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

Report 5: Review Mission to NRA (January 2023)

IAEA
International Atomic Energy Agency

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Executive Summary

The IAEA conducted its second review mission to Japan's Nuclear Regulation Authority (NRA) in 16–20 January 2023. The first review mission focused on NRA was held 21-25 March 2022. The mission was conducted under the terms of reference for the IAEA's assistance to Japan on the Review of Safety Aspects of ALPS (Advanced Liquid Processing System) Treated Water at TEPCO's Fukushima Daiichi Nuclear Power Station (FDNPS) and formed part of the review component relating to regulatory activities and processes. The review team, coordinated and led by a senior IAEA official, included 17 members. The review team was comprised of experts from the IAEA Secretariat and international experts who are designated members of the Task Force.

Consistent with the request from the Government of Japan, the IAEA statutory functions and the mandate of the Task Force, the scope of the IAEA review is tailored to assessing safety related aspects of the implementation of Japan's *Basic Policy on Handling of ALPS Treated Water at the Tokyo Electric Power Company's Holdings' Fukushima Daiichi Nuclear Power Station* against the IAEA's International Safety Standards[1]. The current approach outlined in the Basic Policy is to conduct a series of controlled discharges of ALPS treated water into the sea over a period of approximately 30 years. This mission was conducted focusing on the specific approach outlined in the Basic Policy, controlled discharge to the sea, consistent with the request from the Government of Japan.

To implement this approach, the NRA conducts its regulatory review of TEPCO's proposed amendments to the Implementation Plan (i.e., TEPCO's regulatory authorization for activities at the FDNPS). In this mission, the Task Force reviewed the regulatory process implemented by the NRA for the authorization of the discharge of ALPS treated water from FDNPS, including the approach and criteria followed by the NRA in their review of TEPCO's radiological environmental impact assessment (REIA) and Implementation Plan.

The scope of the review mission covered: the regulatory process for the authorization of discharges, the establishment of dose constraints for discharges, the optimization process for the protection of the public and for the protection of workers, the level of complexity of the REIA, the annual authorized limits for discharges, the requirements for source monitoring and environmental monitoring and the review and approval of monitoring programmes. The site's comprehensive decommissioning activities were considered outside the scope of this mission and the IAEA's overall safety review.

The review against the relevant IAEA International Safety Standards was organized into the following five technical topics:

- A – Responsibilities and Functions of the Government
- B – Major Principles and Safety Objectives
- C – Authorization Process
    - C.1 – Regulatory Process
    - C.2 – Radiological Environmental Impact Assessment
    - C.3 – Characterization of the Source Term
    - C.4 – Occupational Radiation Protection
- D – Source Monitoring and Environmental Monitoring
    - D.1 – Source Monitoring
    - D.2 – Environmental Monitoring
- E – Public Consultation and Involvement of Interested Parties

[1] The International Safety Standards established by the IAEA constitute the global reference for protecting people and the environment. They contribute to a harmonized high level of safety worldwide. The process of developing, reviewing, and establishing the IAEA standards involves the IAEA Secretariat and all IAEA Member States. The IAEA does this in consultation with the competent organs of the United Nations and with the specialized agencies concerned.

Between the first and second missions to NRA, significant progress was made by NRA in conducting their domestic regulatory review. During the mission, NRA provided presentations for each of the five technical topics listed above, with a focus on responding to specific questions and comments from the Task Force shared prior to this mission, and observations from the first mission to NRA (March 2022).

During the mission, the Task Force received full cooperation from counterparts in NRA and noted that the NRA are using the IAEA safety standards in their domestic regulatory review. Over the course of the week a wide range of technical topics were discussed, and the details of these discussions are included in Part II of this report. Several high-level observations from the review team are summarized as follows:

- The Task Force reaffirmed its view that the NRA serves as the independent regulatory body within Japan, has promulgated and implemented an appropriate legal and regulatory framework for safety, and holds the responsibility for assessing the safety of the proposed discharge of ALPS treated water. However, the Task Force will continue to monitor the regulatory process and actions of NRA against the international safety standards, leading up to, and after, the start of proposed discharges of ALPS treated water by TEPCO at FDNPS.
- The NRA agreed to require TEPCO to review optimisation of protection for the discharge of ALPS treated water based on operational experience and associated monitoring following the start of the discharges. NRA further agreed to establish a framework for revisiting discharge limits, operating limits, and conditions to reflect the optimization of protection, in a similar manner, if needed. The Task Force will continue to review these developments.
- The Task Force noted that sufficient information was provided by NRA to clearly explain the authorization process for the ALPS treated water discharge. Additionally, the Task Force understands that NRA is utilising multiple processes to verify TEPCO's compliance with regulatory requirements. The NRA agreed that it will ensure action levels and tolerances are defined, agreed to, and included in formal documentation where appropriate. The Task Force will continue to review these developments.
- The Task Force acknowledged that NRA has conducted a review to determine that sufficient evidence exists that the source term contains all the radiologically significant radionuclides and that it does not exclude any radionuclides that could be significant contributors to the dose to the public or to flora and fauna.
- The Task Force noted the additional information provided by NRA that helped to clarify and further define how the comprehensive environmental monitoring programme, both the existing programme and enhancements in response to the ALPS treated water discharges, will be implemented. The Task Force requested NRA to provide further information about the roles and responsibilities of the expert group mentioned during the mission that will provide advice to the Government of Japan on environmental monitoring, and how the group will operate and how discrepancies in monitoring data results will be investigated. Additionally, the Task Force noted that NRA should ensure TEPCO establishes a process for the collection of information following a discrepancy in monitoring data results to enable root cause analysis to be undertaken.
- The Task Force noted that relevant regulatory arrangements for occupational radiation protection are broadly consistent with the relevant IAEA Safety Standards, in particular GSR Part 3 and GSG-7. The Task Force confirms that NRA's approach to enforce the occupational exposure control is sufficient for compliance with international safety standards.

- The Task Force noted the effort by NRA focused on involving the public in the regulatory review process and noted that it will continue to review how public consultations and the involvement of interested parties are handled by NRA as the regulatory process continues.

No further missions to NRA are planned prior to the issuance of the IAEA's comprehensive report. Remaining clarification or follow up will be handled through electronic communication.

This mission report reflects the discussions between the Task Force and the Government of Japan and documents observations from the Task Force. This report was written and approved by the IAEA Task Force and has been published by the IAEA on its public website. This report, and other mission reports under the IAEA's review, is intended to serve as a progress report and final conclusions will not be drawn while the IAEA's review is still ongoing. The IAEA will issue a comprehensive report in 2023 containing the conclusions of the Task Force across all aspects of the IAEA's review.

I. Part I

I.1. Introduction and Background

In April 2021, Japan announced the *Basic Policy on Handling of ALPS Treated Water at the Tokyo Electric Power Company's Holdings' Fukushima Daiichi Nuclear Power Station*, which includes a plan to discharge the treated water from the advanced liquid processing system (ALPS) into the sea surrounding the plant, subject to domestic regulatory approvals. Soon after, the Japanese authorities requested assistance from the IAEA to monitor and review those plans and activities relating to the discharge of the treated water to ensure they will be implemented in a safe and transparent way, and they will be in accordance with the IAEA's International Safety Standards[2]. The IAEA, in line with its statutory responsibility, accepted the request made by Japan.

In July 2021, the IAEA and the Government of Japan signed the Terms of Reference for IAEA Assistance to Japan on Review of Safety Aspects of ALPS Treated Water at Tokyo Electric Power Company Holdings, Inc. (TEPCO) Fukushima Daiichi Nuclear Power Station (FDNPS). These terms of reference set out the broad framework that the IAEA will use to implement its review. 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.

The Agency's assistance to Japan will consist of a technical review to assess whether the operation to discharge the ALPS treated water over the coming decades is in accordance with the IAEA International Safety Standards. The IAEA will also undertake activities for the corroboration of the source and environmental monitoring programmes of TEPCO before, during and after the discharges. This review will be conducted on the basis of reference materials submitted by Japan and the outcomes of review missions. The IAEA will examine key safety elements of Japan's plan, including the following:

- The radiological characterization of the treated water to be discharged.
- The safety-related aspects of the treated water discharge process, including the equipment to be used and the criteria to be applied and observed for operations.
- The assessment of the radiological environmental impact related to ensuring the protection of people and the environment.
- The environmental monitoring associated with the discharge.
- The regulatory control, including authorization, inspection and ongoing assessment of the discharge plan.

The IAEA's review will be 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 will primarily be coordinated with TEPCO and the Ministry of Economy, Trade, and Industry (METI)[3] and will look at the

[2] The International Safety Standards established by the IAEA constitute the global reference for protecting people and the environment. They contribute to a harmonized high level of safety worldwide. The process of developing, reviewing, and establishing the IAEA standards involves the IAEA Secretariat and all IAEA Member States. The IAEA does this in consultation with the competent organs of the United Nations and with the specialized agencies concerned.

[3] METI, as a government ministry, is the competent authority for overseeing the decommissioning of the FDNPS. Prior to the announcement of the Basic Policy, METI took a leading role in conducting studies for the handling of ALPS treated water. From this point of view, METI is included in the assessment of protection and safety component of the IAEA's review.

expected actions to be performed by TEPCO throughout the process, as defined in the relevant IAEA International Safety Standards.

