IAEA Review of Safety Related Aspects of Monitoring related to the Handling of ALPS Treated Water at TEPCO's Fukushima Daiichi Nuclear Power Station

Report 4: Fourth Review Mission to Japan after the Start of Advanced Liquid Processing System Treated Water Discharge (May 2025)

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Published by the International Atomic Energy Agency in September 2025

EXECUTIVE SUMMARY

In April 2021, the Government of Japan released its Basic Policy on Handling of Advanced Liquid Processing System (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 detailed review of the safety related aspects of handling ALPS treated water stored at FDNPS [1], applying the relevant international safety standards. The objective of the IAEA is to carry out this safety review, before, during and after discharges of ALPS treated water.

The IAEA review before discharge 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 for two years before the discharge of ALPS treated water began. It also comprised of 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 [3].

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. The third review mission took place from December 9 to 12 2024 and covered the main technical topics considered by the IAEA as part of its safety review before the start of discharges. This fourth review mission was conducted from May 26 to 30 2025. The Task Force for this mission comprised of 13 members, including experts from the IAEA Secretariat and international experts who are designated members of the Task Force.

The scope of this fourth review mission focused on reviewing and understanding the various monitoring programmes being carried out for the ALPS treated water to confirm if they are in compliance with relevant international safety standards. These programmes are conducted by the Government of Japan and a local government, the Japanese nuclear regulator: the Nuclear Regulatory Authority (NRA) and the licensee: TEPCO. The mission also reviewed the activities carried out by the IAEA to independently corroborate the results of the source and environmental monitoring programmes.

During the mission the Task Force received detailed information on the source and environmental monitoring programmes carried out in relation to the ALPS treated water. Presentations detailing the structure, execution, analysis, and ongoing results of these programs were made by the NRA, the Japanese Ministry of the Environment (MOE), the Fukushima Prefectural Government (FP), the Fisheries Agency of Japan (FAJ) and TEPCO.

Additionally, staff members from the IAEA's Laboratories provided presentations detailing their ongoing independent corroboration of Japan's monitoring programmes as well as the IAEA's onsite verification activities at the FDNPS. The Task Force had access to all relevant Japanese technical and regulatory experts and was provided with opportunities to inquire about specific issues. The mission also included a visit to the FDNPS by the Task Force to directly observe the equipment and facilities responsible for the management and discharge of ALPS treated water.

Based on the activities conducted by the Task Force during the mission, the IAEA's overall conclusions agree with those highlighted in the previous three missions after the start of the 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 IAEA Comprehensive Report.

- The Task Force noted that the monitoring programmes carried out for the ALPS treated water are consistent with the relevant international safety standards and guidance. The programmes are well described and implemented, and results are consistent with the conclusions of the Radiological Environmental Impact Assessment (REIA) which states the discharges of ALPS treated water pose negligible risk to the public and environment.
- The Task Force highlighted that the NRA has maintained regulatory oversight of the ALPS treated water through its own confirmatory monitoring programmes and its onsite presence to maintain safety oversight of the discharge of ALPS treated water.
- 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 the IAEA's onsite independent testing and analysis. This oversight continues to provide comprehensive, transparent and independent verification of the accuracy and reliability of the data reported by TEPCO and the Government of Japan.

This mission report summarizes the monitoring programmes in place and their results, documents observations from the Task Force and reflects the discussions between the Task Force, Government of Japan and a local government, the NRA, and TEPCO. This report was agreed upon by the IAEA Task Force and has been published by the IAEA on its public website.

GLOSSARY OF ACRONYMS

ALPS – Advanced Liquid Processing System

CRMP – Comprehensive Radiation Monitoring Plan

FAJ – Fisheries Agency of Japan

FDNPS – Fukushima Daiichi Nuclear Power Station

FP – Fukushima Prefectural Government

FWT – Free Water Tritium

IAEA – International Atomic Energy Agency

ILC – Interlaboratory Comparison

ISO – International Organization for Standardization

JAEA NSRC - Japan Atomic Energy Agency Nuclear Safety Research Centre

METI – Ministry of Economy, Trade, and Industry

MOE – Ministry of the Environment

OBT – Organically Bound Tritium

PT – Proficiency Test

REIA – Radiological Environmental Impact Assessment

RML - Marine Environment Laboratories, Radiometrics Laboratory

TEPCO – Tokyo Electric Power Company Holdings'

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BACKGROUND

IAEA Involvement and Role

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 ALPS 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 the 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, the NRA, and the Ministry of Economy, Trade, and Industry (METI); and by 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 and 2023. 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 July 4, 2023 [2].

On September 18, 2023, the IAEA and the 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 in January 2024. The second review mission was conducted in April 2024 and the IAEA issued the corresponding report in July 2024. The third mission was conducted in December 2024 with the corresponding report issued in March 2025.

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., the 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 analyse whether the Japanese comprehensive plans to discharge ALPS treated water are being conducted consistently with the relevant international safety standards. To achieve this, the Task Force reviews the reference materials submitted by the Government of Japan or TEPCO, seeks clarification on technical issues, requests additional information and observes onsite 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 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 NRA's review and approval process is conducted in accordance with the relevant IAEA international safety standards. This component primarily involves the NRA as the independent regulatory body responsible for nuclear safety within Japan; it is focussed only on the regulatory aspects relevant for the 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 ALMERA laboratories. Additionally, this component also includes the corroboration of occupational exposure.

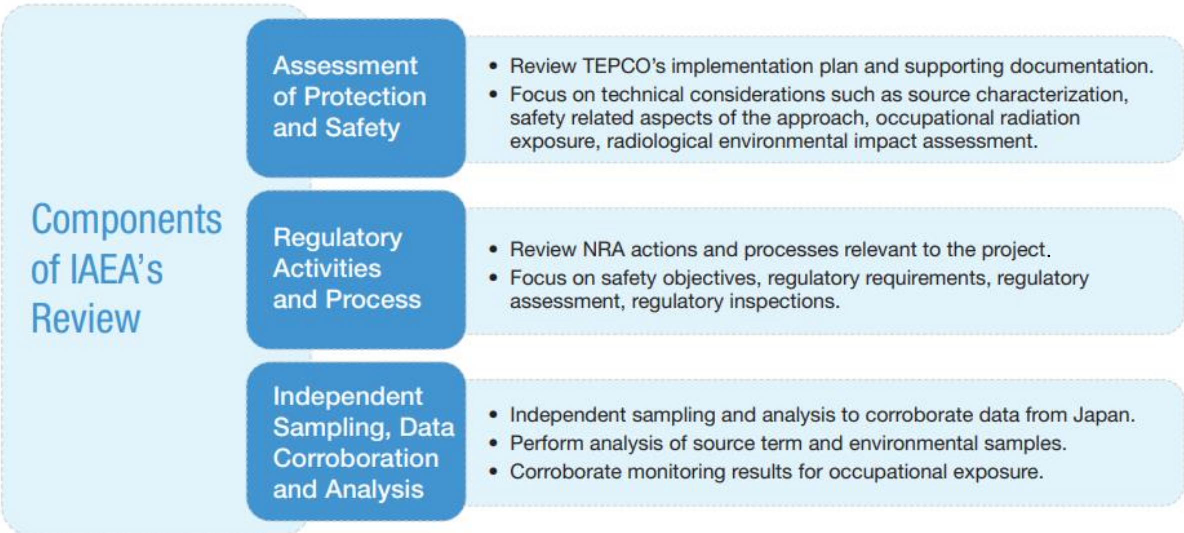

Figure 1: Components of the IAEA Review

As stated above, the third component of the IAEA's review is the independent sampling, data corroboration and analysis. The corroboration of monitoring conducted by TEPCO and relevant Japanese authorities is based on independent sampling and analysis conducted by the IAEA staff onsite at the FDNPS and interlaboratory comparisons (ILCs). ILCs, along with proficiency tests (PTs), are standard methods for laboratories to assess the quality of their measurement results in comparison with those of other participating laboratories and to identify any potential improvements. PTs involve the evaluation of performance against pre-established criteria whereas ILCs involve the organization, performance and evaluation of measurements on the same or similar items by two or more laboratories in accordance with predetermined conditions.

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 Daiichi ALPS treated water discharge [4].

Process of the Discharge of ALPS Treated Water at FDNPS

The purpose of the ALPS is to manage and process the contaminated water generated from the accident at FDNPS and subsequent cleanup operations ongoing. This contaminated water is often highly radioactive and is currently stored onsite in special tanks to prevent it from entering the environment in its current state. To manage this contaminated water, TEPCO developed the ALPS. The ALPS can remove most of the radioactive contamination in the contaminated water, apart from tritium, which is unable to be removed from water on an industrial scale with the current state of technology. The ALPS system is primarily a pumping and filtration system which uses a series of chemical reactions to remove 62 radionuclides from the contaminated water. The radionuclides are captured in filters and stored onsite in high integrity containers. After treatment by the ALPS the water is then designated as ALPS treated water and is stored in large tanks onsite, see Figure 2 below.

After treatment by the ALPS, this treated water is ready for discharge into the sea. To accomplish this TEPCO has constructed a discharge facility onsite at the FDNPS, composed of four main components, see Figure 3 below. The first component is the measurement and confirmation facility. The water to be discharged is received by this facility and homogenized by installed agitators. TEPCO then samples this water and sends it to onsite laboratories for analysis to confirm the treated water meets the discharge criteria set by the Government of Japan before it is released. Once analysis verifies concentration of radionuclides in the treated water meets the discharge criteria it is moved to the transfer facility. The second component, the transfer facility, is the designation for the pumps, pipes, valves, and other engineering controls responsible for moving the treated water to the next step, the dilution facility. The third component is the dilution facility and is responsible for mixing the treated water with seawater in a large section of piping called a header. This is done to dilute the concentration of tritium in the treated water so that it will meet the concentration discharge limit of 1,500 Bq/L. The final component is the discharge facility. This component consists of the discharge vertical shaft, discharge tunnel and discharge outlet. The final discharge of the ALPS treated water occurs through a tunnel running under the seabed about one kilometre off the coast.

At the time of the review mission in May 2025, 12 batches of ALPS treated water had been discharged, starting in 2023. A summary of the concentration of radionuclides in each batch, compared to regulatory limits is available in Annex IV of this report. Detailed results of each batch discharge can be found on TEPCO's Treated Water Portal Site [5].

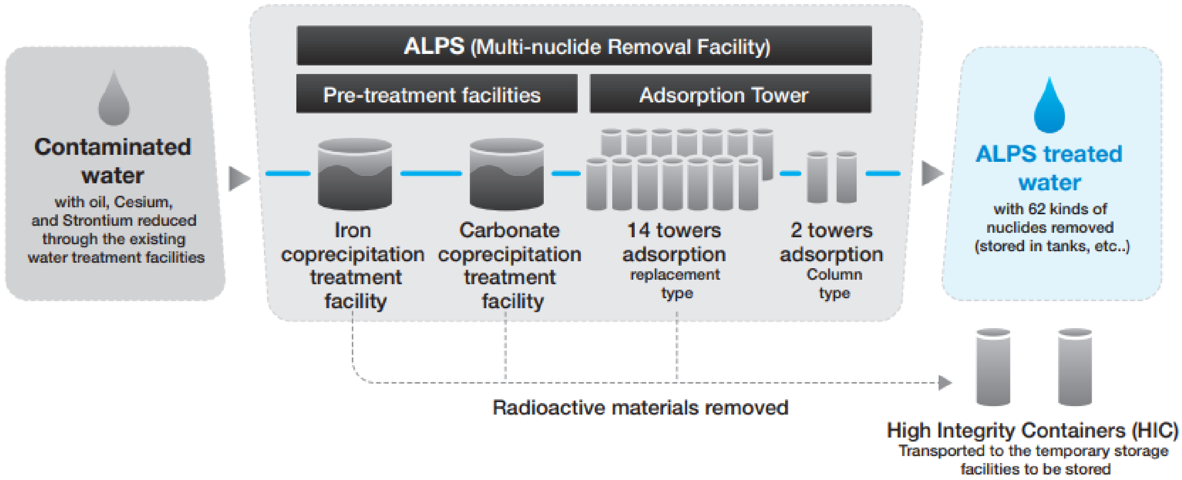

Figure 2: Details of ALPS treatment process to remove radionuclides

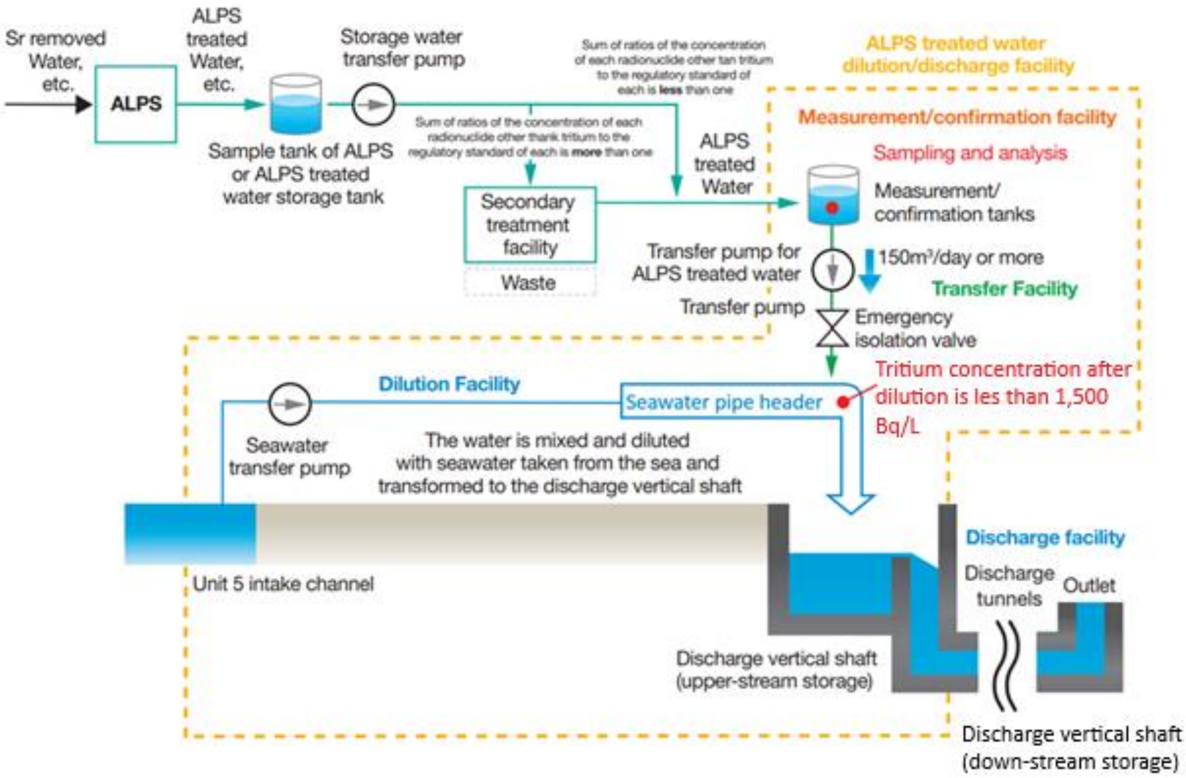

Figure 3: Diagram of the facilities for discharging ALPS treated water into the sea

IAEA Standards and Guidance on Monitoring

The IAEA has three primary standards in place that provide requirements and recommendations for monitoring: the General Safety Requirements Part 3 [6], General Safety Guide GSG-9 [7] and Safety Guide RS-G-1.8 [8]. These documents define two categories of monitoring required for an operating nuclear facility: Source Monitoring and Environmental Monitoring. Source Monitoring is defined in these standards as:

> *"The measurement of activity in radioactive materials being released to the environment or of external dose rates due to sources within a facility or activity"* [6]

In the context of the ALPS treated water, source monitoring refers to the measurements carried out on water treated by the ALPS that will be released to the environment. This is done to ensure the water meets the release criteria before it is released into the sea. The second type of monitoring, Environmental Monitoring, is defined as:

> *"The measurement of external dose rates due to sources in the environment or of radionuclide concentrations in environmental media."* [6]

Environmental monitoring in the context of the ALPS treated water refers to measuring the concentration of radioactive elements in aquatic environmental media around the FDNPS, such as water, sediment, and aquatic organisms such as seaweed and fish. The purpose of environmental monitoring is to use the data collected to validate the models and conclusions of the REIA. This data can also be used to update the REIA with additional information in the future to ensure people and the environment continue to be protected.

