IAEA Review of Safety Related Aspects of Handling ALPS-Treated Water at TEPCO's Fukushima Daiichi Nuclear Power Station

Report on the Mission to Japan conducted in April 2024

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EXECUTIVE SUMMARY

In April 2021, the Government of Japan released its Basic Policy on Handling of ALPS Treated Water at the Tokyo Electric Power Company Holdings' (TEPCO) Fukushima Daiichi Nuclear Power Station (FDNPS). The approach outlined in the Basic Policy is to conduct a series of controlled discharges of ALPS treated water into the sea over many years. Following the announcement of this policy, the Government of Japan requested that the IAEA conduct a detail review of the safety related aspects of handling ALPS treated water stored at FDNPS, applying the relevant international safety standards. The objective of the IAEA is to carry out this safety review, before, during and after discharges of treated water from ALPS.

The IAEA review before the discharge started was completed with the publication of the IAEA's Comprehensive Report on the Safety Review of the ALPS-Treated Water at the Fukushima Daiichi Nuclear Power Station (IAEA's Comprehensive Report) that was released on 4 July 2023 [2]. That report summarized and concluded the work carried out by the IAEA over the two years before the discharge of ALPS treated water began. It also comprised the technical topics and activities to be revisited and corroborated by the IAEA at various times during the ALPS-treated water discharges to assess the consistency of the water discharge activities with relevant international safety standards.

In September 2023, the IAEA and the Government of Japan signed a Memorandum of Cooperation that describes the IAEA basic framework for the safety review during the ALPS treated water discharges, as well as the monitoring and assessment activities carried out by the IAEA.

In October 2023, the IAEA carried out the first review mission since the start of ALPS treated water discharges from the FDNPS. The second review mission was conducted from 23 to 26 April 2024 to follow up on the findings from the IAEA's Comprehensive Report on the Safety Review. The review team, coordinated and led by a senior IAEA official, included 15 members, comprised of experts from the IAEA Secretariat and international experts who are designated members of the Task Force.

In March 2024, the IAEA Director General Rafael Mariano Grossi visited Japan as part of his commitment to monitor the discharge of treated water from the damaged FDNPS. Mr Grossi also met with government leaders in Tokyo and local people and youth groups in Fukushima. Mr Grossi also visited the vertical shaft of the discharge system, where the treated water, already diluted with seawater, is discharged to the sea for the controlled release.

The scope of the review mission covered the main technical topics considered by the IAEA as part of its safety review before the start of discharges. These topics are noted below and are summarized in greater detail in the IAEA's Comprehensive Report. Additionally, as part of the mission's activities, the Task Force reviewed the status of the IAEA's independent corroboration of Japan's source and environmental monitoring programmes, and the onsite sampling and analysis activities conducted by IAEA experts at the FDNPS.

- Regulatory Control and Authorization
- Safety Related Aspects of Systems and Processes for Controlling Discharges
- Characterization of the Source
- Radiological Environmental Impact Assessment
- Source and Environmental Monitoring
- Involvement of Interested Parties
- Occupational Radiation Protection

During the mission the Task Force received updates on the progress made by NRA, TEPCO, METI, and related organizations in commencing and maintaining the discharges of ALPS treated water pursuant to the approved implementation plan and national regulations and laws. The Task Force had access to all relevant technical and regulatory experts and was provided with opportunities to inquire about specific issues. Additionally, the Task Force visited the FDNPS to directly observe the equipment and facilities for the discharge of ALPS treated water.

The IAEA Task Force also discussed the details and activities carried out by the IAEA staff since the discharge including the continuous presence at the site, independent onsite analysis, discussions with TEPCO/METI and IAEA walkdowns through the ALPS facilities. The Task Force also noted the comprehensive approach of the IAEA sampling, independent analysis and data corroboration activities proposed related to the source and environmental monitoring programme conducted by Japan.

Based on the activities conducted by the Task Force during the mission, the IAEA noted several major conclusions raised up during this mission are in line with those highlighted in the first mission after discharge:

- The Task Force did not identify anything that is inconsistent with the requirements in the relevant international safety standards. Therefore, the IAEA can reaffirm the fundamental conclusions of its safety review as outlined in the 4 July 2023 Comprehensive Report.
- The regulatory infrastructure in place is appropriate to provide operational safety oversight of the discharge of ALPS treated water, and the Task Force was able to witness first-hand the continuous onsite presence of the NRA and their activities in this regard.
- The Task Force confirmed that the equipment and facilities are installed and operated in a manner that is consistent with the Implementation Plan and the relevant international safety standards.
- The Task Force noted the importance of the IAEA's ongoing corroboration activities and its on-site independent sampling and analyses, in providing a comprehensive, transparent and objective verification of the accuracy and reliability of the data reported by TEPCO and the Government of Japan.

This mission report documents observations from the Task Force and reflects the discussions between the Task Force, TEPCO, METI, NRA and the Government of Japan. This report was agreed by the IAEA Task Force and has been published by the IAEA on its public website.

BACKGROUND

In April 2021, Japan announced its Basic Policy and soon after, the Japanese authorities requested assistance from the IAEA to monitor and review those plans and activities relating to the discharge of the treated water to ensure they will be implemented in a safe and transparent way, and they will be consistent with the IAEA's international safety standards. The IAEA, in line with its statutory responsibility, accepted the request made by Japan.

In July 2021, the IAEA and the Government of Japan signed the Terms of Reference for IAEA Assistance to Japan on Review of Safety Aspects of ALPS Treated Water at Tokyo Electric Power Company Holdings, Inc. (TEPCO) Fukushima Daiichi Nuclear Power Station (FDNPS). These terms of reference set out the broad framework that the IAEA will use to implement its review. Such a request to the IAEA, and its acceptance by the IAEA, is in accordance with the IAEA function described in Article III.A.6 of the IAEA Statute.

In September 2021, the IAEA sent a team to Tokyo, for meetings and discussions to finalize the agreement on the scope, key milestones and approximate timeline for the Agency's review. The team also travelled to the FDNPS to discuss technical details with experts at the site and to identify key activities and locations of interest for the Agency's review.

To implement the IAEA's review in a fully transparent and inclusive manner, the IAEA Director General established a Task Force. The Task Force operates under the authority of the IAEA and is chaired by a senior IAEA official. The Task Force includes experts from the IAEA Secretariat alongside internationally recognized independent experts with extensive experience from a wide range of technical specialties from Argentina, Australia, Canada, China, France, the Marshall Islands, the Republic of Korea, the Russian Federation, the United Kingdom, the United States and Viet Nam. These independent experts provide advice to the IAEA and serve on the Task Force in their individual professional capacity to help ensure the IAEA's review is comprehensive, benefits from the best international expertise and includes a diverse range of technical viewpoints.

The IAEA primarily conducted its review through the analysis of documentation provided by TEPCO, NRA, and METI; and holding review missions to further clarify questions and to ask for additional materials. The IAEA also conducted onsite visits to FDNPS periodically throughout 2021, 2022, 2023 and 2024. Six review missions to Japan were carried out between 2022 and 2023 and the corresponding technical reports were published. The reports issued after the first four review missions serve as progress reports and final conclusions are only presented for the first time in the comprehensive report which was published on 4 July 2023

On September 18, 2023, the IAEA and Government of Japan signed a Memorandum of Cooperation that outlines the basic framework for the IAEA's ongoing safety review of the ALPS treated water discharges at FDNPS, as well as the associated monitoring and assessment activities conducted by the IAEA.

In October 2023, the IAEA carried out the First Review Mission to Japan after the Start of the ALPS Treated Water Discharge and issued the corresponding report early 2024.