- **Regulatory Activities and Processes** – This component is focused on assessing whether the Nuclear Regulation Authority's (NRA) review and approval process is conducted in accordance with the relevant IAEA International Safety Standards. This component will primarily be coordinated with the NRA as the independent regulatory body for nuclear safety within Japan; it will focus only on the regulatory aspects relevant for NRA's review of the discharge of ALPS treated water from the Fukushima Daiichi Nuclear Power Station.

- **Independent Sampling, Data Corroboration and Analysis** – This component includes all activities associated with the IAEA's independent sampling and analysis that will be performed to corroborate the data from TEPCO and the Government of Japan associated with the ALPS treated water discharge. Samples will be analysed by IAEA laboratories as well as independent third-party laboratories. Additionally, this component includes the corroboration of occupational exposure.

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 internationally recognized experts with extensive experience from a wide range of technical specialties and experts from the IAEA Secretariat. These experts will support the review 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 will conduct its review through a combination of the analysis of documentation, conducting review missions and performing other verification activities. At the start of the review, the Government of Japan, the NRA and TEPCO provided several background materials with information pertaining to the proposed discharge of ALPS treated water, including all laws and regulations relevant to FDNPS. Subsequently, additional materials have been provided upon request by the Task Force, or when ready for submission by TEPCO to the relevant Japanese authorities. This information is carefully reviewed by the Task Force members and forms the basis for the review missions with relevant authorities. The purpose of the review missions is to review the reference materials submitted by the NRA or TEPCO against the IAEA International Safety Standards, seek clarification on technical issues, request additional information and observe on-site activities, as appropriate. Additionally, to support the independent sampling and analysis activities, the Task Force will conduct discussions and on-site sampling activities; these activities will include independent third-party laboratories to ensure that an inclusive and transparent approach is adopted.

With regard to the regulatory activities and processes, the Task Force will review the process implemented by the NRA for the authorization of the discharge of ALPS treated water from FDNPS, including the approach and criteria followed by the NRA in their review of TEPCO's REIA and Implementation Plan, and the interaction of the NRA with TEPCO. The Task Force will check the requirements placed by the NRA on TEPCO for source monitoring and environmental monitoring, and the provisions made by the NRA for an independent environmental monitoring programme. Finally, the Task Force will look at how the NRA provides information to, and engages in consultation with, parties affected by the regulatory decisions and, as appropriate, the public and other interested parties.

The IAEA's review will extend over several years, covering the entire process until full completion, and progress will be reported in different ways. The primary means by which progress will be shared with external interested parties is through formal reports. Reports issued after review missions will reflect discussions between the Task Force and Japan as well as document observations from the Task Force. The reports will be released after each review mission. These reports, by the IAEA Task Force, will be published by the IAEA on its public website. However, these reports are intended to serve as progress reports and final conclusions will not be drawn while the IAEA's review is still ongoing. In

2023, the IAEA will issue a comprehensive report containing the full conclusions of the Task Force across all aspects of the IAEA's review. This comprehensive report will include the final conclusions and findings of the Task Force.

The IAEA will also establish information sharing mechanisms to distribute relevant data and updates through the IAEA's website. This information will be shared in real-time, and near real-time, to allow interested parties to maintain awareness of the status of and developments for the ALPS treated water discharges conducted by TEPCO.

Additional information on the IAEA's review, as well as background information, documents, reports, and other publications can be found online at the dedicated website for the IAEA's Fukushima ALPS review.[4]

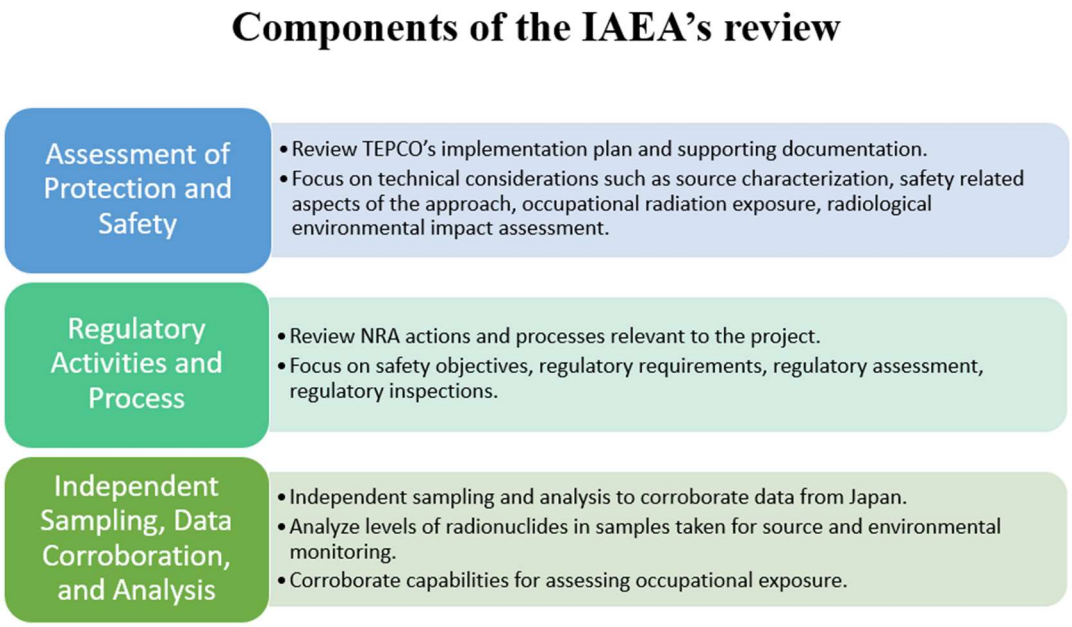

Fig. I–1. Three components of the IAEA's review of ALPS treated water discharge.

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

I.2. Application and Description of Relevant IAEA's International Safety Standards

The IAEA's Statute authorizes the Agency to "establish or adopt… standards of safety for protection of health and minimization of danger to life and property" — standards that the IAEA must use in its own operations, and which Member States can apply by means of their regulatory provisions for nuclear and radiation safety. The IAEA does this in consultation with the competent organs of the United Nations and with the specialized agencies concerned. A comprehensive set of high-quality International Safety Standards under regular review is a key element of a stable and sustainable global safety regime, as is the IAEA's assistance in their application.

The IAEA commenced its safety standards programme in 1958. The emphasis placed on quality, fitness for purpose and continuous improvement has led to the widespread use of the IAEA standards throughout the world. The International Safety Standards Series now includes unified Fundamental Safety Principles, which represent an international consensus on what must constitute a high level of protection and safety. However, standards are only effective if they are properly applied in practice. Therefore, the IAEA is working to promote the global acceptance and use of its standards.

The IAEA's safety services encompass design, siting and engineering safety, operational safety, radiation safety, safe transport of radioactive material and safe management of radioactive waste, as well as governmental organization, regulatory matters and safety culture in organizations. These safety services assist Member States in the application of the standards and enable valuable experience and insights to be shared. Regulating safety is a national responsibility, and many States have decided to adopt the IAEA's standards for use in their national regulations. For parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions.

Fig. I–2. The hierarchy of the IAEA safety standards.

The IAEA International Safety Standards are also applied by regulatory bodies and operators around the world to enhance safety in nuclear power generation and in nuclear applications in medicine, industry, agriculture and research. Safety is not an end in itself but a prerequisite for the purpose of the protection of people in all States and of the environment — now and in the future. The risks associated with ionizing radiation must be assessed and controlled without unduly limiting the contribution of

nuclear energy to equitable and sustainable development. Governments, regulatory bodies and operators everywhere must ensure that nuclear material and radiation sources are used beneficially, safely and ethically. The IAEA International Safety Standards are designed to facilitate this, and all Member States are encouraged to make use of them.

For the purpose of this review, the Task Force identified several IAEA International Safety Standards that are relevant for the proposed discharge of ALPS treated water into the sea. These standards address radiation protection and the safety of radiation sources, regulatory control over radioactive discharges to the environment, the structure and content of radiological environmental impact assessments, and methods for conducting environmental and source monitoring. While all IAEA International Safety Standards will be consulted as needed by the Task Force, the following are the primary safety standards referenced during this review:

- IAEA Safety Standards Series No. SF-1, Fundamental Safety Principles: Safety Fundamentals [1];
- IAEA Safety Standards Series No. GSR Part 1, Governmental, Legal and Regulatory Framework for Safety [2];
- IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards [3];
- IAEA Safety Standards Series No. GSG-7, Occupational Radiation Protection [4];
- IAEA Safety Standards Series No. GSG-9, Regulatory Control of Radioactive Discharges to the Environment [5];
- IAEA Safety Standards Series No. GSG-10, Prospective Radiological Impact Assessment for Facilities and Activities [6];
- IAEA Safety Standards Series No. RS-G-1.8, Environmental and Source Monitoring for Purposes of Radiation Protection [7].