In addition to the monitoring requirements set out in the IAEA safety standards, these documents also describe key responsibilities of organizations involved in source and environmental monitoring. The responsible organizations in these documents are categorized as: the operating organization/licensee., the nuclear regulator and the government. Table 1 below is adapted from the draft revision of RS-G-1.8 (DS505) [8] and provides a summary of the expected responsibilities of each organization under different exposure situations. Among the situations listed in Table 1 the appropriate situation to consider for the ALPS treated water is a planned exposure from a licensed practice or source.

Table 1. Responsibilities for source, environmental and individual monitoring and dose assessment [9]

Exposure Situation		Operating organization[a]	Regulatory body	Government
Planned	Exempted, cleared and notified practice or source	No monitoring required	No monitoring required	No monitoring required
	Registered practice or source	Conduct source monitoring[b]	Review and approve monitoring programmes of registrants and licensees, as appropriate Review periodic reports on public exposure including dose assessments, as appropriate[c] Conduct limited confirmatory environmental monitoring, as appropriate[c,d]	Ensure arrangements are in place for monitoring
	Licensed practice or source	Conduct source and environmental monitoring and dose assessment		
	Multiple sources	Conduct source monitoring of its own facility, site specific environmental[c] monitoring, and dose assessment for its own facility[c]	Review monitoring data and prepare dose assessments cumulative over the relevant period, as appropriate Conduct environmental monitoring to assess cumulative radiological impact[d]	Ensure arrangements are in place for management of countrywide surveys
Emergency	–	Conduct source monitoring and site specific environmental monitoring[c]	Coordinate large scale and/or local environmental monitoring, as appropriate[d,] Coordinate individual monitoring of the public, as appropriate[d,]	Ensure resources and capabilities are available to respond to emergencies Ensure arrangements are in place for management of countrywide monitoring networks Assign responsibilities to the regulatory body or other response organizations depending on the national arrangements
Existing	Areas with residual radioactive material	Conduct source monitoring, site specific environmental monitoring and dose assessment[e]	Review monitoring data and dose assessments Conduct local environmental monitoring, as appropriate Coordinate individual monitoring of the public, as appropriate[d,f]	Screen areas where the radiological impact is of potential concern and a radiological survey is considered necessary Decide on the need for monitoring Ensure arrangements are in place for management of existing exposure sites, including monitoring, as the sites are identified

a - The operating organization can delegate the monitoring to another party, but should maintain the responsibility.
b - For registered practices, the regulatory body might require source monitoring to be performed.
c - Only for licensed practices or sources.
d - The regulatory body can perform activities related to monitoring itself or delegate their implementation.
e - The government can assign this responsibility to other response organizations rather than the regulatory body, depending on the national arrangements.
f - For existing exposure situations resulting from emergencies in which health follow-up was recommended.

JAPAN'S ALPS TREATED WATER MONITORING FRAMEWORK AND PROGRAMMES

Source Monitoring Programmes For ALPS Treated Water

Operator Source Monitoring

TEPCO, as the operating organization of the FDNPS and ALPS conducts source monitoring to ensure that the water has been properly treated before its release to the environment. The approach TEPCO has taken to source monitoring is by preparing batches of ALPS treated water for discharge then performing sampling and laboratory measurements of activity concentrations to ensure the concentration of radionuclides in the batch meet the regulatory limits. A batch in this context is a volume of water that has been treated by the ALPS and is ready for release. This approach is consistent with IAEA Safety Guide RS-G-1.8 [8] which states:

> *"In the case of batch discharges, the material for discharge is adequately characterized by the volume of the batch and the radionuclide composition of a sample taken at the reservoir from the homogenised batch prior to discharge."*

TEPCO conducts source monitoring of the ALPS treated water with every batch prepared for release, this is conducted at the Measurement/confirmation facility before the batch is moved to the dilution facility (Figure 3) and measures and analyses for 31 radionuclides including tritium (as of May, 2025). As stated above, the goal of this source monitoring is to ensure the batch meets the regulatory concentration limits as well as the requirement that the sum of ratios (the sum of each radionuclide concentration in the discharge divided by the regulatory concentration limits) needs to be less than one, with respect to 30 radionuclides excluding tritium. Details of the source monitoring results of each batch processed and released at the time of this mission can be found in Table IV. 1 and Table IV. 2 of Annex IV of this report.

In addition to the source monitoring conducted, TEPCO also conducts monitoring at the dilution facility for tritium during release of the batch to the sea. This is done to ensure the tritium concentration in the batch released to the sea stays below the authorized tritium concentration limit of 1,500 Bq/L. This is done with two methods, the first is that a concentration value for tritium is constantly calculated based on the flow rate of the treated water being released, the undiluted tritium concentration in the batch and the flow rate of seawater used for dilution. The second method, conducted to add confidence in the calculated results, is daily performed by sampling at seawater pipe header and analysing the diluted water to determine the tritium concentration. The combination of these methods provides near real-time tritium concentration data for the diluted ALPS treated water as it is discharged.

As an additional confirmation step before release to the environment, the concentration of tritium is measured in the vertical shaft (Figure 3). Before starting the discharge of ALPS treated water, the treated water is diluted with seawater and stored in the vertical shaft, a sample is taken and analysed for tritium. The goal of this analysis is to confirm the appropriate dilution is performed, indicating the dilution facility is operating as designed.

Regulator Source Monitoring

The NRA conducts independent monitoring annually to complement its oversight of TEPCO's framework for monitoring and analysing the ALPS treated water. The NRA analyses samples of ALPS treated water to verify if the values determined from TEPCO's own analysis agree with their results. Based on this comparison, the NRA can then conclude on whether TEPCO's analytical conclusions from source monitoring are valid and accurately reported. The NRA has selected 7 radionuclides for analysis to confirm TEPCO's results, these radionuclides are: ^{14}C, ^{60}Co, ^{106}Ru, ^{125}Sb, ^{129}I, ^{134}Cs and

^{137}Cs. The NRA selected these radionuclides based on criteria such as being considered major contributors to the dose, such as ^{129}I and ^{14}C, as determined by the REIA, or they can be targeted in a single measurement. Analysis of the NRA's source monitoring samples is conducted by the Japan Atomic Energy Agency Nuclear Safety Research Centre (JAEA NSRC) An example of the results is provided below in Table 2.

Table 2: Comparison of the NRA and TEPCO source monitoring results of radionuclides above detection limit, August 2023

Nuclide	NRA (Bq/L)	TEPCO (Bq/L)	Regulatory Limit (Bq/L)	En
^{60}Co	0.23±0.035	0.24±0.049	200	0.20
^{129}I	1.70±0.12	1.80±0.092	9	0.66
^{137}Cs	0.45±0.064	0.45±0.080	90	0.05
^{14}C	13.19±0.65	13±2.3	2000	0.08

After the analysis is completed, the NRA then compares the results of their analysis with those of TEPCO to verify that the concentration of the radionuclides in the ALPS treated water is correct. To do this, the NRA uses an En number, a performance statistic used to evaluate laboratory measurement results in proficiency testing schemes. An En number less than an absolute value of 1 corresponds to agreement between values with a confidence of 95%.

In addition to the analytical verification activities described above, the onsite NRA inspectors at the FDNPS conduct regular inspections of the ALPS operations. These inspections include operation management inspections conducted weekly, quality assurance inspections conducted monthly and periodic safety inspections of the ALPS performance. The NRA inspectors also receive updates on the project status and observe TEPCO meetings approximately twice a week. Finally, the NRA inspectors are involved in any trouble management, for example if there are any unusual events such as equipment failures or leaks detected. The NRA indicated to the Task Force that to date there have been no safety issues confirmed from their inspection activities.

Government Source Monitoring

Within the international safety standards the government has no specific responsibility to conduct source monitoring at nuclear facilities. Instead, they are responsible for assuring the appropriate agreements are in place to conduct source monitoring. However, the JAEA Okuma Analysis and Research Centre takes samples of ALPS treated water from each batch for analysis, according to the request by METI. This analysis is conducted on the same radionuclides selected for TEPCO's source monitoring and is done to confirm concentrations of radionuclides are below regulatory limits and the sum of ratios is less than one. From discussions between Japanese representatives and the Task Force over the course of the mission, the Task Force and the IAEA did not identify any gaps or shortcomings in the responsibilities of the Government of Japan related to source monitoring for ALPS treated water.

Japan's Comprehensive Radiation Monitoring Plan

The environmental monitoring programme for ALPS treated water is organized through the Government of Japan's Comprehensive Radiation Monitoring Plan (CRMP) [10]. The CRMP represents a coordinated initiative undertaken by government agencies aimed at monitoring and managing radiation levels throughout the country and is chaired by the MOE with several other organizations contributing to its implementation. It was developed in August 2011 in response to the accident at FDNPS and has been reviewed and revised as necessary annually. The objectives stated within the CRMP include:

i. Analysing radiation dose levels and distribution of radioactive materials mainly in the residential areas and locations on a medium-to-long-term basis;

ii. Planning and evaluating a decontamination scheme and other measures to be taken to reduce exposure dose levels in accordance with different exposure situations;

iii. Investigating and decision making with respect to changes and revisions made to evacuation zones based on predictions of future exposure as realistically as possible;

iv. Collecting basic data for managing the health of residents and making health impact assessments; (including external and internal exposure doses of residents in the vicinity)

v. Understanding the state of the dispersion, deposition, migration, and transference of radioactive materials emitted into the environment.

vi. Reducing rumour-based adverse impacts on reputation by handling ALPS Treated Water

The CRMP identifies key organizations and their roles and responsibilities in relation to monitoring [10] for ALPS treated water discharge. The organizations identified fall within the categories of organizations identified in the IAEA international safety standards, namely: the government, the nuclear regulator and the operator. The organizations identified in the CRMP as having monitoring responsibilities in relation to the ALPS treated water are summarized below.

Nuclear Regulation Authority

The NRA is Japan's nuclear regulator. It was established in the wake of the accident at FDNPS when the Government of Japan modified its existing regulatory system to create an independent regulatory body from the rest of the government. The NRA is responsible for regulating nuclear safety and security, safeguards based on international commitments as well as the use of radioactive isotopes and radiation monitoring. As an independent regulatory body, the NRA conducts independent decision-making concerning nuclear regulation, including permitting, approvals and inspections, without involvement of the authorities within Japan responsible for promoting nuclear energy.

Within the CRMP, the NRA is responsible for planning and implementing monitoring of natural environments, analysing and evaluating these monitoring results and consolidating and disseminating them. They are responsible for coordinating the division of monitoring roles and providing scientific and technical advice to relevant ministries and other entities. Finally, they are responsible for consolidating and disseminating the results of the analysis and evaluation of measurement results conducted by relevant ministries and other entities.

In their capacity as the nuclear regulator, the NRA conducts validation of TEPCO's onsite source monitoring as well as conducting inspection activities of the ALPS. The NRA also conducts confirmatory seawater monitoring of tritium, ^{134}Cs, ^{137}Cs and ^{90}Sr around the FDNPS. These programmes are explained in further detail in subsequent sections.

Japanese Ministry of the Environment

The MOE has a mandate from the Government of Japan to prevent environmental pollution and support environmental restoration, among other responsibilities. It is in this capacity that the MOE is involved in environmental monitoring for the ALPS. Within the CRMP the responsibilities of the MOE are to perform environmental monitoring around the FDNPS including seawater, sediment, fish and seaweed monitoring as well as to perform consolidation of aquatic environmental monitoring information from other involved organizations.

Fisheries Agency of Japan

The FAJ is a part of the Japanese Ministry of Agriculture, Forestry and Fisheries and is responsible for the management, conservation and development of Japan's fisheries and aquatic resources. Within the context of ALPS monitoring, the FAJ conducts environmental monitoring with the objective of confirming safety of seafood and increasing fisher and consumer confidence in the fishery resources along the East and Northeastern coast of Japan. The FAJ collects and analyses fish, seaweed, shellfish, cephalopod and crustacean samples for tritium and radioactive caesium.

Fukushima Prefectural Government

FP is the local government responsible for Fukushima Prefecture, the prefecture in which the FDNPS is located. As the local government, FP maintains a key role in remediating and revitalizing the areas of the prefecture affected by the Fukushima accident. FP has been conducting sea area environmental monitoring around the FDNPS since 1973 in agreement with TEPCO and continues to do so under the CRMP. The CRMP indicates local governments:

> *"shall collaborate with the central government and the operator of nuclear facilities to conduct community-based monitoring and consolidate and disseminate the results of the analysis and evaluation of measurement results"* [10]

Based on the CRMP, FP monitors tritium, ^{134}Cs, ^{137}Cs, ^{90}Sr, ^{238}Pu and $^{239+240}$Pu in seawater around the FDNPS. Since the implementation of the ALPS and regular discharges of ALPS treated water, FP has strengthened its existing environmental monitoring programme by expanding the number of sampling locations and working on their analytical process to decrease the detection limits for tritium, and therefore increase analytical precision.

Tokyo Electric Power Company Holdings'

TEPCO is the owner and operator of the FDNPS and is licenced by the NRA to conduct activities related to the ALPS, including its operation and release of ALPS treated water into the Pacific Ocean. As part of their license conditions, TEPCO conducts both source and environmental monitoring in relation to the ALPS. The CRMP also tasks the operator of the nuclear facility, in this case TEPCO, to collaborate with the central government and local governments to conduct its responsible monitoring and consolidate and disseminate the results of the analysis and evaluation of measurement results [10]. Onsite, TEPCO conducts source monitoring of ALPS treated water as well as monitoring of the ALPS treated water after dilution before discharge. Offsite, TEPCO conducts both near and far-field environmental monitoring of seawater, sediment, and aquatic biota.

Environmental Monitoring Programmes for ALPS treated water

From the start of the discharge of ALPS treated water into the sea, the organizations identified as having responsibilities for monitoring related to ALPS treated water have strengthened their monitoring programmes, both adding monitoring locations to their programmes and improving their analytical techniques. A key aspect of these improvements is decreasing the detection limits of their analyses.

As part of the environmental monitoring programmes related to ALPS treated water, two methods of analysis are employed, referred to as rapid analysis and precise analysis. Precise analysis involves a more intensive analytical method and takes longer to conduct, around one week to one month to achieve results, but these results have a lower detection limit thereby allowing detection of smaller concentrations of radionuclides in the environment. Conversely, rapid analysis involves a faster analytical method, approximately one day to achieve results, but consequently has a higher detection limit. The details of each organizations environmental monitoring programmes, including analytes, frequencies and analytical methods employed are discussed in detail below.

