

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

**Report 2: Review Mission to NRA (March 2022)**



**IAEA**

International Atomic Energy Agency

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

**Report 2: Review Mission to the Nuclear Regulation Authority  
(March 2022)**

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## Executive Summary

The IAEA conducted its first review mission to Japan's Nuclear Regulation Authority (NRA) in 21–25 March 2022. This mission was conducted under the terms of reference for the IAEA's assistance to Japan on the Review of Safety Aspects of Handling 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 the regulatory activities and processes. The mission conducted was the second mission in a series of missions that will be conducted as part of the IAEA review. The review team, coordinated and led by a senior IAEA official, included 16 members. The review team was comprised of international experts who are designated members of the Task Force and experts from the IAEA Secretariat.

Consistent with the request from the Government of Japan, the IAEA Statute 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 international safety standards<sup>1</sup>. 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. This mission was conducted focusing on the specific approach outlined in the Basic Policy, controlled discharge to the sea.

To implement this approach, the NRA conducts the regulatory review of TEPCO's proposed amendments to the Implementation Plan (i.e. TEPCO's regulatory authorization to conduct decommissioning activities). 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

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<sup>1</sup> 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.

In preparation for this mission, the NRA provided the Task Force with a self-evaluation of their activities against the requirements and recommendations established in the IAEA safety standards that are applicable to the regulatory body for the regulatory control of radioactive discharges to the environment. The Task Force recognized that the NRA are using the IAEA safety standards in their domestic regulatory review. Additionally, presentations were provided to the review team for each technical area to summarize the information provided in the reference materials and discussions were held between the review team and the NRA. 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 NRA provided additional 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 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 stressed the importance of fully documenting the process that the NRA is using to authorize the discharge of ALPS treated water along with the criteria that the NRA are using to approve the authorization of the discharges and the conditions placed on TEPCO in this authorization. NRA will further develop its detailed approach and the criteria used within the regulatory review as construction and on-going inspections progress.
- The Task Force noted the involvement of the NRA in Japan's current Comprehensive Radiation Monitoring Plan for environmental monitoring and specifically how this supports the requirement for independent monitoring by the regulatory body. The Task Force highlighted the importance of maintaining a strong connection between the characterization of the source term and the design of source and environmental monitoring programmes, as well as linking the environmental monitoring programme to the results of the REIA. The Task Force noted the importance of establishing and communicating a clearly defined plan for source monitoring.
- 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 the 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 noted significant progress from the review mission and highlighted the cooperation with the NRA during the discussions. As the authorization process is still in progress, the Task Force will continue its thorough review.

A second mission to the NRA is currently planned to occur before the start of the water discharge. This second mission will provide an opportunity to follow up on the NRA's review for the authorization of the discharge of ALPS treated water, which will help the Task Force to prepare its conclusions on the regulatory process.

This mission report reflects the discussions between the Task Force and the NRA 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. Prior to the discharge of the ALPS treated water starting, the IAEA will issue a full report containing the combined conclusions of the Task Force across all aspects of the IAEA's review. This full report will include the final findings and conclusions of the Task Force.

# **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 international safety standards<sup>2</sup>. The IAEA welcomed and 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 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)<sup>3</sup> and will look at the

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<sup>2</sup> 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.

<sup>3</sup> 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 also 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 as needed; these activities will include independent third-party laboratories, when possible, to ensure that an inclusive and transparent approach is adopted.

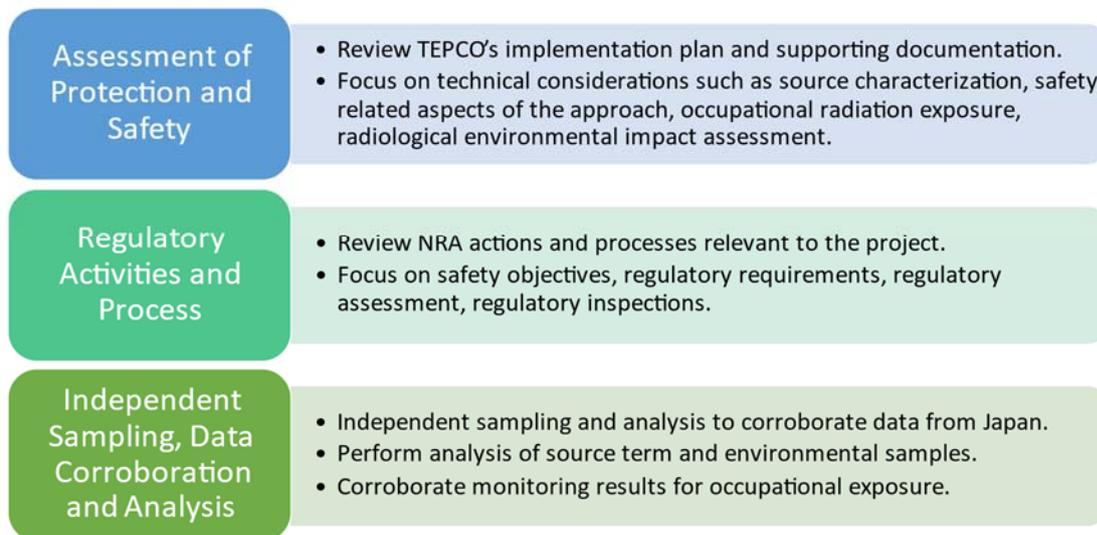
With regard to the regulatory activities and processes, the Task Force will review the process implemented by the NRA for the authorization of the discharge of ALPS treated water from FDNPS, including the approach and criteria followed by the NRA in their review of TEPCO’s REIA and Implementation Plan, 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 engage 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, 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 approximately two months after each review mission. These reports, written and approved 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. Prior to the discharge of the ALPS treated water starting, the IAEA will issue a full report containing the collected conclusions of the Task Force across all aspects of the IAEA’s review. This full report will include the final conclusions and findings of the Task Force.

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.<sup>4</sup>

### Components of the IAEA’s review



**Fig. I-1. Three components of the IAEA’s review of ALPS treated water discharge.**

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<sup>4</sup> <https://www.iaea.org/topics/response/fukushima-daiichi-nuclear-accident/fukushima-daiichi-treated-water-discharge>

## **I.2. Application and Description of Relevant IAEA 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 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 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.

### **The IAEA Safety Standards**



**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 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 acknowledged that the domestic regulatory review of the proposed approach is still ongoing within Japan. The IAEA conducted this review mission to the NRA in 21-25 March 2022. The review team comprised officially designated international experts who are members of the Task Force and experts from the IAEA Secretariat (see Annex I). The mission formed part of the IAEA review component relating to the Regulatory Activities and Processes and included discussions with officials and experts from the NRA.

The review team held discussions with officials of the NRA (see Annex II) at the NRA headquarters in Tokyo, Japan.

Prior to the mission, the Task Force agreed with the NRA on a structure to ensure key technical topics were adequately covered and organized (see Annex III). 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

When necessary, documentation and explanations to address comments on the regulatory process were requested and reviewed to provide a holistic understanding for the Task Force.

To support the IAEA review, the NRA provided the Task Force with a self-evaluation of their activities against the requirements and recommendations established in the IAEA international safety standards that are applicable to NRA's review of the discharge of ALPS treated water. In addition, during the mission, the NRA provided presentations for each technical area to summarize the information provided in the reference materials and to provide additional explanations on complex topics.

The mission was organized around the five main technical topics that had been previously agreed with the NRA (see list of topics above). For each technical topic, the NRA provided an overview presentation that summarized the information included in the reference materials and additional clarifications on issues that the Task Force had previously identified. The review team and the NRA then engaged in an open discussion to further a shared understanding of how the actions taken by the NRA comply with the IAEA international safety standards. At the end of the week, the review team summarized the initial observations from the review mission in a brief presentation for the 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.

A second mission to the NRA is currently planned to occur before the start of the water discharge. This second mission will provide an opportunity to follow up on the NRA's review for the authorization of the discharge of ALPS treated water. This second mission will also cover the inspections planned to be conducted by the NRA after the approval of the Implementation Plan, including pre-service inspections, periodic facility inspections and operational safety inspections.

## 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 Fukushima Daiichi NPS, based on the ALPS Subcommittee report 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, 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. The details of the proposed discharge approach are currently under regulatory review by the NRA and therefore may change based on the results of the domestic review.

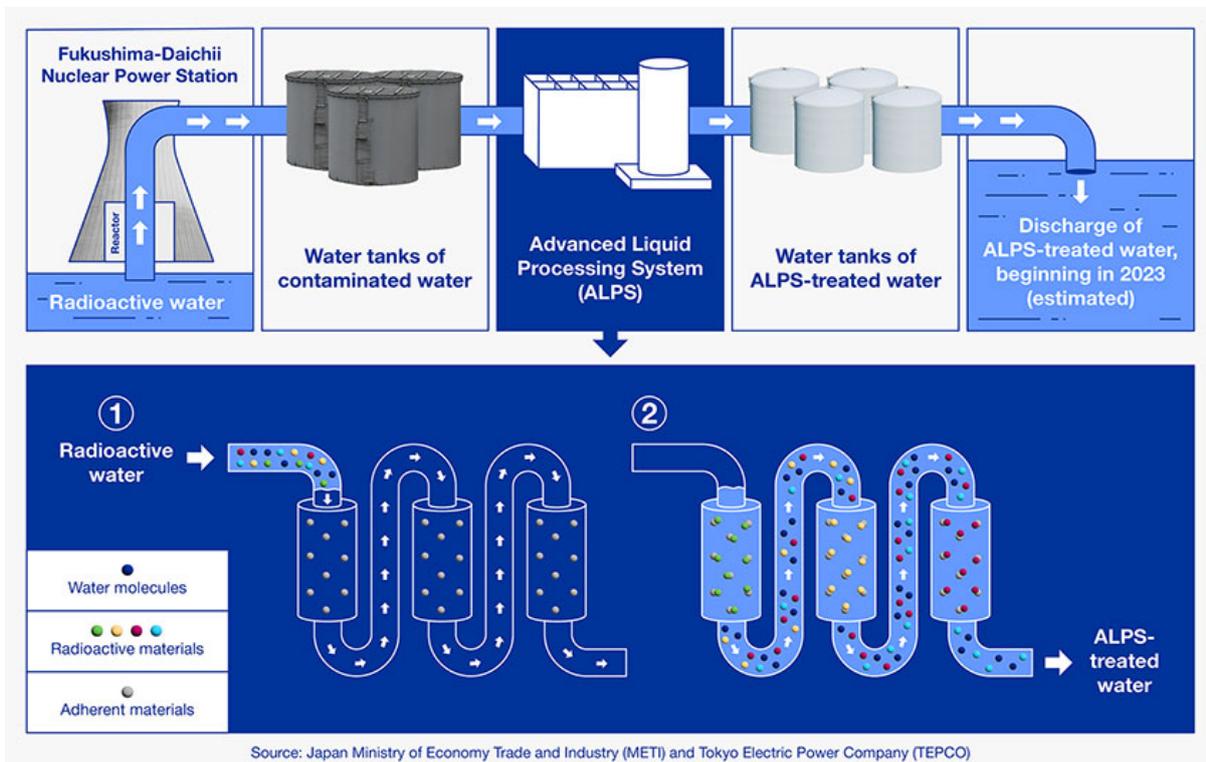


Fig. I-3. Overview of the ALPS treated water discharge system.

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. 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. 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 bounded horizontal 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 in Refs [8–9].



**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.

Paragraph 2.2 of GSR Part 1 (Rev. 1) [2] states:

“The government establishes national policy for safety by means of different instruments, statutes and laws. Typically, the regulatory body, as designated by the government, is charged with the implementation of policies by means of a regulatory programme and a strategy set forth in its regulations or in national standards. The government determines the specific functions of the regulatory body and the allocation of responsibilities. For example, the government establishes laws and adopts policies pertaining to safety, whereas the regulatory body develops strategies and promulgates regulations in implementation of such laws and policies. In addition, the government establishes laws and adopts policies specifying the responsibilities and functions of different governmental entities in respect of safety and emergency preparedness and response, whereas the regulatory body establishes a system to provide effective coordination.”

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.

### (b) Discussion

The NRA provided a presentation that covered two main topics: responsibilities and functions of the NRA, and coordination of different Japanese authorities for the ALPS treated water discharge. The NRA provided additional information on the establishment and organization of the NRA as the regulatory body, after the accident at FDNPS. The NRA noted the importance that they place on transparency, holding meetings open to the public and involvement of interested parties in the regulatory process. The NRA provided an overview of the legal structure for safety, which includes the Atomic Energy Basic Act, the Reactor Regulation Act, cabinet orders, NRA ordinances, regulatory guides and technical documents, when appropriate. The NRA also highlighted the unique legal and regulatory framework that pertains to FDNPS and its status as a ‘Specified Nuclear Facility’ under the Reactor Regulation Act.