I.3. Overview of the Mission Scope and Structure

Consistent with the request from the Government of Japan, and the mandate of the Task Force, the scope of the IAEA review is tailored to assessing safety related aspects of the implementation of Japan's *Basic Policy on Handling of ALPS Treated Water at the Tokyo Electric Power Company's Holdings' Fukushima Daiichi Nuclear Power Station*. Within the Basic Policy, the Government of Japan outlines a plan to discharge ALPS treated water into the sea. The Task Force will conduct its review on the specific approach outlined in the Basic Policy, controlled discharge into the sea, consistent with the request from the Government of Japan. The scope of the IAEA review in this mission is tailored to assessing whether the NRA's review and approval process is conducted in accordance with the relevant IAEA International Safety Standards. This component will primarily be coordinated with the NRA as the independent regulatory body for nuclear safety within Japan; it will focus only on the regulatory aspects relevant for NRA's review of the discharge of ALPS treated water from the Fukushima Daiichi Nuclear Power Station. The Task Force acknowledges that the domestic regulatory review of the proposed approach is still ongoing within Japan.

The IAEA conducted its second review mission to NRA on 16-20 January 2023. The review team was comprised of experts from the IAEA Secretariat and officially designated international experts who are members of the Task Force (see Annex I). This mission forms part of the IAEA review component relating to regulatory activities and processes and included discussions with officials and experts from the NRA.

The review team held discussions with officials of NRA (see Annex II) at the NRA headquarters in Tokyo, Japan. Some members of the review team also visited FDNPS in the Fukushima Prefecture on Tuesday 17 January, where the team witnessed the conduct of pre-service inspections by NRA inspectors.

For this mission, the Task Force utilized the same structure of major technical topics (see Annex III) that was used in the first mission to NRA (March 2023). The review against the relevant IAEA International Safety Standards was organized into five main technical topics (A–E):

- A – Responsibilities and Functions of the Government
- B – Major Principles and Safety Objectives
- C – Authorization Process
    - C.1 – Regulatory Process
    - C.2 – Radiological Environmental Impact Assessment
    - C.3 – Characterization of the Source Term
    - C.4 – Occupational Radiation Protection
- D – Source Monitoring and Environmental Monitoring
    - D.1 – Source Monitoring
    - D.2 – Environmental Monitoring
- E – Involvement of Interested Parties

To support the IAEA review, NRA provided the Task Force with background reference materials and updates on the ongoing domestic regulatory review. During the mission, NRA provided presentations for each of the five technical topics listed above, with a focus on responding to specific questions and comments highlighted during the first mission to NRA in March 2022.

The mission started with an opening session attended by high-level officials from NRA who conveyed opening remarks. On the first day, the review team provided an overview presentation conveying a summary of their feedback so far and highlighting the overall objectives of this mission. The mission was organized around the five technical topics that had been previously agreed with NRA (see list of topics above). For each technical topic, NRA provided an overview presentation that summarized the information included in the reference materials and additional clarifications on questions and issues that the Task Force had identified in advance of this mission. The review team and NRA then engaged in

an open discussion to ensure a shared understanding of how the actions taken by NRA comply with the IAEA International Safety Standards. At the end of the week, the review team summarized the observations from the review mission in a brief presentation for NRA and engaged in follow up discussions to ensure all participants in the mission had a shared understanding of the outcomes. The major discussion themes and observations noted by the Task Force are summarized in the 'Discussion' subsections of Part II of this report.

No further missions to NRA are planned prior to the issuance of the IAEA's comprehensive report. Any remaining clarification or follow up will be handled through electronic communication.

I.4. Overview of the Basic Policy and the Proposed Discharge Approach

The *Basic Policy on Handling of ALPS Treated Water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station* was issued on 13 April 2021 under the authority of the Inter-Ministerial Council of Japan for Contaminated Water, Treated Water, and Decommissioning Issues. The Basic Policy contains the Government of Japan's basic premise, relevant background and an outline for pursuing discharge of ALPS treated water into the sea. In the Basic Policy the Government of Japan notes: "In order to safely and steadily proceed with decommissioning and management of contaminated water and treated water at FDNPS, based on the ALPS Subcommittee report[5] and opinions received from parties concerned, the ALPS treated water will be discharged on the condition that full compliance with the laws and regulations is observed, and measures to minimize adverse impacts on reputation are thoroughly implemented."

The Basic Policy further notes that "…[the] discharge of ALPS treated water into the sea will be implemented at Fukushima Daiichi NPS, on the premise to make best efforts to minimize the risks by taking measures such as purification and dilution based on the ALARA principle[6], under strict control." In support of this decision, the Basic Policy provides background and supporting justification such as the importance of risk reduction, protecting people and the environment and ensuring that reconstruction of Fukushima can be supported. Furthermore, the Basic Policy highlights the work of the Inter-Ministerial Council in assessing other technologies for handling and managing ALPS treated water stored at the Fukushima Daiichi Nuclear Power Station.

The current approach outlined in the Basic Policy is to conduct a series of controlled discharges of ALPS treated water into the sea ('batch discharges') over a period of approximately 30 years. To implement this approach, TEPCO has proposed amendments to its Implementation Plan (i.e., its regulatory authorization to conduct decommissioning activities), including conducting a safety assessment and developing an REIA.

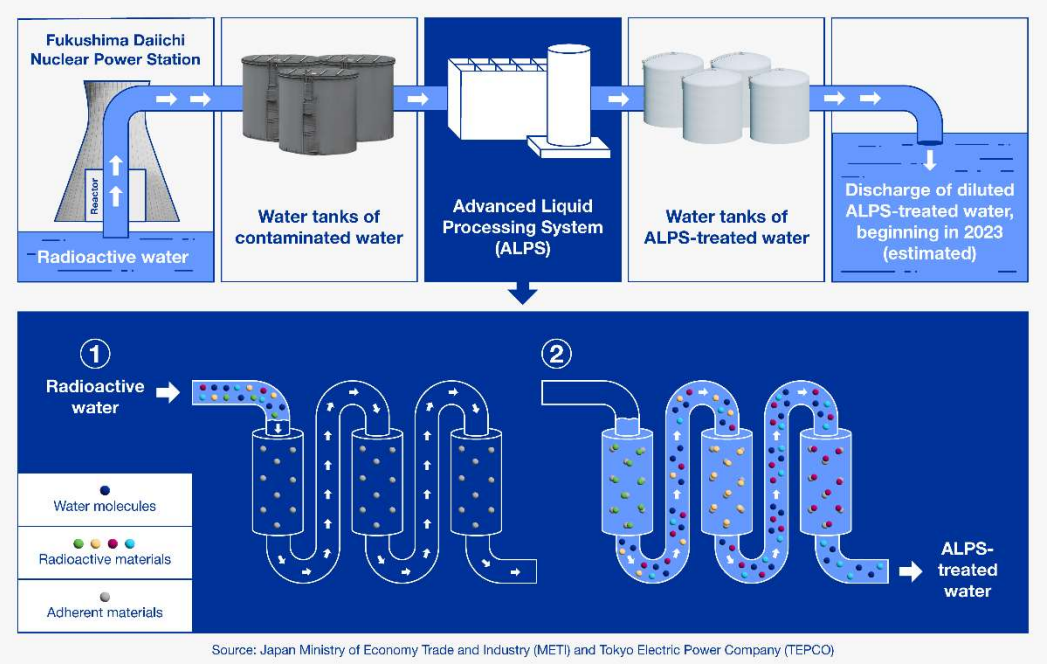

Fig. I–3. Overview of the ALPS treated water discharge system.

[5] https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/20200210_alps.pdf

[6] ALARA refers to the concept of "as low as reasonably achievable" which means making every reasonable effort to keep exposures to ionizing radiation as far below the dose limits as practicable considering relevant technical, social, economic, and other considerations.

TEPCO is proposing to discharge ALPS treated water, after it has been analysed and after it has been confirmed that the radionuclide inventory is in accordance with the regulatory discharge limits set in the authorization. Existing ALPS treated water varies in its radiological composition due to a variety of factors including the time when it was first generated and with what generation of ALPS treatment it was originally processed. Therefore, a secondary ALPS treatment process line will be established that will treat water currently stored on site, as necessary. This water will be processed through the ALPS facility until it meets the criteria for discharge included in the authorization. To verify this, TEPCO will organize the existing K4 tank group into three sets of 10 tanks each. Each tank set will be assigned to one of three rotating functions: receiving water from the ALPS process line, holding water that is pending analysis results and confirmation of its content, and holding water that is ready for discharge.

The water that is deemed ready for discharge will be connected to piping that transfers the water down to sea level where it will be mixed with incoming sea water from the surrounding area. Sea water will be pumped in through the old Fukushima Daiichi Nuclear Power Station Unit 5 water intake port. The sea water and the ALPS treated water will be mixed in a mixing well in a seawater pipe header and then discharged through an undersea tunnel out to approximately 1 km from the shoreline. The discharge point identified by TEPCO is located in a zone restricted for commercial fishing. The chosen operational parameters for the discharge include an annual limit of 22 TBq of tritium, and a concentration limit of 1,500 Bq/L tritium in the discharges. Additional information on the Basic Policy and proposed discharge of ALPS treated water can be found online at TEPCO's and METI's websites [8, 9, 10].