At the start of the review, the Government of Japan and TEPCO provided background materials with information pertaining to the proposed discharge of ALPS treated water. Subsequently, additional materials were provided upon request by the Task Force, or when ready for submission by TEPCO to the relevant Japanese authorities (e.g., NRA). This information was reviewed by the Task Force members and formed the basis for the review missions with relevant authorities and, ultimately, the Comprehensive Report. The purpose of the review missions is to review the reference materials submitted by the Government of Japan or TEPCO, seek clarification on technical issues, request additional information and observe on-site activities, as appropriate.

The IAEA's review is organized into the following three major components to ensure all key safety elements are adequately addressed:

- **Assessment of Protection and Safety** – This component is focused on reviewing technical aspects of the Implementation Plan, Radiological Environmental Impact Assessment (REIA), and other supporting materials prepared by TEPCO as part of their submission for regulatory approval of the discharge of ALPS treated water. This component primarily involves TEPCO and the Ministry of Economy, Trade, and Industry (METI) and looks at the expected actions to be performed by TEPCO throughout the process, as defined in the relevant IAEA international safety standards.
- **Regulatory Activities and Processes** – This component is focused on assessing whether the Nuclear Regulation Authority's (NRA) review and approval process is conducted in accordance with the relevant IAEA international safety standards. This component primarily involves NRA as the independent regulatory body responsible for nuclear safety within Japan; it is focussed only on the regulatory aspects relevant for NRA's review of the discharge of ALPS treated water from the Fukushima Daiichi Nuclear Power Station.
- **Independent Sampling, Data Corroboration and Analysis** – This component includes all activities associated with the IAEA's independent sampling and analysis that is and will be performed to corroborate the data from TEPCO and the Government of Japan associated with the discharge of ALPS treated water. Samples are analysed by IAEA laboratories as well as independent third-party laboratories. Additionally, this component also includes the corroboration of occupational exposure.

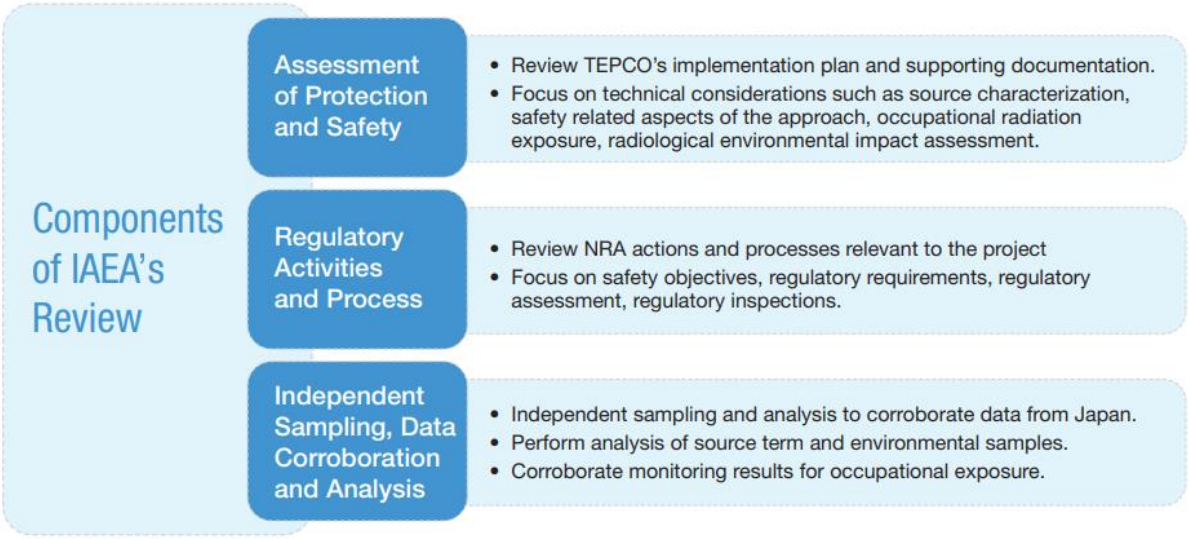


Figure 1: Components of the IAEA Review

Additional information on the IAEA's review, as well as background information, documents, reports, and other publications can be found online at the dedicated website for the IAEA's Fukushima ALPS review.

MISSION ACTIVITIES IN APRIL 2024

Discussions with TEPCO and METI

As planned, at the beginning of the mission, the Task Force met with officials and experts from TEPCO and METI. They provided the current status of the operations for the discharge of ALPS treated water for the Japanese 2023 Fiscal Year (FY) and the planned discharges to be carried out in 2024.

Fiscal Year 2023 (1st April 2023 to 31st March 2024)

- 4 Batches discharged (batches 1st to 4th).
- Total volume of ALPS treated water discharged: approx. 31.145 m^3.
- Total tritium activity discharged: approx. 4.5 TBq

FY 2023 Discharge Plan

ALPS treated water is discharged starting from which stored in the measurement/confirmation facility.

Round	Discharge period	Amount of ALPS treated water	Tritium concentration*1	Amount of tritium
1st	Aug. 2023	Approx. 7,800㎥	14×10^4 Bq/liter	1.1 trillion Bq
2nd	Oct. 2023	Approx. 7,800㎥	14×10^4 Bq/liter	1.1 trillion Bq
3rd	Nov. 2023	Approx. 7,800㎥	13×10^4 Bq/liter	1.0 trillion Bq
4th	Feb. 2024	Approx. 7,800㎥	$17\sim21\times10^4$ Bq/liter	1.4 trillion Bq*2

*1 Tritium concentrations will be less than 1,500Bq/liter by dilution more than 700 times with seawater
*2 Average value of the tank group that was assessed taking into account the radioactive decay until July 1, 2023

Fiscal Year 2024

- Planned to discharge: 7 batches (batch: 5th to 11th)
- During the Task Force Mission 5th batch was being discharged
- 5th Batch: completion by 7 May, 2024

The Task Force discussed the status of the current discharge (5th batch) and the transfer of ALPS treated water in preparation for the 6th and 7th batches. It was explained that there has been no abnormality in parameters, operational limits and sea area monitoring since the commencement of discharge. All radionuclides discharged are below regulatory requirements referring to the sum of the ratios to legally required concentrations of radioactive substances is less than 1. In the particular case of 5th batch the sum of the ratios of concentration is 0.31.

- Discharge plan 2024 FY:
  - 5th batch April-May
  - 6th batch May-June
  - 7th batch June-July
  - 8th batch July-August
  - 9th batch August-September
  - 10th batch September-October
  - 11th batch February-March

Table x: Criteria used by TEPCO for analysis results for quick tritium measurements

Location	Discharge Suspension Level (Bq/L)	Investigation Level (Bq/L)	Detection Limit (Bq/L)
Within 3km of the site (10 locations)	700	350	~10
Within a 10km square in front of the site (4 locations)	30	20	~10

**Note – Historical range for seawater across Japan ranges from around 0.043 Bq/L to 20 Bq/L*

Regarding the regulatory control and authorization, the Task Force reviewed the TEPCO's ongoing consideration of optimization of protection and safety during the operational phase, TEPCO opened by stating that there have been no events leading to changes in the optimization assessment. TEPCO explained that the cumulative amount of radioactivity discharged in FY 2023 over the four discharge campaigns was below the amount of radioactivity in the estimated source term of the Radiological Environmental Impact Assessment (REIA). Further, TEPCO said that there have been no changes to the Basic Policy and the associated discharge limit for tritium.

The Task Force acknowledged that there has been no change to the discharge limit but reminded TEPCO that the Task Force has already indicated its intention to "review NRA's approach to reviewing and potentially revising discharge limits in response to TEPCO's ongoing optimization of protection and safety". The Task Force suggested that TEPCO is gathering important data that could inform the next iteration of optimization, which in turn could inform discussions with NRA about discharge limits.