Sediment is also sampled periodically as part of the larger environmental monitoring programme in place around the FDNPS; however, environmental monitoring conducted in relation to the discharges of ALPS treated water is focused on monitoring water and aquatic organisms. The following discussion on environmental monitoring for ALPS treated water therefore describes the water and aquatic biota monitoring and results.

Government Environmental Monitoring

Under the CRMP, several governmental organizations have responsibilities for environmental monitoring in relation to the ALPS. The government organizations listed as having monitoring responsibilities directly involved in ALPS related monitoring are the MOE, the FAJ and FP.

Japanese Ministry of the Environment

The MOE conducts seawater and biota monitoring around the FDNPS. **Figure *4*** Figure 4 provides a map of the sampling locations that make up the MOE's environmental monitoring programme around the FDNPS. The left map indicates nearfield sampling efforts, while the right map indicates far-field sampling.

Precise tritium analysis is conducted at the sampling locations denoted by the pink stars with thick borders (left image of figure 4, within orange ellipses) and red stars on a quarterly basis. Precise analysis of ^{134}Cs, ^{137}Cs, ^{90}Sr, ^{106}Ru, ^{125}Sb, ^{129}I and ^{60}Co is also conducted at the pink stars on a quarterly basis. Further, precise analysis of ^{125m}Te, ^{144}Ce, ^{154}Eu, ^{155}Eu, ^{54}Mn, ^{55}Fe, ^{238}Pu, ^{239}Pu, ^{240}Pu ^{241}Am, ^{244}Cm, ^{90}Y, ^{99}Tc, ^{113m}Cd, ^{63}Ni, ^{79}Se, ^{234}U, ^{238}U, ^{237}Np and ^{14}C is conducted at the locations indicated by pink stars on an annual basis.

Rapid analysis of tritium is conducted at the pink stars twice while the ALPS is discharging and monthly when it is not. Rapid analysis of tritium is also conducted once per discharge at the red stars. The yellow stars denote sampling locations where tritium rapid analysis is conducted before and during the beach season.

The orange ellipses in the left map denote areas from where aquatic samples are collected. Fish samples are collected seasonally and analysed for free water tritium (FWT), organically bound tritium (OBT) and ^{14}C. Seaweed samples are collected from the sampling locations denoted by the green pentagons in the far field map. They are collected twice a year and analysed for ^{129}I.

A summary of precise analysis results of radionuclides in seawater, fish and seaweed from the MOE's environmental monitoring programme is available in Table IV. 3 of Annex IV of this report. Concentrations of all radionuclides were below regulatory limits.

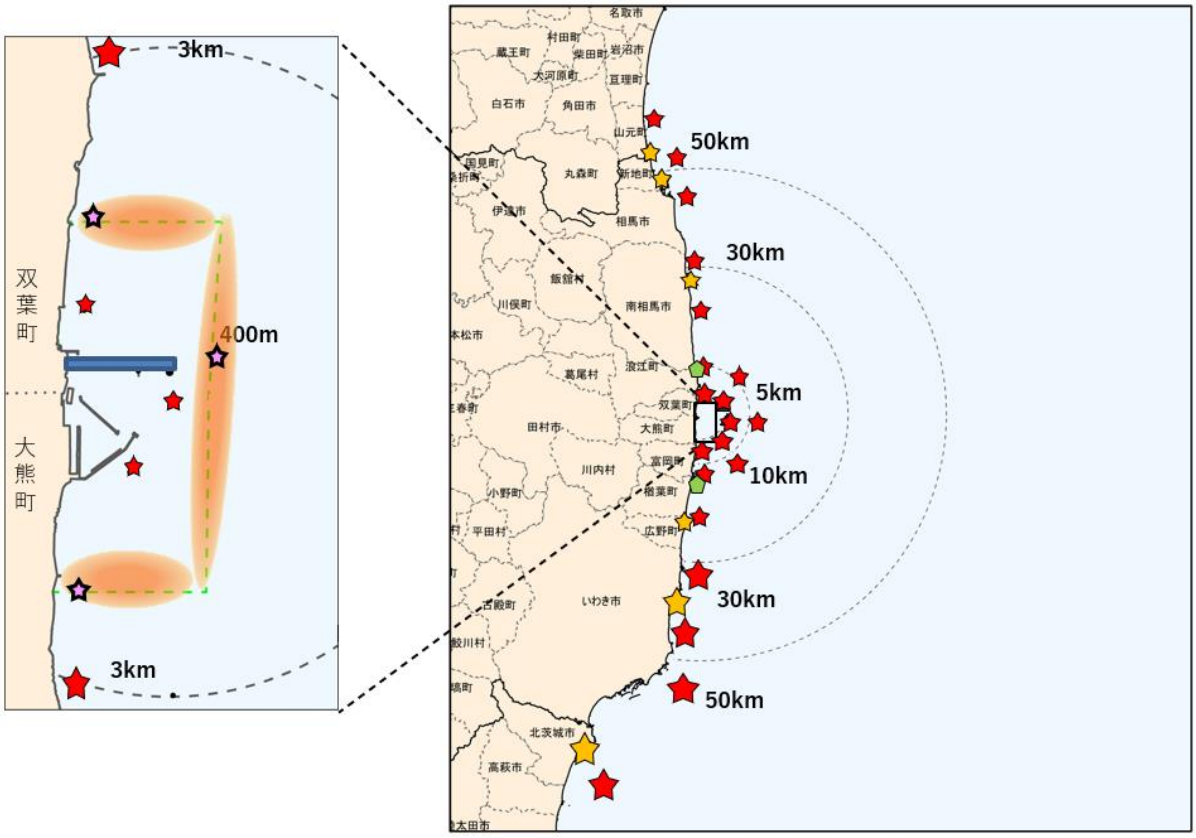

Figure 4: Map of Sampling conducted by the Ministry of the Environment around the Fukushima Daiichi Nuclear Power Station [11]

Fisheries Agency of Japan

The FAJ conducts environmental monitoring focussed on sampling and analysis of tritium in aquatic organisms along the Eastern coast of Japan and into the Pacific Ocean. Their sampling targets the olive flounder as a common species in coastal water but also samples a variety of aquatic organisms which are representative of the sampling area. The FAJ's programme therefore acquires a variety of species, including: 42 fish species, two crustacean species, seven shellfish species, four cephalopod species, four seaweed species and three other species such as sea urchins, sea cucumbers and sea squirts.

In the nearfield of the FDNPS, the FAJ conducts rapid analysis of tritium at the locations denoted by the two yellow triangles in Figure 5**Figure *5***, North and South of the ALPS point of discharge. When discharge is occurring from the ALPS, samples are collected from these locations and analysed four times a week. When there is no discharge occurring, samples are collected and analysed once a week at these locations.

Precise analysis is conducted on samples taken from the locations denoted by the blue circles in Figure 6**Figure *6***. The schedule of collection for these sampling locations results in approximately 200 samples per year collected and analysed by the FAJ. To date, 636 samples have been collected, analysed and published, the concentration of tritium in all these samples has been below the limit of detection.

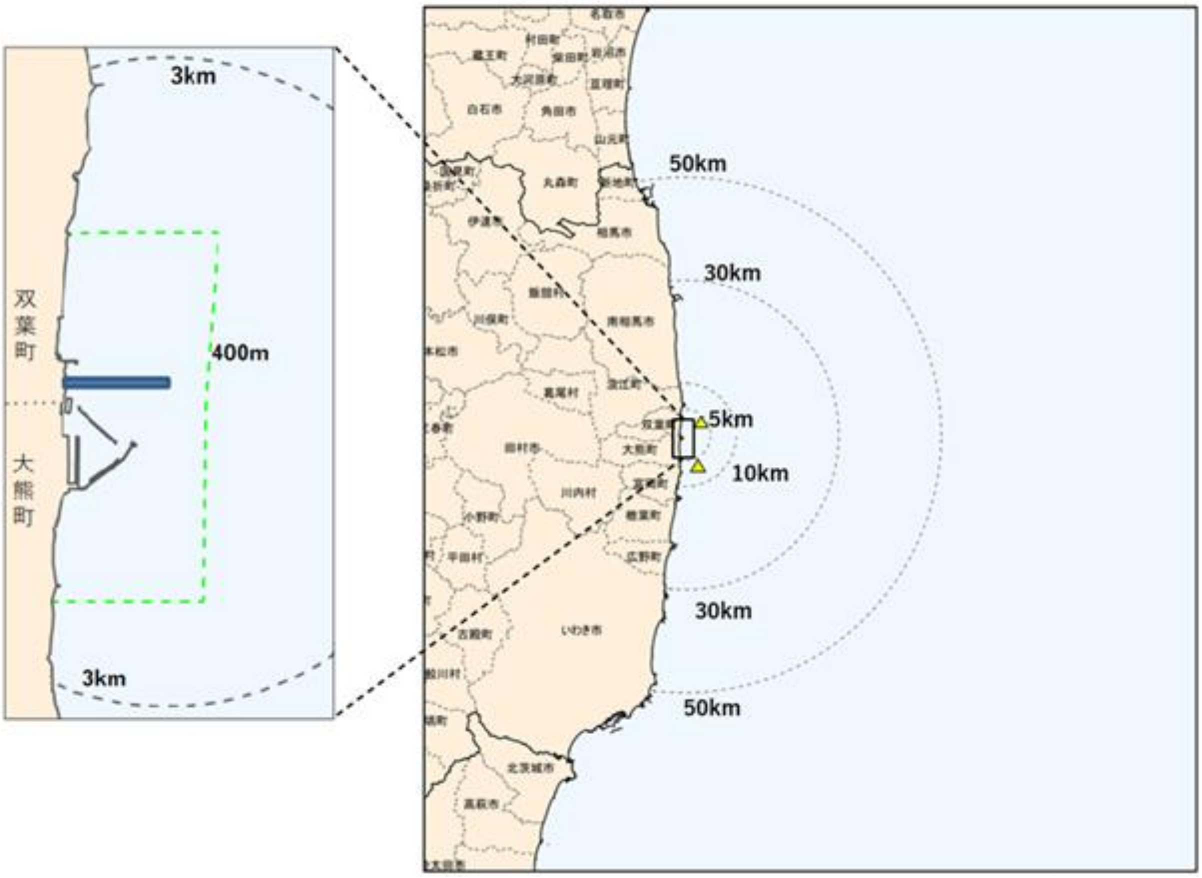

Figure 5: Map of Sampling conducted by the Fisheries Agency of Japan around the Fukushima Daiichi Nuclear Power Station [11]

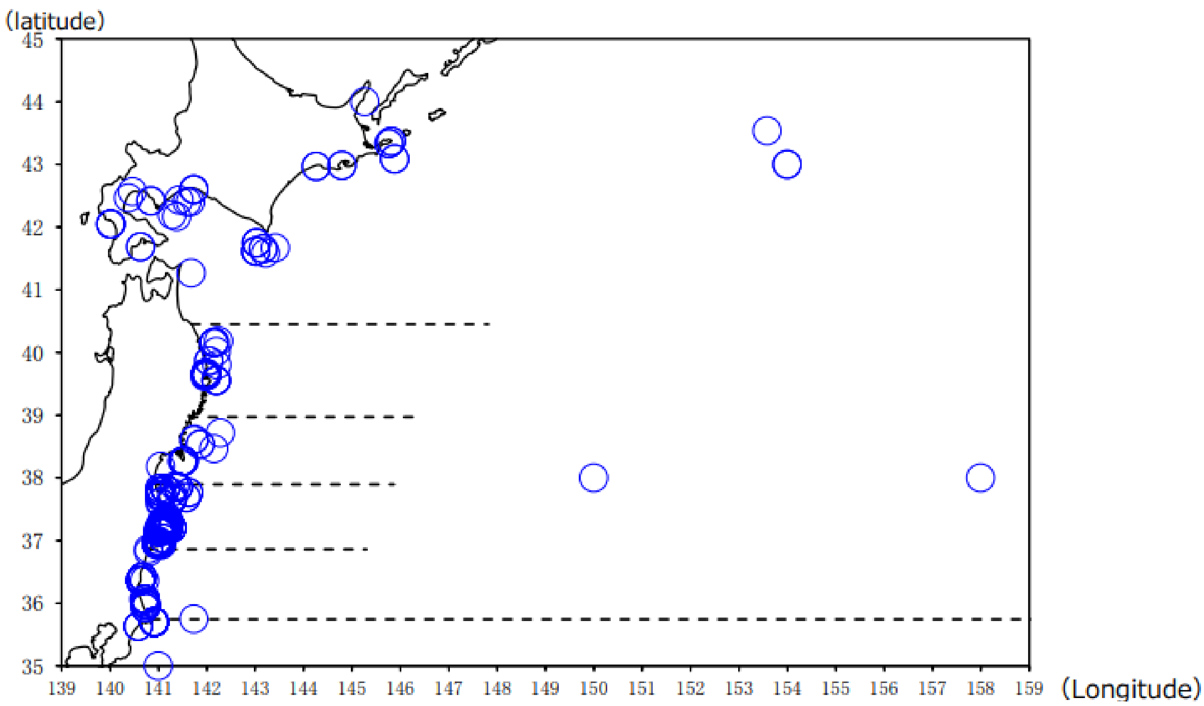

Figure 6: Map of Sampling Conducted by the Fisheries Agency of Japan Along the Japanese coast and Pacific Ocean [11]

Fukushima Prefectural Government

FP's environmental monitoring programme conducts water sampling in the nearfield around the FDNPS. Samples are collected from several locations around the ALPS discharge outlet, denoted by the brown squares in Figure 7. Precise and rapid analysis of tritium occurs monthly at these locations; the frequency of rapid analysis is increased to every week during periods when there is discharge from the ALPS occurring. In addition to tritium, precise analysis is also conducted for ^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu and ^{240}Pu for samples taken at these locations. Tritium and ^{137}Cs are typically the only analytes which return results above the detection limit. A summary of the results of radionuclides above the detection limit from FP's environmental monitoring programme are available in Table IV. 4 of Annex IV of this report.