Fig. I–4. Storage tanks of ALPS treated water at FDNPS (Source: Website of Tokyo Electric Power Company Holdings, Inc.).

II. Part II

II.A. Responsibilities and Functions of the Government

(a) Overview

The IAEA International Safety Standards outline the responsibilities and functions of the government. GSR Part 1 (Rev. 1) [2], establishes requirements on the essential aspects of the governmental and legal framework for establishing a regulatory body and for taking actions necessary to ensure the effective regulatory control of facilities and activities — existing and new — utilized for peaceful purposes.

GSR Part 1 (Rev. 1) [2] also includes specific requirements for the regulatory body, within the broader government infrastructure. Paragraph 4.2 of GSR Part 1 (Rev. 1) [2] states that: "The responsibilities of the regulatory body shall be discharged within, and are dependent upon, the governmental and legal framework for safety." While the regulatory body operates within the overall governmental and legal framework for safety, the importance of the independent role of the regulatory body is emphasized in Requirements 3, 4 and 17 of GSR Part 1 (Rev. 1) [2]. More specifically, Requirement 4 of GSR Part 1 (Rev. 1) [2] states that: "The government shall ensure that the regulatory body is effectively independent in its safety related decision making and that it has functional separation from entities having responsibilities or interests that could unduly influence its decision making."

GSR Part 3 [3] sets requirements for establishing a governmental, legal and regulatory framework for safety for the regulation of activities that give rise to radiation risks. These requirements are applicable to the regulatory body as well as to registrants or licensees. GSG-9 [5] provides recommendations on the regulatory control of discharges in connection with an authorization process and addresses authorizations for discharges from new and modified facilities and activities, and the review of established authorizations for discharges.

In the first mission to NRA, the NRA provided information regarding the responsibilities and functions of the government within Japan and the role of the different authorities and clarified the specific involvement of the NRA for the ALPS treated water discharge. The NRA also presented the relevant regulations applicable to the proposed ALPS discharge. The NRA explained how the Government of Japan's Basic Policy was developed and the role that the NRA played in the Inter-Ministerial Council for Contaminated Water, Treated Water and Decommissioning Issues. The Task Force confirmed that the NRA serves as the independent regulatory body within Japan, has promulgated and implemented an appropriate legal and regulatory framework for safety, and holds the responsibility for assessing the safety of the proposed discharge of ALPS treated water. The Task Force did not identify any items for further discussion or resolution in this technical topic during the first mission to NRA (March 2022).

(b) Discussion

Between the first mission to NRA (March 2022) and this mission, the Task Force received periodic updates on the conduct of the domestic regulatory review. Through summaries and translations of interactions between NRA and TEPCO, the Task Force noted that the responsibilities and functions of an independent safety regulator were continuing to be implemented. Additionally, NRA provided translations and explanations of the major regulatory review results and public meetings during which these findings were discussed.

(c) Summary and Follow Up

The Task Force reaffirmed its view that the NRA serves as the independent regulatory body within Japan, has promulgated and implemented an appropriate legal and regulatory framework for safety, and holds the responsibility for assessing the safety of the proposed discharge of ALPS treated water. However, the Task Force will continue to monitor the regulatory process and actions of NRA against the international safety standards, leading up to, and after, the start of proposed discharges of ALPS treated water by TEPCO at FDNPS.

II.B. Major Principles and Safety Objectives

(a) Overview

In accordance with the requirements established in GSR Part 3 [3] the regulatory body should:

- Establish or approve constraints on dose and constraints on risk to be used in the optimization of protection and safety for members of the public.
- Establish and enforce requirements for the optimization of protection and safety for situations in which individuals are or could be subject to public exposure.
- Ensure that radioactive waste and discharges of radioactive material to the environment are managed in accordance with an authorization.

GSG-9 [5] provides recommendations on the regulatory control and authorization of discharges for both the regulatory body (i.e., NRA) and the licensee (i.e., TEPCO). Paragraph 5.62 of GSG-9 [5] specifically notes that operational limits and conditions associated with the authorization for discharges for such facilities should be expressed in terms that the operating organization can reasonably be expected to control, for example in terms of measured discharges (total activity or activity concentrations and gaseous or liquid volume discharged) rather than doses to the public, which can only be estimated.

At the end of the first mission to NRA, the Task Force noted that the technical and regulatory basis for the NRA's process to grant or deny the discharge authorization was not clear. During the first mission to NRA the Task Force stressed the importance of NRA fully documenting the process it is using to review the authorization of the discharges, including the selection of discharge limits for radionuclides other than tritium. This is discussed further in Chapter II.C.

During the first mission to NRA, NRA explained that it had used 2 different dose criteria: one from the Reactor Regulation Act (1 mSv per year from a hypothetical extreme situation at the site boundary); and one established by NRA for the ALPS treated water discharges (50 μSv per year from ALPS treated water discharges). The Task Force noted that the differences between these 2 criteria are difficult for interested parties to understand and that it should be clearly explained when establishing the dose constraint for the ALPS treated water discharge. The Task Force noted that it is important for the NRA to clearly explain the approach followed for calculating the dose resulting from a hypothetical extreme situation at the site boundary, and how this dose is informing decisions on the optimization and authorization of the discharge of ALPS treated water.

During the first mission to NRA, the Task Force highlighted how dose constraints serve as tools for optimization of exposures and suggested that the NRA could compare the annual discharge limit of 22 TBq/y for tritium that was established in the Government Basic Policy with the amount of tritium that, according to estimates from the dispersion modelling, could be discharged and remain below the dose constraint. The Task Force continued that the NRA may find it useful to discuss with TEPCO the factors that were considered both in setting the dose constraint and how the optimization process resulted in the selected discharge limit for tritium.

(b) Discussion

The NRA explained to the Task Force the difference between the 2 dose criteria. The dose criterion from the Reactor Regulation Act is for the whole FDNPS site, which is managed as an existing exposure situation. Consequently, NRA requires that the additional effective dose resulting from a hypothetical extreme situation at the site boundary is less than 1 mSv per year. NRA indicated that very conservative assumptions are made in assessing the dose from all the exposure pathways considered for comparison with the 1 mSv criterion at the site boundary. The dose criterion for ALPS treated water discharge is a dose constraint of 50 μSv per year from ALPS treated water discharge to the representative person using

habit data typical of the population living in the region. In summary, NRA explained that the discharge of ALPS treated water is a controlled discharge and therefore NRA considers the activity to be a planned exposure situation. However, this is occurring within the context of the larger FDNPS site, which is managed as an existing exposure situation. Therefore, two dose criteria are being used by NRA.

The Task Force understands why these 2 criteria are used by NRA and noted that the use of the 2 dose criteria is not an issue of compliance against the IAEA Safety Standards. However, the Task Force believes that having 2 dose criteria, apparently both relating to the discharge of ALPS treated water but calculated in very different ways, could be a source of confusion for interested parties.

The Task Force advised that the whole site should be taken account of when optimising protection for the discharge of ALPS treated water rather than linking the discharge of ALPS treated water to the 1 mSv dose criterion.

The NRA provided the Task Force with descriptions of where the need for optimization of protection is required. Firstly, NRA highlighted the text from the "Specific Regulatory Requirements" that describes the requirement for optimization of protection from the overall site against the reference level of 1 mSv per year. NRA also stated that the dose constraint of 50 μSv was set for discharges of ALPS treated water "with the recognition that optimization of protection is to be considered in the range below the dose constraint". The Task Force acknowledged these two references to optimization.

NRA informed the task Force that TEPCO plans to periodically revisit the annual amount of tritium to be discharged taking into account factors to be considered in the optimization process. NRA also stated that if discharges of ALPS treated water hampers the progress with decommissioning, it might require TEPCO to reconsider the discharge amount below the range of the dose constraint. However, it is not clear to the Task Force if this is formally documented as a regulatory requirement, and it is also not clear how NRA will ensure that TEPCO revisits the optimisation of protection for discharges (including appropriate involvement of interested parties).

The Task Force understands that discharge limits set in government policy were influenced by a wide range of prevailing circumstances, such as societal concerns and a desire to reduce radioactivity being released to the environment. The Task Force acknowledges that these could be considered as key factors that informed the optimization process.

The Task Force emphasized to NRA that revising the discharge limit for tritium will have implications for discharge limits for other radionuclides as well as other operational limits and conditions.

(c) Summary and Follow Up

The NRA agreed to require TEPCO to review optimisation of protection for the discharge of ALPS treated water based on operational experience and associated monitoring following the start of the discharges. NRA further agreed to establish a framework for revisiting discharge limits, operating limits, and conditions to reflect the optimization of protection, in a similar manner, if needed. The Task Force will continue to review these developments.

II.C. Authorization Process

II.C.1 Regulatory Process

(a) Overview

GSR Part 3 [3] sets requirements for establishing a governmental, legal and regulatory framework for safety for the regulation of activities that give rise to radiation risks. These requirements are applicable to the regulatory body as well as to registrants or licensees and include the establishment of an authorization process for discharges, as well as requirements for operational performance and the periodic review of the authorization. In accordance with the authorization process for discharges described in GSG-9, the regulatory body shall establish or approve operational limits and conditions relating to public exposure, including authorized limits for discharges, to ensure that radiation protection of members of the public is optimized. These discharge limits should be specified for different radionuclides, or groups of radionuclides.