The Task Force noted its appreciation for this overview and highlighted that a deeper understanding of the legal and regulatory framework is important for it to conduct its safety review. The Task Force

inquired about how the current legal and regulatory framework covers relevant international treaties and conventions, the IAEA safety standards and other international legal instruments. The NRA noted that the existing framework incorporates relevant requirements for Japan and the NRA is responsible for implementing these provisions and ensuring that the licensees meet the legal requirements.

The Task Force also inquired whether specific regulatory guides and technical documents had been established to cover the ALPS treated water handling and discharge. The NRA noted that no specific regulatory guidance had been issued, however, as the NRA conducts the regulatory review for the ALPS treated water discharge, they plan to clarify appropriate guidance as necessary for the long-term implementation of the proposed discharge.

With regard to the regulatory review, the NRA noted that FDNPS presents a unique situation that cannot be managed using a traditional regulatory approach such as the establishment of specific review criteria. Therefore, the NRA explained that they follow a less prescriptive approach, where TEPCO formulates the implementation plan and the NRA reviews it against the specific regulatory requirements established by the NRA upon the designation of FDNPS as a Specified Nuclear Facility in 2012. The NRA provided as an example the fact that even though there are no existing explicit requirements or guidance for the conduct of an REIA by licensees and for the application of a dose constraint, the NRA decided to review the REIA conducted by TEPCO to ensure that TEPCO's plan is in line with the Basic Policy. The NRA reinforced that the ALPS discharge is only part of TEPCO's overall implementation plan and the overall risk mitigation for the FDNPS site needs to be considered as part of the regulatory approach. The Task Force noted that the NRA used existing regulations and laws to review TEPCO's implementation plan and explained how the provisions apply in this particular case.

The NRA provided an overview of how the ALPS treated water discharge is coordinated across the Government of Japan and with different competent authorities and agencies from a legal, policy making and technical perspective. The NRA noted that decision making for handling ALPS treated water issues is handled in a coordinated fashion through the Inter-Ministerial Council for Contaminated Water, Treated Water and Decommissioning Issues. This council includes representatives from different ministries including METI, Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Environment (MOE), Ministry of Education, Culture, Sports, Science and Technology (MEXT), while the NRA Chairman attends to provide technical and scientific advice to the council, but not to participate in decision making. The NRA further described the role of the council as the entity that facilitated the decision on the Basic Policy and how it will be implemented. The Task Force noted that the NRA, as the regulatory body, is responsible for safety and maintains their independent role consistent with the IAEA international safety standards. The NRA added that they involve technical support organizations, such as the Japan Atomic Energy Agency (JAEA), for the conduct of independent technical analyses of water samples.

The NRA also described how the Government of Japan coordinates to manage the off-site monitoring around FDNPS through the Comprehensive Radiation Monitoring Plan, which includes relevant ministries, local governments, the NRA, TEPCO and technical support organizations. This topic is covered in more detail in Section D.2 of this report.

The Task Force inquired further about the establishment of the Basic Policy, and the involvement of NRA in the process, and whether the Basic Policy is consistent with the NRA safety regulations. The NRA explained that their role is to ensure that the Basic Policy is implemented in accordance with national laws and regulations and to assess whether TEPCO's REIA is appropriately conducted in line with the relevant IAEA safety standards. The NRA stressed that the discharge of ALPS treated water is a unique situation, and a broader perspective of different agencies and authorities is important. For example, the NRA noted that the annual discharge limit for tritium (22 TBq/year) was selected due to broader societal concerns, not because of a fixed regulatory requirement; however, this limit will ultimately form part of the Implementation Plan and therefore the NRA will include it as part of their

regulatory review. The Task Force highlighted this as an example of how optimization was conducted, taking into account societal considerations.

**(c) Summary and Follow Up**

The NRA provided additional 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 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 NRA presented the relevant regulations applicable to the proposed ALPS discharge. The NRA also 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 noted that these additional clarifications and explanations helped the Task Force establish an understanding of the approach followed by the Government of Japan with regard to the proposed ALPS discharge. The Task Force did not identify any items for further discussion or resolution in this technical topic.

## II.B. Major Principles and Safety Objectives

### (a) Overview

Paragraph 3.119 of GSR Part 3 [3] specifies that “The government or the regulatory body shall establish and enforce requirements for the optimization of protection and safety for situations in which individuals are or could be subject to public exposure.” Paragraph 3.120 of GSR Part 3 [3] states that “The government or the regulatory body shall 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.”

Paragraph 3.22(c) of GSR Part 3 [3] states that “The government or the regulatory body: ...Shall establish or approve constraints...on dose...or shall establish or approve a process for establishing such constraints, to be used in the optimization of protection and safety.”

Requirement 11 of GSR Part 3 [3] states that “**The government or the regulatory body shall establish and enforce requirements for the optimization of protection and safety, and registrants and licensees shall ensure that protection and safety is optimized.**”

Requirement 31 of GSR Part 3 [3] on radioactive waste and discharges states that “**Relevant parties shall ensure that radioactive waste and discharges of radioactive material to the environment are managed in accordance with the authorization.**”

Dose limits and dose constraints are established for the doses received by the public due to the authorized releases of discharges. Dose constraints are used for optimization of protection and safety, the intended outcome of which is that all exposures are controlled to levels that are as low as reasonably achievable, economic, societal and environmental factors being taken into account. Dose constraints are set separately for each source under control and they serve as boundary conditions in defining the range of options for the purposes of optimization of protection and safety.

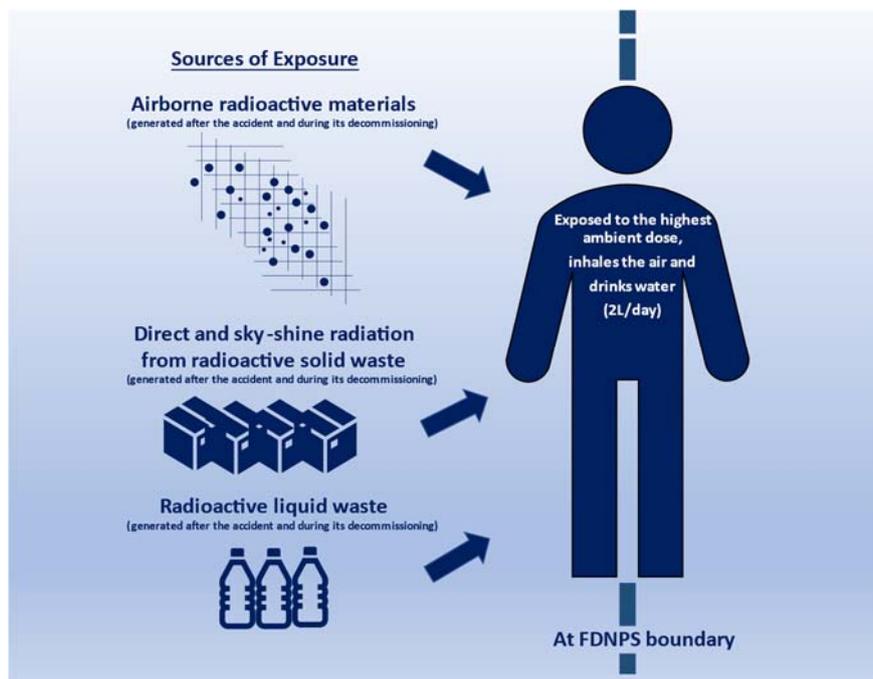
For public exposure in planned exposure situations, the government or the regulatory body ensures the establishment or approval of dose constraints, taking into account the characteristics of the site and of the facility or activity, the scenarios for exposure and the views of interested parties. After exposures have occurred, the dose constraint may be used as a benchmark for assessing the suitability of the optimized strategy for protection and safety (referred to as the protection strategy) that has been implemented and for making adjustments as necessary. The setting of the dose constraint needs to be considered in conjunction with other health and safety provisions and the technology available.

The regulatory body establishes discharge limits for facilities and activities to control the exposures to the public and ensure that protection of members of the public is optimized from the radiation protection perspective. The discharge limits also protect the environment from the effects of ionizing radiation. GSR Part 3 [3] establishes requirements and GSG-9 [5] provides recommendations on the regulatory control and authorization of discharges for both the regulatory body (NRA) and the licensee (TEPCO). In the context of this mission, the Task Force reviewed the application of these requirements by the regulatory body (NRA).

### (b) Discussion

The NRA presented the regulatory framework for the management of FDNPS as a Specified Nuclear Facility, designated under the Reactor Regulation Act, as well as the relevant regulatory requirements. The NRA noted that the decommissioning of the FDNPS is managed as an existing exposure situation. The discharge of ALPS treated water is conducted within this framework of regulation for FDNPS but, in addition to the Reactor Regulation Act, the NRA has decided to review the ALPS treated water discharge as a planned exposure situation considering that the controlled discharge will occur under planned and authorized conditions and considering any potential impacts that the discharge of ALPS treated water might have beyond the site. The regulatory aspects for the authorization of the discharge

of ALPS treated water and the NRA review of the application for authorization by TEPCO are presented in further detail in Section C.1.



**Fig. II-1: Illustration of the concept of the dose criterion for a hypothetical person at the FDNPS boundary.**

The NRA explained that for managing the radiological impact of FDNPS, TEPCO had optimized the protection associated with the decommissioning activities and TEPCO had used the ‘additional effective dose’ at the site boundary to check whether they comply with the set dose criterion of 1 mSv/y at the boundary of the FDNPS (equivalent to the dose limit for the public during normal operation). The NRA continued that the ‘additional effective dose’ is not assessed for the representative person (as defined in the IAEA safety standards), but for a theoretical extreme situation where a person is constantly exposed to the highest ambient dose, inhales the air and drinks water (about 2 L/d) containing radioactive material with the highest concentration of radioactive effluents generated after the accident and from decommissioning activities (see Fig. II-1). The Task Force noted that this approach is extremely conservative with regard to the estimation of doses.

The NRA provided a detailed explanation on the establishment of a criterion equivalent to a dose constraint for protection of the public for the ALPS treated water discharge. Recognizing the practical range for dose constraints provided in GSG-9 [5] (i.e. from 0.1 to less than 1 mSv in a year), the NRA has chosen a criterion of 50  $\mu$ Sv/y, which is below but broadly comparable with the range of values provided in GSG-9 [5] and which the NRA regards as the equivalent of a dose constraint. The NRA continued that it views this dose constraint as appropriate, taking into account the fact that the decommissioning work will continue for many years and there might be some activities in the future that could potentially have a radiological impact outside the area of FDNPS. The NRA stated that the dose constraint is being used to review the results of the REIA included in the application submitted by TEPCO for authorization of the ALPS treated water discharge.

The Task Force noted that the approach followed by the NRA for the establishment of the dose criterion of 50 $\mu$ Sv/y is equivalent to a dose constraint and is in accordance with the recommendations provided in GSG-9 [5], including the fact that the establishment of this criterion also takes into account societal

considerations. The Task Force also noted that putting the dose constraint for the ALPS treated water discharge under the whole framework for decommissioning at the site is a reasonable approach.

The Task Force commented on the approach followed for the protection of the public, using the concept of the additional effective dose to a hypothetical person at the site fence. The Task Force noted that typically the assessment of doses to the public would be made using the representative person and not for a theoretical extreme situation, which is not realistic. The NRA clarified that the assessment of doses to the representative person is undertaken by TEPCO in the REIA. Both approaches make some conservative assumptions, although different ones, and have been used by TEPCO to ensure that both established domestic requirements and relevant international requirements are satisfied.

The Task Force recognized that two different approaches are used – one for the representative person (against the dose constraint of 50  $\mu\text{Sv}/\text{y}$ ) and one for a hypothetical person at the site boundary (against the dose criterion of the additional effective dose of 1  $\text{mSv}/\text{y}$ ) – and that the estimated dose from the ALPS discharge is different for each approach. The Task Force noted that further explanations on how these two approaches are used would help to avoid potential confusion or misinterpretation of the results. The Task Force noted that TEPCO estimates that the ALPS treated water discharge would contribute 0.035  $\text{mSv}$  per year to the effective dose at the site boundary. The Task Force noted to the NRA the importance of clearly explaining this highly conservative estimate to avoid confusion with the dose constraint of 50  $\mu\text{Sv}/\text{y}$  for the protection of the public for the proposed ALPS discharge.

The Task Force noted that when managing planned exposure situations from a radiation protection perspective it is not uncommon to begin with a worst case scenario to scope the possible impact, but, as more information and data become available, this scenario can be refined to develop a more realistic scenario. The Task Force suggested that the NRA might want to consider this as the NRA is reviewing the methodology used by TEPCO.

The NRA also explained the establishment of the annual discharge limits for tritium. The NRA stated that in the report of the Subcommittee on Handling of the ALPS Treated Water published in February 2020 (before the Government Basic Policy was decided) and in the decision regarding the discharge of ALPS treated water (e.g. duration, amount of discharges, timing of commencement of the discharge), the following factors were taken into consideration:

- The progress of future decommissioning work (including the necessity of freeing up land for building new facilities and the limitation of the additional tank installation);
- The risks associated with the storage of large quantities of liquid waste;
- The radioactive decay of tritium contained in the ALPS treated water;
- The societal impact (e.g. reputational harm to local communities and the fishing industry).

The NRA noted that societal impact and public acceptance were the key factors taken into account in the optimization process regarding the discharge limit for tritium that was stipulated by the Government in the Basic Policy.

As part of the regulatory review, the NRA requested TEPCO to explain the role of the discharge of ALPS treated water in the overall programme of decommissioning as well as the expected contribution of the discharge facility in reducing risks at FDNPS as a whole. This would consider perspectives such as the necessity of new equipment installation, the risk of leakage associated with storage, and human resource allocation.

The NRA noted that TEPCO, as the licensee, included the value of 22  $\text{TBq}/\text{y}$  as the annual discharge limit for tritium in their Implementation Plan, in compliance with the Government Basic Policy. The NRA will review whether the radiological impact assessment resulting from an annual discharge amount of tritium equivalent to 22  $\text{TBq}/\text{y}$  is appropriate before giving a judgement on the approval of TEPCO's Implementation Plan. After the approval is granted, TEPCO will be required to comply with the approved Implementation Plan.

The Task Force asked whether the discharge of 22 TBq/y of tritium would be expected to result in a dose of 50 $\mu$ Sv/y to the representative person and how this value would affect the overall decommissioning progress. The NRA explained that the discharge limits for tritium (annual limit of 22 TBq/y and concentration limit of 1,500 Bq/L) were decided by the Government taking into account the report of the Subcommittee. The Task Force summarized the process for establishing discharge limits in accordance with GSG-9 [5] and explained that a dose constraint represents a boundary value (i.e. a value below which optimization is conducted). The NRA noted that under the prevailing circumstances, TEPCO has selected the optimal discharge value. The Task Force suggested that the NRA describe the methodology they applied to assess this discharge value in a clear manner to better communicate their approach.

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, and taking into account optimization and other available techniques for discharge. The Task Force also suggested that the NRA provide a clear explanation on the selection of the discharge limits for radionuclides other than tritium and how the 'sum of the ratios' methodology will be used in practice to ensure that the levels of the radionuclides other than tritium is confirmed to be less than 1. The Task Force also noted that they would be interested to receive more explanations on the role of dilution in this methodology for the discharges of other radionuclides.

The NRA explained that they had discussed with TEPCO the required assessment for setting the discharge limit and agreed to provide more information to the Task Force on the approaches used. The NRA also explained how TEPCO set the operational conditions for implementing the discharge of ALPS treated water. In accordance with the information provided to the NRA by TEPCO, the NRA explained that the sum of the ratios of the radionuclides other than tritium to each concentration limit stipulated in the Japanese regulation is less than 1 in ALPS treated water. The NRA continued that ALPS treated water will be diluted with seawater (more than 100 times), prior to final discharge into the sea, so that the tritium concentration of the water being discharged into the sea is below 1,500 Bq/L. This value is the operational limit of the concentration of tritium for discharges from the FDNPS, as stated in the Basic Policy. The NRA also noted that in the revision of the Implementation Plan, they had agreed that TEPCO will include the definition of operational limits and conditions that will be used to check whether the discharge limits are met.

The NRA explained that before the discharge starts, as part of their inspections, they will be checking to ensure that TEPCO meets the defined discharge conditions, including the operational limits and conditions, and that if these authorized limits are exceeded or if the operational limits and conditions are not met, TEPCO will suspend the discharge immediately, in accordance with the Implementation Plan. Further, in accordance with the Reactor Regulation Act (Article 64-3-6), if TEPCO is not following the operational safety measures 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 of the discharge facility.

The Task Force also inquired whether modelling over the entire discharge period had been conducted to understand the long-term behaviour of radionuclides in the environment and how the dose to the representative person might evolve over time (especially with regard to the review of the REIA by the NRA). The NRA explained that TEPCO, who is in the progress of reviewing the assessment done in the REIA to cover dose commitment from discharges over the proposed period, is taking into consideration the long-term behaviour of the radionuclides in the basic assumptions used in the assessment.

The Task Force noted that no specific guidance or requirements to the discharge had been developed by the NRA, given the unique situation and the timeframe. The Task Force suggested that the NRA could clarify the obligations of the licensee, specifically noting technical limits and operational criteria imposed by the NRA, and could document the specific process that is being followed for the review of

TEPCO's implementation plan, noting that this will be valuable in explaining the process being adopted to interested parties and the international community.

**(c) Summary and Follow Up**

The NRA explained that they will manage the ALPS treated water discharge as a planned exposure situation, while the overall site decommissioning programme is managed as an existing exposure situation. The NRA provided a detailed description on the establishment of a criterion equivalent to a dose constraint for protection of the public for ALPS treated water discharge in accordance with GSG-9 [5].

The Task Force inquired whether the NRA plans to develop any specific guidance or requirements for TEPCO on the discharge of ALPS treated water beyond the current regulations and what is required in the Implementation Plan. The Task Force suggested that the NRA clarify the obligations of the licensee and document the specific approaches that are being followed for the review. The NRA noted that they had discussed with TEPCO, through the periodic review meetings the required assessment for setting the discharge limit and the NRA agreed to provide more information to the Task Force on the approaches used.

The Task Force noted that it is important for the NRA to clearly explain the approach followed for calculating the dose to a person at the site boundary under conservative assumptions and the more broadly utilized approach of assessing the dose from the discharges to the representative person. The Task Force continued that it would be of interest how these two approaches are viewed in the context of assessing compliance with the dose constraint that is being used for the ALPS treated water discharge.

The Task Force explained 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 respective amount estimated using the dose constraint, over the entire discharge period. 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.

## **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.

For facilities or activities that might present potentially higher radiation risks, it may be appropriate for the regulation of the releases from such facilities or activities to be managed by means of an authorization (registration or licensing, as relevant) that establishes stringent technical and regulatory conditions, including for the adequate management and control of these discharges and their radiological consequences. In accordance with the requirements established in GSR Part 3 [3], discharges are required to be properly managed by the licensee in order to ensure the optimized protection of the public and the environment.

Paragraph 3.132 of GSR Part 3 [3] states that:

“Registrants and licensees, in cooperation with suppliers, in applying for an authorization for discharges, as appropriate:

- (a) Shall determine the characteristics and activity of the material to be discharged, and the possible points and methods of discharge;
- (b) Shall determine by an appropriate pre-operational study all significant exposure pathways by which discharged radionuclides could give rise to exposure of members of the public;
- (c) Shall assess the doses to the representative person due to the planned discharges;
- (d) Shall consider the radiological environmental impacts in an integrated manner with features of the system of protection and safety, as required by the regulatory body;
- (e) Shall submit to the regulatory body the findings of (a)–(d) above as an input to the establishment by the regulatory body, in accordance with para. 3.123, of authorized limits on discharges and conditions for their implementation.”

Authorization is defined in GSR Part 3 [3] as “The granting by a regulatory body or other governmental body of written permission for a person or organization... to conduct specified activities.” The control of discharges is one important aspect to be addressed within the authorization process for a facility or activity and at different stages throughout the lifetime of the facility or activity. Authorization applies to practices for which exemption cannot be granted and notification is not sufficient.

The regulatory body establishes discharge limits for facilities and activities to control the exposures to the public and ensure that protection of members of the public is optimized from the radiation protection perspective. The discharge limits also protect the environment from the effects of ionizing radiation. This approach is based on the conclusion that the environment is protected by means of the conditions under which the practice is authorized. Some Member States consider that, in addition to the optimization of the protection of the public, there may be a need to assess more explicitly the protection of the environment, including, for instance, estimation of the impact of radiation exposure on populations of flora and fauna.

Paragraph 3.123 of GSR Part 3 [3] establishes specific requirements relating to the control of discharges as follows:

“The regulatory body shall establish or approve operational limits and conditions relating to public exposure, including authorized limits for discharges. These operational limits and conditions:

- (a) Shall be used by registrants and licensees as the criteria for demonstration of compliance after the commencement of operation of a source;
- (b) Shall correspond to doses below the dose limits with account taken of the results of optimization of protection and safety;
- (c) Shall reflect good practice in the operation of similar facilities or activities;
- (d) Shall allow for operational flexibility;
- (e) Shall take into account the results of the prospective assessment for radiological environmental impacts that is undertaken in accordance with requirements of the regulatory body”.

GSR Part 3 [3] establishes requirements and GSG-9 [5] provides recommendations on the regulatory control and authorization of discharges for both the regulatory body (NRA) and the licensee (TEPCO). In the context of this mission, the Task Force reviewed the application of these requirements by the regulatory body (NRA). Appendix I presents the applicable requirements and recommendations that were taken into consideration by the Task Force during their review of the regulatory control and authorization of discharges.

Paragraph 5.13 of GSG-9 [5] provides recommendations on the steps of the authorization process for setting discharge limits and fig. 3 of GSG-9 [5] identifies the actions of the regulatory body (reproduced in Fig. II–2). The steps of the authorization process with actions on the regulatory body in Figure II–2 can be summarized as follows:

- The regulatory body specifies the relevant dose constraint for the facility or activity under consideration (see Section B).
- Following the submission of the REIA by the applicant to the regulatory body, the regulatory body evaluates whether the models and assumptions used by the applicant are appropriate, compares the results of the assessment with dose limits and dose constraints, and evaluates whether the assessed doses are in accordance with the need to provide optimized protection of the public (see Section C.2).
- The regulatory body sets the discharge limits and establishes conditions by which compliance during operation is to be demonstrated, including by means of source monitoring and environmental monitoring systems and programmes.
- The regulatory body issues an authorization for discharges upon its satisfaction that the models and assumptions are valid and that the doses will not be higher than the optimized levels.

GSG-9 [5] states that:

“5.59. The authorization for discharges should take the form of written permission from the regulatory body. ...

“5.60. The regulatory body should record formally the basis for its decision on an authorization for discharges, or on the amendment, renewal, suspension or revocation of the authorization for discharges, and should inform the applicant, in a timely manner, of its decision, including the reasons and justification.”

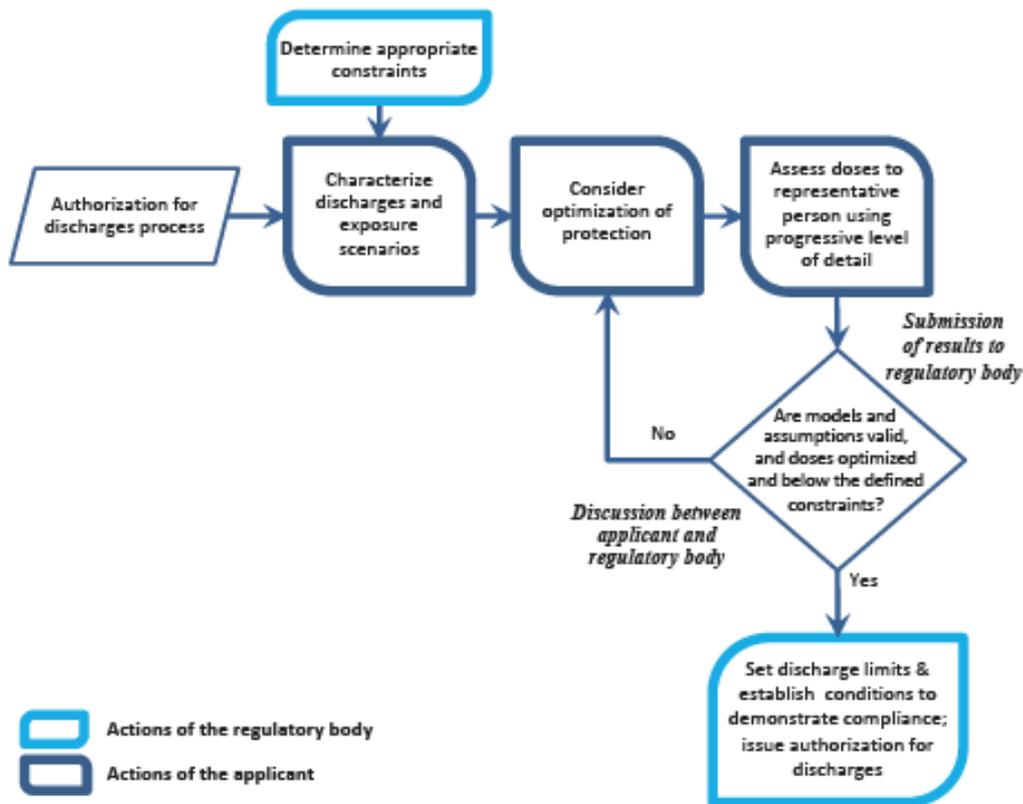


Fig. II-2: Steps in setting discharge limits, indicating those responsible (fig. 3 of GSG-9 [5]).

**(b) Discussion**

**Authorization Process**

The NRA explained to the Task Force that the authorization of the discharge of ALPS treated water will include the approval of TEPCO’s Implementation Plan for managing the safety of all the activities at the FDNPS. The Task Force noted that for this unique approach, the NRA used in their regulatory review the Reactor Regulation Act and the Basic Policy.

In accordance with the process for amending the Implementation Plan for FDNPS, TEPCO submits the proposed amendments to the NRA, which grants the relevant authorization following the regulatory review. The NRA presented the regulatory process for the review and approval of the Implementation Plan with regard to the installation and operation of the discharge facility for ALPS treated water prior to the start of discharges, which is used to assess whether TEPCO fulfils the applicable legal and regulatory requirements established under the Reactor Regulation Act (see Fig. II-3). The relevant regulatory requirements are shown in Table II.1. Fig. II-3 is based on material presented by the NRA during the mission.

The NRA explained further that the Implementation Plan had been adapted by TEPCO to include the overall process for the handling of ALPS treated water, the design of the ALPS related facilities and the relevant structures, systems and components, the operational safety measures for the ALPS treated water discharge within the context of safety for the whole FDNPS site and the measures to achieve the goals set in the Basic Policy, including the conduct of an REIA.



**Fig. II-3: Schematic representation of the authorization process.**

The NRA explained that the process followed for the approval of the Implementation Plan is iterative and flexible to determine whether TEPCO’s operational conditions for the discharge of the ALPS treated water are appropriate. The Task Force noted that the Implementation Plan will continue to be developed, updated and reviewed, as necessary, before final approval is granted by the NRA, through the completion of pre-service inspections, for the discharges to start. The NRA agreed with the Task Force to fully document the process that they are implementing to authorize the discharge of ALPS treated water under the Reactor Regulation Act as well as the criteria that the NRA are using to approve the authorization of the discharges and the process for identifying the conditions that they will place on TEPCO for the authorization.

The Task Force highlighted that because of the tailored and iterative approach being taken, the detailed approach for the regulatory review and the criteria used within this review will also develop up to the final approval of the operation as the construction proceeds and on-going inspections are conducted. The Task Force noted that the NRA will need to continue reviewing future versions of the Implementation Plan as it is further developed prior to the start of discharge.

The timeline for the review of the Implementation Plan by the NRA prior to its approval was described by the NRA. The NRA stated that they intend to approve the Implementation Plan before construction of the ALPS discharge facility is started as the revised source term (see Sections II.C2 and II.C3) is not expected to impact the approval based on the initial REIA. The NRA continued that the revised source term and subsequent revised results of the REIA will be reviewed when they are submitted by TEPCO to the NRA. As the approval for the construction will be given by the NRA before TEPCO has completed the revision of the characterization of the source term, the Task Force suggested that the NRA clearly describe the process that they will follow, especially with regard to the reviews that will be carried out later by the NRA to agree on the final operational conditions.

TABLE II.1: MAIN RELEVANT REGULATORY REQUIREMENTS FOR THE DISCHARGE OF ALPS TREATED WATER FROM THE DECISION OF NRA COMMISSION (7 NOVEMBER 2012) ON “ITEMS REQUIRED FOR MEASURES WHICH SHOULD BE TAKEN AT TOKYO ELECTRIC POWER Co., INC.’S FUKUSHIMA DAIICHI NUCLEAR POWER STATION IN LINE WITH THE DESIGNATION AS THE SPECIFIED NUCLEAR FACILITY”.

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<b>Relevant regulatory requirements</b>
I. Measures to be taken with regard to the overall process and risk assessment
II. Items concerning measures to be taken for design and equipment
II-8. Treatment, storage, and management of radioactive solid waste
II-9. Treatment, storage, and management of radioactive liquid waste
II-11. Radiation protection in the area surrounding the site by restricting release of radioactive materials
II-12. Management of workers’ exposure dose
II-13. Emergency measures
II-14. Design considerations
III. Measures taken for operational safety of the Specified Nuclear Facility

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The NRA explained further that after the approval of the Implementation Plan, NRA inspectors will undertake a pre-service inspection for the facilities related to the discharge of ALPS treated water before discharge can commence to confirm that the facilities were constructed in compliance with the Implementation Plan and have the required functionality specified in the Implementation Plan. The Task Force suggested that it needs to be very clearly documented when the final approval will be given for the discharge of ALPS treated water to start.

**Interaction between the regulatory body and the applicant (TEPCO)**

Paragraph 2.36 of GSR Part 3 [3] states that “The regulatory body shall establish mechanisms for communication and discussion that involve professional and constructive interactions with relevant parties for all protection and safety related issues.”

Paragraph 5.14 of GSG-9 [5] describes this further as follows:

“The process illustrated in Fig. 3 [Fig. II–2] identifies actions of the regulatory body and actions of the applicant. In setting the discharge limits, there should be regular engagement and discussion between the applicant and the regulatory body with regard to the validity of the assumptions made to estimate doses, the optimization process and the implications that the discharge limits and the operational limits and conditions under discussion may have for the operation of the facility or the conduct of the activity... This process should be conducted in an iterative manner in order to reach an acceptable optimal solution from the point of view of safety and radiation protection.”

The NRA described that there is an ongoing exchange of information between the NRA and TEPCO through review meetings. The NRA added that these review meetings are being conducted to review the Implementation Plan provided by TEPCO against the regulatory requirements listed in Table II.1. During the meetings, the NRA had explained that they might ask TEPCO to provide clarifications on specific points or request from TEPCO to do further work on the REIA and the Implementation Plan. The outcomes of these meetings are recorded and the minutes of selected meetings were provided to the Task Force as an example to demonstrate how the process is implemented in practice.

### **Establishment of an authorization for discharges**

Paragraph 3.123 of GSR Part 3 [3] states that “The regulatory body shall establish or approve operational limits and conditions relating to public exposure, including authorized limits for discharges.”

Paragraph 5.68 of GSG-9 [5] states:

“Discharge limits should be specified for different radionuclides, or groups of radionuclides, depending on:

- (a) The feasibility of measurement of the individual radionuclides;
- (b) The significance of the radionuclides in terms of dose to the representative person;
- (c) The relevance of the measurement of the individual radionuclides as an indicator of the performance of the facility or activity.”

The NRA explained that in the Implementation Plan, TEPCO uses a fixed discharge rate for tritium of 22 TBq/y that is equal to the annual discharge limit established in the Basic Policy. The Task Force noted that it is not clear whether there are specific regulatory requirements on the discharge of ALPS treated water for TEPCO beyond the total amount of tritium discharged per year and the maximum activity concentration of 1500 Bq/l of tritium. The Task Force noted the importance for the NRA to clearly document their explanation on the selection of the discharge limits for radionuclides other than tritium. The Task Force noted their previous observations during the TEPCO/METI mission are in agreement with NRA’s decision to request TEPCO to use more realistic and less conservative approaches.

### **Periodic regulatory review of the authorization for discharges**

Paragraph 3.134 of GSR Part 3 [3] states:

“Registrants and licensees shall review and modify their discharge control measures, as appropriate and in agreement with the regulatory body, taking into account:

- (a) Operating experience;
- (b) Any changes in exposure pathways or in the characteristics of the representative person that could affect the assessment of doses due to the discharges.”

GSG-9 [5] states:

“5.10. The authorization for discharges should be reviewed during the operation stage, for example as part of a periodic safety review of the facility or activity [GSR Part 3]. Significant changes in any condition that could affect public exposure should be taken into account during the review of an existing authorization.

...

“5.64. The period of validity of the discharge limits should be specified in the authorization for discharges or in another related regulatory document, with a provision for their review whenever deemed appropriate by the regulatory body, but at least once every ten years.”

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 (see also Section B). 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.

## **Inspection and Enforcement**

GSG-9 [5] states:

“5.92. The regulatory body should verify compliance with the regulatory requirements and the operational limits and conditions of the authorization for discharges. This should involve, as appropriate, auditing of the operating organization’s records (including those setting out the results of discharge monitoring and environmental monitoring), review of the periodic reports on the results of the radiological environmental impact assessment review, of the results of the independent monitoring programmes, and inspection.

“5.93. The regulatory body should establish a process for identifying and managing any identified non-compliance with the regulatory requirements on discharges. ...

“5.94. The actions to be taken by the regulatory body in response to non-compliance should be graded in accordance with the seriousness of the failure. Depending on the national legal and regulatory system, such actions may range from a simple warning to legal procedures (including prosecution) and the imposition of fines, through to the suspension or withdrawal of the authorization.”

The Task Force would like to receive more information on the process that the NRA will follow to identify potential non-compliance of TEPCO in adhering to discharge limits and operational conditions and what actions the NRA will take in case a non-compliance is identified.

### **(c) Summary and Follow Up**

The NRA presented the regulatory requirements in Japan and the unique approach that the NRA is following for the authorization of the discharge of the ALPS treated water to the Task Force. The NRA explained that the authorization of the discharge of ALPS treated water is being included in the Implementation Plan submitted by TEPCO to the NRA. The Task Force stressed the importance of fully documenting the process that the NRA is using to authorize the discharge of ALPS treated water within their normal regulatory process under the Reactor Regulation Act along with the criteria that the NRA are using to approve the authorization of the discharges and conditions placed on TEPCO in this authorization, including the selection of the discharge limits for radionuclides other than tritium.

The Task Force noted that their previous observations during the TEPCO/METI mission are in agreement with NRA’s decision to request TEPCO to use more realistic and less conservative approaches. The Task Force noted that because of the tailored and iterative approach being taken by the NRA, the detailed review approach and the criteria used within this review will also be further developed as construction and on-going inspection progress.

## **II.C.2. Radiological Environmental Impact Assessment**

### **(a) Overview**

The regulatory control and authorization of discharges is covered in Section C.1 of this report, where it is further explained that the establishment of an authorization for discharges takes into account the results of a prospective assessment of the radiological environmental impacts; such an assessment is usually called an REIA.

The responsibilities of the registrants or licensees when applying for an authorization for discharges to the environment are given in GSR Part 3 [3]. Paragraph 3.9 of GSR Part 3 [3] states that:

“Any person or organization applying for authorization:

(e) 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”

Paragraph 5.13 of GSG-9 [5] states that:

“The regulatory body should establish the process to be followed by an applicant seeking an authorization for discharges once the need for an authorization for discharges has been established. The steps of the authorization process may be as follows:

...

(d) The applicant should assess the doses to the representative person. This may involve a number of iterations, starting with a simple, cautious generic assessment and, if necessary, a more detailed, site-specific study.

(e) The applicant should submit the results of the assessment to the regulatory body. The regulatory body should evaluate whether the models and assumptions used by the applicant are appropriate, should compare the results of the assessment with dose limits and dose constraints, and should evaluate whether the assessed doses are in accordance with the need to provide optimized protection of the public.”

#### **(b) Discussion**

The NRA explained that although in the Reactor Regulation Act there is no requirement for TEPCO to undertake an REIA for the proposed discharge of ALPS treated water, the NRA decided to review the REIA conducted by TEPCO in response to the Basic Policy in the application for the discharge of the ALPS treated water. The NRA added that during the regular review meetings with TEPCO, the NRA received explanations by TEPCO regarding the approach they had followed and the assumptions they had made in the REIA. The NRA received further clarifications from TEPCO and also suggested changes to the REIA. As a result of these meetings, TEPCO are in the process of updating the REIA. The discussions between TEPCO and the NRA are still on-going, and changes and decisions are documented in the minutes of the meetings.

The NRA summarized the following main points that are related to the review of the REIA and were raised in the review meetings with TEPCO:

- Uncertainties in the predicted dose estimates;
- Exposure pathways considered in the REIA;
- Choice of input values for parameters used in the REIA;
- Choice of processes for the transfer of radionuclides in the environment that are used in models;
- Selection of the dose coefficient used for tritium for members of the public (ratio of tritiated water and organically bound tritium);
- Approach taken for estimating doses from potential exposures;
- Potential impact of radionuclides contained in the seawater used to dilute the ALPS treated water.

GSG-10 [6] states:

“4.2. The required level of complexity of the radiological environmental impact assessment should also be defined by the government or the regulatory body in the national legal framework or regulations. Account should be taken of the characteristics of the activity or facility, based on considerations of the risk to the public and the environment due to exposures expected in normal operation and potential exposures.

...

5.4. The national regulatory body should decide, in discussion with the applicant and other interested parties, which methodology is suited to carrying out a particular assessment and should agree that the methodology adopted is adequate for its proposed purpose.

...

5.33. The characteristics of the representative person should be specified by the applicant in accordance with national regulations and in agreement with the regulatory body. For example, the regulatory body may require the use of more detailed and site specific habit data for assessments carried out for certain types of facility or at later stages in the authorization process.”

The Task Force noted that they supported the NRA decision to review the REIA conducted by TEPCO as part of the authorization process. The NRA clarified that they are reviewing the methodology adopted by TEPCO to ensure that it is in line with the IAEA safety standards (i.e. GSG-10 [6]). The Task Force also noted that the NRA is requiring from TEPCO to provide more realistic assumptions in the REIA rather than relying on excessive conservatism and to undertake further assessment of the uncertainties associated with the predicted doses. The Task Force suggested that the objective of the REIA needs to be clearly defined in the authorization process so that it is not confused with the assessment of doses valid immediately after the FDNPS accident in 2011.

The NRA presented the results of a study that had been undertaken to verify the simulation used by TEPCO in the REIA to assess the dispersion of discharged tritium in the ocean. For this verification, the NRA noted that they used the same model, assumptions and endpoints as the ones used by TEPCO and that they obtained comparable results as TEPCO. While the Task Force acknowledged the importance of replicating the dispersion simulations, the Task Force explained that consideration also needs to be given to undertaking independent modelling and sensitivity testing to validate that TEPCO's modelling assumptions and outputs are fit for purpose.

The NRA presented to the Task Force the following criteria that they are using to review TEPCO's REIA, including the assessment of doses from potential exposure scenarios, and assess whether the REIA is fit for purpose:

- Whether the assessment methodology is in line with the relevant IAEA safety standards;
- Whether the dose to the representative person is below 50  $\mu\text{Sv}/\text{y}$  (equivalent of a dose constraint);
- Whether the assessed doses for potential exposures are below the dose criterion of 5 mSv per abnormal event;
- Whether the assessed impact to flora and fauna is smaller than the lowest value of derived consideration reference levels for the reference animals and plants.

The NRA added that the evaluation of the REIA will continue until the final approval of the Implementation Plan. The Task Force recognized that the NRA decided to review the REIA conducted by TEPCO even though this is not included within the normal regulatory framework in Japan. The Task Force noted that for the benefit of demonstrating completeness of the REIA, minor exposure pathways and all relevant marine transfer processes need to be taken into account, independent of the fact that low doses are estimated, to facilitate communication of the results of the REIA to interested parties.

The Task Force also explained that the monitoring programme and the results of the REIA need to be linked, both in terms of the radionuclides and exposure pathways contributing most to the doses and the Task Force suggested to reflect this in the REIA (see also Section D.2).

The Task Force noted that the NRA had agreed with TEPCO that TEPCO will update the source term of ALPS treated water following further evaluation and then update the REIA.

The high-level aim of the protection of the environment set by the International Commission on Radiological Protection (ICRP) is to provide for the maintenance of biological diversity and to ensure the conservation of species and the health of natural habitats, communities and ecosystems. This is also addressed in SF-1. A generic methodology for assessing the exposure of flora and fauna from discharges is provided in GSG-10 [6] and is based on the ICRP approach for the protection of the environment (see Ref. [10]). The need for the explicit assessment of the protection of flora and fauna is subject to the national or internationally applicable regulations and depends on the characteristics of the facility or activity and the environmental conditions under consideration (para. I-2 of GSG-10 [6]). The Task Force noted that the NRA decided to review the assessment of doses to flora and fauna included in the REIA by TEPCO using the methodology described in GSG-10 [6].

Paragraph 5.44 of GSG-10 [6] states that “As part of the safety assessment for facilities and activities, various types of accident are postulated to identify engineered safety features and operational actions to reduce their likelihood and, if an accident does occur, to mitigate its consequences.” In accordance with GSG-10 [6], the prospective assessment of potential exposures is recommended to use estimates of doses to members of the public resulting from postulated accidents after identifying the potential exposure scenarios on the basis of the safety assessment. Paragraph 5.68 of GSG-10 [6] states that “For consideration of potential exposures that uses as an end point a dose or a measure of the risk of health effects, the restrictions established by the regulatory body should be a reference dose criterion or risk criterion, as appropriate.”

The NRA explained to the Task Force that they have set a dose criterion of 5 mSv for a single event following the recommendations provided in GSG-10 [6]. The NRA continued that no event progression is expected for the ALPS discharge facility except for the continuation of an unplanned discharge and, therefore, the NRA is satisfied with TEPCO following a deterministic approach for the safety assessment. In the review of the REIA undertaken by TEPCO for a potential exposure scenario, the NRA explained that they had identified that TEPCO had not followed the process for assessing potential exposures as described in Fig. II-4 (fig. 3 of GSG-10 [6]). The NRA had requested TEPCO to revise the REIA and to consider all possible exposure pathways from occurrences that could happen without being detected or for a situation where countermeasures might be delayed. Discussions had been held on this topic as part of the regular meetings between the NRA and TEPCO, and TEPCO had presented the revised scenarios and the assessment to the NRA on 18th March 2022. During that review meeting, the NRA had pointed out the excessive conservatism on the source term and had requested further consideration on the matter by TEPCO.

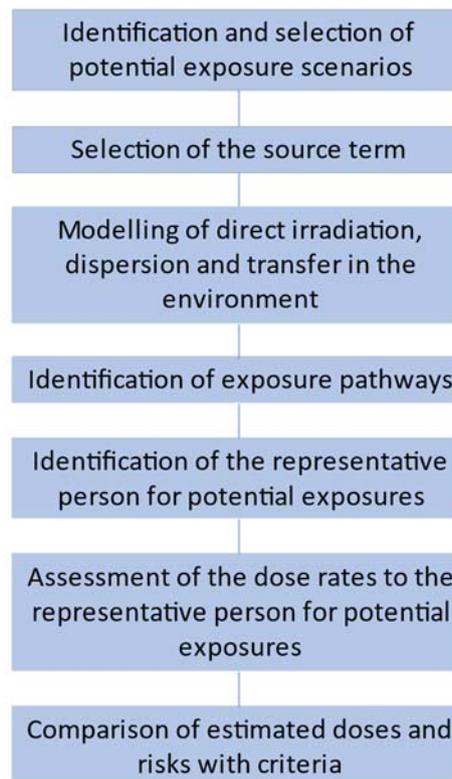
The Task Force noted that the NRA had set a dose criterion for a single potential accident involving the unplanned discharge of ALPS treated water and had required that a prospective assessment of potential exposures is undertaken by TEPCO in line with the IAEA safety standards. The Task Force also noted that the NRA were reviewing this aspect of the safety assessment within the overall review of the Implementation Plan which is on-going until the Implementation Plan is approved.

With regard to the biological effects of selected internal emitters, the UNSCEAR 2016 Report [11] states:

“54. ... An aspect of environmental and food-chain transfer that warrants further investigation is the accumulation of tritium in the organic component of foodstuffs, referred to as organically bound tritium

“57. For tritium, models are available in the form of tritiated water, representing its distribution throughout body organs and tissues according to their water content. Less information is available with which to construct adequate models for the behaviour of various forms of organically bound tritium and other tritiated compounds, including amino acids, some of which are involved in the synthesis of DNA and associated proteins.”

The Task Force noted that it would be difficult to identify precisely the amount of tritium that would arrive into the environment as organically bound tritium, and the age distribution of the population affected. NRA explained that in the assessment, three age groups are considered to evaluate the committed effective dose and this method is in accordance with paragraphs 5.36 and 5.37 of GSG-10. The Task Force also noted that in order to be conservative, all calculations of committed effective dose could be performed using the higher values of committed effective dose per unit intake of activity of tritium established in the international safety standards.



**Fig. II-4. Components of an assessment for consideration of potential exposures. (The figure is not intended as a detailed step by step procedure and is presented to illustrate the elements of the assessment and facilitate its description.) (fig. 3 of GSG-10 [6])**

### **(c) Summary and Follow Up**

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. The NRA had reviewed the REIA submitted by TEPCO and they 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 received information on the criteria that the NRA are using to assess whether the REIA is fit for purpose and that the NRA evaluation of the REIA will 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.

## II.C.3. Characterization of the Source Term

### (a) Overview

In accordance with the authorization process for discharges described in GSG-9 [5], it is recommended that the applicant seeking an authorization for the discharge of ALPS treated water, characterize the discharges. Further, the regulatory body is recommended to evaluate the models and assumptions used for this characterization, and the subsequent identification of the main exposure pathways, to ensure an adequate assessment of the exposure of the representative person.

The IAEA safety standards encourage regular dialogue between the regulatory body and the applicant as a recommended pre-operational analysis 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, their physical and chemical forms, the methods and routes of discharge and the rates of discharge.

### (b) Discussion

The NRA presented an overview of TEPCO's actions to characterize the ALPS treated water source term, as well the NRA's proposed methodology for verifying the results of the characterization. This overview included details of the modelling approach used to identify the 62 fission and neutron activation radionuclides targeted for removal by ALPS. These 62 radionuclides as well as  $^3\text{H}$  and  $^{14}\text{C}$  (which are not removed by ALPS) were also included in the source term used for the REIA.

The NRA presented TEPCO's methodology for the identification of fission and neutron activation radionuclides which involved the calculation of fuel isotopic compositions and subsequent depletion and decay using the Oak Ridge Isotope GENERation (ORIGEN) code<sup>5</sup>. The NRA also described the assumptions and decisions made at various stages while TEPCO were undertaking this modelling. The Task Force discussed with the NRA the methodology used by TEPCO, including specific points regarding the flowchart description of the ORIGEN modelling approach. The NRA also explained that this methodology was being revised by TEPCO, most notably to include the assumption of a much longer reactor cool down period of 12 years, which was expected to result in the exclusion from the source term of many short-lived radionuclides that could not possibly still be present when discharges start (in 2023), as significant fission and neutron activation has not taken place since 2011.

The Task Force noted that at the time of the mission, only a subset of radionuclides listed in the REIA had been analysed in samples of actual ALPS treated water from most of the storage tanks. Namely, of the 63 nuclides (other than  $^3\text{H}$ ) identified using the original methodology, only  $^{134}\text{Cs}$ ,  $^{137}\text{Cs}$ ,  $^{90}\text{Sr}$ ,  $^{60}\text{Co}$ ,  $^{125}\text{Sb}$ ,  $^{106}\text{Ru}$ ,  $^{129}\text{I}$ ,  $^{99}\text{Tc}$ ,  $^{14}\text{C}$ , and gross  $\alpha$  and gross  $\beta$  had been routinely measured over the past ten years. The Task Force explained that the adoption of a 12-year cool down period could help refine this list.

The Task Force agreed with the general approach followed to identify the radionuclides present in the ALPS treated water. Specifically, the Task Force concurred that it is not feasible to analyse ALPS treated water samples for all possible radionuclides, other than gamma emitters, without the targeting achieved by the initial modelling step taken by TEPCO. The Task Force stressed the importance of the subsequent verification by measurements of the presence and the levels of radionuclides indicated by the modelling.

The NRA also described TEPCO's ongoing monitoring of radionuclides in water sampled from various points in the ALPS processing stream since 2011, including the identification of significant levels of  $^{14}\text{C}$  and  $^{99}\text{Tc}$  discovered in 2019 through comparison of the results of total beta measurements and

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<sup>5</sup> <https://www.ornl.gov/project/origen>

analyses for individual beta-emitting radionuclides. In addition, the NRA added that, in their view, there might be activation nuclides originating from the reactor internal structure or low energy  $\beta$ -emitting nuclides which have not been measured and evaluated. The NRA explained that they were interested in this as an additional check for radionuclides that might be present in the source term and that they did not have any concerns regarding the ORIGEN modelling approach.

On the basis of the above information, the NRA concluded that there is no considerable gap in knowledge between the radionuclides already identified for inclusion in the source term and those that are really present in the ALPS treated water. The Task Force suggested that this needs to be supported by evidence considering the continuing work being done by TEPCO to refine and review the characterization of the source term.

The NRA described their plans to verify the source term by analysing samples of ALPS treated water collected from the K4-B tank group in February 2022. The NRA explained that the Japan Atomic Energy Agency (JAEA) is NRA's technical support organization and will be contracted to undertake analyses of a range of radionuclides, including those with a relatively high radiological impact such as  $^{14}\text{C}$  and  $^{129}\text{I}$ . The Task Force suggested that the determination of alpha emitters, particularly uranium isotopes (to confirm expected negligible concentrations) and transuranics; and those radionuclides with a potentially global impact following discharge into the sea, including  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{129}\text{I}$  and  $^{99}\text{Tc}$ , could be included in NRA's verification measurements. The Task Force noted that development of new analytical methods may be needed to undertake these confirmatory measurements.

The Task Force highlighted that the characterization of the source term for the discharge of ALPS treated water is fundamental to the entire REIA and to complying with the requirements for source and environmental monitoring. In view of the significant adjustments being made to the methodology used by TEPCO, the Task Force recognized that the schedule for concluding the characterization needs to be arranged so that all the planned steps leading to the authorization of the discharge can be done to a sufficiently high quality – including NRA's review at each step – before discharges start in 2023. Furthermore, the Task Force indicated that the REIA and source and environmental monitoring plans will need to be revised once the source term characterization has been finalized.

Taking into account the information and the data provided, the Task Force also noted that there are different radionuclide compositions in the different ALPS treated water tanks and the characterization of the source term needs to be sufficiently conservative to safely cover all discharges that are anticipated.

### **(c) Summary and Follow Up**

The Task Force agreed with the approach presented by the NRA regarding their approach to have TEPCO develop a sufficiently conservative, yet realistic, source term as a basis for a source monitoring plan as well as a revised REIA. The Task Force inquired whether the NRA plans to verify the list of the 64 radionuclides selected by TEPCO for the conduct of the REIA and the NRA replied that they have requested from TEPCO to reassess the list and they are also planning to independently verify TEPCO's assessment.

The Task Force noted that TEPCO needs to finalize and resubmit the characterization of the source term to allow time for review and approval by the NRA. The Task Force highlighted the importance of maintaining a strong connection between the characterization of the source term and the design of source and environmental monitoring programmes. This will ensure that a priori assumptions can be verified and that the REIA can be refined as appropriate.

## II.C.4. Occupational Radiation Protection

### (a) Overview

Paragraph 5.3 of GSG-7 [4] states:

“Contamination of areas can arise from facilities and activities that are subject to regulatory control in terms of the requirements for planned exposure situations, as a result of authorized activities such as discharges, the management of radioactive waste and decommissioning. An exposure situation resulting from such contamination is controlled as part of the overall practice and is, therefore, a planned exposure situation and not an existing exposure situation.”

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. The obligations of workers in this regard are listed in para. 3.83 of GSR Part 3 [3] and relate to rules and procedures, the proper use of monitoring equipment and personal protective equipment, cooperation in health surveillance and dose assessment programmes, and acceptance of instruction and training. Workers are also required to provide relevant information to management and to act in a responsible manner with regard to protection and safety.

### (b) Discussion

The NRA provided an overview of the regulations on occupational radiation protection in Japan and explained that for the implementation of these regulations the NRA coordinates with the Ministry of Health, Labour and Welfare (MHLW).

The Task Force explained that in accordance with the IAEA safety standards, for authorized discharges, planned exposure situation requirements need to be taken into account for control, monitoring and recording of occupational exposure. More specifically, relevant requirements are provided in paras 3.88–3.98 of GSR Part 3 [3] and relevant recommendations are provided in paras 3.49–3.158 of GSG-

7 [4]). The Task Force noted that the approach followed by the NRA is consistent with the approach in the IAEA safety standards.

With regard to occupational radiation protection, the Task Force recognized that the relevant legislative arrangements in Japan and the relevant regulations are, in general, in agreement with the relevant IAEA safety standards. Occupationally exposed workers working at FDNPS, regardless of whether they are contractors or staff, are under the same occupational radiation protection regime.

The NRA explained that the NRA and the Ministry of Health, Labor and Welfare are the primary governmental authorities responsible for the implementation of the legislative requirements concerning occupational exposure through the Reactor Regulation Act (which includes provisions for the establishment of controlled areas, measuring and recording of air dose rates of controlled areas, measures to control exposure of radiation workers and special education) and the Industrial Safety and Health Act (which includes provisions for medical examinations and delivering exposure records to the designated institution), respectively. The Task Force highlighted the importance of integration of protection and safety into the general occupational health and safety programme in Japan in industrial sites.

The NRA described their role 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 also provided information on the occupational radiation protection programme in FDNPS (covering also the ALPS installation). They noted that approximately the whole area of FDNPS site is designated as '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 relevant instructions for radiation protection and safety are included in TEPCO's Implementation Plan. The NRA noted that they are satisfied with the occupational radiation protection measures implemented by TEPCO for the works on the ALPS treated water discharge as they have a broad scope and cover protection in terms of individual and workplace monitoring.

The NRA explained that optimization of the radiation protection of workers at FDNPS is conducted using dose limits and concentration limits for radioactive materials in the air inhaled by radiation workers (with these limits prescribed by the NRA). The Task Force suggested that the NRA can establish benchmarking tools for checking the process implementation and that the NRA can use values well below the limits for benchmarking. The Task Force highlighted that there is no single way to implement optimization of occupational exposure and added that the approach followed by the NRA is well documented.

The Task Force noted that levels of exposure are in place at the operational level for the purpose of demonstrating the optimization of protection, even though these are not required through the national regulations. The Task Force also encouraged the NRA to set rules for monitoring exposure to the eyes, skin and extremities for the construction, installation and operation of ALPS.

The Task Force noted that contractors are involved in the works under the overall ALPS project and that might give rise to uncertainties over the allocation of responsibilities for the arrangements for the protection of workers or difficulties with regard to the control of the exposure of individual contractors over time. As such, the Task Force suggested that the NRA might consider putting emphasis on checking the managerial control (e.g. local work procedures, remote supervision) that TEPCO exercises over occupational exposure.

### **(c) Summary and Follow Up**

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 noted that the recording levels, reporting levels and investigation levels for occupational exposure play a crucial role in the monitoring strategy implemented by TEPCO as well as in the keeping of dose records in the national dose registry. The Task Force noted that the exposure pathways (including potential exposure) that are considered in TEPCO's REIA are also applicable for the assessment of occupational exposure for the ALPS workers.

The Task Force explained that in a facility, occupational radiation protection starts with dose projection for potential occupationally exposed workers (through the conduct of the safety assessment) and ends with recording the actual doses. The Task Force noted that the operational safety inspections to TEPCO that are planned to be conducted by the NRA will be essential elements for checking TEPCO's compliance with the regulations for occupational radiation protection.

## **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 covering, inter alia, the design and implementation of the monitoring programmes, including properly maintained and calibrated equipment, sampling locations, suitably qualified and trained personnel and documented procedures.

The regulatory body places requirements on the operator for the frequency for reporting of results and the form and required content of the reports. Paragraph 5.76 of GSG-9 [5] states that “The requirements for source monitoring and environmental monitoring should be specified in the authorization for discharges by the regulatory body. The necessity for and frequency of monitoring should be determined by the assessed level of risk of radiological impact.” The regulatory body is also responsible for 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.

Paragraph 5.74 of GSG-9 [5] states that “The operating organization should make available, on request, results from source monitoring. This request may be incorporated within the operational limits and conditions of the authorization or specified in other regulatory documents.”

Paragraphs 5.84–5.85 of GSG-9 [5] provide recommendations for independent monitoring to the regulatory body.

#### **(b) Discussion**

The NRA presented its review of whether TEPCO’s plans for source monitoring, as described in the proposed amendment to TEPCO’s Implementation Plan, conforms to the regulatory requirements, including the criteria established for quality assurance of the analyses. The NRA provided an overview of TEPCO’s analytical facilities, its quality management system, relevant aspects of its organizational structure, its approach to measurement and confirmation of each batch of ALPS treated water and the radionuclides targeted for analysis.

The Task Force noted that the proposed amendment to the Implementation Plan does not contain the same level of detail that TEPCO had made available to the Task Force in presentations during the IAEA review mission to TEPCO and METI in February 2022. The Task Force also noted the importance for the NRA to ensure that TEPCO establishes and communicates a clearly defined plan for source monitoring covering sampling and analysis at the measurement and confirmation facility, the vertical discharge shaft and any other relevant locations.

The Task Force discussed with the NRA whether all this additional information was being considered by the NRA and, if so, how that transfer of information was managed and recorded. The NRA explained that all additional information was being considered at weekly review meetings with TEPCO and recorded in the minutes of those meetings.

The Task Force noted that the scope of TEPCO's laboratory quality management system<sup>6</sup>, which is accredited under ISO/IEC17025<sup>7</sup>, is limited to <sup>134</sup>Cs, <sup>137</sup>Cs and <sup>3</sup>H in public waters, wastewater, soil, ash and sludge. The Task Force asked for additional information on how the NRA supported its stated aim to ensure that analyses for other radionuclides are conducted at an equivalent level of quality to that specified under the ISO/IEC-17025 accreditation. The NRA explained that TEPCO – and all laboratories conducting analyses for radionuclides in Japan for monitoring purposes – are recommended to use national methods noted by the NRA and if a laboratory wishes to use a different method it needs to justify this to the NRA. The NRA provided more information on these recommended methods<sup>8</sup> and on the approach taken for radionuclides for which no suitable method is available.

The Task Force noted that the IAEA Seawater Proficiency Tests (PTs)<sup>9</sup> that are used by TEPCO to demonstrate measurement quality and the competency of analysts do not cover the full range of radionuclides and sample media required for source and environmental monitoring related to the discharge of ALPS treated water. The Task Force noted that additional proficiency testing, including other radionuclides and solid matrices (e.g. sediment and biota) might be needed. The Task Force also informed the NRA that, in tandem, the IAEA was actively developing the scope of its proficiency tests to cover a broader range of analytical methods and matrices.

The NRA explained that they had established general requirements for quality assurance in the field of radiation measurement (with reference to para 9.2 of RS-G-1.8 [7]), as well as additional requirements specifically for TEPCO for FDNPS. The Task Force noted that they would be interested to receive more information by the NRA on these requirements.

The Task Force inquired about the requirements on TEPCO that the NRA had specified as part of the Implementation Plan for source monitoring, including those defining the frequency for reporting results to the NRA and the results to be reported. The NRA also explained that they planned to ensure the ongoing quality of source monitoring through regulatory inspections and by conducting their own independent source monitoring.

The NRA presented the preliminary results of TEPCO's circulation and agitation test which aimed to demonstrate how homogeneity will be achieved and demonstrated in each batch of ALPS treated water prior to discharge. The Task Force explained that homogeneity is fundamental to the ALPS discharge methodology and the results of this test will be used as the basis of all future assumptions of homogeneity prior to discharge. Therefore, the Task Force expressed their opinion that an independent check of the homogeneity measurements would strengthen the review of the methodology used by TEPCO.

### **(c) Summary and Follow Up**

The NRA provided 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 the NRA to ensure that TEPCO establishes a clearly defined and definitive plan for source monitoring covering sampling and analysis at the measurement and confirmation facility, the vertical discharge shaft and any other relevant locations.

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<sup>6</sup> <https://www.pjview.com/clients/pjl/viewcert.cfm?certnumber=19886>

<sup>7</sup> <https://www.iso.org/ISO-IEC-17025-testing-and-calibration-laboratories.html>

<sup>8</sup> <https://radioactivity.nsr.go.jp/en/list/332/list-1.html>

<sup>9</sup> <https://www.iaea.org/topics/coastal-and-marine/coastal-pollution-trends/marine-monitoring-confidence-building-and-data-quality-assurance>

## 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.

Specifically for environmental monitoring para. 5.84 of GSG-9 [5] states:

“The regulatory body should make provision for independent monitoring. The characteristics of independent monitoring and the resources devoted to independent monitoring should be based on a graded approach and should incorporate best practices and scientifically sound analytical methods. 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.”

Paragraph 5.25 of RS-G-1.8 [7] states:

“The design of an environmental monitoring programme should be consistent with the objectives of monitoring. The need for and the scale of an environmental monitoring programme will be determined primarily by the significance of the expected doses to the critical group. Measurements should be made and sampling carried out at appropriate locations accessible to the public outside the operations boundary of the facility. The measurements should include measurements of external radiation levels and of radionuclide concentrations in all relevant environmental samples, food products and drinking water. The locations for measurements and sampling should be determined on a site specific basis with the aim of determining the highest radiation doses to the public and identifying the areas most contaminated with radionuclides.”

### (b) Discussion

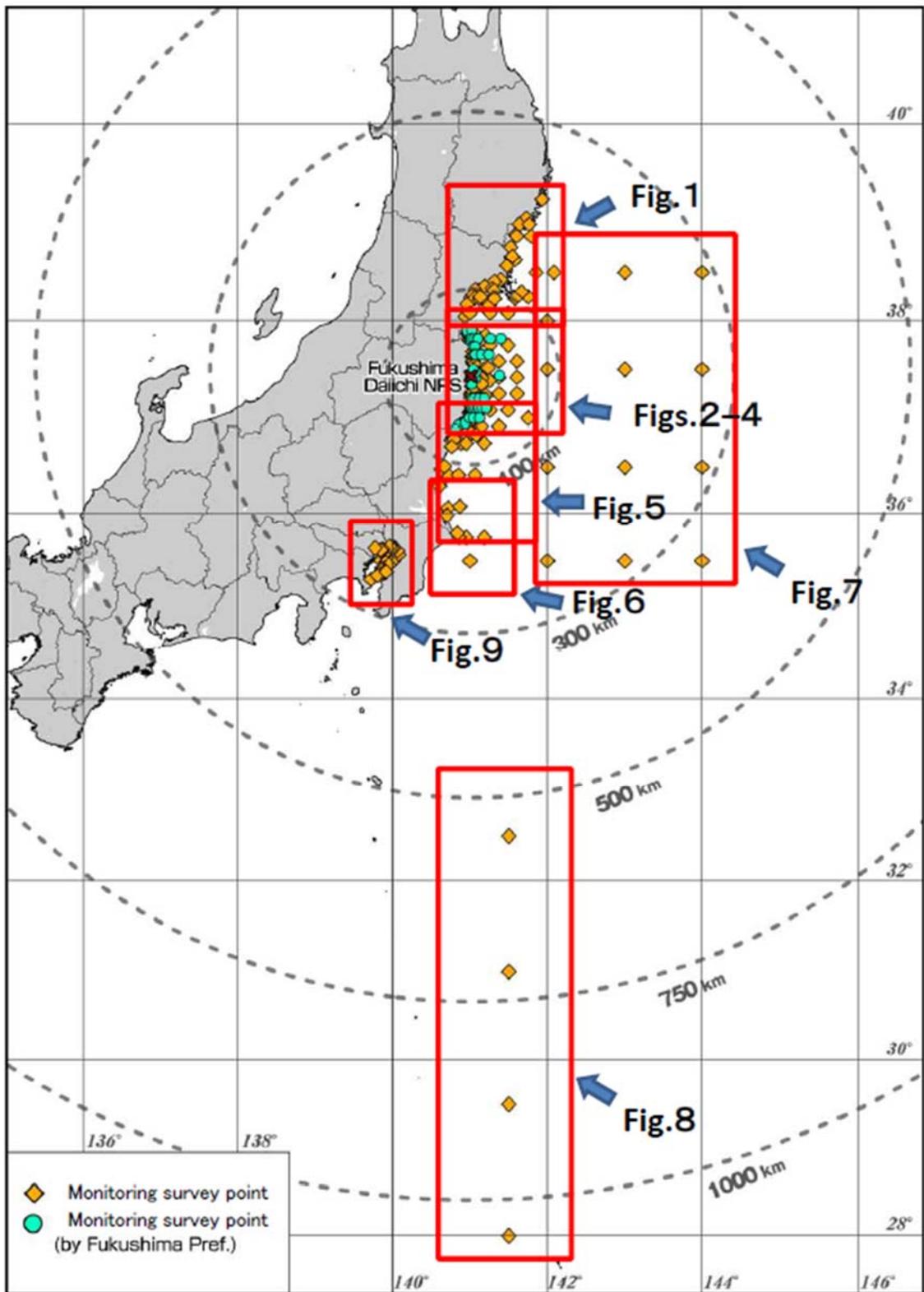
The NRA presented an overview of the marine radioactivity component of environmental monitoring in Japan’s Comprehensive Radiation Monitoring Plan (CRMP)<sup>10</sup>. The CRMP was initiated in 2011 to monitor radioactive materials discharged into the environment as a result of the accident at FDNPS in a coordinated manner. The CRMP is coordinated jointly by the Ministry of Environment and NRA and it is regularly reviewed and revised.

Extensive monitoring of the marine environment around the FDNPS is carried out by various government ministries and agencies and TEPCO. Marine monitoring is carried out according to the ‘Sea Area Monitoring Plan’ that defines sampling locations, frequency of sampling, detection limits and responsibilities of the organizations involved. Monitoring comprises sampling and analysis of seawater to different depths, sediment and marine biota (fish, shellfish and seaweed) and is separated into zones at varying distances from the FDNPS site which are: the sea area close to FDNPS; the coastal area; the off-shore area; and the outer sea area (see Fig. II–5). The aim of this plan includes ensuring a comprehensive overview of the radiological situation in the marine environment and providing an adequate basis for assessments of radiation exposures from marine pathways.

Proposed enhancements to the existing environmental monitoring to specifically address the discharge of ALPS treated water were also presented by the NRA. These included the monitoring of <sup>3</sup>H in seawater at increased frequency plus monitoring quarterly for ‘seven major radionuclides’, namely <sup>134</sup>Cs, <sup>137</sup>Cs, <sup>60</sup>Co, <sup>106</sup>Ru, <sup>125</sup>Sb, <sup>90</sup>Sr, <sup>129</sup>I). Monitoring of organically bound tritium (OBT), free-water tritium (FWT) and <sup>14</sup>C in fish and <sup>129</sup>I in seaweed is also planned. The Task Force noted that the radionuclides selected for the monitoring programme need to link to the results of the REIA as well as to the radionuclides that are providing the major contributions to the dose to members of the public.

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<sup>10</sup> <https://radioactivity.nsr.go.jp/en/list/191/list-1.html>



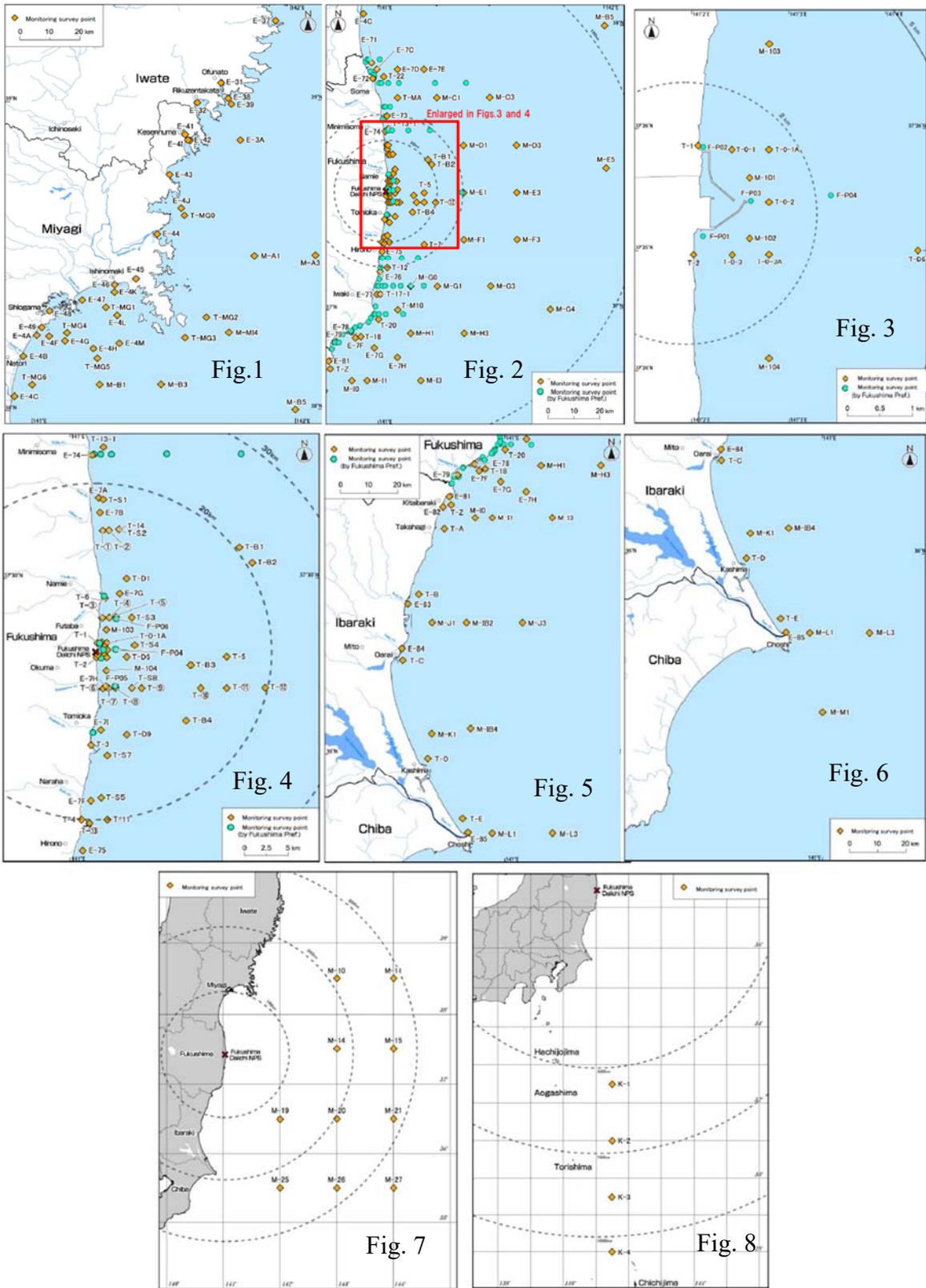


Fig. II-5. Overview of Sea Area Monitoring Plan

([https://radioactivity.nsr.go.jp/en/contents/16000/15098/24/274\\_20210401\\_s.pdf](https://radioactivity.nsr.go.jp/en/contents/16000/15098/24/274_20210401_s.pdf)).

The NRA explained that the enhanced marine monitoring was scheduled to start approximately one year before the discharge is scheduled to start and can provide a baseline of activity concentrations in the marine environment. The Task Force noted that baseline environmental monitoring ideally has to be undertaken over the longest period feasible prior to the start of discharges in order to assess the influence of seasonal effects. The NRA assured the Task Force that the results of the monitoring will be disclosed promptly.

The NRA also informed the Task Force that, in addition to its responsibilities within the Sea Area Monitoring plan, TEPCO implements its own 'Unique Monitoring Plan' in the marine environment. This plan is also being enhanced to encompass additional ALPS-specific monitoring at additional sampling locations, including  $^3\text{H}$  in seawater at increased sampling frequency and at additional sampling locations,  $^3\text{H}$  and  $^{129}\text{I}$  in fish (in addition to radiocaesium), and  $^3\text{H}$  and  $^{129}\text{I}$  in seaweed (in addition to gamma emitting radionuclides). The NRA informed the Task Force that it is also planned to incorporate TEPCO's enhanced 'Unique Monitoring Plan' into the broader 'Sea Area Monitoring Plan'.

The Task Force acknowledged NRA's understanding regarding the responsibilities of the licensee and the regulatory body for environmental monitoring. The Task Force noted that there will be a single comprehensive monitoring plan for environmental monitoring after the start of the discharge of ALPS treated water in which both TEPCO and the NRA will contribute.

The Task Force recognized that some aspects of independent monitoring by the regulatory body are clearly present (e.g. monitoring of the same sample locations by different organizations, including TEPCO and the NRA, contracting of accredited commercial laboratories by the NRA). However, more information on the methodology used for independent monitoring could aid the Task Force's understanding. In particular, the Task Force would welcome 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 and how any discrepancies or inconsistencies will be resolved; for example, the NRA may want to consider defining criteria for confirmatory analyses, taking into consideration measurement uncertainties. The Task Force highlighted that a robust and transparent system for independently verifying TEPCO's monitoring results will provide reassurance to interested parties of the independence of the CRMP.

The Task Force explained that GSG-9 [5] presents some secondary objectives which 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 by using data from environmental monitoring collected after the discharge has started. The Task Force encouraged NRA to consider how the results of environmental monitoring will be used, particularly with regard to verification and possible refinement of the REIA in the future.

### **(c) Summary and Follow Up**

The Task Force welcomed the plans for enhanced environmental monitoring by the Government of Japan that were presented by the NRA. The Task Force noted the current CRMP plan for environmental monitoring, specifically acknowledging how this can help satisfy the requirement for independent monitoring by the regulatory body; however the Task Force highlighted that the involvement of TEPCO in the CRMP needs to be carefully considered to ensure sufficient checks and balances are in place in order to maintain the independence of the NRA in the conduct of the monitoring programme. The Task Force also stressed the importance of linking the environmental monitoring programme to the results of the REIA, so it is focused on the radionuclides and exposure pathways contributing the most to the doses to the public.

## **II.E. Public Consultation and Involvement of Interested Parties**

### **(a) 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.

GSR Part 3 [3] states:

“3.124. When a source within a practice could cause public exposure outside the territory or other area under the jurisdiction or control of the State in which the source is located, the government or the regulatory body: ...

(c) Shall arrange with the affected State the means for the exchange of information and consultations, as appropriate.”

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.”

Paragraph 5.101 of GSG-9 [5] further notes that:

“In some cases, there may be specific requirements for the exchange of information with interested parties before the authorization for discharges has been finalized. One means of doing this is through the establishment of a group reflecting local public concerns for liaison with both the operating organization and the regulatory body. Among other things, the results of the prospective radiological environmental impact assessment should be a focal point of the discussions.”

Any exchange of information relating to the control of discharges may form part of other decision making processes. Such exchange of information should include consideration of societal aspects, for example public concern over the risks associated with radiation exposure, and consideration of the doses to the public that might result from discharges during operation.

### **(b) Discussion**

The NRA provided an overview of the actions undertaken for public communication and involvement of interested parties. The NRA highlighted that their main message to the public on ALPS Treated Water Discharge is: “ALPS treated water discharge does not have substantial adversary effects to health and the environment as far as satisfying the regulatory requirements and it is necessary to progress the decommissioning of the FDNPS”.

After TEPCO submitted amendments to their implementation plan to facilitate the discharge of ALPS treated water at FDNPS, the NRA and TEPCO have been participating in regular review meetings to

discuss TEPCO's plan. These review meetings are open to the public, both for in-person attendance and via web-streaming. All materials, including the minutes of the meetings, are posted on the NRA website, and are also made available in English. The NRA explained that they intend to publish the draft result of their review, solicit public comments and reflect such comments to the draft as appropriate. More specifically, the draft results will be posted on the Government website in Japanese, and the English version will also be provided for reference. The period for receiving comments from the public is generally set at one month.

The NRA presented to the Task Force their communication framework at the national level that consists of the following components:

- Local government meetings held in prefectures around Fukushima;
- Explanations provided to political parties and interested groups after the adoption of the Basic Policy;
- National diet<sup>11</sup> sessions where the status of NRA's review and future schedules have been raised;
- Regular press conferences for the provision of updated information to the public;
- NRA's website where the NRA posts the materials and minutes of the review meetings.

After the completion of the review of the REIA and TEPCO's revised implementation plan, the NRA also plans to attend hearings at municipalities to explain the details of the review result to the prefectures and municipalities through the framework under the Ministerial Conference for the consistent execution of Basic Policy on handling of ALPS treated water.

At the international level, the NRA has held meetings with other countries and organizations and explained the up-to-date status around the ALPS treated water discharge. The NRA has provided and will continue to provide information to neighbouring states as appropriate, including through the framework for cooperation among regulatory bodies, and the NRA responds to questions submitted by other countries and stakeholders in the broader region.

The Task Force commented positively on the efforts undertaken by the NRA and highlighted that the NRA is following a comprehensive approach in their communication with interested parties. The Task Force noted the importance of using appropriate language and presentation means when communicating with the public. The Task Force confirmed the importance of ensuring that the actions undertaken by the NRA are presented in an open and transparent manner and can be reviewed by interested parties. The Task Force also noted the importance of clarifying the difference in risks associated with ALPS discharge from those associated with overall decommissioning of the site. The NRA noted that they are being proactive in their communication and that the decommissioning of FNDPS is based on the approvals issued by the NRA. The NRA added that they explain their actions and activities to the public, but this does not necessarily lead to acceptance. The NRA continued that there are interested groups mainly concerned about the reputational damage that might be induced by the discharge of the ALPS treated water – for example, fishermen who worry about putting their goods on the market. The NRA emphasized that dealing with public perception (not facts) is one of the biggest challenge they face in communicating clearly and effectively.

The Task Force also noted that the public perception of the NRA and NRA's affiliation with the Government of Japan is a factor that can also affect communication activities undertaken by the NRA. The NRA noted that they are an independent regulatory body and that they demonstrate their independence in the communication approaches they follow.

The Task Force asked whether the NRA verifies if TEPCO is incorporating the input from their public consultation process into the revision of the REIA. The NRA explained that they check the methodology

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<sup>11</sup> The National Diet is Japan's bicameral legislature and it is the highest organ of State power.

used by TEPCO for public communication, but checking how TEPCO processes information is outside the scope of the regulatory body. NRA's public communication is focused on the regulatory decision.

The Task Force commented that although each interested party has its own viewpoint, interested parties can be grouped to facilitate communication and different approaches can be used when communicating with different groups. Regarding international involvement, the NRA noted that they maintain direct communication channels with authorities of neighbouring countries and respond to questions and comments from both individual countries as well as other stakeholders throughout the region. The NRA added that they will continue following this approach in the future. Although the NRA are undertaking actions to communicate with national regulatory bodies in neighbouring countries, the NRA noted that other government ministries also communicate regularly with counterparts in neighbouring countries.

### **(c) Summary and Follow Up**

The NRA provided a comprehensive overview of the activities they implement for communication with the public domestically and internationally in a proactive manner regarding the Basic Policy and the proposed discharge of ALPS treated water into the sea. The NRA explained to the Task Force that they are planning to solicit public comments on the results of their review of TEPCO's implementation plan.

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 the 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. The Task Force noted the importance of clarifying the difference in risks associated with ALPS discharge from those associated with overall decommissioning of the site.

## 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
<b>II.A. Responsibilities and Functions of the Government</b>	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,
<b>II.B. Major Principles and Safety Objectives</b>	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
<b>II.C.1. Regulatory Process</b>	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
<b>II.C.2. Radiological Environmental Impact Assessment (REIA)</b>	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
<b>II.C.3. Characterization of the Source Term</b>	GSR-Part 3	3.9(c)
	RS-G-1.8	
<b>II.C.4. Occupational Radiation Protection</b>	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
<b>II.D.1. Source Monitoring</b>	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

<b>II.D.2. Environmental Monitoring</b>	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
<b>II.E. Involvement of Interested Parties</b>	GSR-Part 3	3.124(c)
	GSG-9	5.99, 5.101, 5.102

## APPENDIX II. LIST OF 64 RADIONUCLIDES

This appendix presents the 64 radionuclides selected by TEPCO for assessment:  $^3\text{H}$ ,  $^{14}\text{C}$  and the 62 radionuclides to be removed by ALPS.

	<b>Radionuclide</b>	<b>Half-life</b>		<b>Radionuclide</b>	<b>Half-life</b>
<b>1</b>	H-3	12.3 a	<b>33</b>	Te-129m	33.6 d
<b>2</b>	C-14	$5.73 \times 10^3$ a	<b>34</b>	I-129	$1.57 \times 10^7$ a
<b>3</b>	Mn-54	312 d	<b>35</b>	Cs-134	2.06 a
<b>4</b>	Fe-59	44.5 d	<b>36</b>	Cs-135	$2.30 \times 10^6$ a
<b>5</b>	Co-58	70.8 d	<b>37</b>	Cs-136	13.1 d
<b>6</b>	Co-60	5.27 a	<b>38</b>	Cs-137	30.0 a
<b>7</b>	Ni-63	96.0 a	<b>39</b>	Ba-137m	153 s
<b>8</b>	Zn-65	244 d	<b>40</b>	Ba-140	12.7 d
<b>9</b>	Rb-86	18.6 d	<b>41</b>	Ce-141	32.5 d
<b>10</b>	Sr-89	50.5 d	<b>42</b>	Ce-144	284 d
<b>11</b>	Sr-90	29.1 a	<b>43</b>	Pr-144	0.288 h
<b>12</b>	Y-90	2.67 d	<b>44</b>	Pr-144m	432 s
<b>13</b>	Y-91	58.5 d	<b>45</b>	Pm-146	5.53 a
<b>14</b>	Nb-95	35.1 d	<b>46</b>	Pm-147	2.62 a
<b>15</b>	Tc-99	$2.13 \times 10^5$ a	<b>47</b>	Pm-148	5.37 d
<b>16</b>	Ru-103	39.3 d	<b>48</b>	Pm-148m	41.3 d
<b>17</b>	Ru-106	1.01 a	<b>49</b>	Sm-151	90.0 a
<b>18</b>	Rh-103m	0.935 h	<b>50</b>	Eu-152	13.3 a
<b>19</b>	Rh-106	30.1 s	<b>51</b>	Eu-154	8.80 a
<b>20</b>	Ag-110m	250 d	<b>52</b>	Eu-155	4.96 a
<b>21</b>	Cd-113m	13.6 a	<b>53</b>	Gd-153	242 d
<b>22</b>	Cd-115m	44.6 d	<b>54</b>	Tb-160	72.3 d
<b>23</b>	Sn-119m	293 d	<b>55</b>	Pu-238	87.7 a
<b>24</b>	Sn-123	129 d	<b>56</b>	Pu-239	$2.41 \times 10^4$ a
<b>25</b>	Sn-126	$1.00 \times 10^5$ a	<b>57</b>	Pu-240	$6.54 \times 10^3$ a
<b>26</b>	Sb-124	60.2 d	<b>58</b>	Pu-241	14.4 a
<b>27</b>	Sb-125	2.77 a	<b>59</b>	Am-241	$4.32 \times 10^2$ a
<b>28</b>	Te-123m	120 d	<b>60</b>	Am-242m	$1.52 \times 10^2$ a
<b>29</b>	Te-125m	58.0 d	<b>61</b>	Am-243	$7.38 \times 10^3$ a
<b>30</b>	Te-127	9.35 h	<b>62</b>	Cm-242	163 d
<b>31</b>	Te-127m	109 d	<b>63</b>	Cm-243	28.5 a
<b>32</b>	Te-129	1.16 h	<b>64</b>	Cm-244	18.1 a

## REFERENCES

- [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/decommission/planaction/alps/index-e.html>
- [10] INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Protection of the Environment under Different Exposure Situations, Publication 124, Sage Publishing, London (2014).
- [11] UNITED NATIONS, Sources, Effects and Risks of Ionizing Radiation. UNSCEAR 2016 Report (Report to the General Assembly), Scientific Annexes A, B, C and D, Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2017).

## **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
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- Paul MCGINNITY Research Scientist, IAEA Marine Environment Laboratory
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### International Experts

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- Abel GONZALEZ Argentina
- Nguyen HAO QUANG Viet Nam
- Hongsuk KIM Republic of Korea
- Jean-Luc LACHAUME France
- Senlin LIU People's Republic of China
- Sergey SHINKAREV Russian Federation
- Rick Allan TINKER Australia



## Annex II: List of Participants – Japan

### NRA

- Toyoshi FUKETA Chairman
- Nobuhiko BAN Commissioner
- Shuichi KANEKO DG – Emergency Response

### Office for Accident Measures of Fukushima-Daiichi NPS

- Jun TAKEUCHI Director
- Kohei IWANAGA Director for Planning and Research
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- Kai ONOYAMA (\*) Specialist
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- Shouichi NAGAYOSHI (\*) Director
- Shuichiro ARAFUNE (\*) Assistant Director
- Takashi SATO (\*) Researcher
- Ryota SAKEMI (\*) Researcher
- Kohei MIURA (\*) Assistant Director

(\*) remote participants

## **Annex III: Mission Agenda**

### **First Review Mission to the Nuclear Regulation Authority**

**21-25 March 2022**

#### **Agenda**

<b>Monday 21 March 2022</b>	
<b>09:00 – 10:00</b>	Opening Session
<b>11:00 – 12:30</b>	Topic A: Responsibilities and Functions of the Government
<b>12:30 – 13:30</b>	Lunch
<b>13:30 – 15:10</b>	Topic B: Major Principles and Safety Objectives
<b>15:30 – 17:00</b>	Topic C.4: Occupational Radiation Protection
<b>17:00 – 18:00</b>	Review Team Wrap Up (Internal)

<b>Tuesday 22 March 2022</b>	
<b>09:00 – 12:30</b>	Topic C.3: Characterization of Source Term
<b>12:30 – 13:30</b>	Lunch
<b>13:30 – 15:10</b>	Topic D.1: Source Monitoring
<b>15:30 – 17:00</b>	Topic D.2: Overview of NRA's Environmental Monitoring based on Comprehensive Radiation Monitoring Plan
<b>17:00 – 18:00</b>	Review Team Wrap Up (Internal)

<b>Wednesday 23 March 2022</b>	
<b>09:00 – 12:30</b>	Topic C.1: Authorization Process
<b>12:30 – 13:30</b>	Lunch
<b>13:30 – 17:00</b>	Topic C.2: Radiological Environmental Impact Assessment
<b>17:00 – 18:00</b>	Review Team Wrap Up (Internal)

<b>Thursday 24 March 2022</b>	
<b>09:00 – 10:40</b>	Topic E: Public Consultation and Involvement of Interested Parties
<b>11:00 – 12:30</b>	Any other topics or follow up discussions needed
<b>12:30 – 13:30</b>	Lunch
<b>13:30 – 15:10</b>	Mission Team to Prepare Initial Presentation
<b>15:30 – 17:00</b>	Initial Presentation from Mission Team
<b>17:00 – 18:00</b>	Review Team Wrap Up (Internal)

<b>Friday 25 March 2022</b>	
<b>11:00 – 12:30</b>	Wrap-up discussion
<b>12:30 – 13:30</b>	Lunch
<b>13:30 – 15:10</b>	Wrap up discussion
<b>15:30 – 17:00</b>	Press Conference at FPCJ