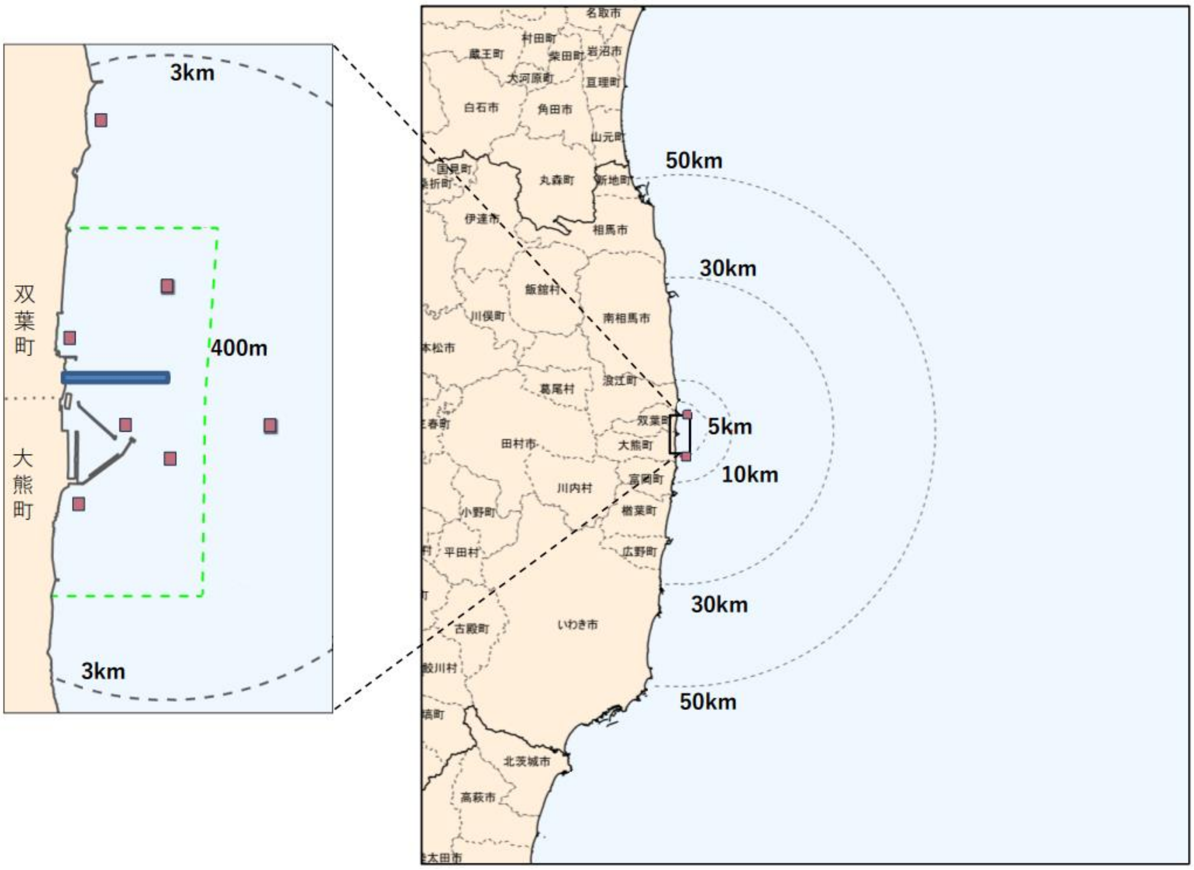

Figure 7: Map of Sampling Conducted by the Fukushima Prefectural Government around the Fukushima Daiichi Nuclear Power Station [11]

Regulator Environmental Monitoring

The NRA conducts its own monitoring in the environment, as part of its responsibilities outlined in the CRMP [10] as well as in its capacity as the nuclear regulator. Precise analysis of tritium is conducted for seawater samples taken monthly from the four locations denoted by the orange circles in Figure 8. Precise analysis of tritium, ^{134}Cs, ^{137}Cs and ^{90}Sr is undertaken for seawater samples taken every three months at the sampling locations denoted by the green circles in Figure 8.

Additionally, the NRA compares results of their environmental monitoring to that of other organizations to ensure data are accurate and trends in concentrations of radionuclides over time are behaving as predicted. An upper and lower 95% prediction interval is calculated based on available data to create expected behaviour of data into the future; results are then compared to this trend. If results fall within the upper and lower prediction intervals of the calculated trend, they are considered to be behaving within predictions, datapoints falling outside the prediction intervals are identified as outliers. If a datapoint is an outlier it does not mean the value is incorrect, but it requires additional evaluation to confirm the result is accurate, such as reanalysing the sample or investigating potential causes of the outlier, under the NRA oversight. A visualization of this analysis is available below in Figure 9.

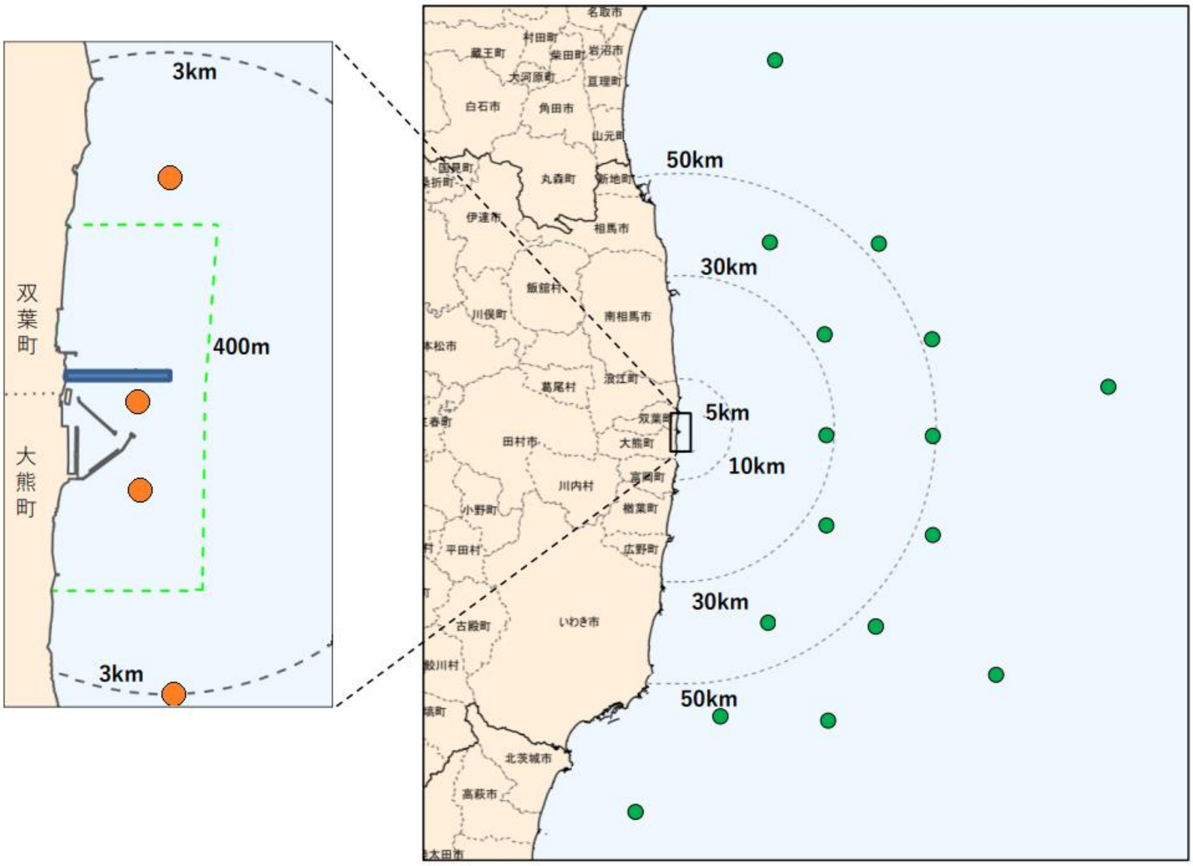

Figure 8: Map of Sampling Conducted by the Nuclear Regulatory Authority around the Fukushima Daiichi Nuclear Power Station [11]

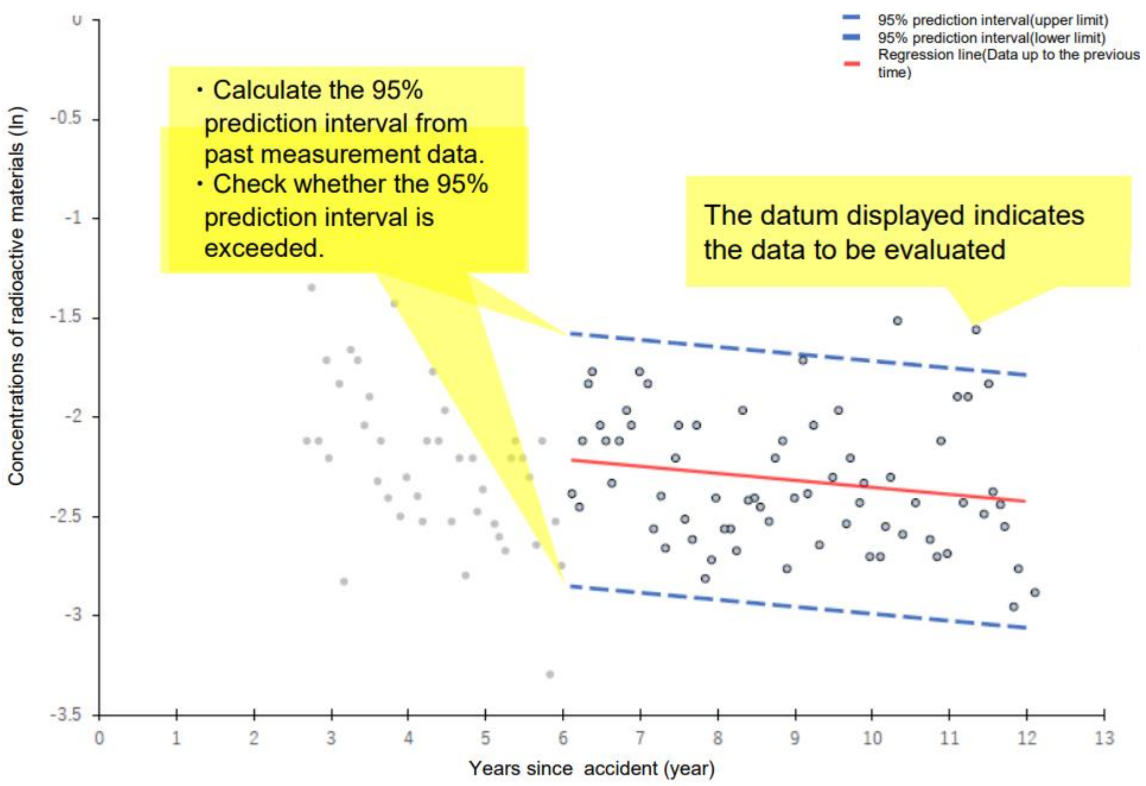

Figure 9: **Example of analysis of results conducted by the Nuclear Regulatory Authority [11]**

Operator Environmental Monitoring

TEPCO has established a sea area environmental monitoring plan and is conducting its environmental monitoring plan based on this plan. Monitoring has been occurring for seawater, fish and seaweed since April 20, 2022, before ALPS treated water discharge began. This was done to establish and understand baseline conditions in the sea area around the FDNPS ahead of implementing the discharge of ALPS treated water into the sea. The monitoring plan was strengthened by the addition of rapid analysis of tritium to quickly record its concentration in the environment during ALPS treated water discharge. This has been conducted since August 23, 2023, with the start of ALPS treated water discharge. TEPCO's environmental monitoring programme is comprehensive but can be divided into four main categories for simplicity: rapid monitoring for tritium in seawater, precise monitoring for tritium in seawater, fish and seaweed monitoring and monitoring, for radionuclides other than tritium.

The locations of TEPCO's rapid tritium analysis programme can be seen in Figure 10, below. Frequency of quick tritium analysis is dependent on whether the ALPS treated water is being discharged or not. When the ALPS treated water is being discharged, the sampling locations outlined in red in the left figure of Figure 10 are sampled and analysed daily, while sites outlined in blue and black are sampled and analysed twice a week. When discharge of ALPS treated water is suspended, sample sites outlined in red are sampled and analysed weekly, while sites outlined in blue and black are sampled and analysed monthly. Sample sites outlined in green in the right figure of Figure 10 are sampled and analysed monthly, with the exception of site T-D5, which is sampled weekly. The main goal of TEPCO's rapid tritium analysis is to track tritium concentrations in the seawater in as close to real time as possible. TEPCO uses the results of their rapid tritium analysis to compare to their established tritium indicators which are used to trigger an investigation into an increased tritium concentration in the environment or to suspend discharge altogether. In the nearfield, results from the sites outlined in red, blue and black are compared to an investigation concentration of 350 Bq/L of tritium in seawater and a suspension level of 700 Bq/L of tritium in seawater [12]. Similarly, the mid field investigation and suspension levels for tritium are 20 Bq/L and 30 Bq/L respectively and are compared against results from the four sampling locations outlined in green. Since the beginning of monitoring no tritium concentrations determined from rapid analysis have exceeded the above indicators.

Precise analysis of tritium conducted by TEPCO occurs at 36 locations. Nearfield precise tritium sampling locations are denoted by the sampling locations outlined in red in Figure 11, below, while midfield sampling locations are denoted by sampling locations outlined in blue. Nearfield sampling locations are sampled monthly and analysed using a method that can achieve a detection limit of 0.1 Bq/L. They are also sampled weekly and analysed using a slightly faster method that achieves a detection limit of 0.4 Bq/L. The midfield sampling locations are sampled monthly and analysed using the 0.1 Bq/L analytical method. Precise analysis indicates there is an observable increase in tritium concentrations near the discharge outlet but remains below regulatory limits and agrees with modelling conducted ahead of the beginning of discharge [12]. Beyond 3km from the FDNPS there has been no significant observable increase in tritium in ocean water since the beginning of discharge.

Concerning aquatic biota, TEPCO collects and analyses both fish and seaweed samples around the FDNPS. Figure 12, indicates TEPCO's sampling locations for seaweed, denoted by the areas outlined in red and fish, denoted by the yellow diamonds. Fish are sampled from these locations and analysed for both FWT and OBT once a month. Seaweed is collected and analysed for FWT, OBT and ^{129}I three times a year. Results from fish and seaweed analysis indicates that FWT in both were comparable with those in seawater and OBT results to date have been below the limit of detection. ^{137}Cs results have also been similarly low. A summary of key results from TEPCO's environmental monitoring programme are available in

Table IV. *5* and Table IV. 6.

The final piece of TEPCO's environmental monitoring programme is monitoring for radionuclides other than tritium. TEPCO monitors both seawater and sediments for ^{134}Cs, ^{137}Cs, ^{238}Pu, $^{239+240}Pu$, ^{90}Sr, Gross α and Gross β. The monitoring of these radionuclides takes place at varying sites and frequencies and are subject to different analytical methods, depending on the desired precision of the analysis. In general, the sampling locations can be split into three categories, based on distance from the FDNPS. These three categories are sites located within 3km of the FDNPS, sites located within 20km of the FDNPS, and sites located further than 20km of the FDNPS. Sites closer to the FDNPS are typically subject to more frequent sampling of a wider suite of radionuclides than those located further away. Information regarding each sampling site, the radionuclides sampled at that site, and the frequency of sampling can be found in Table V. 1 of Annex V of this report. The corresponding locations of the sites listed in Table V. 1 can be found in Figure 11. Monitoring for radionuclides other than tritium has shown no observable increase from the range of results obtained since the beginning of discharge.

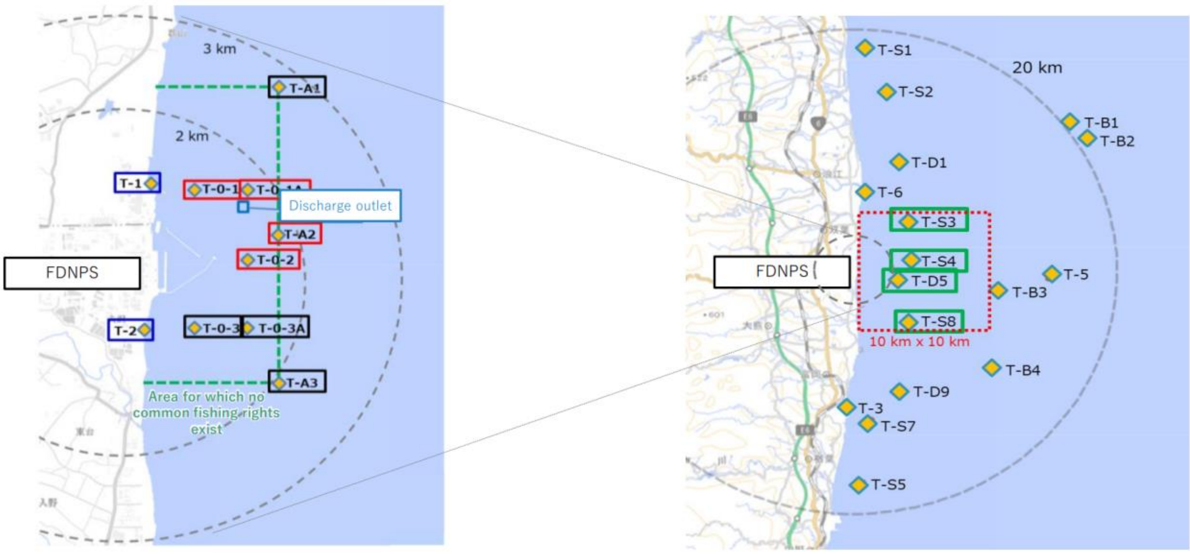

Figure 10: Map of Rapid Sampling Locations for Tritium Conducted by Tokyo Electric Power Company Holdings' [12]

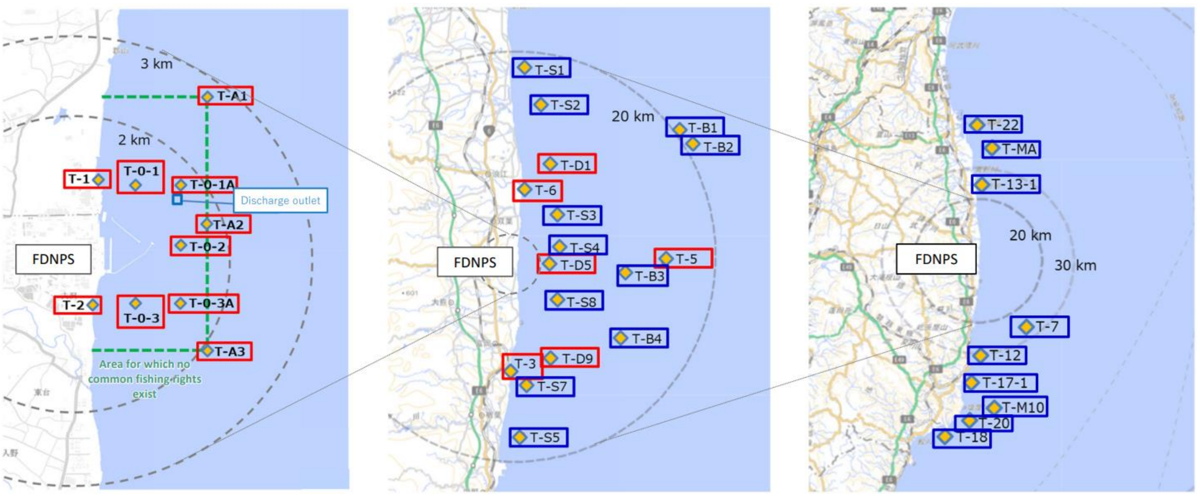

Figure 11: Map of Near, Mid and Far-field Sampling Locations Conducted by Tokyo Electric Power Company Holdings' [12]

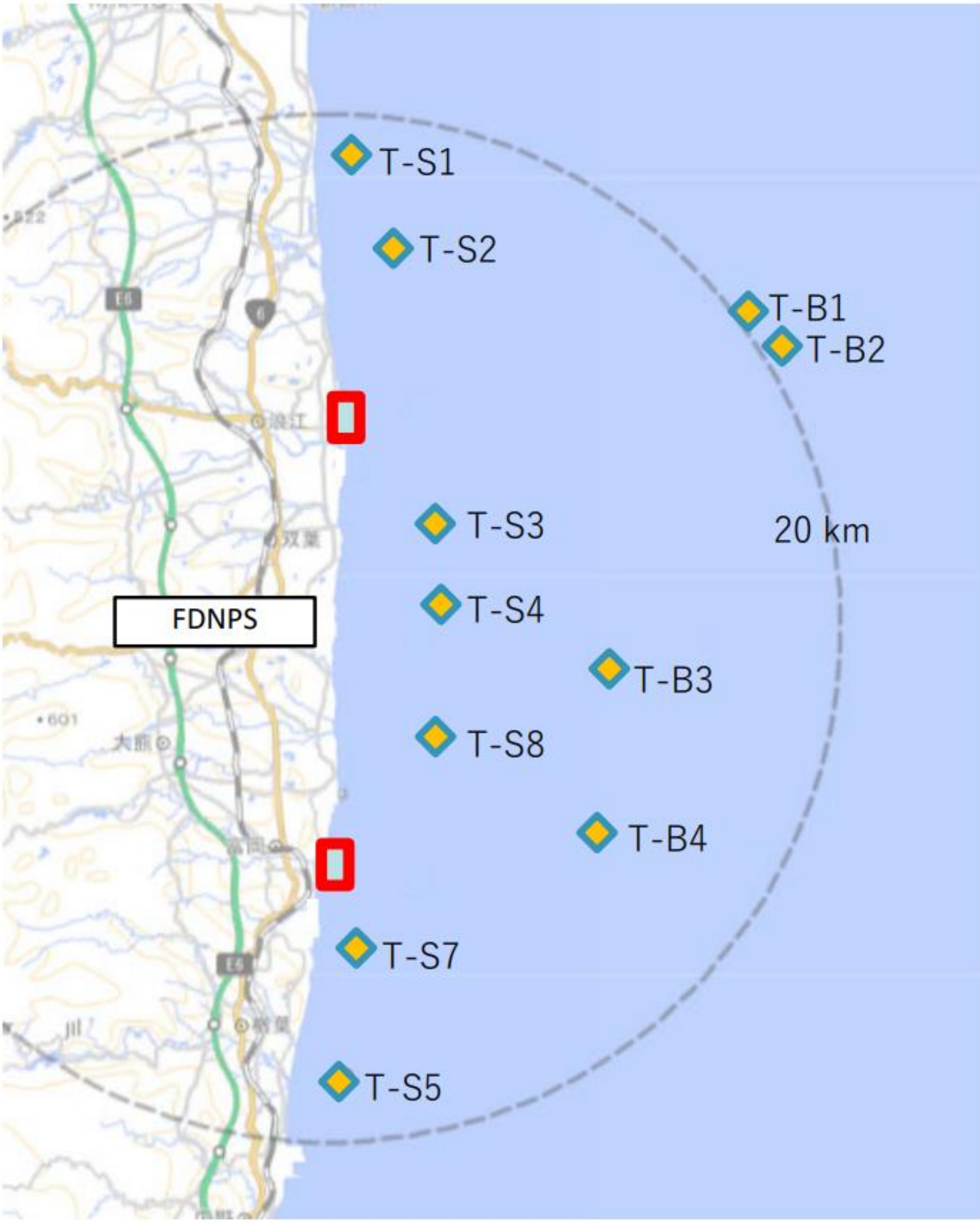

Figure 12: Map of Fish and Seaweed Sampling Locations Conducted by Tokyo Electric Power Company Holdings' [12]

IAEA CORROBORATION ACTIVITIES

Sampling, independent analysis and data corroboration is one of the three components in the IAEA's multi-annual safety review which also includes assessments of the technical plans and of regulatory activities and processes related to the treated water discharge. The corroboration activities include three elements:

- Sampling, analysis and interlaboratory comparison for ALPS treated water from the FDNPS.
- Sampling, analysis and interlaboratory comparison for environmental samples (e.g., seawater, fish) from the surrounding environment of FDNPS.
- Assessment of the capabilities of dosimetry service providers involved in the monitoring of internal and external radiation exposure of workers at FDNPS is also part of the corroboration.

This mission was focussed on the first and the second.

The corroboration of source and environmental monitoring conducted by TEPCO and other Japanese ministries and organizations is based on a combination of interlaboratory comparisons (ILCs) and prompt measurements undertaken by the IAEA at FDNPS.

ILCs, along with PTs are standard methods for laboratories to assess the quality of their measurement results in comparison with those of other participating laboratories, and to identify any potential improvements. PTs involve the evaluation of performance against pre-established criteria whereas ILCs involve the organization, performance, and evaluation of measurements on the same or similar items by two or more laboratories in accordance with predetermined conditions. ILCs are carried out on an annual basis by the IAEA to check the long-term measurement quality of all Japanese laboratories undertaking monitoring related to ALPS treated water.

Prompt measurements undertaken by the IAEA at FDNPS ensure that tritium levels in each batch are at expected levels.

The IAEA's corroboration activities provide an independent check of the veracity of the radiological data resulting from source and environmental monitoring programmes related to the ALPS treated water discharges upon which the safety related aspects of the discharges of ALPS treated water are being evaluated. They also promote transparency and provide sound information to enable interested parties to evaluate the radiological data used as the basis for planning and implementing the discharges of ALPS treated water into the sea.

IAEA Corroboration of Source Monitoring

Interlaboratory Comparisons

IAEA ILCs to corroborate the results of source monitoring are based on identical samples of ALPS treated water samples taken from homogenized batches prior to discharge. The sampling is undertaken by TEPCO employees with observation by IAEA staff members. The samples are analyzed by TEPCO, the IAEA and third-party member laboratories of the IAEA ALMERA network (Analytical Laboratories for the Measurement of Environmental Radioactivity) selected by the IAEA. The target radionuclides in the ALPS treated water source term, identified in the radiological environmental impact assessment conducted by TEPCO [13], defines the radionuclides that are included in its source monitoring plan. The results submitted by each participating laboratory are compiled and evaluated by the IAEA. A report of the exercise is published as vital information required for the completion of the IAEA's Review.

The objective of the ILCs is to assess TEPCO's capability to undertake analyses relevant to source monitoring with respect to discharges of ALPS treated water to the required standards and to report high quality and comparable results.

The first ILC included an additional comprehensive radiological characterization of the samples, determination of the activity concentrations or detection limits for any radionuclides in addition to those included in the ALPS source term that may be present at significant levels in the sample. Participating laboratories were encouraged to analyse the sample as comprehensively as possible for additional radionuclides, subject to their available analytical capability.

The results of the three ILCs completed so far indicate that:

- TEPCO have reported accurate results demonstrating a high level of technical competence.
- TEPCO's sample collection procedures follow the appropriate methodological standards required to obtain representative samples.
- The selected analytical methods utilized by TEPCO for different radionuclides are appropriate and fit for purpose.

The additional comprehensive radiological characterization of the samples carried out as part of the first ILC indicated no detection of any additional radionuclides at significant levels by the IAEA nor the participating third-party laboratories.

These findings provide confidence in TEPCO's capability for conducting reliable and high-quality monitoring related to the discharge of ALPS treated water.

Prompt measurements undertaken by the IAEA at FDNPS

During discharges, IAEA staff located onsite take a sample of ALPS treated water and analyse it for key radioisotopes to compare against TEPCO's results. IAEA staff also sample the diluted ALPS treated water for tritium the day before discharge begins, the first day of discharge and then weekly for the duration of the discharge, typically resulting in a total of four samples collected and analysed. A summary of the results of IAEA source monitoring analysis is available in Table IV. 7 of Annex IV, concentrations of radionuclides in the diluted ALPS treated water are summarized in Table IV. 8 of Annex IV.

Samples are analysed and the results compared with those reported by TEPCO using zeta scores, a standard performance statistic used to evaluate laboratory results. From all batches analysed by the IAEA, elements above the limit of detection agreed with TEPCO's results. IAEA results of tritium in the diluted ALPS treated water also agreed with TEPCO's values. These results indicate that TEPCO is reporting its source monitoring and dilution monitoring results accurately and that the concentration of tritium is below Japan's operating limit.

IAEA Corroboration of Environmental Monitoring

Interlaboratory Comparisons

IAEA ILCs to corroborate the results of environmental monitoring are based on samples of seawater, sediment, fish and seaweed collected from offshore locations and fish markets close to FDNPS. The sampling is undertaken jointly by TEPCO and relevant Japanese authorities with observation by IAEA staff members, using the same techniques employed for routine monitoring under the CRMP. The samples are analysed by Japanese laboratories participating in marine monitoring within the CRMP relevant to the ALPS treated water discharges, the IAEA, and third-party member laboratories of the IAEA ALMERA network selected by the IAEA. The target radionuclides analysed for each sample type are defined in the CRMP and include ^{3}H, ^{60}Co, ^{90}Sr, ^{106}Ru, ^{125}Sb, ^{129}I, ^{134}Cs, ^{137}Cs in seawater; ^{134}Cs and ^{137}Cs in sediment; OBT, FWT and ^{14}C in fish; and ^{129}I in seaweed. The results submitted by each participating laboratory are compiled and evaluated by the IAEA using established statistical methods. A report of each exercise is published as vital information required for the completion of the IAEA's Review.

The objective of the ILCs is to assess the capability of Japanese laboratories to undertake analyses relevant to environmental monitoring with respect to discharges of ALPS treated water to the required standards and to report high quality and comparable results. The studies also serve to verify Japan's sample collection procedures and analytical methodologies used for baseline environmental monitoring before discharge initiation and operational monitoring thereafter.

The first ILC on environmental samples was conducted in November 2022 before the start of ALPS treated water discharges and served to corroborate baseline monitoring results. The second ILC was conducted in October 2023, constituting the first corroboration of monitoring results since discharges began in August 2023. Both exercises involved complex analytical methods that were relatively new to some participating laboratories, being implemented specifically to assess the ALPS treated water discharges.

The results of the two ILCs completed so far indicate that:

- Japanese laboratories have reported accurate results demonstrating a high level of technical competence and proficiency.
- Japan's sample collection procedures follow the appropriate methodological standards required to obtain representative samples.
- The analytical methods utilized by Japanese laboratories for different radionuclides are appropriate, reliable and fit for purpose.
- Despite the complexity of some analyses and typically low activity concentrations near detection limits, laboratories consistently produced reliable results with no systematic deviations between Japanese and international laboratory results.

These findings provide confidence in Japan's capability for conducting reliable and high-quality environmental monitoring related to the discharge of ALPS treated water. The IAEA recommends the continuation of such ILCs annually to maintain and improve the quality of monitoring data reported by participating laboratories as part of Japan's comprehensive environmental monitoring program.

Prompt measurements undertaken by the IAEA at FDNPS

Since the start of discharges, IAEA staff onsite have been developing their laboratory capacity and have begun environmental sampling from Batch 5 onwards. Environmental monitoring corroboration activities are conducted for tritium in seawater and take place at five monitoring locations within 3km of the FDNPS. The leftmost figure in Figure 11 shows the locations of monitoring points within 3km of the FDNPS, samples are taken for tritium analysis by the IAEA at sampling locations T-0-1A, T-0-1 and T-0-2 twice weekly and from T-A-2 and T-1 every two weeks. Tritium in sea water was far below the investigation and discharge suspension levels. Most of the results were below the detection limit. Some values were above the detection limit, which correspond to the sampling locations T-0-1A and T-0-1, near the discharge outlet. Results of IAEA's corroboration analysis of tritium in seawater indicate concentrations of measured radionuclides in the environment agree with those of TEPCO, environmental concentration are below operational limits. Results also support the conclusions of the REIA that indicate concentrations of radionuclides in the environment pose negligible risk to the public and environment.

MISSION ACTIVITIES IN MAY 2025

The focus of this fourth review mission since the start of the discharge of ALPS treated water was for the Task Force to gain a better understanding of the ongoing monitoring programmes for the ALPS treated water along with the organizations involved in monitoring and their responsibilities. The Task Force also had the goal to review these programmes against the requirements and guidance set out in the international safety standards.

Discussions with Monitoring Organizations

Throughout the course of the mission the organizations involved in monitoring, including the NRA, the MOE, the FAJ, FP and TEPCO all provided presentations to the Task Force outlining their specific roles and responsibilities with respect to source and environmental monitoring for the ALPS treated water. These presentations included thorough explanations of the goal and structure of their respective monitoring programmes, including the locations of sampling, number of samples taken, types of samples collected, elements analysed, analysis methods and detection limits and results. The NRA and TEPCO also provided presentations mapping how their monitoring programmes were consistent with the requirements of relevant IAEA international safety standards.

Additional presentations the NRA provided included an update on the development of its comprehensive information system for all CRMP monitoring results, RAMDAS. The aim of this system is to consolidate and share the monitoring results from all organizations responsible for monitoring under the CRMP. The NRA explained that it had modified the development plan of this system in order to accelerate the consolidation of all monitoring results by the end of the current financial year. At that stage all data will also be available to the IAEA's Marine Radioactivity Information System (MARIS). The Task Force had previously recommended such as a system but had also expressed concern about its lengthy development time. News that implementing this system was progressing more rapidly was welcomed by the Task Force.

Concerning the monitoring framework established by Japan under the CRMP, members of the Task Force requested additional details on how the sampling methodology for the monitoring programmes were developed, such as choice of sampling locations, frequency of sampling and if there was the possibility to further optimize the monitoring for the ALPS treated water. Japanese representatives explained that locations were decided on based on the needs of each organization, while frequency was determined based on proximity to the FDNPS, with closer points being sampled more frequently. The NRA also indicated frequency of sampling was informed based on operational experience, as they have been conducting environmental monitoring since immediately after the accident and have adjusted their monitoring based on results over time. As the CRMP is revised annually, monitoring can be adjusted as necessary. The MOE representatives also explained they are investigating opportunities to optimize the programme.

The Task Force and Japanese representatives also had a discussion on how to define the different types of onsite monitoring conducted at the ALPS treated water discharging facility for as source monitoring, as defined in the IAEA international safety standards. Onsite, sampling is conducted after ALPS treatment prior to dilution at the measurement and confirmation facility but also after dilution of the ALPS treated water immediately before discharge into the environment. Source monitoring at the measurement and confirmation facility confirms that radionuclide levels comply with regulatory limits before discharge proceeds. The Task Force reconfirms that daily source monitoring in the context of the ALPS treated water generally refer to monitoring at the measurement and confirmation facility before dilution. In addition to the source monitoring mentioned above, the Task Force recognised that of tritium in diluted water as one of the onsite monitoring activities is an additional safeguard measure confirming compliance with discharge limits. These are consistent with IAEA international safety standards and the previous conclusions of the IAEA [2].

The Task Force appreciated the presentations provided by the NRA and TEPCO clearly outlining how their respective monitoring programmes are consistent with IAEA international safety standards. From the presentations as well as from their own independent review, the Task Force agreed that the monitoring programmes related to the ALPS treated water are consistent with the requirements and guidance set out in these safety standards. The Task Force commended Japan and the organizations involved for the scale of monitoring and data collection that is being undertaken to ensure operation of the discharge of ALPS treated water into the sea is well documented and well understood.

Concerning the NRA's confirmatory source monitoring, members of the Task Force requested the NRA comment on why they do not analyse tritium as part of their monitoring. The NRA representatives indicated they did not feel it necessary to completely duplicate the analysis conducted by TEPCO, rather they focus on elements that require more complex analysis. Therefore, if the NRA's confirmatory monitoring results of these more complex analyses agree with TEPCO's results, it is reasonable to deduce that elements that are easier to measure, such as tritium, will also be accurate. This achieves the goal of the NRA's source monitoring to maintain regulatory oversight, ensuring TEPCO's source monitoring is conducted appropriately and is producing accurate results.

While discussing the NRA's source monitoring, Task Force members also requested the NRA explain the process undertaken if their results did not agree with TEPCO's. The NRA representatives explained their approach by providing an example of when this situation occurred. The first step was to reanalyse the samples to confirm the values were correct. Once the samples were reanalysed, a new En number was calculated using the new values which then indicated that the TEPCO and the NRA values agreed, indicating the discrepancy had been due to analytical error. The Task Force indicated they would like to know if there was a documented process covering the potential situation when the new En number also indicated a lack of consistency. If not, they recommended creating a formally documented process to be followed if this situation arises in future.

Throughout the mission, the Task Force made several recommendations focussed on clarifying language and terminology to make it more consistent and avoid confusion. The Task Force members recommended aligning terminology with the IAEA international safety standards to achieve consistency with internationally recognized terminology.

A specific example of this challenge was some confusion from the Task Force regarding communication of the various detection limits used in the monitoring framework. For example, some discussion was required to properly understand the differences between target detection limits, method detection limits and analytical detection limits and how they were used. Japanese officials explained to the Task Force target detection limits are those set beforehand by regulatory requirements and are the detection limits any analysis must meet to achieve the goals set in the regulations. A method detection limit is the limit of detection a specific analytical method can achieve. A laboratory must select an appropriate method that can meet the target detection limits set in regulations. Finally, the analytical detection limit is the actual recorded detection limit achieved during the analysis. The Task Force was thankful for the explanation on the different types of detection limits by Japanese officials and had a better understanding of these detection limits, their relationships with one another and their place in the monitoring framework.

Japanese representatives acknowledged some challenges. They stated that achieving a perfect match when translating Japanese to English in technical documents is sometimes difficult. However, they agreed with the recommendation. They committed to working towards aligning text in their English language documents with IAEA safety standards terminology. They also agreed to align with other relevant documents such as ISO standards used for laboratory analyses. These International Organization for Standardization (ISO) standards may take precedence in certain cases.

IAEA Corroboration and Monitoring Activities

An overview of the ILCs used to corroborate source and environmental monitoring of ALPS treated water discharges was presented. Key topics included the ILC methodologies, participating laboratories, and results as described above. Information was also provided on the development of specific analytical capabilities to meet the needs of the corroboration for ALPS treated water at the IAEA laboratories supporting these ILCs: the Marine Environment Laboratories' Radiometrics Laboratory (RML) in Monaco, and the Terrestrial Environmental Radiochemistry Laboratory (TERC) and Isotope Hydrology Laboratory (IHL) in Austria. These capabilities include low level methods for the analysis of tritium in seawater and fish.

The presentation describing IAEA activities onsite at FDNPS was delivered by the staff stationed onsite. IAEA staff provided information on how their source and environmental monitoring programmes for corroboration were conducted, including sampling sites, sampling frequency, and analytical methods. IAEA Staff explained how they have refined their analytical procedures to decrease their detection limits of tritium over time. IAEA staff then provided the results of their own monitoring and as well as the results of their comparison of results with those of TEPCO, concluding that IAEA and TEPCO results agreed, and therefore TEPCO results were being accurately reported. Finally, IAEA staff described their activities in implementing the additional measures, describing the sampling locations, frequency, and radionuclides targeted for both source and environmental monitoring.

Visit to Fukushima Daiichi Nuclear Power Station

As part of the mission, the Task Force carried out a comprehensive visit to FDNPS, as was conducted in previous years' missions to Japan after the start of ALPS treated water discharge.

During the mission, the Task Force travelled to Fukushima Prefecture to visit the FDNPS. While at the site, the Task Force was provided with an updated 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 (the location where sampling of ALPS treated water prior to dilution for source monitoring is conducted)
- Seawater pumps and seawater pipe header, (the location where sampling of ALPS treated water after dilution is conducted) radiation detectors installed near the seaside pumps and the vertical shaft, and the vertical shaft leading to the discharge tunnel
- Storage Tanks which will be dismantled (J8 and J9 Tanks area)

Most zones related to the discharge of ALPS treated water were visited, and important maintenance activities were performed in each zone because at the time of the mission, there was no batch discharging ALPS treated water. TEPCO experts accompanied the members of the Task Force and explained about the functions of the components of the discharge system in each zone. The Task Force saw the related components and systems of the ALPS treated water discharge systems in the field and learned about the details of the functions of each component of the discharge system and the maintenance activities status.

CONCLUSIONS AND OUTCOMES

During the mission, the Task Force received full cooperation from representatives of the NRA, the MOE, the FAJ, the METI, the MOFA, FP and TEPCO and noted their commitment to provide comprehensive information on their source and environmental monitoring programmes related to the ALPS treated water discharge.

The Task Force did not identify anything related to monitoring that is inconsistent with the requirements in the relevant international safety standards. Therefore, the IAEA can reaffirm its conclusions of the safety review, as outlined in the Comprehensive Report [2].

Over the course of the mission the Task Force came to several conclusions and outcomes, which are summarized below:

The Task Force continues to acknowledge the significant efforts with respect to monitoring made by the Japanese authorities including the NRA, the MOE, the METI, the FAJ, FP and TEPCO contributing to marine environmental monitoring related to the ALPS treated water discharges, noting both the comprehensiveness of the programme and the professionalism demonstrated in its implementation.

The Task Force noted that details of the monitoring programmes were provided in a transparent manner and that the results of these programmes are showing that concentrations of radionuclides in the environment are behaving as was predicted from assessments and modelling conducted ahead of release of ALPS treated water.

The Task Force appreciated that representatives from each of the organizations involved in source and environmental monitoring were present and able to provide their expertise. The Task Force welcomed this collaboration.

The Task Force concluded that the monitoring programmes put in place by Japan are consistent with the requirements and guidance set out in relevant IAEA international safety standards. The programmes are well described and implemented, and results are consistent with the conclusions of the Radiological Environmental Impact Assessment (REIA) which states the discharges of ALPS treated water pose negligible risk to the public and environment.

The Task Force highlighted that the NRA has maintained regulatory oversight of the ALPS treated water through its own confirmatory monitoring programmes and its onsite presence to maintain safety oversight of the discharge of ALPS treated water.

The Task Force recommended the NRA formally documents the procedure involved for their validation process to ensure it is well understood and applied consistently. This is recommended for any other important processes that are employed as part of the monitoring programmes in place.

The Task Force reconfirms that source monitoring in the context of the ALPS treated water generally refers to the monitoring which takes place at the measurement/confirmation facility, before dilution. In addition to the source monitoring mentioned above, the Task Force recognised that monitoring of tritium in diluted water as part of the onsite monitoring is an additional safety measure confirming compliance with discharge limits and the international safety standards. These are consistent with IAEA international safety standards and the previous conclusions of the IAEA [2].

The Task Force appreciated the efforts made by the organizations involved in monitoring to address the comments made during the previous mission. The Task Force noted the efforts taken to increase clarity on types of monitoring conducted with respect to delineating rapid vs precise analysis and the different analytical processes and detection limits involved in these analyses. The Task Force was also appreciative that work on the single portal for all monitoring data was progressing faster than the original timeline quoted during the previous mission and encouraged targeting an earlier implementation of the portal.

The Task Force also recommended aligning technical language and definitions used in English language documentation to maintain consistency. Ensuring terminology was consistent with that used in IAEA safety standards would ensure the English language documentation produced by monitoring organizations would agree with the internationally recognized terminology.

Based on its observations at the site of 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.

Finally, the Task Force again noted the importance of the IAEA's ongoing corroboration activities in providing an independent verification of the accuracy and reliability of the data reported by TEPCO and the Government of Japan. The ILCs and the onsite monitoring continue to provide the robust, independent corroboration of TEPCO's source monitoring, and the Government of Japan's marine environmental monitoring required for the IAEA review of the ALPS treated water discharges, as requested at an early stage by the IAEA Task Force. This corroboration is a key component of the IAEA's review of the safety aspects of the ALPS treated water discharges. The Task Force noted that laboratories are selected to participate in ILCs purely on technical factors, namely sufficient laboratory analytical capability and demonstrable measurement quality over an extended period.

REFERENCES

[1] International Atomic Energy Agency. (2021, July 8). *IAEA to Review and Monitor the Safety of Water Release at Fukushima Daiichi* [Press release]. Retrieved from https://www.iaea.org/newscenter/pressreleases/iaea-to-review-and-monitor-the-safety-of-water-release-at-fukushima-daiichi

[2] International Atomic Energy Agency. (2023, July 4). *Comprehensive report on the safety review of the ALPS-treated water at the Fukushima Daiichi Nuclear Power Station* [PDF]. Retrieved from https://www.iaea.org/sites/default/files/iaea_comprehensive_alps_report.pdf

[3] International Atomic Energy Agency. (2023, September 18). *IAEA and Japan sign agreement on continuous monitoring and safety assessment of ALPS treated water discharge*. Retrieved from https://www.iaea.org/newscenter/pressreleases/iaea-and-japan-sign-agreement-on-continuous-monitoring-and-safety-assessment-of-alps-treated-water-discharge

[4] International Atomic Energy Agency. *Fukushima Daiichi ALPS-treated water discharge* [Web page]. Retrieved from https://www.iaea.org/topics/response/fukushima-daiichi-nuclear-accident/fukushima-daiichi-alps-treated-water-discharge

[5] Tokyo Electric Power Company Holdings. *Treated water portal site - discharge history* [Web page]. Retrieved from https://www.tepco.co.jp/en/decommission/progress/watertreatment/performance_of_discharges/index-e.html

[6] International Atomic Energy Agency. (2014). *Radiation protection and safety of radiation sources: International basic safety standards* (IAEA Safety Standards Series No. GSR Part 3). https://www.iaea.org/publications/8930

[7] International Atomic Energy Agency. (2018). *Regulatory control of radioactive discharges to the environment* (IAEA Safety Standards Series No. GSG-9; STI/PUB/1818). https://www.iaea.org/publications/12197/regulatory-control-of-radioactive-discharges-to-the-environment

[8] International Atomic Energy Agency. (2005). *Environmental and source monitoring for purposes of radiation protection* (IAEA Safety Standards Series No. RS-G-1.8; STI/PUB/1216). https://www.iaea.org/publications/7176/environmental-and-source-monitoring-for-purposes-of-radiation-protection

[9] International Atomic Energy Agency. (2024, January). *Draft safety guide DS-505: Radiological monitoring for protection of the public and the environment* [PDF]. Retrieved from https://www.iaea.org/sites/default/files/24/01/draft_ds505.pdf

[10] Nuclear Regulation Authority. (2024, March). *Comprehensive Radiation Monitoring Plan* [PDF]. Retrieved from https://radioactivity.nra.go.jp/cont/en/plan/meetings/274_20240321.pdf

[11] Kawaguchi, Y. (2025). *Comprehensive Radiation Monitoring Plan* [PowerPoint slides]. Nuclear Regulatory Authority, Government of Japan.

[12] Tokyo Electric Power Company Holdings. (2025). *Sea area monitoring related to ALPS treated water discharge conducted by TEPCO* [PowerPoint Slides]

[13] Tokyo Electric Power Company Holdings, Inc. (2024, December). *Radiological Environmental Impact Assessment Report for one year after the commencement of discharge*

regarding the discharge of ALPS treated water into the sea (Operation stage) [PDF]**.** Retrieved, from
https://www.tepco.co.jp/en/hd/newsroom/announcements/archives/2024/pdf/241209e0103.pdf

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
• Paul MC GINNITY	Research Scientist, NAML/MEL (Monaco)
• Funda BARLAS ŞIMŞEK	Research Scientist, NAML/MEL (Monaco)
• Daniel SAUVÉ	Consultant, NSRW/WES

International Experts

• Abel GONZALEZ	Argentina
• Marie-Claude GREGOIRE	Canada
• Senlin LIU	People's Republic of China
• Hongsuk KIM	Republic of Korea
• Sergey SHINKAREV	Russian Federation
• Michael BOYD	United States of America
• Nguyen HAO QUANG	Viet Nam

ANNEX II. LIST OF PARTICPANTS - JAPAN

26 May 2025

Ministry of Economy, Trade, and Industry (METI)

MIYAZAKI Takaya, Director-General for Nuclear Accident Disaster Response

Nuclear Accident Response Office, Agency for Natural Resources and Energy

UEMATSU Takeshi, Director for International Affairs

ISHIBASHI Hirotsugu, Deputy Director

HAYAKAWA Kohei, Deputy Director

YAMANAKA Naoki, Deputy Director

URATA Haruhiko, Assistant Director

UMETSU Hajime, Assistant Director

Nuclear Regulation Authority (NRA)

BAN Nobuhiko, Commissioner

KOGANEYA Toshiyuki, Director-General for Emergency Response

Radiation Monitoring Division

KAWAGUCHI Yoshio, Director

FURUKAWA Takuya, Deputy Director

KAWABE Atsushi, Deputy Director

SUZUKI Minoru, Deputy Director

KONO Takahiko, Chief

MATSUDA Soichiro, Chief

TOMOOKA Yumino, Chief

International Affairs Office

FUNADA Teruyo, Director

ISHIZUKI Sumiyo, Specialist

ONOYAMA Kai, Specialist

Ministry of the Environment (MOE)

Marine Environment Division

TANIGUCHI Kazuyuki, Senior Assistant for Radioactive Material Monitoring

MUTO Shizuka, Deputy Director

ISHIKAWA Daisuke, Chief

Fisheries Agency (FAJ)

Research and Technological Guidance Division, Resources Enhancement Promotion Department

TAKASE Chikara, Deputy Director

TAKANO Yuki, Chief

NOMURA Hiroto, Officer

Fukushima Prefecture

Nuclear Emergency Preparedness and Monitoring Division

KASHIWAKURA Susumu, Director

NISHIUCHI Masashi, Senior Staff

TEPCO

Fukushima Daiichi Decontamination and Decommissioning Engineering Company

MATSUMOTO Junichi, Fellow, Chief Officer for ALPS Treated Water Management

SATO Gaku, General Manager of Project Management Office

MATSUZAWA Toshiharu, Manager, Planning Radioactive/Chemical Analysis & Evaluation for Treated Water Project Group

KANNO Kousuke, Member, Mid and Long Term Planning Group, Project Management Office

CHIDA Kazuki, Member, Mid and Long Term Planning Group, Project Management Office

KOBAYASHI Kazuhiko, Section Manager, Communication Promotion Group, D&D Communication Center

YAMASHITA Ekubo, Member, Communication Promotion Group, D&D Communication Center

HASHIMOTO Naoki, Member, Communication Promotion Group, D&D Communication Center

Ministry of Foreign Affairs (MOFA) Observers

Disarmament, Non-Proliferation and Science Department

HAYASHI Mitsuko, Deputy Director-General (Ambassador)

International Nuclear Cooperation Division

TANAKA Kenichiro, Director

INOUE Yuki, Deputy Director

KAWAGUCHI Masaru, Official

YAMADA Junta, Researcher

KAWAGUCHI Mihiro, Researcher

27 May 2025

Ministry of Economy, Trade, and Industry (METI)

MIYAZAKI Takaya, Director-General for Nuclear Accident Disaster Response

Nuclear Accident Response Office, Agency for Natural Resources and Energy

UEMATSU Takeshi, Director for International Affairs

ISHIBASHI Hirotsugu, Deputy Director

HAYAKAWA Kohei, Deputy Director

YAMANAKA Naoki, Deputy Director

URATA Haruhiko, Assistant Director

UMETSU Hajime, Assistant Director

Nuclear Regulation Authority (NRA)

KOGANEYA Toshiyuki, Director-General for Emergency Response

Office for Accident Measures of Fukushima-Daiichi NPS

IWANAGA Kohei, Director

WATANABE Tatsuki, Deputy Director

SHIINA Kenichiro, Chief

International Affairs Office

FUNADA Teruyo, Director

ISHIZUKI Sumiyo, Specialist

ONOYAMA Kai, Specialist

TEPCO

Fukushima Daiichi Decontamination and Decommissioning Engineering Company

MATSUMOTO Junichi, Fellow, Chief Officer for ALPS Treated Water Management

SATO Gaku, General Manager of Project Management Office

MATSUZAWA Toshiharu, Manager, Planning Radioactive/Chemical Analysis & Evaluation for Treated Water Project Group

CHIDA Kazuki, Member, Mid and Long Term Planning Group, Project Management Office

Ministry of Foreign Affairs (MOFA) Observers

International Nuclear Cooperation Division

INOUE Yuki, Deputy Director

SHIOZAWA Fumio, Deputy Director

YAMADA Junta, Researcher

KAWAGUCHI Mihiro, Researcher

KOGA Nonoka, Researcher

28 May 2025

Ministry of Economy, Trade, and Industry (METI)

Nuclear Accident Response Office, Agency for Natural Resources and Energy

UEMATSU Takeshi, Director for International Affairs

URATA Haruhiko, Assistant Director

UMETSU Hajime, Assistant Director

TEPCO

Fukushima Daiichi Decontamination and Decommissioning Engineering Company

MATSUMOTO Junichi, Fellow, Chief Officer for ALPS Treated Water Management

CHIDA Kazuki, Member, Mid and Long Term Planning Group, Project Management Office

Ministry of Foreign Affairs (MOFA) Observers

International Nuclear Cooperation Division

YAMADA Junta, Researcher

29 May 2025

Ministry of Economy, Trade, and Industry (METI)

MIYAZAKI Takaya, Director-General for Nuclear Accident Disaster Response

Nuclear Accident Response Office, Agency for Natural Resources and Energy

UEMATSU Takeshi, Director for International Affairs

ISHIBASHI Hirotsugu, Deputy Director

HAYAKAWA Kohei, Deputy Director

YAMANAKA Naoki, Deputy Director

URATA Haruhiko, Assistant Director

UMETSU Hajime, Assistant Director

Nuclear Regulation Authority (NRA)

BAN Nobuhiko, Commissioner

KOGANEYA Toshiyuki, Director-General for Emergency Response

Radiation Monitoring Division

KAWAGUCHI Yoshio, Director

FURUKAWA Takuya, Deputy Director

SUZUKI Minoru, Deputy Director

KONO Takahiko, Chief

TOMOOKA Yumino, Chief

International Affairs Office

FUNADA Teruyo, Director

ISHIZUKI Sumiyo, Specialist

ONOYAMA Kai, Specialist

Division of Research for Radiation Protection and Radioactive Waste Management

NAKASONE Shunya, Researcher

Ministry of the Environment (MOE)

Marine Environment Division

ISHIKAWA Daisuke, Chief

TEPCO

Fukushima Daiichi Decontamination and Decommissioning Engineering Company

MATSUMOTO Junichi, Fellow, Chief Officer for ALPS Treated Water Management

SATO Gaku, General Manager of Project Management Office

MATSUZAWA Toshiharu, Manager, Planning Radioactive/Chemical Analysis & Evaluation for Treated Water Project Group

CHIDA Kazuki, Member, Mid and Long Term Planning Group, Project Management Office

Ministry of Foreign Affairs (MOFA) Observers

International Nuclear Cooperation Division

SHIOZAWA Fumio, Deputy Director

YAMADA Junta, Researcher

KAWAGUCHI Mihiro, Researcher

KOGA Nonoka, Researcher

ANNEX III. MISSION AGENDA

Fourth Review Mission to Japan after the Start of ALPS Treated Water (26th-30th May, 2025)

Date	Time	Location	Activities
May 26 (Mon)	10:00 ～ 12:30	MOFA (Tokyo) @Conference Room 893	TF internal meeting
	13:30 ～ 14:00	MOFA (Tokyo) @Conference Room 893	**Opening Remarks (NRA/METI/TEPCO/MOFA)**
	14:00 ～ 17:00	MOFA (Tokyo) @Conference Room 893	**Offsite Monitoring (NRA/MOE/FAJ/FP/METI/TEPCO)** 1. Comprehensive Radiation Monitoring Plan (CRMP) (NRA) 2. Results of the sea-area monitoring for one year after discharge of the ALPS treated water into the sea discussed by 5th Task Force Meeting on Monitoring and Measurement of sea-area (27th Feb, 2025) (MOE) 3. Updates of sea-area monitoring data（NRA, FAJ, MOE, FP, TEPCO） 4. Integration of Information system, FUA update (NRA) 5. Responses to the findings of previous review mission (TEPCO) 6. Relationship between IAEA Safety Standards and Japan's Sea-area Monitoring (NRA, TEPCO)
May 27 (Tue)	10:00 ～ 12:30	MOFA (Tokyo) @Conference Room 893	**On site Monitoring, Source (METI/TEPCO)** - Status of TEPCO's source monitoring and monitoring at discharge vertical shaft/ seawater pipe header in accordance with international safety standards(TEPCO)
	13:30 14:30		**On site Monitoring, Source (NRA)** - NRA's independent analysis
	15:00 ～ 19:00	-	Travel from Tokyo to the hotel in Fukushima (Iwaki Washington Hotel) via Hotel Vista Tsukiji Tokyo
May 28 (Wed)	9:00 ～ 9:50	-	Travel from the hotel in Fukushima (Iwaki Washington Hotel) to TEPCO Decommissioning Archive Center
	10:00 ～ 15:00	FDNPS (Fukushima)	**Plant visit** 1) Transfer facility building (the location where sampling of ALPS treated water prior to dilution for source monitoring is conducted) 2) Green deck (observation of the whole ALPS treated water discharge facilities) 3) Seawater pipe header 4) J9 tanks area (dismantling of tanks is proceeding)
	15:00 ～ 19:30	-	Travel from TEPCO Decommissioning Archive Center to Tokyo
May 29 (Thu)	10:00 ～ 12:30	MOFA (Tokyo) @Conference Room 893	**Additional Discussion about On-site and Off-site Monitoring** (if required)
	13:30 ～ 17:00		**Presentations of the IAEA laboratories** Representatives of the IAEA laboratories will present the corroboration activities related to the monitoring carried out by Japanese Government, NRA and TEPCO.
May 30 (Fri)	10:00 ～ 17:00	MOFA (Tokyo) @Conference Room 893	TF internal meeting

ANNEX IV. RESULTS OF MONITORING PROGRAMMES

Table IV. 1: Concentration of Radionuclides in Bq/L in batches 1 to 6 before dilution

Batch Number	1	2	3	4	5	6	Regulatory Limit
Discharge Start	2023-08-24	2023-10-05	2023-11-02	2024-02-28	2024-04-19	2024-05-17	
Discharge End	2023-09-11	2023-10-23	2023-11-20	2024-03-17	2024-05-07	2024-06-04	
Volume (m^3)	7.8E+03	7.8E+03	7.8E+03	7.8E+03	7.9E+03	7.9E+03	
^{14}C	1.4E+01	1.3E+01	1.4E+01	1.4E+01	1.6E+01	1.3E+01	2.0E+03
^{54}Mn	<2.6E-02	<2.3E-02	<2.5E-02	<2.4E-02	<2.9E-02	<2.4E-02	1.0E+03
^{55}Fe	<1.5E+01	<1.4E+01	<1.6E+01	<1.4E+01	<1.5E+01	<1.6E+01	2.0E+03
^{60}Co	3.5E-01	2.4E-01	3.3E-01	3.4E-01	4.1E-01	3.0E-01	2.0E+02
^{63}Ni	<8.8E+00	<8.9E+00	<9.0E+00	<9.7E+00	<9.2E+00	<8.9E+00	6.0E+03
^{79}Se	<9.3E-01	<8.7E-01	<8.9E-01	<1.1E+00	<1.1E+00	<1.3E+00	2.0E+02
^{90}Sr	4.1E-01	<3.2E-02	4.1E-02	3.1E-01	3.9E-01	2.8E-01	3.0E+01
^{90}Y	4.1E-01	<3.2E-02	4.1E-02	3.1E-01	3.9E-01	2.8E-01	3.0E+02
^{99}Tc	6.8E-01	<1.9E-01	<2.0E-01	3.4E+00	3.5E+00	5.5E-01	1.0E+03
^{106}Ru	<2.5E-01	<2.1E+01	<2.3E-01	<2.5E-01	<2.4E-01	<2.6E-01	1.0E+02
^{113m}Cd	<8.4E-02	<8.5E-02	<9.3E-02	<8.8E-02	<8.5E-02	<8.6E-02	4.0E+01
^{125}Sb	1.8E-01	<8.8E-02	<9.4E-02	1.1E-01	9.7E-02	1.4E-01	8.0E+02
^{125m}Te	6.4E-02	<3.1E-02	<3.3E-02	4.0E-02	3.6E-02	5.2E-02	9.0E+02
^{129}I	2.0E+00	1.8E+00	1.9E+00	2.5E+00	2.3E+00	1.0E+00	9.0E+00
^{134}Cs	<3.3E-02	<3.0E-02	<2.9E-02	<3.4E-02	<3.2E-02	<3.0E-02	6.0E+01
^{137}Cs	4.7E-01	4.5E-01	3.8E-01	5.0E-01	3.9E-01	3.0E-01	9.0E+01
^{144}Ce	<3.6E-01	<3.6E-01	<4.0E-01	<3.7E-01	<3.8E-01	<5.1E-01	2.0E+02
^{147}Pm	<3.1E-01	<3.2E-01	<3.4E-01	<3.3E-01	<3.5E-01	<3.3E-01	3.0E+03
^{151}Sm	<1.2E-02	<1.2E-02	<1.3E-02	<1.3E-02	<1.3E-02	<1.3E-02	8.0E+03
^{154}Eu	<7.0E-02	<7.1E-02	<7.7E-02	<7.4E-02	<7.8E-02	<7.4E-02	4.0E+02
^{155}Eu	<1.9E-01	<2.4E-01	<2.6E-01	<2.0E-01	<3.1E-01	<2.1E-01	3.0E+03
^{234}U	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	2.0E+01
^{238}U	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	2.0E+01
^{237}Np	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	9.0E+00
^{238}Pu	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	4.0E+00
^{239}Pu	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	4.0E+00
^{240}Pu	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	4.0E+00
^{241}Am	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	5.0E+00
^{244}Cm	<2.1E-02	<3.0E-02	<2.4E-02	<2.5E-02	<2.2E-02	<2.5E-02	7.0E+00
^{241}Pu	<5.8E-01	<8.1E-01	<6.5E-01	<7.0E-01	<5.9E-01	<7.0E-01	2.0E+02
^{3}H	1.4E+05	1.4E+05	1.3E+05	1.7E+05	1.9E+05	1.7E+05	6.0E+04

- symbol signifies that the radionuclide was not the radionuclide to be measured and assessed at the time of the batch release. This is because Cd-113m was added to the list of radionuclides to be measured and assessed for ALPS treated water after it was found in significant concentration in pre-treatment contaminated water sampled in February 2024. TEPCO stated it would begin analysing it from August 1, 2024, onwards. TEPCO voluntarily analysed Cd-113m before then and the analysis results are posted in the parentheses.

< symbol indicates value is below the detection limit, the detection limit is the value listed after the < symbol

Table IV. 2: Concentration of Radionuclides in Bq/L in batches 7 to 12 before dilution

Batch Number	7	8	9	10	11	12	Regulatory Limit
Discharge Start	2024-06-28	2024-08-07	2024-09-26	2024-10-17	2025-03-12	2025-04-10	
Discharge End	2024-07-16	2024-08-25	2024-10-14	2024-11-04	2025-03-30	2025-04-28	
Volume (m^3)	7.8E+03	7.9E+03	7.8E+03	7.8E+03	7.9E+03	7.9E+03	
C-14	9.9E+00	1.2E+01	1.1E+01	1.2E+01	8.5E+00	1.2E+01	2.0E+03
Mn-54	<2.6E-02	<2.6E-02	<2.3E-02	<2.2E-02	<2.4E-02	<2.3E-02	1.0E+03
Fe-55	<1.9E+01	<1.6E+01	<1.7E+01	<1.5E+01	<1.7E+01	<1.8E+01	2.0E+03
Co-60	5.0E-01	4.4E-01	1.9E-01	2.4E-01	2.2E-01	2.3E-01	2.0E+02
Ni-63	<9.1E+00	<8.1E+00	<7.8E+00	<7.9E+00	<9.2E+00	<9.3E+00	6.0E+03
Se-79	<8.8E-01	<9.8E-01	<8.9E-01	<8.9E-01	<1.0E+00	<9.9E-01	2.0E+02
Sr-90	1.4E+00	1.2E+00	2.9E-01	8.4E-01	6.2E-01	7.1E-01	3.0E+01
Y-90	1.4E+00	1.2E+00	2.9E-01	8.4E-01	6.2E-01	7.1E-01	3.0E+02
Tc-99	8.0E-01	7.3E-01	8.8E-02	1.0E-01	1.4E-01	1.9E-01	1.0E+03
Ru-106	<2.5E-01	<2.2E-01	<2.4E-01	<2.3E-01	<2.2E-01	<2.1E-01	1.0E+02
Cd-113m	<8.6E-02	<7.7E-02	<7.8E-02	<7.7E-02	<8.5E-02	<8.8E-02	4.0E+01
Sb-125	2.6E-01	2.3E-01	1.4E-01	1.3E-01	1.2E-01	1.0E-01	8.0E+02
Te-125m	9.6E-02	8.7E-02	5.2E-02	4.8E-02	4.6E-02	3.8E-02	9.0E+02
I-129	7.8E-01	2.9E-01	2.4E-01	1.1E-01	1.3E-01	1.0E-01	9.0E+00
Cs-134	<3.3E-02	<3.4E-02	<2.6E-02	<2.9E-02	<2.9E-02	<3.0E-02	6.0E+01
Cs-137	2.9E-01	2.2E-01	4.8E-02	5.4E-02	1.4E-01	4.0E-01	9.0E+01
Ce-144	<3.8E-01	<3.8E-01	<3.7E-01	<3.6E-01	<3.4E-01	<3.1E-01	2.0E+02
Pm-147	<3.3E-01	<3.3E-01	<2.8E-01	<3.2E-01	<3.4E-01	<3.0E-01	3.0E+03
Sm-151	<1.3E-02	<1.3E-02	<1.1E-02	<1.2E-02	<1.3E-02	<1.2E-02	8.0E+03
Eu-154	<7.4E-02	<7.4E-02	<6.3E-02	<7.3E-02	<7.6E-02	<6.8E-02	4.0E+02
Eu-155	<2.6E-01	<2.1E-01	<2.1E-01	<1.9E-01	<2.0E-01	<1.7E-01	3.0E+03
U-234	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	2.0E+01
U-238	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	2.0E+01
Np-237	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	9.0E+00
Pu-238	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	4.0E+00
Pu-239	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	4.0E+00
Pu-240	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	4.0E+00
Am-241	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	5.0E+00
Cm-244	<2.8E-02	<2.9E-02	<3.3E-02	<3.0E-02	<2.6E-02	<2.9E-02	7.0E+00
Pu-241	<7.8E-01	<7.9E-01	<8.9E-01	<8.2E-01	<7.0E-01	<7.9E-01	2.0E+02
H-3	1.7E+05	2.0E+05	2.8E+05	3.1E+05	3.1E+05	3.7E+05	6.0E+04

- symbol signifies that the radionuclide was not the radionuclide to be measured and assessed at the time of the batch release. This is because Cd-113m was added to the list of radionuclides to be measured and assessed for ALPS treated water after it was found in significant concentration in pre-treatment contaminated water sampled in February 2024. TEPCO stated it would begin analysing it from August 1, 2024, onwards. TEPCO voluntarily analysed Cd-113m before then and the analysis results are posted in the parentheses.

< symbol indicates value is below the detection limit, the detection limit is the value listed after the < symbol

Table IV. 3: Concentration of Radionuclides Measured in Seawater, Fish and Seaweed from the Ministry of Environment's Environmental Monitoring Programme

Seawater (Bq/L)	Past Fluctuation Range (Apr. 2015 - Jul. 2023)	Before discharge (Apr. 2022 – Aug. 2023)	After discharge (Aug. 2023)	After discharge (Aug. 2024)
^{3}H	ND—2E-1	ND—1.7E-1	ND—5E0	ND—1.9E-1
^{137}Cs	ND—1.1E0	3.1E-3—3.1E-2	2.2E-4—4.4E-2	2.2E-4—4.4E-2
^{90}Sr	ND—7.6E-1	5.5E-4—1.1E-3	5.8E-4—8.8E-3	ND—8.8E-3
^{137m}Ba	ND—1E0	1.7E-2—2.9E-2	2.6E-3—4.2E-2	2.6E-3—3.4E-2
$^{239+240}$Pu	ND—3.6E-5	8.2E-6—2.6E-5	ND—7.4E-6	ND—6.2E-6
^{241}Am	No Data	3.3E-6—1.2E-5	ND—6.4E-6	ND—4.0-6
^{234}U	No Data	Not Measured	4E-2—4.8E-2	4.4E-2—4.8E-2
^{238}U	No Data	Not Measured	3.6E-2—4.2E-2	3.7E-2—4.2E-2
^{90}Y	ND—7.6E-1	7E-4—1.1E-3	6.2E-4—8.8E-3	6.2E-4—8.8E-3
^{14}C	No Data	4.7E-3—6.1E-3	5.1E-3—6E-3	5.8E-3—5.9E-3
Fish (FWT: Bq/L) (OBT, ^{14}C : Bq/kg fresh)	**Past Fluctuation Range (Apr. 2015 - Jul. 2023)**	**Before discharge (Apr. 2022 – Aug. 2023)**	**After discharge (Sep. 2023)**	**After discharge (Aug. 2024)**
FWT	No Data	ND—1.8E-1	4.2E-2—1.6E0	6.9E-2-1.8E-1
OBT	No Data	ND	ND—0.11	ND
^{14}C	No Data	1.6E1—2.8E1	1.9E1—3E1	2E1-2.6E1
Seaweed (Bq/kg fresh)	**Past Fluctuation Range (Apr. 2015 - Jul. 2023)**	**Before discharge (Apr. 2022 – Aug. 2023)**	**After discharge (Sep. 2023)**	**After discharge (Aug. 2024)**
^{129}I	No Data	ND	ND	ND

Nuclides for which all results were below the detection limit are excluded from the table.
ND, no detection, signifies concentration was below the limit of detection
No data, no past measurement data was available for the surrounding areas, such as off the coast of Fukushima Prefecture
Not available, results not available at the time of publication

Table IV. 4: Concentration of Radionuclides Measured in Seawater from the Fukushima Prefectural Government's Environmental Monitoring Programme

Seawater (Bq/L)	Before FDNPS Accident	After FDNPS Accident		
		Before the Discharge of ALPS Treated Water	After the Discharge of ALPS Treated Water	
	(2001-2010)	(2011 – Aug. 2023)	(Sep. 2023 – Jul. 2024)	(Aug. 2024)
^{3}H	ND—2.9E0	ND—6.2E0	ND—1.6E0	ND—1.5E0
^{137}Cs	ND—3E-3	ND—5E0	ND—1.2E-1	ND—1.2E-1

ND = no detection, signifies concentration was below the limit of detection

Table IV. 5: Summary of Monitoring Results of Tritium and Caesium-137 in Seawater from Tokyo Electric Power Company Holdings' Environmental Monitoring Programme

Area	Tritium Range (Bq/L)	Caesium-137 Range (Bq/L)
Within 3km of the coast	4.3E-2 – 5E1	8.8E-3 – 1.3E0
Within 20km of the coast	3E-20 – 2.7E0	9.8E-4 – 1.1E-1
Beyond 20km of the coast	6.8E-2 – 1E-1	1E-3 – 5.8E-3

Table IV. 6: Comparison of Free Water Tritium in Fish and Tritium in Seawater from Results of Tokyo Electric Power Company Holdings' Holdings Environmental Monitoring Programme

Area	Fish Free Water Tritium Range (Bq/L)	Tritium in Seawater Range (Bq/L)
Within 20km of the coast	4.1E-2 – 4.2E-1	3E-2 – 2.7E0

Table IV. 7: Results in Bq/L of Source Monitoring Corroboration Activities Conducted by the International Atomic Energy Agency for Batches 8 to 12

Batch	^{3}H	^{14}C	^{60}Co	^{90}Sr	^{125}Sb	^{137}Cs	^{54}Mn
8	2.03E+05	-	3.65E-01	1.36E+00	2.02E-01	1.88E-01	<1.2E-02
9	2.81E+05	-	1.82E-01	-	1.24E-01	5.30E-02	<2E-02
10	3.10E+05	1.21E+01	2.57E-01	8.10E-01	1.81E-01	6.80E-02	<2E-02
11	3.18E+05	1.08E+01	2.30E-01	5.20E-01	1.48E-01	1.54E-01	<2E-02
12	3.70E+05	1.41E+01	2.19E-01	6.40E-01	1.31E-01	3.58E-01	<9E-03
Batch	**^{106}Ru**	**^{129}I**	**^{134}Cs**	**^{144}Ce**	**^{154}Eu**	**^{155}Eu**	**^{241}Am**
8	<1E-01	<1E-01	<1E-02	<2E-01	<3E-02	<5E-02	<5E-02
9	<1E-01	<1E-01	<9E-03	<2E-01	<4E-02	<6E-02	<2E-01
10	<2E-01	<1E-01	<3E-02	<2E-01	<5E-02	<9E-02	<1E-01
11	<2E-01	<2E-01	<2E-02	<2E-01	<6E-02	<8E-02	<1E-01
12	<9E-02	<1E-01	<1E-02	<1E-01	<3E-02	<5E-02	<6E-02

- symbol signifies no value recorded

< symbol indicates value is below the detection limit, the detection limit is the value listed after the < symbol

Table IV. 8: Results of International Atomic Energy Agency Corroboration Analysis of Tritium in Diluted ALPS Treated Water

Batch	IAEA		TEPCO		Zeta Score (IAEA/TEPCO)
	^{3}H Concentration (Bq/L)	Uncertainty (Bq/L)	^{3}H Concentration (Bq/L)	Uncertainty (Bq/L)	
5	2.59E+02	3.90E+01	2.22E+02	1.20E+01	0.91
6	2.29E+02	3.90E+01	2.02E+02	1.10E+01	0.68
7	2.45E+02	2.10E+01	2.17E+02	1.20E+01	1.17
8	2.52E+02	1.90E+01	2.31E+02	1.30E+01	0.93
9	3.46E+02	1.40E+01	3.36E+02	1.60E+01	0.48
10	3.77E+02	5.00E+00	3.81E+02	1.80E+01	-0.22
11	3.62E+02	8.00E+00	3.44E+02	1.60E+01	1.01
12	4.26E+02	1.30E+01	4.30E+02	1.90E+01	-0.17

ANNEX V. TEPCO MONITORING FOR ELEMENTS OTHER THAN TRITIUM

Table V. 1: Sampling of Elements other than Tritium Conducted around the Fukushima Daiichi Nuclear Power Station by Tokyo Electric Power Company Holdings’

Site ID	Seawater							Sediment			
	^{134}Cs, ^{137}Cs (1 Bq/L)*	^{134}Cs, ^{137}Cs (1E-3 Bq/L)*	^{134}Cs, ^{137}Cs (4E-1 Bq/L)*	^{238}Pu, $^{239+240}$Pu	^{90}Sr	Gross α	Gross β	^{134}Cs, ^{137}Cs	^{90}Sr	^{238}Pu, $^{239+240}$Pu	^{240}Pu/^{239}Pu ratio
Sites within 3 km of FDNPS											
T-1	Daily	Weekly		Bi-annually	Monthly	Monthly	Weekly	Monthly	1 per 2 months	1 per 3 months	1 per 3 months
T-2	Daily	Weekly		Bi-annually	Monthly	Monthly	Weekly	Monthly	1 per 2 months	1 per 3 months	1 per 3 months
T-0-1			Weekly				Weekly				
T-0-1A			Weekly				Weekly				
T-0-2			Weekly				Weekly				
T-0-3			Weekly				Weekly				
T-0-3A			Weekly				Weekly				
T-A1			Weekly								
T-A2			Weekly								
T-A3			Weekly								
Sites within 20km of FDNPS											
T-3	Weekly	Weekly					2 per Month	Monthly			
T-4	Weekly	Weekly						Monthly			
T-6		Weekly					2 per Month				
T-14 (T-S2)		Weekly						Monthly			
T-11		Weekly						Monthly			
T-D1		Weekly		Bi-annually	Monthly	Monthly	2 per Month	Monthly		1 per 3 months	1 per 3 months

Site ID	Seawater							Sediment			
	^{134}Cs, ^{137}Cs (1 Bq/L)*	^{134}Cs, ^{137}Cs (1E-3 Bq/L)*	^{134}Cs, ^{137}Cs (4E-1 Bq/L)*	^{238}Pu, $^{239+240}Pu$	^{90}Sr	Gross α	Gross β	^{134}Cs, ^{137}Cs	^{90}Sr	^{238}Pu, $^{239+240}Pu$	$^{240}Pu/^{239}Pu$ ratio
T-D5		Weekly		Bi-annually	Monthly	Monthly	2 per Month	Monthly		1 per 3 months	1 per 3 months
T-D9		Weekly		Bi-annually	Monthly	Monthly	2 per Month	Monthly		1 per 3 months	1 per 3 months
T-5		Weekly		Bi-annually	Monthly	Monthly	2 per Month	Monthly		1 per 3 months	1 per 3 months
T-①								Monthly			
T-②								Monthly			
T-③								Monthly			
T-④								Monthly			
T-⑤								Monthly			
T-⑥								Monthly			
T-⑦								Monthly			
T-⑧								Monthly			
T-⑨								Monthly			
T-⑩								Monthly			
T-⑪								Monthly			
T-⑫								Monthly			
T-⑬								Monthly			
T-S1		Monthly						Monthly			
T-S3		Monthly						Monthly			
T-S4		Monthly						Monthly			
T-S5		Monthly						Monthly			
T-S7		Monthly						Monthly			
T-S8		Monthly						Monthly			
T-B1		Monthly						Monthly			
T-B2		Monthly						Monthly			
T-B3		Monthly						Monthly			
T-B4		Monthly						Monthly			

Site ID	Seawater							Sediment			
	^{134}Cs, ^{137}Cs (1 Bq/L)*	^{134}Cs, ^{137}Cs (1E-3 Bq/L)*	^{134}Cs, ^{137}Cs (4E-1 Bq/L)*	^{238}Pu, $^{239+240}Pu$	^{90}Sr	Gross α	Gross β	^{134}Cs, ^{137}Cs	^{90}Sr	^{238}Pu, $^{239+240}Pu$	$^{240}Pu/^{239}Pu$ ratio
Sites 20km and further from FDNPS											
T-7		Monthly						1 per 2 months			
T-13-1		Monthly						1 per 2 months			
T-22		Monthly						1 per 2 months			
T-MA		Monthly						1 per 2 months			
T-18		Monthly						1 per 2 months			
T-M10		Monthly						1 per 2 months			
T-17-1		Monthly						1 per 2 months			
T-20		Monthly						1 per 2 months			
T-12		Monthly						1 per 2 months			

* - Target detection limit for the sample

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