At the end of the first mission to NRA, the Task Force stressed the importance of NRA fully documenting the process it is implementing to authorize the discharge of ALPS treated water under both the Reactor Regulation Act and the Government Policy for discharge of ALPS treated water. The Task Force also requested information on the process that the NRA is using to approve the authorization of the discharges and to identify the conditions that it will place on TEPCO in the authorization, including the selection of discharge limits for radionuclides other than tritium.

During the first mission, the Task Force discussed with the NRA the importance of deciding the appropriate period for the validity of the authorization that will be issued, and of selecting criteria for future review of the discharge limits or setting a time interval for conducting periodic review of the discharge limits. The Task Force also inquired whether the NRA plans to develop any specific guidance or requirements for TEPCO for the discharge of ALPS treated water beyond the current regulations and requirements. The Task Force suggested that the NRA should clarify the obligations of the licensee and document the specific approach being followed for the review of the Implementation Plan.

At the end of the first mission, the Task Force requested to receive more information on the process that the NRA will follow to identify potential non-compliance in adhering to discharge limits and operational conditions by TEPCO in the Implementation Plan and what actions the NRA will take in case a non-compliance is identified.

(b) Discussion

After the first mission, NRA responded to the comments and suggestions made during the mission and provided further documents to support their position. The Task Force reviewed the NRA's responses and identified further comments and points for discussion during this mission.

Authorization process

The NRA provided a more detailed explanation to the Task Force of the authorization process in place for the discharge of ALPS treated water. The NRA explained that the requirements placed on TEPCO are listed in the Reactor Regulation Act and the Government Policy for discharge of ALPS treated water, and that operational limits and conditions are set out in the approved Implementation Plan. NRA described the process for checking the operational limits and conditions by inspections and independent monitoring.

The authorization process can be summarized as:

- Requirements are listed in Reactor Regulation Act and the Basic Policy issued by the Government of Japan in April 2021.
- TEPCO writes the Implementation Plan (or revisions thereto) to reflect all relevant regulatory and legal requirements.
- NRA reviews the Implementation Plan and documents its findings in the "Review Results Document"
- Once the revised Implementation Plan is approved (i.e., NRA confirms that the Implementation Plan meets the overarching requirements) then the new version of the Implementation Plan becomes the legally binding document that describes the operational limits and conditions
- NRA performs inspections as part of its routine regulatory oversight processes to ensure that TEPCO complies with the approved Implementation Plan

The Task Force noted that significant changes in any condition that could affect public exposure should be considered during the review of an existing authorization. For the Task Force to confirm that the NRA is meeting this requirement, the Task Force requested that the NRA provide further information about the process it will adopt to review and potentially revise the authorization for discharges in the future after discharges have started. For example, a revision in the authorization could be in response to monitoring data or updates to the REIA performed by TEPCO. NRA explained to the Task Force that TEPCO is required to update the Implementation Plan whenever significant changes are proposed (including any changes to the source term, REIA, monitoring programmes, etc.), and that NRA will then review the revised plan against the requirements in the Reactor Regulation Act and Government Policy for discharge of ALPS treated water. Once the revised Implementation Plan is approved by NRA it will become legally binding.

NRA stated that periodic review of the authorization of discharge will be conducted within the process of optimization of protection related to the decommissioning activities for the whole site, typically once per year.

Establishment of an authorization for discharges

The discharge limit for tritium defined in the Government Policy for discharges of ALPS treated water is 22 TBq per year. NRA explained that it does not intend to set discharge limits for other radionuclides because tritium is the only radionuclide that cannot be sufficiently removed by ALPS treatment to meet existing discharge requirements. All other radionuclides are subject to operational conditions based on concentration limits set in the Reactor Regulation Act along with a requirement that the sum of ratios (i.e., the sum of each radionuclide concentration in the discharge divided by the regulatory concentration limits) needs to be less than one. Contaminated water is treated by ALPS until these operational limits are met. NRA shared calculations with the Task Force that show how the discharge limit for tritium and the operational conditions for other radionuclides work together to control the quantity of other radionuclides being discharged.

The Task Force understands the logic presented by NRA for not setting discharge limits for radionuclides other than tritium but highlighted that they may be required if the discharge limit for tritium is changed in the future as a consequence of optimisation of protection by TEPCO. The NRA agreed with this conclusion. The Task Force encourages the NRA to set explicit discharge limits for radionuclides other than tritium, particularly for those that have a more significant radiological impact when discharged (i.e., I-129 and C-14). The Task Force also noted that if the discharge limit for tritium is increased, operational conditions may need to be revisited for other radionuclides as a consequence of optimization of protection by TEPCO.

The Task Force inquired whether the NRA plans to re-evaluate the discharge limit for tritium in the future, when sufficient operational experience has been gathered. The NRA noted that this is a broader

Governmental decision, to which the NRA would contribute its views from the perspective of nuclear safety.

Inspection and Enforcement

Regarding instances of potential non-compliance, NRA noted that the Reactor Regulation Act states that if operational safety measures performed by TEPCO are not in compliance with the Implementation Plan, the NRA may order TEPCO to take measures necessary for operational safety, including suspension of discharge or alteration of the design on the Discharge Facility. However, it is not clear how NRA will determine the severity of the non-compliance and a proportionate response.

The Task Force observed that limits and conditions in the Implementation Plan are mainly focussed on the hardware (e.g., installed equipment) and actions to be taken if these are not met. However, NRA also highlighted the 'softer' conditions (e.g., conditions associated with management systems, competency, quality management, etc.) that are part of the Implementation Plan and within the Quality Management System in place.

NRA explained that the Implementation Plan describes TEPCO's response to "unusual occurrences", "unusual values" and "significant discrepancies". However, the Task Force noted that some of the action limits for a response or the acceptable tolerances that will be implemented are still to be defined. The Task Force stressed that to the greatest extent possible, limits and tolerances should be set before the start of ALPS treated water discharges. However the Task Force acknowledged that it is not yet possible to define some of the action limits that are related to environmental monitoring because the variation in reported monitoring results have not yet been fully established.

The Task Force understands that NRA is utilising multiple processes to verify TEPCO's compliance with national regulatory requirements.

(c) Summary and Follow Up

The Task Force noted that sufficient information was provided by NRA to clearly explain the authorization process for the ALPS treated water discharge.

The Task Force understood the logic for why the NRA considers it unnecessary to set the discharge limits for the other nuclides at this time. However, the Task Force encouraged NRA to set discharge limits for other radionuclides that have a more significant radiological impact (i.e., I-129 and C-14). This would become particularly important in the event the discharge limit for tritium changes in response to the future optimization of protection of people and the environment for the discharge of ALPS treated water. The Task Force will continue to review the latest information provided by NRA.

The Task Force understands that NRA are utilising multiple processes to verify TEPCO's compliance with national regulatory requirements. The NRA agreed that it will ensure action levels / tolerances are defined, agreed and included in formal documentation where appropriate (e.g., approved Implementation Plan, Inspection Manuals, and documents that include source and environmental monitoring requirements). The Task Force requested that NRA provide a copy of the enforcement procedure/policy and other relevant inspections procedures to highlight how the above-mentioned issues are captured in existing documentation. NRA subsequently provided the requested information for the Task Force's review.

II.C.2 Radiological Environmental Impact Assessment

(a) Overview

In accordance with the authorization process for discharges in GSR Part 3 [3], any organization applying for authorization shall, as required by the regulatory body, have an appropriate prospective assessment

made for radiological environmental impacts, commensurate with the radiation risks associated with the facility or activity.

At the end of the first mission, the NRA explained that there is no requirement to undertake an REIA in the Reactor Regulation Act and that including an REIA for the authorization of the discharge of the ALPS treated water is a special case required by the Basic Policy issued by the Government of Japan in April 2021. The NRA reviewed the REIA submitted by TEPCO and presented to the Task Force the main points raised in the discussions with TEPCO and their requests for clarifications and further work on the REIA. The Task Force noted that the IAEA Safety Standards say that the regulator 'should agree that the methodology adopted is adequate for its proposed purpose' in discussion with the applicant (GSG-9) which NRA has done. However, the Task Force noted that it is good practice for the regulator to undertake or arrange for independent modelling to validate that the applicant's modelling assumptions and outputs are fit for purpose.

The Task Force were informed that the NRA evaluation of the REIA would continue until the final approval of the Implementation Plan. The Task Force suggested that consideration could be given to undertaking independent modelling and sensitivity testing to validate that TEPCO's modelling assumptions and outputs are fit for purpose.

(b) Discussion

Following the suggestion made by the Task Force at the first mission in March 2022, NRA explained that they had undertaken an independent verification of TEPCO's marine dispersion model and they presented the results to the Task Force. NRA also presented details and updates regarding their ongoing (at the time of the mission) review of the November 2022 version of the Implementation Plan and REIA. The Task Force specifically noted that NRA has reviewed TEPCO's approach for calculating activity concentrations in the aquatic environment (TEPCO has used concentration factors in their assessment which is more conservative in the aquatic environment).

(c) Summary and Follow Up

NRA presented the results of their review of the REIA and the independent verification of TEPCO's dispersion model. The Task Force understands that the NRA's evaluation of the revised Implementation Plan and REIA is ongoing and will only be finalized in 2023 consistent with their domestic regulatory processes. Following the mission, NRA provided the Task Force with a copy of the draft review results document published by the NRA on 22 February 2023.

II.C.3 Characterization of the Source Term

(a) Overview

The IAEA safety standards encourage regular dialogue between the regulatory body and the applicant to identify the inventories of radionuclides and the amounts that will be discharged to the environment, in accordance with a graded approach. In accordance with RS-G-1.8 [7], as part of pre-operational studies performed to determine the impacts of the source, including the prediction of doses to the public from discharges to the environment, it is necessary to determine:

- The expected activity inventory and radiation characteristics of the source;
- the types and activities of radionuclides that will be discharged and their physical and chemical forms;
- the methods and routes of discharge; and
- the rates of discharge.

At the end of the first mission, the Task Force agreed with the approach presented by the NRA regarding their plan to require a sufficiently conservative, yet realistic, source term from TEPCO as a basis for a REIA. NRA explained that they had requested TEPCO to reassess the list of 64 radionuclides in the source term (from the earliest versions of the REIA) and they were also planning to independently verify TEPCO's assessment. The Task Force also highlighted the importance of maintaining a strong connection between the characterization of the source term and the design of source and environmental monitoring programmes.

(b) Discussion

During this mission, NRA provided the Task Force with an update on their review of the model used by TEPCO to determine the source term for the REIA based on regulatory concentration limits. NRA provided evidence to the Task Force that, from their perspective, no significant radionuclides have been excluded from the source term. The evidence provided by the NRA included independent calculations of doses associated with the exposure pathways used to set the regulatory concentration limits and exposure pathways considered in the REIA and comparisons of the results of those two calculations. The Task Force discussed with NRA alternative characterization approaches that could be considered for determining the source term, if TEPCO makes further revisions in the future.

(c) Summary and Follow Up

The Task Force acknowledged that NRA has conducted a review to determine that sufficient evidence exists that the source term contains all the radiologically significant radionuclides and that it does not exclude any radionuclides that could be significant contributors to the dose to the public or to flora and fauna in the relevant area(s).

However, the Task Force noted that NRA could request that TEPCO considers using alternative characterization approaches if there are future revisions of the source term, and after operational experience has been gathered. This could address the differences in the exposure pathways considered in the REIA and those considered in setting the regulatory concentration limits.

II.C.4 Occupational Radiation Protection

(a) Overview

The responsibilities of the regulatory body specific to occupational exposure in planned exposure situations are laid out in Requirement 19 and paras 3.69–3.73 of GSR Part 3 [3]. In accordance with GSR Part 3 [3], the regulatory body is required to establish and enforce requirements to ensure that protection and safety is optimized and is required to enforce compliance with the applicable dose limits. Further, the regulatory body is responsible for the establishment and enforcement of requirements for the monitoring, recording and control of occupational exposures in planned exposure situations in accordance with the requirements of GSR Part 3 [3], and for the review of monitoring programmes of registrants and licensees.

Requirement 4 of GSR Part 3 [3] states that: "The person or organization responsible for facilities and activities that give rise to radiation risks shall have the prime responsibility for protection and safety. Other parties shall have specified responsibilities for protection and safety."

Requirement 21 of GSR Part 3 [3] states that: "Employers, registrants and licensees shall be responsible for the protection of workers against occupational exposure. Employers, registrants and licensees shall ensure that protection and safety is optimized and that the dose limits for occupational exposure are not exceeded." In planned exposure situations, employers, registrants and licensees are responsible for ensuring that appropriate radiation protection programmes are established and implemented including organization of radiation protection (management), radiation dose and medical surveillance of occupationally exposed workers (radiation work categories & surveillance), area and zoning based on radiation exposure conditions, work permit, training, procedures and control arrangements.

Requirement 22 of GSR Part 3 [3] states that: "Workers shall fulfil their obligations and carry out their duties for protection and safety." This requirement reflects that workers can by their own actions contribute to the protection and safety of themselves and others at work. For contractors providing specialized services (in the case of ALPS, entire operation is conducted by contractors), legislative arrangements are required for employers to ensure that contractors, including subcontractors, are provided with the necessary information on radiological characteristics of the workplace and the management of facilities should ensure that contractors carrying out work at the facility are using personnel who are competent to carry out the work.

In accordance with the GSR Part 3 [3] and GSG-7 [4], consideration should also be given to the establishment of a national dose registry as a central point for the collection and maintenance of dose records. The storage of information at the national dose registry should be designed to allow workers, during and after their working life, to retrieve information on the doses they received while being occupationally exposed.

In the first mission to NRA, the Task Force received significant information pertaining to occupational radiation protection at the FDNPS, including the role of the NRA in the establishment of dose limits for occupational exposure, and also in the approval of the licensees' conditions of operations as a part of the operational safety programme (including arrangements for monitoring and recording of occupational exposures). The NRA further highlighted that almost the entire area of FDNPS is designated as an 'expanded controlled area', with individual monitoring for workers, and they also presented the criteria for area control ('zoning') that are based on the level of contamination and the protection measures for workers in each area. The NRA confirmed that the relevant instructions for radiation protection and safety are included in TEPCO's Implementation Plan. The Task Force recognized that the legislative arrangements in Japan and the regulations on occupational radiation protection are generally in agreement with the relevant IAEA safety standards. The Task Force also noted that the approach followed by the NRA is consistent with the approach in the IAEA safety standards.

(b) Discussion

Referring to the previous missions to NRA and TEPCO, the Task Force noted that the Implementation Plan approved by NRA ensures that relevant regulatory requirements governing control, monitoring and recording of occupational exposure for ALPS operation and the construction and operation of measurement, dilution, and discharge facilities for ALPS treated water are properly fulfilled at FDNPS.

The NRA presented an overview of the relevant documents and regulations which are the basis for regulatory oversight with regard to occupational radiation protection and regulatory oversight (e.g., through the implementation of investigation levels and recording levels). Two examples of the documents discussed are the NRA Ordinance for Fukushima Daiichi NPS, and NRA Notification for Fukushima Daiichi NPS.

By definition, contractors are considered as occupationally exposed workers within the framework of relevant regulations and covered by the Implementation Plan for FDNPS. The Task Force noted that particular attention should be paid to contractors, including subcontractors, and TEPCO as their employer assumes the primary management responsibility as required by the NRA regulations.

Regarding occupational exposure record keeping, the NRA explained that the Radiation Effects Association (Radiation Dose Registry Center, RADREC) is the registry institution of dose records of radiation workers (i.e., nuclear workers, radioisotope workers, and decontamination workers) as stipulated in the NRA Ordinance for Fukushima Daiichi NPS. The Task Force noted that long term storage of such information in a dose registry has a crucial role for supporting a regulatory authority in their oversight role.

In line with the discussion on the authorization/approval of Individual Monitoring Services and calibration services as described in GSR Part 1 (Rev.1) [2], GSR Part 3 [3], and GSG-7 [4], ISO/IEC 17025 [11] laboratory accreditation is considered satisfactory and arrangements for traceability and verification are required to be in line with the NRA Ordinance.

With regard to optimization, the Task Force noted that the dose constraint is a tool to be established and used in the optimization of protection and safety by the person or organization responsible for a facility or an activity for occupational exposure. The Task Force highlighted the conceptual difference of dose constraints specific to occupational radiation protection where dose constraints are set separately for each source by the operator and serve as boundary conditions in defining the range of options for the purposes of optimization of protection and safety. Based on the Task Force's observations during the previous missions (to both NRA and METI/TEPCO), the Task Force notes that TEPCO implements the concept of optimization of protection and safety by using target values, daily dose follow-up, and work permits related to workplace characteristics (including ALPS activities). The NRA presented an overview of these topics and their review of TEPCO approach, which indicates that the NRA oversees optimization of doses to workers through the application of Implementation Plan.

(c) Summary and Follow Up

The Task Force noted that relevant regulatory arrangements for occupational radiation protection are broadly consistent with the relevant IAEA Safety Standards, in particular GSR Part 3 [3] and GSG-7 [4]. The Task Force confirms that NRA's approach to enforce the occupational exposure control is sufficient for compliance with international safety standards.

The Task Force noted that conducting optimization of protection and safety, as noted in previous conclusions of review missions, would also be expected to benefit occupational radiation protection.

The Task Force notes the complex relationship between TEPCO and the large number of contractors at the FDNPS site, and how this must be considered for the construction, operation, and maintenance of the ALPS system, and associated equipment and facilities for discharges. In this regard, the NRA

highlighted that TEPCO has assumed the responsibility as an employer, for overall protection and safety for contractors. The Task Force requested NRA to provide examples of how TEPCO is required (e.g., through the Implementation Plan) to conduct checks to ensure workers are adequately trained and understand how to implement activities at FDNPS (relevant to the ALPS discharges) in a way that ensures the doses to workers are consistent with expectations. Following the mission, NRA provided additional information to the Task Force. The Task Force will continue to review the latest information provided by NRA.

II.D. Source Monitoring and Environmental Monitoring

II.D.1 Source Monitoring

(a) Overview

Requirement 14 of GSR Part 3 [3] on monitoring for verification of compliance states that "Registrants and licensees and employers shall conduct monitoring to verify compliance with the requirements for protection and safety." Paragraph 3.37 of GSR Part 3 [3] states: "The regulatory body shall establish requirements that monitoring and measurements be performed to verify compliance with the requirements for protection and safety. The regulatory body shall be responsible for review and approval of the monitoring and measurement programmes of registrants and licensees." In accordance with GSR Part 3 [3], all monitoring activities are required to adhere to criteria for quality assurance established by the regulatory body.

The regulatory body is also responsible for the review and approval of monitoring programmes, for ensuring their proper implementation and for recording and making available the results. The regulatory body also needs to periodically perform an independent review of the licensees' or registrants' source (and environmental) monitoring programmes and make provision for independent monitoring.

During the first mission to NRA, the Task Force received information on the source monitoring conducted by TEPCO. The Task Force and the NRA discussed the regulatory requirements for quality assurance for radiation measurements. The Task Force noted that there is a need for a clearly defined and definitive plan for source monitoring before discharges, including sampling and analysis at the measurement and confirmation facility.

NRA responded to the comments and suggestions made during the first mission to NRA and provided further documents to support their position. The Task Force reviewed NRA's responses and identified further comments and points for discussion during this mission.

(b) Discussion

The Task Force discussed with NRA the regulatory requirements placed on TEPCO to perform and report monitoring and measurements, which will be used to verify compliance with regulatory criteria for protection and safety.

During the mission, NRA provided an overview of their plans to conduct independent source monitoring. The NRA will utilize a third-party laboratory to conduct an assessment of samples taken prior to the start of discharges of ALPS treated water and will examine a subset of radionuclides to compare analytical results against TEPCO's results. Additionally, NRA will require that certain radionuclides are analysed for their presence in ALPS treated water (separate from an analytical comparison with TEPCO results) as an additional level of independent assessment. The analytical results prepared for NRA will include the identification of any discrepancies and their potential cause. NRA explained the process for responding to discrepancies between the independent monitoring and TEPCO measurements. The Task Force explained that the information required for a root cause analysis (e.g., quality assurance and control processes, analytical method/instrumentation used) should be defined in advance.

NRA stated that TEPCO has established a quality assurance plan for the analysis of radionuclides and that NRA inspects this and other laboratory and quality manuals. However, it was not clear to the Task Force how these inspections would be undertaken and specifically, which clauses of ISO 9001 [12] and ISO/IEC 17025 [11] are utilised during the inspections. The Task Force noted that there are specific clauses which would provide the NRA with an improved evaluation (e.g., ISO/IEC17025 clause 8.8 internal audits and clause 7.7 ensuring the validity of results). The Task Force requested further clarification on these points.

The Task Force also noted the importance of ensuring homogeneity for sampling under the source monitoring programme and highlighted that NRA should ensure this is considered as part of their routine ongoing oversight of the FDNPS site.

(c) Summary and Follow Up

The Task Force noted that additional information has been provided by the NRA on the plan for independent source monitoring, and the elements that NRA will prioritize in their regulatory oversight role. The Task Force noted that NRA intends to conduct oversight of the quality assurance programmes at FDNPS for analysis work but requested to see a matrix of the clauses in ISO 9001 [12] and ISO/IEC 17025 [11] that are included in inspections under the quality assurance plan. The Task Force also advised that the NRA should ensure that TEPCO establishes a process for the collection of information when a discrepancy is found in monitoring results to enable root cause analysis to be undertaken. Following the mission, NRA provided further information in response to the Task Force's request regarding the NRA's inspection on the quality assurance plan, including how ISO 9001 [12] and ISO/IEC 17025 [11] are utilised. The Task Force will continue to review the latest information provided by NRA.

II.D.2 Environmental Monitoring

(a) Overview

The requirements and recommendations established in the IAEA safety standards for monitoring of discharges are covered in Section D.1 of this report. However, in accordance with GSG-9, specifically for environmental monitoring, the regulatory body should make provision for independent monitoring to verify compliance with the requirements for protection and safety. Such monitoring may be undertaken by the regulatory body or on behalf of the regulatory body by another organization that is independent of the operating organization.

During the first mission, the Task Force welcomed the plans for enhanced environmental monitoring by the Government of Japan that were presented by the NRA. However, the Task Force highlighted that the involvement of TEPCO in the Comprehensive Radiation Monitoring Plan (CRMP)[7] needs to be carefully considered to ensure sufficient checks and balances are in place to demonstrate that independence is maintained. The Task Force also pointed out that, as several organizations are undertaking environmental monitoring activities at reference sampling points, the NRA (or other relevant Government of Japan ministry) needs to define criteria for comparative confirmatory analyses.

(b) Discussion

During the mission, the NRA provided further information regarding the plan for enhanced environmental monitoring, the NRA's role, and the CRMP. The Task Force welcomed a more detailed description of how the results of TEPCO's monitoring will be assessed and compared against those from the organizations independent of TEPCO under the CRMP. NRA's requirements on TEPCO for identifying and resolving discrepancies between TEPCO's monitoring results and those from independent monitoring (CRMP) were also discussed.

The Task Force explained that GSG-9 presents some secondary objectives that can be fulfilled by a monitoring programme, one of which is to check the predictions of environmental models in order to reduce uncertainties in the dose assessment. This can be achieved using data from the environmental

[7] The CRMP is a document published by the Government of Japan and details the Government-wide approach for monitoring the large amount of radioactive materials released into the environment due to the accident at TEPCO's FDNPS in March 2011.

monitoring programme that is collected after the discharge has started. The Task Force noted the importance of better understanding how the results of environmental monitoring will be used by TEPCO and the NRA, particularly with regard to verification and possible refinement of the REIA in the future.

NRA provided an overview of how an expert group (nominated by the Government of Japan) will be utilized to provide advice on details of the environmental monitoring taking place around FDNPS. The expert group will consider both the parameters set regarding location and frequency of environmental sampling and will also be involved in reviewing the data. The Task Force welcomed the involvement of this expert group in the review and implementation of environmental monitoring, however additional details regarding the composition and work of this expert group would be beneficial to the Task Force and the public.

The Task Force also encouraged NRA to consider the impact of the CRMP sampling regime on the environment to ensure there are no significant impacts to the environmental biota as a result of sampling decisions made by the Government of Japan (e.g., sampling should not deplete the native seaweed population at chosen sampling points considering relevant factors such as seasonal growth and baseline availability).

(c) Summary and Follow Up

The Task Force noted the additional information provided by NRA that helped to clarify and further define how the comprehensive environmental monitoring programme, both the existing programme and enhancements in response to the ALPS discharges, will be implemented. The Task Force requested NRA to provide further information about the roles and responsibilities of the expert group mentioned during the mission, how the group will operate and how discrepancies in monitoring data results will be investigated. Additionally, the Task Force noted that NRA should ensure TEPCO establishes a process for the collection of information following a discrepancy in monitoring data results to enable root cause analysis to be undertaken. Following the mission, NRA provided further information in response to the Task Force's request regarding the roles and responsibilities of the expert group as well as its operation. The Task Force will continue to review the latest information provided by NRA.

II.E. Public Consultation and Involvement of Interested Parties

(d) Overview

In accordance with GSR Part 3 [3], the government or the regulatory body are required to provide information to, and engage in consultation with, parties affected by its decisions and, as appropriate, the public and other interested parties. In the IAEA International Safety Standards, the term 'interested parties' is used in a broad sense to mean a person or group having an interest in the activities and performance of an organization. In the context of radioactive discharges to the environment, 'interested parties' typically include individuals or organizations representing members of the public; industry; government agencies or departments whose responsibilities cover public health, nuclear energy and the environment; scientific bodies; the news media; environmental groups; and groups in the population with particular habits that might be affected significantly by the discharges, such as local producers and indigenous peoples living in the vicinity of the facility or activity under consideration.

Paragraph 5.99 of GSG-9 [5] states: "Because the regulatory control of radioactive discharges takes into account both operational and societal aspects, such as radioactive waste management in the facility and the optimization of the level of protection of the public, there are a number of different interested parties whose views should be considered, as appropriate. A process resulting in the granting of an authorization for discharges is likely to necessitate an exchange of information between the regulatory body, the applicant, and other interested parties. Some interested parties may be located in other States, especially in neighbouring States."

In the first mission to NRA, the Task Force noted that the NRA is following an open and transparent approach for communicating with interested parties with regard to the discharge of ALPS treated water. The Task Force also noted that the NRA recognizes that a main concern of interested parties and the Japanese public is the reputational damage caused by the discharge and, as a result, societal acceptance constitutes an important factor in the optimization process. The Task Force emphasized the importance of perception by the public of the NRA as an independent body, and that building public trust is a continuous process that takes time.

(e) Discussion

Between the first mission to NRA, and this mission, no significant questions or concerns were raised by the Task Force regarding public consultations and the involvement of interested parties in regulatory processes. However, during the mission NRA provided an update on how their processes involve the public and steps they've taken since the first mission to NRA in March 2022.

In particular, the NRA highlighted that in their review of the revised Implementation Plan and REIA (submitted originally in November 2021 and subsequently revised), the review meetings are all open to the public, all documents are made available online, and press briefings are held after the public meetings. Additionally, the NRA has provided an explanation in meetings/briefings for the National Diet, local governments, municipalities, press conferences, and international conferences, among others. The Task Force noted global interest in the discharge of ALPS treated water and the importance of providing evidence-based information to demonstrate protection of people and the environment globally.

The NRA provided additional details regarding the public's involvement in the review of the Implementation Plan and REIA, noting how many comments were received and how they were addressed. Recognizing the submission of information is in Japanese, and over 1200 comments were received, the Task Force asked NRA to summarize the main technical or political comments and questions received from the public to see how these were considered and addressed. The NRA was able to provide this additional detail by the end of the week for the Task Force to review during the

mission. Additionally, the NRA noted that for the existing revised Implementation Plan and REIA under review by the NRA, a similar process will be followed involving public comment.

(f) Summary and Follow Up

The Task Force noted the effort by NRA focused on involving the public in the regulatory review process and noted that it will continue to review how public consultations and the involvement of interested parties are handled by NRA as the regulatory process continues. During the mission the Task Force requested that NRA provide a summary of the main comments and questions received from the public during the first regulatory review. NRA provided this information during the mission and the Task Force will review for its awareness.

APPENDIX I. APPLICABLE IAEA INTERNATIONAL SAFETY STANDARDS

This appendix contains a list of the IAEA International Safety Standards applicable to radioactive discharges in the environment.

Topic	Safety Standard	Paragraphs
II.A. Responsibilities and Functions of the Government	GSR-Part 1	2.2, 4.2 Reqs 1, 3, 4, 17
	GSR-Part 3	Req. 13, 3.27, 3.29, 3.31, 3.32, 3.37, 3.69–3.71, 3.73, 3.118–3.124, 3.139,
II.B. Major Principles and Safety Objectives	GSG-Part 3	1.23, 3.22 (a, b, c), 3.26, 3.27, 3.119, 3.120 (a,c,d), 3.121, 3.124, 3.131–3.134 Reqs 11, 12, 29, 31
	GSG-9	5.9, 5.13 (a), 5.15, 5.18 (a,b)
	GSG-10	4.44, 5.38
II.C.1. Regulatory Process	GSR-Part 3	3.9 (a-e) 3.122, 3.127(b)
	GSG-9	5.1, 5.2, 5.5, 5.8, 5.13 (b, c, d, e, f, g), 5.14, 5.31, 5.35, 5.43, 5.59–5.62, 5.66 (a–g), 5.67, 5.68 (a–c), 5.69, 5.73 (a, b), 5.76, 5.99, 5.101
II.C.2. Radiological Environmental Impact Assessment (REIA)	GSR-Part 3	3.122, 3.123(c), 3.124(a), 3.126(a, c, d)
	GSG-10	4.2, 4.4, 5.4, 5.6, 5.15, 5.33, 5.76
II.C.3. Characterization of the Source Term	GSR-Part 3	3.9(c)
	RS-G-1.8	
II.C.4. Occupational Radiation Protection	GSR-Part 3	3.69–3.73, 3.83, 3.88–3.98 Reqs 4, 19, 21, 22, 25, 26, 28
	GSG-7	3.49–3.158, 5.3
II.D.1. Source Monitoring	GSR-Part 3	3.37, 3.135(c), 3.136 Req. 14
	GSG-9	5.74, 5.76, 5.84–5.85
	RS-G-1.8	9.2

II.D.2. Environmental Monitoring	GSR-Part 3	3.37, 3.135 (a, c–f), 3.136, 3.137 Req 32
	GSG-9	5.36, 5.68 (a–c), 5.84
	RS-G-1.8	2.23, 5.25
II.E. Involvement of Interested Parties	GSR-Part 3	3.124(c)
	GSG-9	5.99, 5.101, 5.102

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[1] EUROPEAN ATOMIC ENERGY COMMUNITY, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Fundamental Safety Principles, IAEA Safety Standards Series No. SF-1, IAEA, Vienna (2006).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), IAEA, Vienna (2016).

[3] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, Occupational Radiation Protection, IAEA Safety Standards Series No. GSG-7, IAEA, Vienna (2018).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, UNITED NATIONS ENVIRONMENT PROGRAMME, Regulatory Control of Radioactive Discharges to the Environment, IAEA Safety Standards Series No. GSG-9, IAEA, Vienna (2018).

[6] INTERNATIONAL ATOMIC ENERGY AGENCY, UNITED NATIONS ENVIRONMENT PROGRAMME, Prospective Radiological Environmental Impact Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSG-10, IAEA, Vienna (2018).

[7] INTERNATIONAL ATOMIC ENERGY AGENCY, Environmental and Source Monitoring for Purposes of Radiation Protection, IAEA Safety Standards Series No. RS-G-1.8, IAEA, Vienna (2005).

[8] https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/atw.html

[9] https://www.tepco.co.jp/en/decommision/planaction/alps/index-e.html

[10] https://www.tepco.co.jp/en/decommission/progress/watertreatment/index-e.html

[11] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, INTERNATIONAL ELECTROTECHNICAL COMMISSION, General Requirements for the Competence of Testing and Calibration Laboratories, ISO/IEC 17025:2017, ISO, Geneva (2017).

[12] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Quality Management Systems, ISO 9001:2015, ISO, Geneva (2015)

III. Part III – Annexes

ANNEX I. LIST OF REVIEW TEAM MEMBERS

Task Force Chairman

- Gustavo CARUSO — Director and Coordinator, DDGO-NS

IAEA Secretariat

- Joanne BROWN — Unit Head, NSRW/WES
- Anna CLARK — Section Head, NSRW/WES
- Megan COOK — Research Scientist, IAEA Marine Environment Laboratory
- Eric FREEMAN — Programme Officer, DDGO-NS
- Burcin OKYAR — Radiation Safety Specialist, NSRW/RSM

International Experts

- Michael BOYD — United States of America
- Abel GONZALEZ — Argentina
- Marie-Claude GREGOIRE — Canada
- Candice GUAVIS — Marshall Islands
- Nguyen HAO QUANG — Viet Nam
- Hongsuk KIM — Republic of Korea
- Jean-Luc LACHAUME — France
- Senlin LIU — People's Republic of China
- Jo NETTLETON — United Kingdom
- Sergey SHINKAREV — Russian Federation
- Rick TINKER — Australia

ANNEX II. LIST OF PARTICIPANTS – JAPAN

Nuclear Regulation Authority (NRA)

- Shinsuke YAMANAKA — Chairman
- Nobuhiko BAN — Commissioner
- Yasushi MORISHITA — Deputy Director-General

NRA Office for Accident Measures of Fukushima-Daiichi Nuclear Power Station

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- Takeo KUROKAWA — Nuclear Safety Inspector
- Toru KIMURA — Nuclear Safety Inspector

Ministry of Environment – Water Environment Division, Environmental Management Bureau

- Naohiro MAEDA — Deputy Director
- Mihoko MORI — Section Chief

ANNEX III. MISSION AGENDA

Second Review Mission to NRA

16-20 January 2023

Monday 16 January 2023 (at NRA HQ)	
09:30 – 10:00	Opening Session
10:00 – 10:40	Task Force Presentation – Objectives of this mission
10:40 – 12:30	Updates from the NRA including the July review results
12:30 – 13:30	Lunch
13:30 – 14:30	Topic C1 (focused on pre-service inspections)
14:30 – 17:00	Topic A, Topic B

Tuesday 17 January 2023 (at NRA HQ)	
09:00 – 11:00	Topic B
11:00 – 12:30	Topic C1
12:30 – 13:30	Lunch
13:30 – 15:30	Topic C3
15:30 – 17:00	Topic C2

**Note – on Tuesday 17 January, some members of the review team travelled to FDNPS to observe preserve inspections conducted by NRA.*

Wednesday 18 January 2023 (at NRA HQ)	
09:00 – 11:00	Topic C4
11:00 – 12:30	Topic E

12:30 – 13:30	Lunch
13:30 – 15:30	Topic D1
15:30 – 17:00	Topic D2

Thursday 19 January 2023 (at NRA HQ)	
09:00 – 11:00	Any other business
11:00 – 15:30	Task Force Internal Meeting
15:30 – 17:00	Task Force Presentation to NRA

Friday 20 January 2023 (at NRA HQ)	
09:00 – 11:00	Task Force Internal Meeting
11:00 – 12:30	Wrap Up Meeting
16:00 – 17:00	IAEA Press Conference

- **Topic A – Responsibilities and Functions of the Government**
- **Topic B – Major Principles and Safety Objectives**
- **Topic C1 – Regulatory Process**
- **Topic C2 – REIA**
- **Topic C3 – Characterization of the Source Term**
- **Topic C4 – Occupational Radiation Protection**
- **Topic D1 – Source Monitoring**
- **Topic D2 – Environmental Monitoring**
- **Topic E – Public Consultation and Involvement of Interested Parties**

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA