number of people, but an accidental script that there happens to be a man at sea and he gets exposed by uncontrolled discharge of treated water.

○Ogino, (S/NRA)

Ogino of the Nuclear Regulation Authority.

Thank you. In connection with this, you have assessed the exposure in the scenario you mentioned and compared it with the event of 5mSv/event. GSG-10 states that it applies for facilities with very few inventories and low environmental releases in the event of an accident, and the dose criteria could be 1 to a few mSv, typically 5mSv. On the other hand, if the inventory is very large such as nuclear facilities, the criteria are given in terms of dose levels that differ a little more or the risk level considering the frequency of occurrence. Please explain the validity of the comparison of 5mSv, which applies to the facility with a small inventory.

○Matsumoto (TEPCO HD):

Looking at the properties of ALPS treated water stored in the measurement/confirmation facilities, it can be seen that the concentration of tritium is approximately 150k Bq/L to 2.16mil. Bq/L, but all other nuclear species are less than 1 in the sum of Notification concentration ratios. Therefore, I think that there is no problem in the category of being small as an inventory.

○Ogino (S/NRA):

Ogino of the Nuclear Regulation Authority.I understand that you used the dose when the inventory is small this time. That's all from me.

○Kaneko (S/NRA):

Thank you.

Mr. Takeuchi.

○Takeuchi (S/NRA):

This is Mr. Takeuchi from NRA.

Regarding the potential exposure that Mr. Ogino also discussed. This time your scope is limited to external exposure only because whenever you recognize an accident happens, you immediately stop taking marine products as you explained. However, history tells that you may not necessarily be able to recognize accidents immediately after they happen. So I recommend you to reconsider not to limit the scope to external exposure.

○Matsumoto (TEPCO HD):

TEPCO basically recognizes accidents, in that sense, no fishing after the accident and no eating marine products are assumed. However, as Mr. Takeuchi thinks, you may or may not recognize the accident, or even after the recognition, instructions not to fish or eat may come late. Let us study how to evaluate in such cases.

○Takeuchi (S/NRA):

Thank you in advance.

One thing that is not listed on the major discussion points. On page 34, you have formula to evaluate external exposure. In the formula, both first and second terms are multiplied by 0.5. Can you tell what the 0.5 means?

○Okamura (TEPCO HD):

Okamura is going to answer. As for the use of the dose conversion factor originally indicated by ICRP, when the impact from the seabed soil is not considered, this 0.5 is set to 1, and the second term is gone and gets the exposure from all directions of the ocean. This equation indicates that when there are fish or marine organisms on the seabed, lower half of it gets the exposure from the soil and upper half of it gets the exposure from seawater. So 0.5 is allocated to both terms.

○Takeuchi (S/NRA):

I agree to halve the exposure from surface source of seabed soil for the ones at the boundary surface between seabed soil and seabed. On the other hand, for the ones in seawater side because they are immersed in the seawater, 1 instead of 0.5 seems suitable for me and I also couldn't find such examples. Now, I understood that 0.5 should be multiplied to both terms since they are at boundary surface. However, I still want to confirm if it is standard procedure.

○Kaneko (S/NRA):

As to the current issue, I think TEPCO and NRA should make sure again, just in case. If something happens, we can always make comments or share information.

Anyone else?

○Otsuji (S/NRA):

I'm Otsuji from another room of NRA. There has been a disconnection of online meeting system for a short time, so I'm afraid I couldn't follow the discussion until now. If I mention the points that have been discussed already, I would like you to skip over it.

I would like to ask one point about the various coefficients used in this assessment. On page 5 of the slide, there is an explanation of the factors that are used in references to IAEA, ICRP, and as for those that are not there, on page 19 of the slides, you have explained about the factors that have been taken from documents that have already been used as basis in Japan. I think this is okay.

On the other hand, as in the second item on page 44, regarding coefficients which are

scheduled to be revised in the future, you explained that calculation will be performed on a trial basis using the coefficients in the documents which have been published recently such as Pub.144 of ICRP to see if how the use of these coefficients effects the assessment results.
I think you have already looked at the difference itself in the coefficients, but I understand you have not yet considered the difference nor performed a trial calculation. If you have already made any considerations, I would like you to let us know how much it will affect it.
And one more point, I would like to ask you about a rough idea of the time and schedule required for the revision, as you explained on page 44.

○Kaneko (S/NRA):
TEPCO, please.

○Matsumoto (TEPCO HD):
As you pointed out, in principle, we use the necessary coefficients from official sources, as shown on page 5 or page 19. Therefore, I think you understand that those are not the number that were used arbitrarily. Although we used them as a package, there are new data such as in Pub.144 among them, and we thought that it would be better to refer to them as well, so we picked them up as the content of the revisions this time.
Basically, it is estimated that there will be no significant impact, but we would like to make a judgment after calculating actually on a trial basis properly.
Regarding your second question, we will take into account the opinions and questions you gave us at this review meeting, and at the same tome we are also receiving IAEA review. Based on these results, we are considering revision next time. We think it will take about one month.
Nevertheless, as this is just our wish, while preparing replies from now on, we will deal with the revision based on your comments such that consideration is still insufficient.

○Otsuji (S/NRA):
I understand that there will be no major impact due to coefficient, so I would like to

confirm the results of the trial calculation when you explain the revision next time. Thank you very much.

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

○Ban (NRA Commissioner):
I am sorry for the very detailed issue, but at the bottom of page 19, you mentioned that you used ICRP Pub.144. This is probably a new coefficient, isn't it? So I think it's a calculation using the so-called voxel phantom with the Pub.103-based tissue weighting factor. On the other hand, in Pub.72, internal exposure is an effective dose based on Pub.60, so in fact different dose must have been calculated.
So I don't think there will be such a big impact, but I think it would be better to mention why you selected this coefficient while recognizing that you use such a different one.

○Kaneko (S/NRA):
Thank you very much.
In a sense, it looks like consistency, as a whole. I would appreciate it if you could prepare explanations including the point.

○Matsumoto (TEPCO HD):
I understand. In addition to simply describing the documents cited, I would also like to show the description related or reasons.

○Kaneko (S/NRA):
Is there anything else? Is that okay with you?
So, there have been a number of comments, including comments on very detailed technical matters. In any case, as explained by Mr. Matsumoto, including items which TEPCO is going to revise voluntarily as shown on page 44, as well as the items pointed out today, it will take about one month as mentioned, we would like to discuss about what

should be clarified again and matters on which explanations should be added while keeping this time frame in mind. It is not to say that we set a deadline, I hope that you will proceed with deliberation so that the content will be thoroughly fulfilled, and that we will be able to discuss the matter again at the review meeting at an appropriate time. In this way, for now, is this matter okay with TEPCO?

○Matsumoto (TEPCO HD):
I understand. Thank you very much.

○Kaneko (S/NRA)
Thank you very much.
Then, if there is nothing else that you have in particular about this matter, we will take a 10 minute break to change seats. It is just half past three, so I would like to start the latter half part from 3:40. Let's take a 10 minute break.

(Break)

○Kaneko (S/NRA):
Now time has come. We would like to start the second half of the sixth review meeting.
In the first half, we had much discussion on radiological impact assessment. In the latter half, we would like to discuss the concept and specifications of the design of facilities and equipment, with a focus on them.
It's on page 45 and later of the document 1 TEPCO prepared, so we would like TEPCO to explain about it one after another, and if we have any confirmations or questions, we would like to discuss them.
Then, I would like TEPCO to explain the document first.

○Matsumoto (TEPCO HD):
I am Matsumoto, TEPCO.
Then, please see page 45. I will explain this time about ⑤ the structure and strength of

equipment, protection against natural phenomena such as earthquake and tsunami, prevention of misoperation, reliability, etc. for the facilities for discharge into the sea among the main points for the examination based on the Reactor Regulation Act.
Regarding the issues to be discussed, as enclosed, we are provided with the points to be summarized and explained for each structure, system and equipment consisting the facilities for discharge into the sea: safety function, impact in the event of the loss of the safety function, basic specifications and the basis for establishing them, the main structure, applicable codes and standards, etc.

See page 46. Today's explanation is given to ALPS treated water dilution/discharge facilities surrounded by a yellow dotted line excluding the upstream storage of the discharge vertical shaft. There are three kinds of facilities such as measurement/confirmation facilities written in orange, ALPS treated water transfer pump written in green and dilution facilities.

See page 47. Regarding applicable codes and standards, as shown with four squares, we apply the Code for Nuclear Power Generation Facilities – Rules on Design and Construction for Nuclear Power Plants (JSME), Japan Industrial Standards (JIS), etc. In addition, they fall within the scope of Class 3 equipment equivalent to waste disposal facilities specified in the Regulations on Technical Standards for Commercial Power Reactors and their Auxiliary Facilities. In addition, for steel pipes containing ALPS treated water, JSME S NC1 2012 and other private-sector standards such as JIS standards will be applied. Polyethylene pipes are considered to have structural strength if they conform to ISO or JWWA standards and are used within the scope of application. Pressure hoses and expansion joints are considered to have structural strength if they are used at pressures and temperatures within the manufacturer's specifications.

On page 48, we have shown handling of metal materials. As for an evaluation method, according to the evaluation equations ① and ② described here, the required thickness is calculated for a pipe that receives pressure on the inside surface, and the minimum

thickness is determined for a carbon steel pipe.
On page 49, the results of the evaluation are shown. TEPCO evaluated every pipe satisfies the required thickness and has sufficient structural strength.
Please see page 50. This is handling of non-metallic materials not specified in JSME standards, and polyethylene pipes fall under this. Polyethylene pipes are considered to have structural strength if they conform to ISO or JWWA standards and are used within the scope of application. As I mentioned earlier, pressure hoses and expansion joints are used at pressures and temperatures within the manufacturer's specifications.
As the range of application of non-metallic pipes, the maximum allowable operating pressure and maximum operating temperature of polyethylene pipes, pressure-resistant hoses, and expansion joints are shown. TEPCO will use them within the range of these pressure and temperature

See page 51. With regard to seismic design, as for the ALPS treated water dilution/discharge facilities, we consider seismic importance level as Class C, and as for equipment class of tanks and pipes as Class 3. And, as for circulation pump and ALPS treated water transfer pump, we will conduct calculation of strength according to the "Guide for Procedure regarding Construction Permit of Commercial Power Reactors", and as for pumps connecting to Class 3 equipment according to the Design and Construction Rules or JIS.

As for seismic design, please see pages 53 and 54. As shown on page 53, the seismic categories of seismic design provided by the Nuclear Regulatory Authority are classified according to the exposure dose to the public around the site. In this case, as for ALPS treated water dilution/discharge facilities, the exposure dose to the public around the site is 50μSv or less, therefore, we consider that the seismic class as Class C is appropriate.
On page 54, the results of assessment of the radiological impact on the public due to transfer of the leaked water into the air are shown as 0.4 μSv. With regard to swift initial response in the event of an earthquake with a seismic intensity of 5^{-} or higher, the site of tanks with connecting valves open must be checked first, and if leakage is confirmed, the

connection valve shall be closed immediately We will install a foundation weir to prevent the stored water from leaking significantly out of the site in case the seismic class C tanks are damaged by the earthquake. This weir is designed as seismic Class B and the necessary strength is ensured for the horizontal design seismic intensity required for Class B structure. If the stored water leaks and accumulate inside the foundation weir, the leaked water is collected by a temporary pump, a high-pressure suction vehicle, etc. The collected leaked water will be delivered to a sound tank or building.

As for evaluation method, see page 55. As shown in the figure, tanks are connected with connection valves, On the assumption that ALPS treated water leaks from the damaged part and all the water stored in the tanks leaks out of the tanks, we conducted assessment of radiation impact on the public by simulating a single large cylindrical shape that has the same volume and height as a group of tanks.

The assessment results are shown on pages 56 and 57. The exposure dose due to directrays and skyshine rays is estimated as $0.9^{*} \times 10^{-3}$ μSv/year.

*1.9 is correct figure as shown in the meeting documents.

In addition, on page 57, the radiation exposure due to transfer into the air is estimated as 0.4 μSv.

See page 58 for the case of loss of functions. We assessed the impact in case of loss of functions of equipment downstream from the confirmation/measurement tanks. As shown in the figure at the bottom right, we will lay a piping described in green pipes for transfer of ALPS treated water from the ALPS treated water transfer pump to the discharge vertical shaft. The section assessed for this time is the section from the treated water transfer pump to the emergency isolation valve-1. With regard to this piping, the diameter is 100A and the length is about 1km. So, even if the downstream equipment is damaged, the largest leakage is approximately $8m^3$. We believe that this amount of leakage is much smaller than the estimated amount of leakage in the measurement/confirmation tanks. Therefore, we believe that the radiological impact on the public due to loss of functions of ALPS treated water dilution/discharge facilities can be represented by the assessment of

the measurement/confirmation tanks.

As for this point, please skip to page 76. Regarding the exposure assessment in case of liquid leakage, when the treated water facilities were damaged and the stored water leaked, an adult injected 2L of this water once, the dose was estimated as 32 μSv for a single event. However, the adult's drinking of 2L of the leaked treated water is considered to be extremely unrealistic. Therefore, in the application for the amendment, I would like to withdraw this case.

Please return to page 59. I would like to make some supplement to the swift initial response. In the event of an earthquake with a seismic intensity of 5^- or larger, the discharge into the sea will be stopped, and the motor operated valve at the outlet of the measurement/confirmation tanks will be closed and tank water levels will be checked to see if there is leakage or not. In addition, after the earthquake, we will conduct intensive patrols of all equipment, including outdoor transfer piping to check for any abnormalities in the facilities. For outdoor transfer piping, the polyethylene pipe and polyethylene pipe joints are fused to prevent the occurrence of leakage. And, the seismic resistance of polyethylene pipe will be ensured by the flexibility of materials. In particular, damage to polyethylene pipes laid in the premises of the Fukushima Daiichi NPS has not been confirmed due to the earthquake that occurred off the coast of Fukushima Prefecture on February 13, 2021.

And, if there is a roadway running by the transfer piping, fences, etc. will be installed to prevent damage to the equipment due to external factors. In addition, the transfer piping will be separated as far as possible from drainage channels, and at the point where the drainage channel is crossed, the piping will be laid in the box steel, etc., and sandbags will be set to make sure water leaking from the end of the box steel will not directly flow into the drainage channel.

See page 60. In order to deal with natural phenomena other than earthquakes, facilities will be designed so that the safety of facilities will not be impaired due to tsunami, heavy rain, typhoon, tornado, etc.

In the event of tsunami, among the ALPS treated water dilution/discharge facilities, the measurement/confirmation facilities and part of the transfer facilities, excluding the dilution facilities, will be installed at a height of 33.5m or higher above T.P. at which it is considered that tsunami will not reach. In this picture, though the measurement/confirmation facilities are located at the height of 33.5m, the ground level described previously extends to the location of emergency isolation valve-1 and seawall. In addition, in the event of a major tsunami warning, the transfer and dilution facilities will be stopped in consideration of the risk of damage to the facilities due to tsunami.

Next, please see page 61. This figure shows the location of inundation in the event of tsunami. Based on the result of analysis for the Japan Trench Tsunami, flooding depth assumed on the T.P. +2.5 m ground is 9m or more, which means that seawater pumps, etc. are likely to be inundated. On the other hand, the emergency isolation valves-1 located on the T.P. +11.5m ground are surrounded by seawall, so they will not be inundated. ALPS treated water transfer line is planned to be laid at a height of about 0.3 to 0.4m above the ground, so inundation will not be assumed, since the maximum inundation depth is less than 0.2m at any location.
Therefore, as shown in the picture on the right, we believe that electrical components installed in the electrical component chamber for of ALPS treated water and the emergency isolation valves can be protected in the event of tsunami.

See page 62. Regarding other natural phenomena, design considerations on snow accumulation, lightning strike, tornado, and typhoon are described.
If it is known beforehand that such natural phenomena may occur by means of advisories such as tsunami advisory and tornado advisory, we will judge that the facilities may be damaged or discharge into the sea may not be carried out as designed. In that case, we will conduct an operation to stop the facilities.
Those are explanations of this issue.

○Kaneko (S/NRA):

Thank you very much

So, if there is anything you would like to confirm about the content of the explanation, please go ahead.

Yes, Mr. Arai.

○Arai (S/NRA):

I'd like to ask about the natural phenomena first.

On pages 53-59, the basis for setting the seismic class for this facilities was described. As explained by Mr. Matsumoto earlier, I confirmed that the oral intake of page 76 does not serve as the basis for setting the seismic class this time.

In view of the fact that ALPS treated water contains relatively low radioactivity liquid, we also confirmed that measures to mitigate the impact are taken for tanks and piping downstream of the tanks. We would like to confirm the conditions for setting the radioactivity necessary for the assessment and the details of the mitigation measures in the materials in the future.

In that regard, I would like to discuss about a more broad topic. For example, on page 62, I would like to confirm whether or not the natural phenomena that should be assumed in the design of these facilities have been selected comprehensively. This time, snow accumulation, lightning strike, tornado, and typhoon have been mentioned, but heavy rain which is common in daily life and freezing are missing. May I understand that these are also considered in design?

○Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

Of course, we will also consider heavy rain and freezing. As it is the outdoor piping. we will take measures to prevent it from freezing in winter as well as to prevent the foundations that support the piping from being pulled down and drifted by landslide.

○Arai (S/NRA):

I understand. I would also like to confirm the details of the specific measures in the

materials.

Next on page 62, the same page. Since they are in seismic Class C level this case, I think the natural phenomena that should be assumed will be set according to the level and they will be designed. However, it is mentioned that when an event that exceeds the level occurs, you will stop them. I would like you to explain about the time interval between the actual perceiving of the tsunami and tornado and the actual stopping by operators, and the procedure for stopping as well.

In concrete terms, in relation to the deployment of the emergency isolation valve, please explain whether to stop discharge all together by the emergency isolation valve or whether to stop it in the order according to the procedure that is reverse to the start-up of the pump.

○Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

Please see page 58.

For tornado advisory or typhoon that are likely to be known in advance, we will close the motor operated valve installed between the measurement/confirmation tank and the ALPS treated water transfer pump as mentioned on page 58 to stop discharge itself. Of course, the ALPS treated water transfer pump will also be stopped, but we would like to take such steps as normal start-up and normal shutdown for the treated water.

The emergency isolation valve will be used differently such as for stopping discharge through interlock based on the judgement that the performance of seawater pump for diluting the ALPS treated water has declined or that the conditions cannot be satisfied due to some abnormality during discharge.

As for time to make a decision, when we get such warnings or advisories, though we have not yet shown it specifically, as our idea, we are considering that the shift supervisor who is responsible for the facilities will decide to stop discharge of the treated water and instruct the shift staff to close the motor operated valve.

So, in regard to the time for that action, as our usual practice for operation, we will

prepare a procedure in advance, so I think it will be stopped within a few minutes.

○Arai (S/NRA):

I understand. Then, I would like to confirm the contents such as detailed procedures and the outline in the materials.

So, in the final note on page 62, the content I have confirmed now is written. However, the meaning of Japanese in the line with “or” is not understandable a little, could you explain once again whether or not the case where the discharge into the sea as designed may be unable to be achieve has a relation with natural phenomena?

○Matsumoto (TEPCO HD)

We assume tsunami in particular and so-called storm surge. Although the discharge into the sea is not included in the category explained today, the method to be pushed out by gravity is employed by utilizing the so-called difference in water level between the discharge vertical shaft and the sea level. Therefore, if the sea surface rises due to tsunami or storm surge, the head between the discharge side and the water surface becomes smaller, so the pushing out force becomes weaker. We are thinking of such situation in the event that the discharge cannot be achieved as designed, so the tsunami or storm surge will fall under this category.

○Arai (S/NRA)

Then, I would like to confirm about the tide level that should be considered in the detailed design in the issue related to the sea.

Those are my comments on natural phenomena.

○Kaneko (S/NRA):

Regarding natural phenomena, is there any additional confirmation?

Yes, Mr. Masaoka.

○Masaoka (S/NRA)

I would like to ask you to explain about following matters in the future concerning your

reply to Arai's last comment. As stated at the bottom of page 62, there is a condition such as deviation from the design or a risk that the equipment may be damaged. As you mentioned now, I understand that procedure will be developed properly and the shift supervisor will decide. What do you use to detect that, for example, by means of tide gauge or water level gauge of the vertical shaft? I think the head is about 2 meters originally, so it will be structured and designed to flow out water with a water level difference of about 2 meters. Therefore, I would like you to summarize how you detect it together with that.
This is just a confirmation, but on page 49 and page 50, steel pipes, polyethylene pipes, or hoses are used in this piping system, and, each system diagram is attached from page 69. Concretely, it is common in ordinary power stations to use steel pipes basically. However, based on the situation of the 1F, it is well understandable that polyethylene pipes with more flexibility and earthquake resistance will be used. Please explain how to use each of these three kinds of pipe for what portions respectively, if there is a design consideration.

○Matsumoto (TEPCO HD)
The matter pointed out in the first half is what we are thinking about what we should do. We have a route to obtain weather information such as tsunami advisory, typhoon, tornado advisory, etc., at our power station. We basically think that we will use it, receive them, and then convey them to the shift supervisor. I think while measuring the tide level with a so-called tide gauge meter, it will be in time, but I think that it will not fit in with the practice of stopping discharge in advance. So we are considering to prefer the route for receiving such weather-related advisories and warnings.

What we now think to be considered is that, like the recent eruption of a submarine volcano off the coast of Tonga, when tsunami was actually reaching 1F, no advisory had been issued yet. I feel that we should consider such a case in the future as well.
On the other hand, normally, we can respond to typhoon or tsunami after we detect earthquake based on the recognition that they may come, but I am thinking that the case of the week before last was a bit of a bother.

Next, Yamane will answer about steel pipes.

○Yamane (TEPCO HD):

I am Yamane, TEPCO.

This time, we use PE pipes. Basically, we intend to adopt polyethylene pipes, etc., considering the workability unique to the 1F. However, as for the portions used with steel pipes this time, I believe it is important to appropriately measure the amount of ALPS treated water transferred or the amount of seawater transferred. Therefore, orifices are used as flow meters. In order to use an orifices, the accuracy of the inner diameter of the pipe, etc. is required. For such portions, we decided to use steel pipes.

That is my explanation.

○Masaoka (S/NRA):

I understand.

Regarding the first point, what I have learned from your explanation is that if an advisory of tsunami or tornado is issued, as described on page 62, of course you will judge with that information. On the other hand, although I do not know whether it is for just in case, I understood that you are considering widely about the abnormal water level in the vertical shaft in case of the tsunami like the previous one, which I was worried about.

As for the second point, I understand that basically PE pipe will be used, and as shown in this system diagram, and the steel pipes are used around valves, or around the flowmeters where we have no choice but to use steel pipes.

At that time, there were two points that I do not understand. First, the diagram of sampling tanks on page 71. One point is that I do not understand where these sampling lines come from and where they are connected to in the piping diagram.

Also, on page 73, there are many expansion joints in the portion from the header to the discharge guide. Though I understand that the expansion joints are basically used for the portion where relative displacement occurs or for disconnecting vibration of pump. I couldn't understand there are so many expansion joints from this header to the discharge

guide. Please explain about these two points additionally.

○Yamane (TEPCO HD):

Regarding the expansion joints on page 73, the piping here is embedded under the ground once, so the expansion joints are designed to be inserted to absorb the relative displacement.

And let me check on page 71. I will reply it separately.

○Masaoka (S/NRA):

I understand that expansion joints are used instead of elbows on page 73, but I didn't quite understand what you said about the relative displacement right now. Is this a place where relative displacement occurs?

○Yamane (TEPCO HD):

This piping is assembled on the ground and then run under the ground once. After that it is connected to the discharge guide and other structure, so we consider relative displacement.

○Masaoka (S/NRA):

It will be a little bit detailed matter, so I'd like to look at the isometric drawing in the materials and check the location of their installation.

○ Yamane (TEPCO HD):

I see. Thank you.

○ Kaneko (S/NRA):

Is there anything else regarding this?

Yes, Mr. Arai.

○Arai (S/NRA)

I would like to confirm several points in the evaluation of strength for structure. In the

previous confirmation made by Masaoka, regarding the reason for using carbon steel, stainless steel, and polyethylene pipes, stainless steel is included. Could you explain why this was adopted?

○Yamane (TEPCO HD):
First of all, we consider using SUS316L basically when using stainless steel for the ALPS treatment water piping. Also, basically, we consider to use lining carbon steel pipe for seawater system, but as I mentioned earlier, an orifice is inserted in a flowmeter, so we are considering to use two-phase stainless steel because lining is difficult to be provided to such portion.

○Arai (S/NRA):
On the reference diagram this time, the sea water transfer system is described in dotted line, I would like you to present the material of the sea water transfer pump, piping, and valve in the sea water transfer system as necessary specifications in addition to isometric drawing mentioned earlier.
By the way, my understanding is that the seawater transfer pump is made of stainless steel. Is that correct?

○Yamane (TEPCO HD):
I think the casing is casting of carbon steel.

○Arai (S/NRA):
Casing is the part that covers a pump, isn't it? I thought that some stainless steel would be used for the soaking part on the inner surface like a normal seawater pump.

○Yamane (TEPCO HD):
Do you mean the part of the shaft of pump?

○Arai (S/NRA):

Yes.

○Yamane (TEPCO HD)

I think it is stainless steel, but please let me confirm it.

○Arai (S/NRA):

I understand. So, please present it later.

And regarding the expansion joints around the seawater piping header mentioned earlier, on page 73, for example, I think that the part marked ⑪ is the fuselage of seawater pipe header, and this is evaluated structurally as Class 3 component according to JSME, and it is written on page 49 that the part ⑫ on the exit side of the pipe header is carbon steel.

I think there is a tapered part between them, please explain how to evaluate this part structurally.

○Yamane (TEPCO HD):

Excuse me, please let me confirm it.

○Arai (S/NRA):

Looking through the system diagram and at the table on page 49, it is difficult a bit to understand what are used and where they are after all, for example it seems that the tapered part is also included in the part marked ⑪. So please present the main structure and the basic specifications in the future.

○Yamane (TEPCO HD):

I understand.

○Kanko (S/NRA):

Is there anything else?

Yes, Mr. Chimi.

○Chimi (S/NRA):

Regarding the response in case of an earthquake on page 58, it is stated that "When an earthquake with a seismic intensity of 5- or larger occurs, the discharge into the sea must be suspended, the motor-operated valve at the outlet of the measurement/confirmation tanks must be closed." This is just a confirmation, but can I understand that the valve closes automatically by means of interlock?

○Matsumoto (TEPCO HD):
The valve will be closed manually under the direction of the shift supervisor after detecting an earthquake.

○Chimi (S/NRA):
May I think that the time required for the response is about a few minutes like the same time as the previous one?

○Matsumoto (TEPCO HD):
As you said, I think it will be a few minutes even if I estimate it to the maximum.

○Chimi (S/NRA):
I understand the response time.
Does it take some time for the motor-operated valve to close?

○Matsumoto (TEPCO HD):
This is a valve installed on a pipe with 100A diameter, so it will close in a few seconds.

○Chimi (S/NRA):
I understand. In that case, I believe that in case of an earthquake, the damage that causes leaks probably occurs when an earthquake is taking place, so I think some amount will leak during the time until the response. Have you evaluated it?

○Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

Regarding that, we have not included it in the evaluation. Currently, the leakage amount of $8m^3$ shown on page 58 is calculated from the pipe diameter and length, so we will reevaluate how much we should assume considering conservativeness in relation to what has been pointed out earlier.

○Chimi (S/NRA)

Okay, thank you.

One more point, as for the situation that the discharge into the sea is stopped, I think the severest situation will be the case that an earthquake occurs during discharge and something is damaged. I would like you to show us in any material how the situation will change from during discharge to during stopping discharge.

○Matsumoto (TEPCO HD):

Basically, as means to stop discharge into the sea, other than closing any of these emergency isolation valves, there are two means: closing the motor-operated valve and stopping the transfer pump of treated water. After that, depending on the work to be done, I think various valves will be operated. So I think that the means to stop discharge into the sea are these two.

On the other hand, regarding the seawater transfer pumps for dilution, the object discharged into the sea is basically the treated water, we think that it is better to continue the operation of the seawater pumps and the circulation of seawater.

However, we have not yet decided on a concrete basis.

○Chimi (S/NRA):

I would like you to make the situation of stopping discharge understandable.

○Matsumoto (TEPCO HD):

I understand.

○Kaneko (S/NRA):

Is there anything else?

If you don't mind, please allow me to confirm a little in relation to the points that have been discussed so far.

First of all, in the pictures on pages 82 and 83 which are the same as provided before and describe how valves and flowmeters are placed on the piping lines which have been discussed earlier. according to your earlier explanation, the emergency isolation valves were provided with a logic to close automatically. Though there are some other valves, may I understand that in relation to the earlier explanation on manual operation, the motor-operated valves are structured or designed to be remotely closed or opened by pressing switches at the control panel in the emergency response center.

○Matsumoto (TEPCO HD):

Yes, it's okay.

○Kaneko (S/NRA):

Then, they are not the valves operated at a field, aren't they? Of course, I understand they can be operated at a field as well.

And the valves for seawater are the same, aren't they? Including the valves on page 83?

○Matsumoto (TEPCO HD):

The valves for seawater are motor-operated type. As for the check valves it is different, though.

○Kaneko (S/NRA):

In any case, they will be operated remotely in the center.

○Matsumoto (TEPCO HD):

Yes. That's right.

○Kaneko (S/NRA):

I understand.

Then, this is mentioned just before about natural disaster, and it may be close to the situation of emergency. I understand that a seawall is located on the ground where the emergency isolation valves-1 are installed, so they will be protected. And the piping upstream of them are obviously higher than that, so is it designed to eliminate the impact of tsunami?

○Matsumoto (TEPCO HD):

Yes. That's right. Elevation are shown on page 60, and no problem would occur above 11.5m.

○Kaneko (S/NRA):

11.5 meters, so it will no longer come up over that height, isn't it? May I understand that it will not come to the upstream of the emergency isolation valves-1 anymore. Tsunami driftage also do not come.

○Matsumoto (TEPCO HD):

Yes. they are protected by the seawall.

○Kaneko (S/NRA):

So, you mean that tsunami will not come up to the height where equipment is located as exposed, don't you?

○Matsumoto (TEPCOHD):

Yes. But the ground becomes wet.

○Kaneko (S/NRA):

As for ground, it’s okay. Looking at the green line in the picture on the right side on page 58, the emergency isolation valve-1 is at the top right and this place is protected by a

seawall, then the piping runs from there toward the bottom left, and that place is no longer protected, but there is no piping running at the height where the tsunami reaches.

○Matsumoto (TEPCO HD):

Yes. That's right.

○Kaneko (S/NRA):

So, do you mean that there is no particular concern?

One more thing, as an issue regarding how to do in case of emergency, I think it might be necessary to evaluate whether the emergency isolation valve and the like is needed at that height and whether closing the valve quickly is necessary in relation to the operation of the motor-operated valve mentioned earlier. That's all I am concerned about in the current discussion.

Is there anything else? Yes, Mr. Arai.

○Arai (S/NRA):

Please see page 45. I think that selection of materials or why expansion joints are used should be provided in the explanation of design concept or design basis. In your explanation this time according to the point of issues which we presented to you last December and require your explanation about, I think safety functions and the impact in case of loss of safety functions have been almost mentioned. On the other hand, I think that basic specifications have been set to some extent, because the specifications of tank are shown in the later pages as was used in the application which was already approved. But it seems that the basic specifications of transfer pumps and seawater pipe header are missing, and the design concept and main structure for them as well as what kind of codes and standards applied to what parts have not been summarized yet. When do you plan to fix them?

○Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

We will improve the materials. We will prepare them as soon as possible.

○Arai (S/NRA):

Thank you.

○Kaneko (S/NRA):

I will comment a bit. Regarding the seawater pipe header just mentioned now, I am concerned about this structure, so I hope you will share the specific design structure as soon as possible.

Is there anything else? Do you think it's okay?

Though some information are needed to be added to the detailed design, specific state of specification and design drawings, I think we could understand the basic concept, and no major issue nor issue on safety seems to be hidden. So, I think examination will proceed, if you respond to the matters pointed out.

We have pointed out various matters regarding this issue. Do you have something to confirm about the point or confirm about any future responses, from TEPCO side?

○Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

Regarding the structural strength, basis, design drawing, etc. of the facilities pointed out by Mr. Arai earlier, we would like to explain to S/NRA as soon as we are ready.

Besides, there are a few questions regarding operation of the facilities, but some design of the facilities have not been fixed yet, so we would like to explain about them as soon as we are ready.

○Kaneko (S/NRA):

I understand. I think it is not necessary to put them together as one. I think you may prepare it at the time when confirmation will be needed for matters which are related to other issues.

Regarding the discussion so far, are you all right with what is prepared for two issue

today? Is there anything to be confirmed? Is it okay for TEPCO with the document-1 that TEPCO prepared?

○Matsumoto (TEPCO HD):

It is okay with us.

○Kaneko (S/NRA):

Thank you very much.

In the end, TEPCO prepared a sheet as reference 1 which is a draft schedule for discussion items grouped into several sessions so that the examination would be conducted smoothly while overlooking future progress as far as possible. Could you explain it briefly?

○Matsumoto (TEPCO HD):

I am Matsumoto, TEPCO.

Today is the sixth time of the review meeting, which corresponds to the date of January 27. Though it has not filled yet, I think we have conducted it today.

After that, subsequently from the seventh, eighth, ninth, tenth, and eleventh review meetings on, we, TEPCO will proceed with preparations for each group of issues presented to us and attend review meetings taking roughly these steps.

Also, as described in the note, since this is assumed by TEPCO, the order of explanation may be changed depending on the preparation status of the materials, and the answers to the questions received at the review meetings will be presented after the eleventh meetings. However, considering the discussion on the facilities made earlier, we would like to include such answers in sequence from near review meetings.

○Kaneko (S/NRA):

Thank you very much.

In that sense, the schedule is still needed to be adjusted. In the next meeting, issues of stopping discharge in case of unusual events which discussed relatedly today, prevention of misoperation related to the operation of equipment including hardware-related

measures, adequacy evaluation for the design of facilities, etc. will be included. If there are issues which could be explained in this meeting in relation to the issues discussed today or at the previous meetings, I would like you to incorporate them. Otherwise, those issues may be carried over after that. I think the next meeting will focus on response in case of unusual events or design of facilities and method of operation to prevent unusual events. So I would like you to prepare materials bearing such issues in mind.

○Matsumoto (TEPCO HD):
I understand.

○Kaneko (S/NRA)
Thank you very much.
Is there anything about this schedule, from the NRA side? Yes, Mr. Masaoka.

○Masaoka (S/NRA)
I'd like to confirm about a few points. The schedule for response to our comments depends on the situation of the comments which will be made in the future, but I understand that your company would like to finish the explanations on the points presented by us by the tenth review meeting. I would like you to let us know if you have any prospects, by what time do you think you would like to finish the round for the moment?

And, may I understand that regarding the radiological impact assessment discussed today, you are going to explain about the revision at the tenth meeting after you revise it? I would like to confirm those two points.

○Matsumoto (TEPCO HD):
I am sorry, but because of our convenience, based on the comments received in today's examination, we would like to prepare follow-up materials while reflecting them. It is difficult for us to answer categorically by when we are going to finish this process, but we

would like to proceed with preparation as appropriate as possible through the review meetings.
Also, regarding the radiation impact assessment of today, as Ms. Otsuji asked, about a month later, we would like to explain about it again at the review meeting about a month later, while responding the questions raised so far or to be raised at later review meetings during the term.

○Masaoka (S/NRA):
I understand.

○Kaneko (S/NRA):
We are thinking how quickly we can proceed with the examination well. Assuming that it is conducted once a week, and that the scope which we can see now will be finished with effort in about a month, depending on how long it will take to address the homework which can be responded during the term or will be responded afterwards, I think the time frame will come in view. I would like you to prepare as quickly as possible, and we also would like to prepare so that we can discuss intensively. I appreciate your cooperation.

○Matsumoto (TEPCO HD):
I understand.

○Kaneko (S/NRA):
If there is nothing else in particular, I would like to conclude the sixth review meeting.
Thank you for your cooperation on smooth progress. Thank you for your hard work.