The Task Force explained that 'optimization of protection' involves comparing options for radiological protection taking account of prevailing circumstances while respecting the dose constraint (set at 50 µSv per year for discharge of ALPS treated water), and that an obvious protection parameter that could be varied is the rate of discharge. TEPCO said that formulating a discharge plan is complex, especially when aligning it with the roadmap for decommissioning FDNPS. TEPCO has calculated that since no new tritium has been produced at FDNPS since the accident, and considering natural radioactive decay, it is plausible to complete the discharge of ALPS treated water by 2051 (a milestone in the decommissioning roadmap). However, TEPCO went on to explain that careful consideration will be needed in the development of the discharge plan to secure the enough space to construct facilities required for decommissioning. To create this space, it will be necessary to transfer water from one storage location to another in order that tanks can be emptied and removed. The Task Force noted that both enabling decommissioning of FDNPS, and revising ALPS treated water discharge limits with its associated risks, are important factors to consider when optimizing protection and safety.

Several discussions were held about the periodic review of REIA and TEPCO's approach to updating the REIA if information changes, including the source term, habits of the population over time and results of the environmental monitoring.

Regarding periodic review of the REIA, TEPCO presented that there have been no changes that would lead to changes in the assumptions (source term or exposure pathway) set in the REIA. For example, results of the sea area monitoring have confirmed the sea area dispersion simulations. The REIA review period is not set in NRA regulations, but TEPCO said that it was considering reviewing the REIA every 10 years, or sooner if a significant change occurs that warrants a review.

The Task Force indicated its full support for periodic reviews of the REIA even if nothing changes. It acknowledged that there is nothing in the international safety standards that dictate a specific review period but suggested that it might be prudent to review the REIA more frequently than every 10 years, especially in the early years when so much additional information is being acquired. TEPCO said that it would like to consider the review frequency and proposed a review based on first year of discharges. The Task Force agreed that this would be extremely useful; it would allow TEPCO to test assumptions made for some parameters in the REIA, such as assumptions made about the source term and accumulation of radionuclides in organisms.

TEPCO indicated its belief that there are a lot of conservative assumptions in the REIA and that actual doses to the public will be well below the dose criteria. TEPCO also acknowledged the value of a more realistic assessment and said it will continue to monitor parameters that may affect the REIA such as habits of the representative person.

The Task Force discussed the status of the safety related aspects and processes for controlling the discharges. Particularly focused on the implementation of the maintenance plans for the equipment, structures and systems. Specifically, these include mechanical systems (tanks, pipes, pumps, and valves), instrumentation (flowmeters, water level gauges, leakage detectors, radiation monitors, remote and local devices and local panels), electrical systems (power supply panels, transformers high voltage cable and motors etc) and buildings and civil structures (vertical shaft, tunnel and buildings). The Task Force also discussed the concept of the maintenance plan, formulation policy and effectiveness evaluation. Aspects such as vertical shaft reparations, tanks structural integrity, corrosion, inspection of the discharge tunnel and downstream storage were also discussed. Regarding the operations, procedures and manuals including actions in case of alarms, they are conducted as specified in the implementation manual. In addition, TEPCO provided the information related to the conducted inspections of each facility after the discharges.

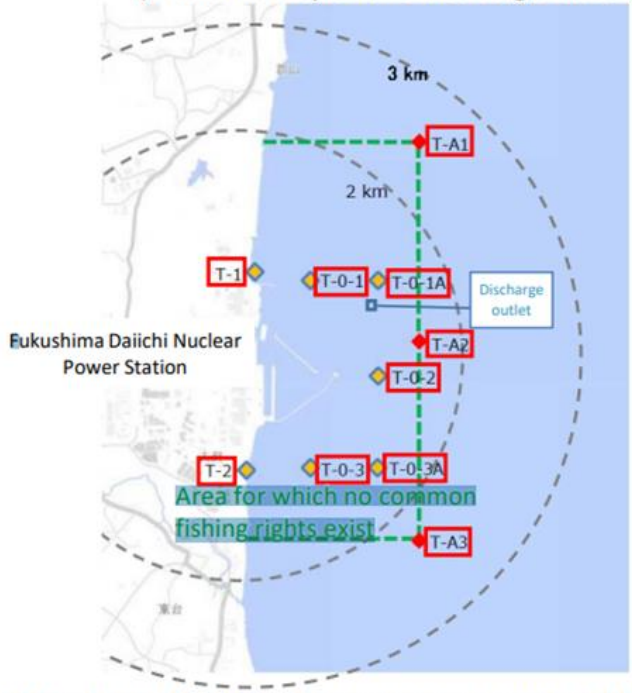
The Task Force discussed the response to the recent earthquakes on 15th and 17th March 2024. On 15th March, an earthquake with its epicentre off the coast of Fukushima Prefecture occurred (The seismic intensity of 5 lower was measured in Naraha Town, one of the towns where power stations are located). Discharge was suspended in accordance with pre-defined operational procedures. TEPCO resumed the discharge after conducting field inspections and confirming that there was no abnormality on its facilities. On 17th March, an earthquake with its epicentre off the coast of Fukushima Prefecture occurred (The seismic intensity of 4 was measured in one of the towns). It was confirmed that there was no abnormality on the facilities after checking parameters and conducting field inspections. TEPCO has prepared procedures in case of tsunamis taking into account the measures for the safety response.

TEPCO provided to the Task Force a detailed description of the analyses of the activity concentration of radionuclides undertaken in each batch of ALPS treated water in the measurement/confirmation tanks prior to discharge. Activity concentrations of tritium measured in the sea water piping daily during the discharge of the first, second, third and fourth batches were also presented. These results showed that the tritium activity concentrations in the discharged ALPS treated water for the first four batches were far below the Basic Policy limit of 1,500 Bq/L and the operational limit (700 Bq/L) and also consistent with the expected values based on the target discharge concentration for each batch.

The results of the sea area monitoring conducted since the start of discharges in August 2023 up to the end of March 2024 were shared with the Task Force. These included the results of “quick” measurements of tritium activity concentrations in samples of seawater collected from 10 sampling locations within one kilometre of the discharge location and four locations within 3 kilometres. The results indicate that the concentrations are below the discharge suspension and investigation levels (see Table x below). Most measurement results indicate tritium levels below the detection limit of 10 Bq/L.

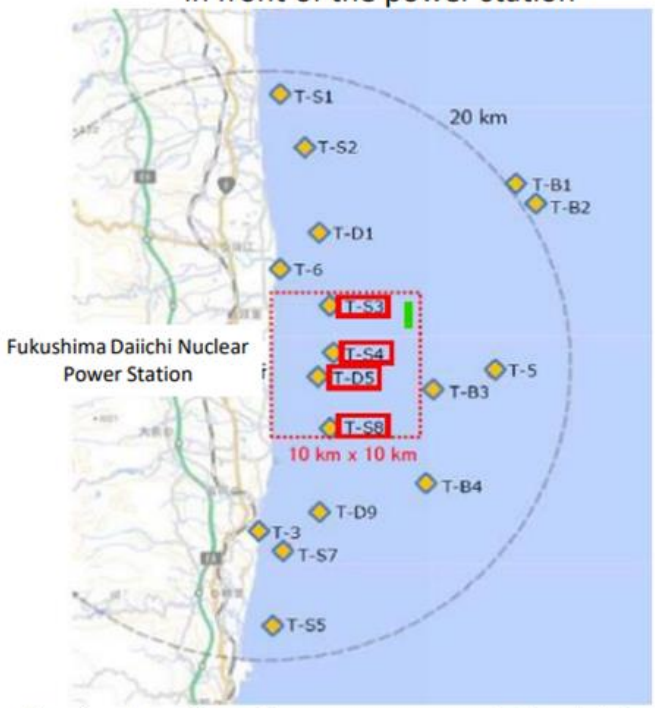
The results of monitoring undertaken close to FDNPS demonstrated that the tritium activity concentrations in seawater are well below the operational limits (investigation level of 350 Bq/L and discharge suspension level is 700 Bq/L) set for 10 locations within three kilometres of the power station.

Figure 1. Sampling locations within a 3km radius of the power station
(in the vicinity of the discharge outlet)



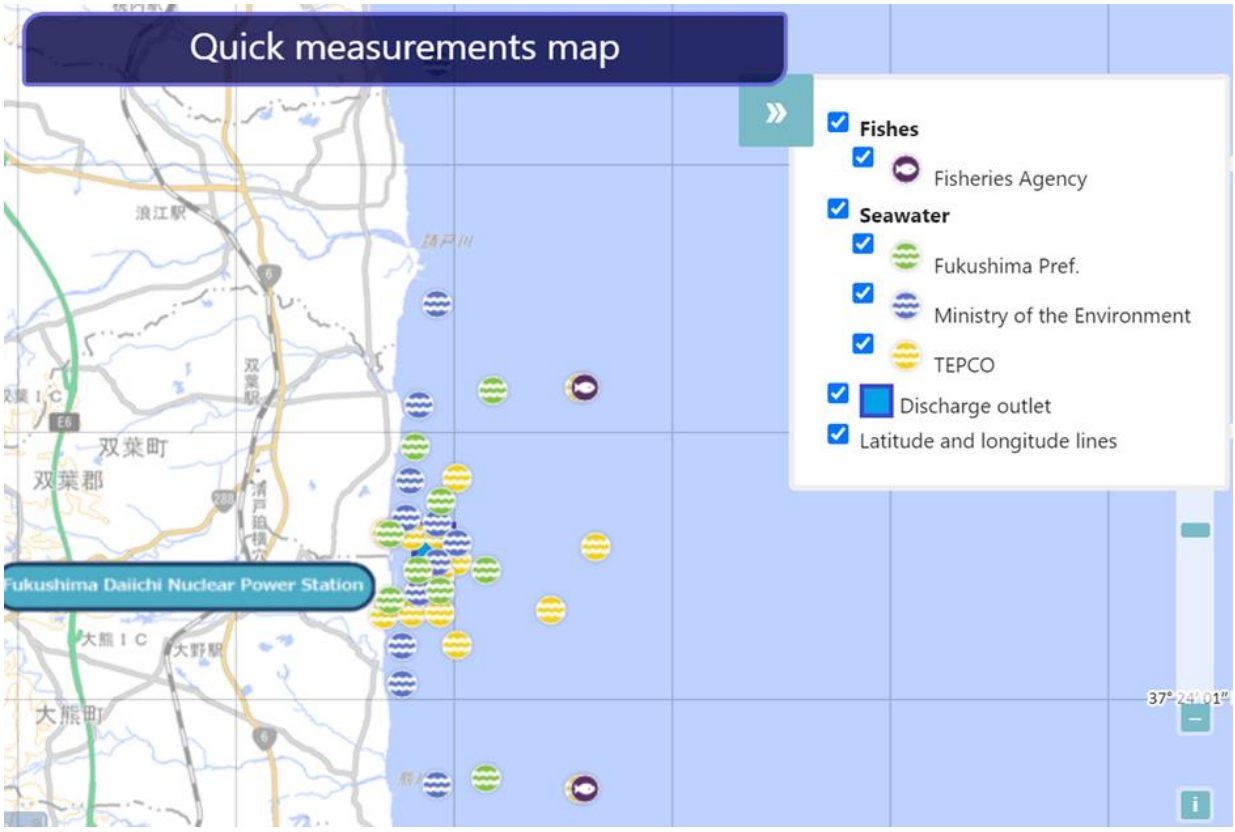
: Monitoring locations for measurements to obtain results quickly (10 locations)
Indicator (discharge suspension level): 700Bq/liter
Analysis frequency: once a week → **Every day for the time being**

Figure 2. Sampling locations within a 10km square in front of the power station

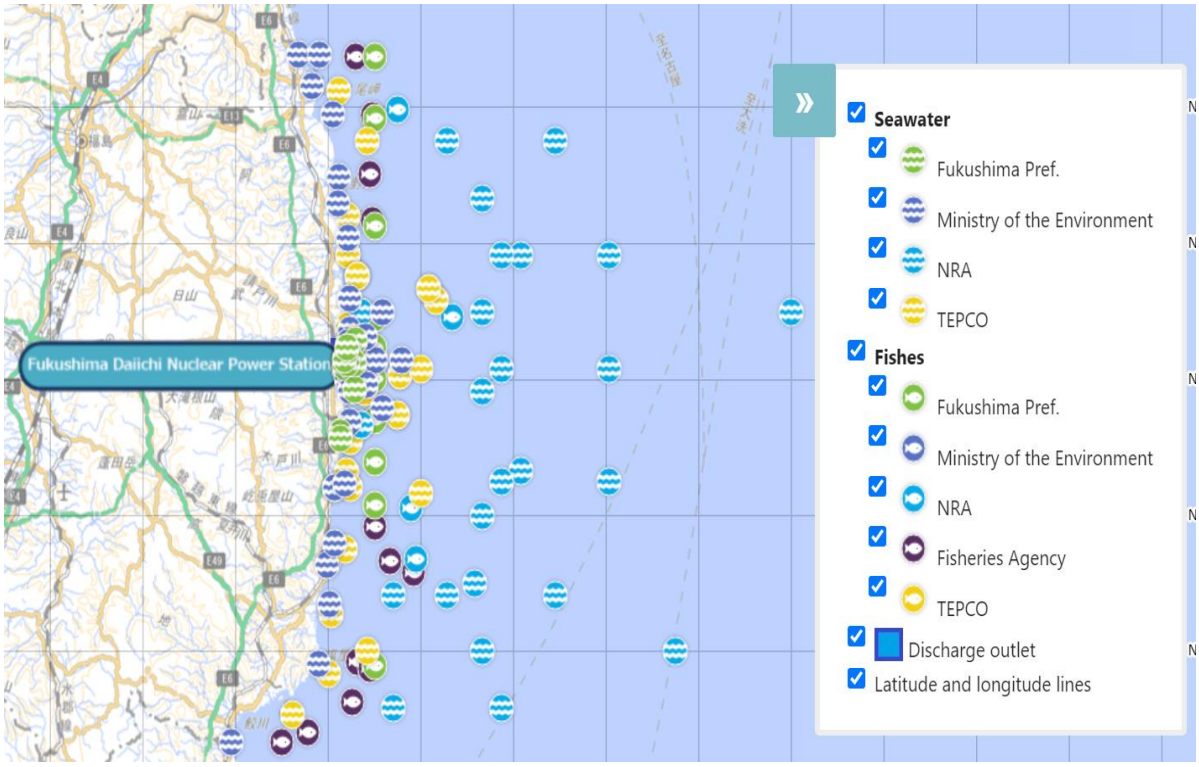


: Monitoring locations for measurements to obtain results quickly (4 locations)
Indicator (discharge suspension level): 30Bq/liter
Analysis frequency: Once a week (T-D5),
Once a month (T-S3, T-S4, T-S8)

Weekly measurements of tritium in seawater at the same locations were also presented to the Task Force. These are more sensitive – target detection limits 0.1 - 0.4 Bq/L – but analyses take about two weeks to be completed. These measurements also confirm that activity concentrations in seawater are below and are not distinguishable from tritium activity concentrations measured in seawater historically around Japan. The highest activity concentration measured to date with using this sensitive technique was 14Bq/L at sampling location T-0-1A (closest to the discharge point) in October 2023 during discharge of the second batch of ALPS treated water. A more complete picture will emerge as the dataset of the results of more sensitive tritium analyses of seawater samples grows.



TEPCO also described a new information system – Overarching Radiation-monitoring data Browsing System (ORBS) – that presents monitoring data relevant to the ALPS treated water discharges from all agencies contributing to the Comprehensive Radiation Monitoring Plan (CRMP). It is possible to view the latest data available for each sampling location and to view time-series plots of measurements since 2021.



Regarding occupational exposure, TEPCO confirmed it would be better to have a proper assessment of the radiological conditions (including occupational exposure data for external exposures of TEPCO workers, contractors, and sub-contractors – so-called partner companies) who are involved in normal operation and inspection of ALPS treated water facility on a periodic basis. Referring to November 2022 mission and respective report (*Report 4: Review Mission to TEPCO and METI, November 2022*), individual dose records at FDNPS including ALPS are registered and stored in TEPCO's Personal Dose Control System for both TEPCO employees and contractor workers and transferred in a routine basis to the system of Radiation Dose Registration Center for Workers and also reported to the NRA (declared during the meeting with NRA).

Compliance with dose limits for occupational exposure of TEPCO workers, contractors and sub-contractors has been confirmed without any further information on dose values and ranges. The Task Force reiterated that workers of ALPS related operation could be characterised by a broad individual dose distribution, often in the shape of a Gaussian distribution, whereas the dose distribution of a planned exposure situation is much more a skewed distribution, approaching a log-normal, which could be considered by TEPCO and METI for future dose evaluation.

TEPCO informed the Task Force that organisational, procedural and technical arrangements for the designation of controlled and supervised areas, local rules and workplace monitoring arrangements are properly implemented according to the Radiation Control Plan and ALARA Checklist.

TEPCO provided information on operational occurrences (including the occurrences not directly related with ALPS treated water discharge operation, e.g., October 2023 contamination and February 2024 leakage) which are expected and considered normal by the Task Force in such an industrial setting.

The Task Force discussed the involvement of the interested parties, in particular information exchange and communication related to the ALPS treated water discharge. The Task Force noted that since the discharge started the Government of Japan has provided: explanations about the current status for the discharge, dissemination of information, carry out regular public meetings, exchange of opinions, briefing to the local communities and disseminating the information to the international community. The Task Force encouraged the Government of Japan to continue with this approach.

Visit to FDNPS

As part of the mission, the Task Force carried out a comprehensive visit to Fukushima Daiichi NPS, as was conducted in October 2023 in the first review mission to Japan after the start of ALPS treated water discharge.

During the mission the Task Force travelled to the Fukushima prefecture to have a meeting with TEPCO and METI and to visit the FDNPS. While at the site the Task Force was provided with an update overview of the technical status of the ALPS treated water discharges and was able to visit each step of the discharge process.

This included:

- Confirmation/measurement tanks (K4 tank area).
- ALPS treated water transfer facility building.
- Electrical room which includes flow control valves and emergency isolation valve.
- Seawater pumps and header piping, radiation detectors installed near the seaside pumps and the vertical shaft, and the vertical shaft leading to the discharge tunnel.

The Task Force was also provided with an updated overview of the sampling and analysis that takes place before and during each batch of ALPS treated water to be discharged. This included observing the sampling used to sample from the measurement/confirmation tanks, as well as the sampling points used to sample treated, diluted water during the discharge process.

During the visit to FDNPS, there was an automatic suspension of the operation of the ALPS treated water dilution/discharge facility due the loss of on-site power because a worker damaged the cable during an excavation work. Since this automatic suspension occurred as designed and no abnormality was identified with the ALPS treated water dilution/discharge facility, the discharge restarted on the same day.

Discussions with NRA

The Task Force reviewed NRA's approach to encourage optimization of protection and safety during future reviews of the authorization and its approach to reviewing and potentially revising discharge limits in response to TEPCO's ongoing optimisation of protection and safety. This review also included the NRA's approach to identify "unusual values" and refine action limits based on incoming environmental monitoring data and other operational experience.

Regarding optimization of protection and safety, NRA outlined that the periodic review of the authorization of discharge is conducted in the process of revising the document "Measures for Mid-term Risk Reduction for Decommissioning TEPCO's Fukushima Daiichi NPS", typically once per year. NRA's review is based on three perspectives:

1. Whether ALPS treated water is discharged in the approved way and amount continues to contribute to the progress of decommissioning
2. Whether there are any substantial changes in the assumptions or conditions made in the reviewed REIA
3. Whether there are any indications in source or environmental monitoring that might affect the reviewed REIA

NRA explained that revisions to the above document has been discussed with TEPCO and other stakeholders at the Oversight and Review Meeting since discharges began. To support discussions, NRA shared its vision and specific targets to be achieved in the next decade (by 2033) including a vision for: waste from water treatment; rubble; demolition waste; and, risk reduction inside reactor buildings; as well as a vision for discharge of ALPS treated water in accordance with the agreed plan and without it being a barrier to other targets.

NRA went on to present examples of recent discussions at the Oversight and Review Meeting, which involves external experts and local stakeholders in addition to NRA Commissioners, NRA staff and TEPCO. Representatives of the local community have expressed different opinions such as "a slight hope that discharge could be completed not in 30 years but in 15 years" and on the other hand that "for

a while at the beginning, I hope that the discharge is implemented slowly confirming safety and reducing everyone's worry and anxiety. After for example 5 years, if there have been no negative influence and more could be discharged, I think the discharge could be speeded up". Recognizing those different views, NRA will continue to review TEPCO's practice from the perspective of optimization of protection. That includes the discussion of the possibility of revising the discharge limit on the basis of accumulated operational experience.

The Task Force commended the NRA for creating and sharing the vision and targets, which consider the discharge of ALPS treated water within the overall decommissioning of FDNPS (the prevailing circumstances). This provides important context for stakeholders and for optimization of protection and safety.

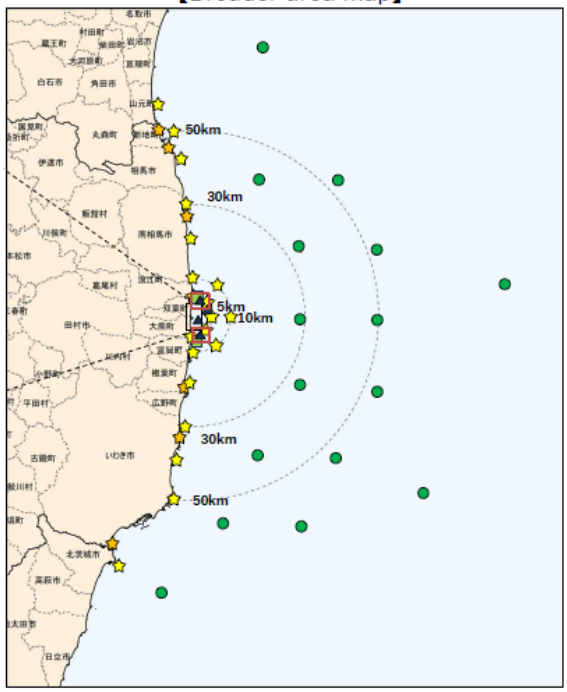
The Task Force reiterated its intention set out in the Comprehensive Report to "review NRA's approach to encourage optimization of protection and safety" and "review NRA's approach to reviewing and potentially revising discharge limits in response to TEPCO's ongoing optimisation of protection and safety" noting that discharge limits should be influenced by the optimization of protection and safety, and not the other way around. The Task Force reminded NRA of findings in the Comprehensive Report; that "the discharge limit [22 TBq tritium per year] was selected without reference to the dose to the representative person calculated in the REIA and the optimization of protection and safety" and encouraged NRA to "set discharge limits based on the REIA in the future after additional operational experience and sampling data have been collected".

During the previous mission in October 2023, the NRA explained the independent source monitoring that it is undertaking to complement the operational safety inspections and more broadly, the regulatory oversight of the discharge activities. It plans to conduct independent monitoring for one batch each year. As already done in 2023 for the second batch, the NRA will verify TEPCO's source monitoring by analysing samples from each batch monitored for ^{14}C and ^{129}I, as the two major contributors to dose according to TEPCO's REIA and for ^{60}Co, ^{106}Ru, ^{125}Sb, ^{134}Cs and ^{137}Cs, as "major" gamma-emitting radionuclides, i.e., those frequently detected in ALPS treated water. The Task Force was satisfied that this approach was justified.

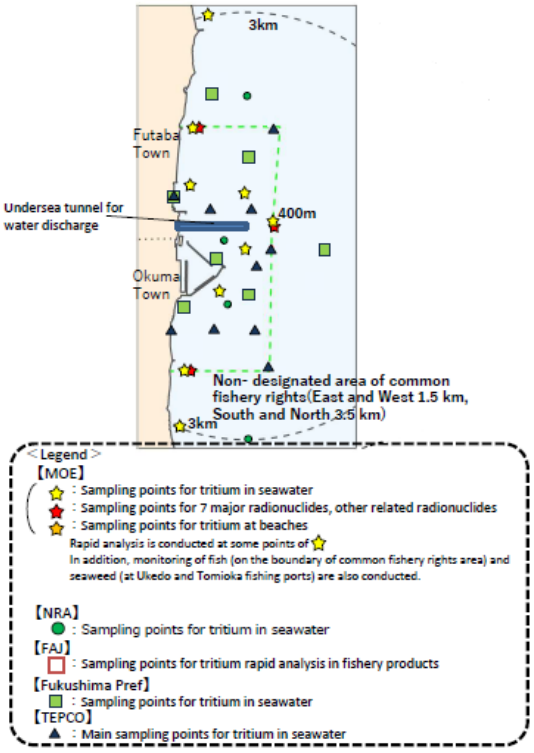
The NRA provided an update on the marine environmental monitoring that is being undertaken close to the FDNPS as part of the CRMP to specifically address the discharges of ALPS treated water. The NRA, Ministry of Environment (MOE), the Fukushima Prefecture (FP) government and TEPCO are also monitoring tritium in seawater while the Fisheries Agency of Japan (FAJ) is monitoring fishery products. The NRA reminded that for seawater a dual approach is being taken which balances the need to publish results frequently and soon after sampling, thus keeping the public informed, with the longer times required for low level analyses of tritium. MOE, FP and TEPCO perform "quick" results whereby samples are analysed with a target detection limits for tritium of 10 Bq/L. The results of more sensitive analyses – with target detection limits of 0.1 – 0.4 Bq/L depending on the distance of the sampling location from the discharge point – are performed by the NRA and, again, MOE, FP, and TEPCO. The NRA is undertaking seawater monitoring for tritium on a monthly basis at four points within three kilometres of the FDNPS site.

The NRA explained that, in addition, tritium and other nuclides including ^{14}C, ^{129}I and gamma-emitters are monitored regularly in seawater, marine sediment and marine biota.

【Broader area map】



【Enlarged map (3 km radius)】



Sea Area Monitoring (17th April 2024)

	MOE (Ministry of the Environment)	NRA (Nuclear Regulation Authority)	FAJ (Fisheries Agency, Japan)	Fukushima Pref	TEPCO (Tokyo Electric Power Company Holdings)
Sample	Seawater	Seawater	Fish	Seawater	Seawater
Frequency	○ One time during the discharge/ Twice during the discharge— One time a month during the suspension ●Every 3 months	●Every month – Every 3 months	○Four times a week during the discharge– One time a week during the suspension ● 200 samples / year	○Every week during the discharge/ One time a month during the suspension ●Every month	○ Daily - Every month △ Three times a month ● Every month
Number of sampling points	○20 points / 3 points ●29 points	●20 points	○2 points ●Pacific side of the eastern Japan	○9 points ●9 points	○ 14 points △ 16 points ● 36 points
Detection limit	○10 Bq/L ●0.1 Bq/L	●0.1 Bq/L	○10 Bq/kg fresh ●0.4 Bq/kg fresh	○10 Bq/L ●0.1 Bq/L	○10 Bq/L △ 0.4 Bq/L ● 0.1 Bq/L
Analytical result	○below DL ●below DL - 5.0Bq/L	●below DL - 1.1Bq/L	○below DL ●below DL	○below DL ●below DL-1.6 Bq/L	○ below DL-22 Bq/L △ below DL-14 Bq/L ● below DL-12 Bq/L
Official Website	https://shorisuimonitoring.env.go.jp/en/	https://radioactivity.nra.go.jp/en/results#sec-10	https://www.jfa.maff.go.jp/e/inspection/index.html	https://www.pref.fukushima.lg.jp/site/portal/moni-k.html	https://www.tepco.co.jp/decommission/progress/watertreatment/

The NRA presented upgraded and new information systems that present the results of environmental monitoring including a "Database for Radioactive Substance Monitoring Data (EMDB)" that includes data from all organisations contributing to monitoring within the CRMP. This addresses the Task Force's recommendation from the previous mission that a comprehensive website containing all the monitoring and analysis results would be beneficial for the public and help to streamline the access and consumption of relevant data.

The NRA reiterated the importance of the IAEA's ongoing corroboration of Japan's marine monitoring data. In January 2024, the IAEA published the results of two interlaboratory comparisons (ILC) for corroboration of ALPS-related monitoring: a second ILC based on samples of ALPS treated water and a first ILC based on environmental samples. Follow-up ILCs for corroboration of both source and environmental monitoring are currently in progress and will continue to be carried out on an annual basis.

Discussions were also focused on operation status, operational safety and TEPCO's experience with ALPS operation in industrial setting with long-term perspectives. Dose records at FDNPS including ALPS are reported to the NRA.

CONCLUSIONS AND OUTCOMES

During the mission, the Task Force received the full cooperation from counterparts in TEPCO, METI and NRA and noted their commitment to providing the Task Force with comprehensive update information related to the discharge.

Several major conclusions raised up during this mission are in line with those highlighted in the first mission after discharge. The Task Force did not identify anything that is inconsistent with the requirements in the relevant international safety standards. Therefore, the IAEA is able to reaffirm the fundamental conclusions of its safety review as outlined in the 4 July 2023 Comprehensive Report.

As part of its discussions during this mission, the Task Force identified several conclusions and outcomes that are summarized below.

The Task Force noted the robust regulatory infrastructure in place to provide operational safety oversight of the discharge of ALPS treated water and was able to witness first-hand the onsite presence of the NRA and their activities in this regard. Based on its observations at FDNPS, the Task Force confirmed that the equipment and facilities are installed and operated in a manner that is consistent with the Implementation Plan and the relevant international safety standards.

The Task Force highlighted the importance of the IAEA's corroboration and the IAEA on-site independent sampling and analyses, highlighting that its purpose is to provide comprehensive, transparent and objective verification of the accuracy and reliability in the data reported by TEPCO and the Government of Japan.

The Task Force welcomed TEPCO's consideration of when to review the Radiological Environmental Impact Assessment (REIA) and indicated its full support for periodic reviews of the REIA even if nothing changes. The Task Force acknowledged that there is nothing in national regulations or international safety standards that prescribe the REIA review period and discussed with TEPCO the potential benefits of reviewing the REIA after the first year of discharges.

The Task Force suggested that TEPCO is gathering important data that could inform the next iteration of optimizing protection and safety. This includes information that allows TEPCO to test assumptions in the REIA, but not only that. Through complex work on the discharge plan, TEPCO is building an understanding of the relationship between the discharge rate and the decommissioning of Fukushima Daiichi NPS. The Task Force highlighted the significance of this information noting that the discharge limit is an obvious parameter to vary when comparing options for optimizing protection and safety.

The Task Force commended NRA for creating and sharing a vision and targets for all aspects of decommissioning Fukushima Daiichi NPS. This vision includes targets for all aspects of the decommissioning programme including the discharge of ALPS treated water, which provide important context for stakeholders and for optimization of protection and safety by TEPCO.

The Task Force reiterated its intention set out in the Comprehensive Report to "review NRA's approach to reviewing and potentially revising discharge limits in response to TEPCO's ongoing optimisation of protection and safety" noting that discharge limits should be influenced by the optimization of protection and safety, and not the other way around. Thus, it follows that TEPCO does not need to wait for the discharge limit to be changed for the next iteration of optimizing protection and safety.

The Task Force noted TEPCO's arrangements for the monitoring of each batch of ALPS treated water prior to discharge and NRA's arrangements for independent verification of this source monitoring. It found both to be fit-for-purpose and in line with the requirements of relevant international safety standards.

The Task Force praised the Japanese authorities – including NRA, MOE, FAJ, FP and TEPCO – contributing to marine environmental monitoring related to the ALPS treated water discharges regarding the comprehensiveness of the programme and its proper implementation. It re-emphasised

the importance of this monitoring for encouraging confidence and providing transparency for all interested parties, not least the international community.

The Task Force considered the results of environmental monitoring so far available. It concluded that the tritium activity concentrations that have been measured in seawater from some sampling locations close to the ALPS treated water discharge point are at generally expected levels and consistent with experience at other nuclear facilities. It also noted that these monitoring results are generally consistent with the results of TEPCO's dispersion modelling of each batch that were presented during the mission. This provides further confidence in the REIA as the same modelling techniques were used to simulate future seawater activity concentrations for this assessment.

The Task Force encouraged Japan to carefully analyse all monitoring results as they continue to become available to track consistency with projections from the REIA and to identify any developing trends.

The Task Force noted that several new and updated information systems are maintained for the purpose of sharing the results of marine environmental monitoring data related to ALPS. To a certain extent the Task Force's recommendation to develop a collection of all the monitoring data into a single website and to share it in an easily accessible format has been addressed. However, there are now so many information systems available, all containing similar but not identical data (for instance, as not all information systems contain data from providers and the different systems may have different update frequencies), and the Task Force believes that there is still a need for a single, clearly identified, one-stop-shop for the most up to date monitoring data by the Government of Japan. While acknowledging that this is not directly required by relevant international safety standards, this important data should be shared as effectively and as widely as possible, not least to promote transparency and to support the involvement of interested parties.

The Task Force reiterates that workers of ALPS treated water discharge could be characterised by a broad individual dose distribution, often in the shape of a Gaussian distribution, whereas the dose distribution of a planned exposure situation is much more a skewed distribution, approaching a log-normal, which could be considered by TEPCO and METI for future dose evaluation.

The Task Force encourages NRA to reconsider control items for optimization which is a dynamic process, and ongoing monitoring of occupational exposure and adjustments are essential to maintain.

The Task Force will continue to review the activities of TEPCO and NRA to assess whether they are consistent with the relevant international safety standards. During this mission the Task Force discussed its next steps and highlighted a desire to continue conducting routine review missions to Japan. The next review mission is anticipated to take place in the last quarter 2024. In addition to the routine review missions, the Task Force may conduct additional ad hoc missions or technical reviews depending on the operational situation of the discharge of ALPS treated water or if key technical documents such as the Implementation Plan or REIA were to change significantly.

REFERENCES

[1] https://www.iaea.org/newscenter/pressreleases/iaea-and-japan-sign-agreement-on-continuous-monitoring-and-safety-assessment-of-alps-treated-water-discharge#:~:text=The%20International%20Atomic%20Energy%20Agency,for%20decades%20of%20independent%20monitoring%2C

[2] https://www.iaea.org/sites/default/files/iaea_comprehensive_alps_report.pdf

[3] https://www.iaea.org/topics/response/fukushima-daiichi-nuclear-accident/fukushima-daiichi-alps-treated-water-discharge

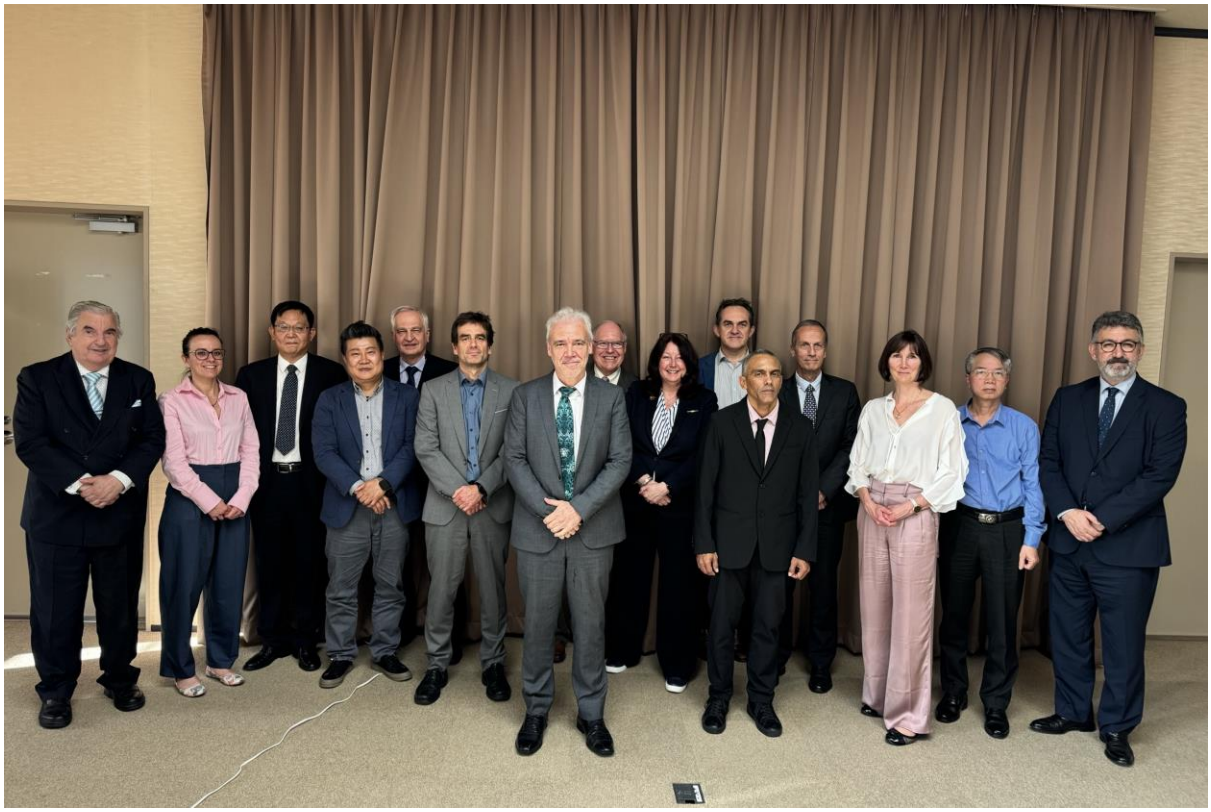
ANNEX I. LIST OF REVIEW TEAM MEMBERS

IAEA Secretariat

• Gustavo CARUSO	Director and ALPS Coordinator, DDGO-NS
• Fabiana GENTILE	Radiation Protection and Laboratory Specialist, DDGO-NS
• Hector CARTAS	Laboratory Technical Officer, DDGO-NS
• Anna CLARK	Section Head, NSRW/WES
• Paul MC GINNITY	Research Scientist, NA/NAML (Monaco)
• Burcin OKYAR	Radiation Safety Specialist, NSRW/RSM

International Experts

• Abel GONZALEZ	Argentina
• Rick TINKER	Australia
• Senlin LIU	People's Republic of China
• Jean-Luc LACHAUME	France
• Hongsuk KIM	Republic of Korea
• Sergey SHINKAREV	Russian Federation
• Jo NETTLETON	United Kingdom
• Michael BOYD	United States of America
• Nguyen HAO QUANG	Viet Nam



ANNEX II. LIST OF PARTICPANTS - JAPAN

23 April 2024

Ministry of Economy, Trade, and Industry (METI)

- Keiichi YUMOTO Director-General for Nuclear Accident Disaster Response
- Yuki TANABE Director for international issues
- Akira IZUMO Director for international issues
- Norikazu WATANABE Director for international issues
- Atsushi WAKUI Deputy Director
- Shino KUWA Deputy Director
- Chiaki IIZUKA Deputy Director
- Sachi MURAKAMI Assistant Director
- Haruhiko URATA Assistant Director

Nuclear Regulation Authority (NRA)

- Toshiyuki KOGANEYA Director-General for Emergency Response
- Teruyo FUNADA International Affairs Office Director
- Sumiyo ISHIZUKI International Affairs Office Specialist

TEPCO

- Akira ONO, Executive Vice President, President of Fukushima-Daiichi D&D Engineering Company (FDEC)
- Junichi MATSUMOTO, Fellow, Chief Officer for ALPS Treated Water Management, FDEC
- Gaku SATO, General Manager, Project Management Office, FDEC
- Katsuhisa MATSUZAKI, Team Leader, Mid and Long Term Planning Group, Project Management Office, FDEC

Ministry of Foreign Affairs (MOFA) Observers

- *Kimitake NAKAMURA, Deputy Director-General, Disarmament, Non-Proliferation and Science Department*
- *Maki YAMAMOTO, Principal Deputy Director, International Nuclear Cooperation Division, Disarmament, Non-Proliferation and Science Department*

24 April 2024

Ministry of Economy, Trade, and Industry (METI)

- Keiichi YUMOTO Director-General for Nuclear Accident Disaster Response
- Haruhiko URATA Assistant Director

TEPCO

- Junichi MATSUMOTO, Fellow, Chief Officer for ALPS Treated Water Management, FDEC
- Takahiro KIMOTO, Deputy General Manager, D&D Communication Center, FDEC

- Katsuhisa MATSUZAKI, Team Leader, Mid and Long Term Planning Group, Project Management Office, FDEC

25 April 2024

Ministry of Economy, Trade, and Industry (METI)

- Keiichi YUMOTO Director-General for Nuclear Accident Disaster Response
- Yuki TANABE Director for international issues
- Akira IZUMO Director for international issues
- Norikazu WATANABE Director for international issues
- Atsushi WAKUI Deputy Director
- Shino KUWA Deputy Director
- Chiaki IIZUKA Deputy Director
- Sachi MURAKAMI Assistant Director
- Haruhiko URATA Assistant Director

TEPCO

- Junichi MATSUMOTO, Fellow, Chief Officer for ALPS Treated Water Management, FDEC
- Gaku SATO, General Manager, Project Management Office, FDEC
- Tadashi YAMANE, Manager, Mechanical Equipment for Treated Water Installation Project Group, ALPS Treated Water Program Department, Fukushima Daiichi Nuclear Power Station (FDNPS), FDEC
- Kenro FURUKAWAZONO, Manager, Civil Equipment for Treated Water Installation Project Group, ALPS Treated Water Program Department, FDNPS, FDEC
- Toshiharu MATSUZAWA, Manager, Planning Radioactive/Chemical Analysis & Evaluation for Treated Water Project Group, ALPS Treated Water Program Department, FDNPS, FDEC
- Masayoshi GOTO, Team Leader, Planning Radioactive/Chemical Analysis & Evaluation for Treated Water Project Group, ALPS Treated Water Program Department, FDNPS, FDEC
- Katsuhisa MATSUZAKI, Team Leader, Mid and Long Term Planning Group, Project Management Office, FDEC

26 April 2024

Nuclear Regulation Authority (NRA)

- Nobuhiko BAN, Commissioner
- Toshiyuki KOGANEYA, Director-General for Emergency Response

NRA Office for Accident Measures of Fukushima-Daiichi NPS

- Ayako OTSUJI YAMAMOTO, Deputy Director
- Kenichiro SHIINA, Chief

NRA Radiation Monitoring Division

- Toshihiro IMAI, Director
- Takuya FURUKAWA, Deputy Director

- Takafumi IKEDA, Deputy Director
- Takahiko KONO, Chief
- Hana KAWAMURA, Chief

NRA international affairs office

- Teruyo FUNADA, Director
- Yoshie AOKI, Chief
- Sumiyo ISHIZUKI, Specialist
- Kai ONOYAMA, Specialist

Ministry of the Environment (MOE) - Marine Environment Division, Environmental Management Bureau

- Naohiro MAEDA, Deputy Director
- Daisuke ISHIKAWA, Chief

Fisheries Agency (FAJ) - Research and Technological Guidance Division, Resources Enhancement Promotion Department

- Yousuke NAKAYAMA, Deputy Director
- Yuki TAKANO , Section Chief
- Hiroto NOMURA, Officer

ANNEX III. MISSION AGENDA

Second Review Mission to Japan

23-26 April 2024

Date	Time	Location	Activities
23 April	10:00 ～ 10:30	MOFA	Opening Remarks (media present)
	10:30 15:00	METI	IAEA, METI and TEPCO Meeting - Overview of the 4 discharges (discharge amount, monitoring result, facility inspection result) - Briefing on the conditions on site, for the site visit tomorrow (including the plans on the 5th discharge)
	15:00 16:00	METI	Briefing on ORP corroboration actions (Mr. R. Cruz Suárez)
	16:00 ～	-	Travel from Tokyo to Fukushima
24 April	10:00 ～ 16:00	Fukushima	Site visit to FDNPS 1) Confirmation/measurement tanks (K4 tank area). 2) ALPS treated water transfer facility building. 3) Electrical room which includes flow control valves and emergency isolation valve. 4) Seawater pumps and header piping, radiation detectors installed near the seaside pumps and the vertical shaft, and the vertical shaft leading to the discharge tunnel.
	16:00 ～	-	Travel from Fukushima to Tokyo
25 April	09:00 ～ 17:00	METI	IAEA, METI and TEPCO Meeting - Presentation of self-evaluation according to the related IAEA standards
	17:00 ～ 19:00	METI	
26 April	09:00 ～ 15:00	NRA (Tokyo)	IAEA and NRA Meeting Regulatory overview of the ALPS discharge Presentation of self-evaluation according to the related IAEA standards TF Internal Meeting

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA