Ministry of Economy, Trade and Industry

July 2023

Discharge of ALPS Treated Water

Executive summary of the IAEA Comprehensive Report

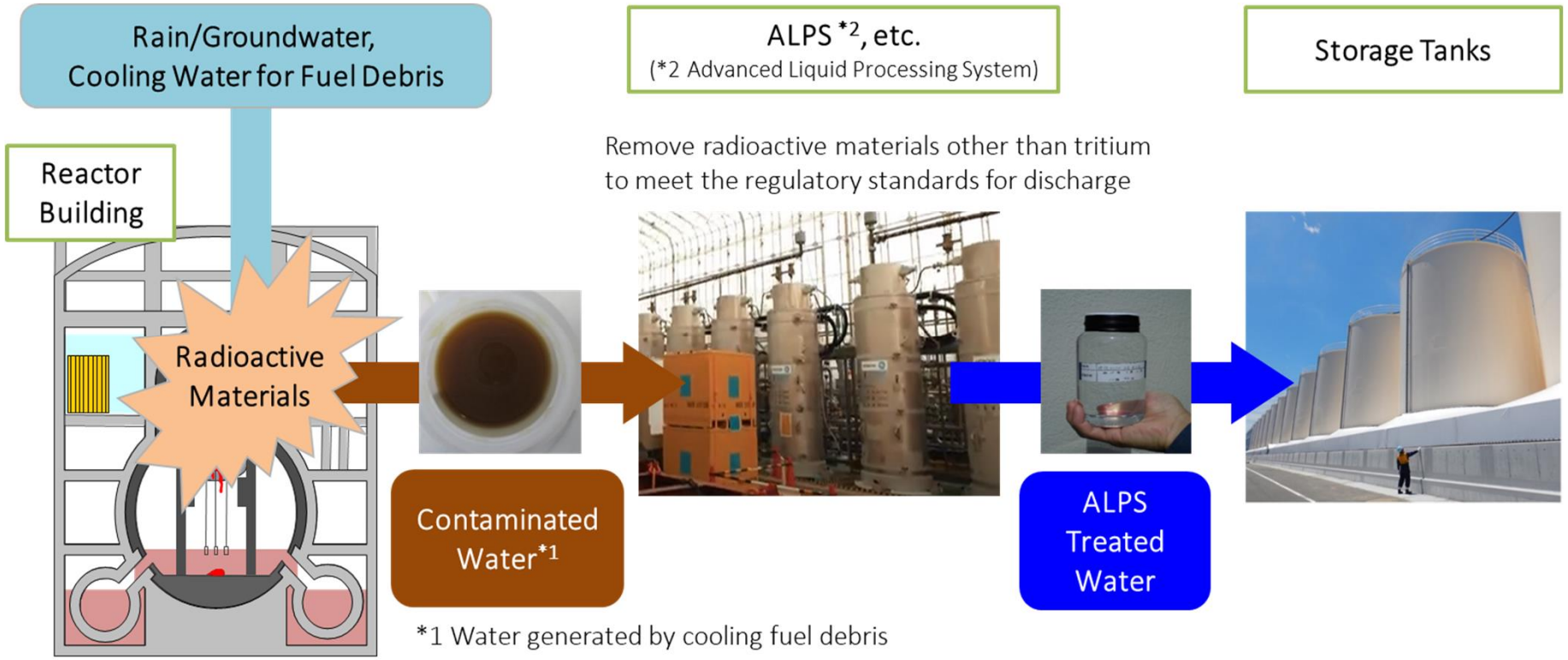
- The IAEA activities consist of a technical review to assess whether the actions of TEPCO and the Government of Japan to discharge the ALPS treated water over the coming decades are consistent with international safety standards.
- The IAEA's review is organized into the following three major components to ensure all key safety elements are adequately addressed:
  - Assessment of Protection and Safety
  - Regulatory Activities and Processes
  - Independent Sampling, Data Corroboration, and Analysis
- The Task Force includes experts from the IAEA Secretariat alongside internationally recognized independent experts with extensive experience from a wide range of technical specialties from Argentina, Australia, Canada, China, France, the Marshall Islands, the Republic of Korea, the Russian Federation, the United Kingdom, the United States and Viet Nam.
- Since September 2021 when the IAEA Task Force held its first meeting, there have been five review missions, six technical reports, and numerous Task Force meetings.

Executive summary of the IAEA Comprehensive Report

- This report includes an assessment of the application of the fundamental safety principles, the relevant safety requirements, and supporting safety guides.
- Based on its comprehensive assessment, the IAEA has concluded that the approach to the discharge of ALPS treated water into the sea, and the associated activities by TEPCO, NRA, and the Government of Japan, are consistent with relevant international safety standards.
- The IAEA has concluded, based on its comprehensive assessment, that the discharge of the ALPS treated water, as currently planned by TEPCO, will have a negligible radiological impact on people and the environment.
- In the first interlaboratory comparison, based on the observations of the IAEA, TEPCO has demonstrated that it has a sustainable and robust analytical system in place to support the ongoing technical needs at FDNPS during the discharge of ALPS treated water.
- The IAEA is committed to engaging with Japan on the discharge of ALPS treated water not only before, but also during, and after the treated water discharges occur. Additional review and monitoring activities are envisaged that will continue and which will provide additional transparency and reassurance to the international community by continuously providing for the application of the relevant international safety standards.

Why ALPS treated water needs to be discharged into the sea ?

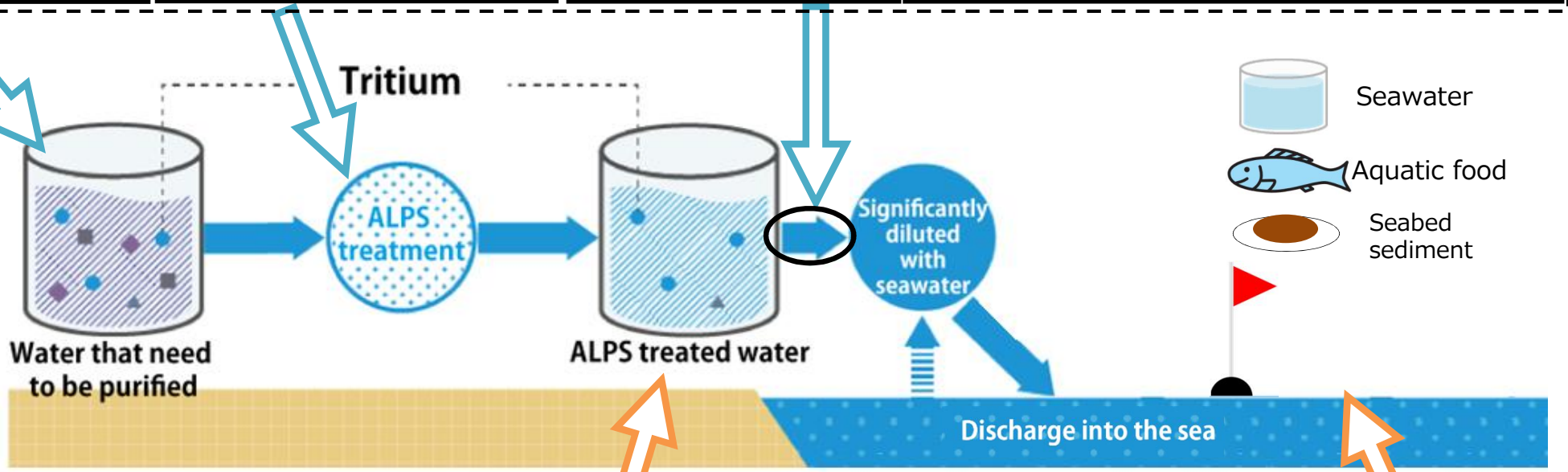
- **Decommissioning of FDNPS is premise of reconstruction of Fukushima**, which is continuous activity to gradually reduce the risk of radioactive materials to the surrounding area.
- The storage tanks exceeding one thousand become an obstacle to secure enough site for the planned decommissioning of the FDNPS.
- Also, maintaining tanks could pose other risks (aging and leakage due to a disaster).
- Therefore, it is necessary to properly discharge ALPS treated water into the sea.



Overall Picture of Treated Water Discharge into the Sea

IAEA Review 1 Safety of ALPS treated water
(Characterization of Treated Water, Safety of the Facilities, Radiological Environmental Impact Assessment)

Characterization of Treated Water	Safety of the Facilities	Radiological Impact Assessment (International Approach)
29 nuclides other than tritium were selected for radiation exposure evaluation	**Treated water is purified until the concentrations of nuclides** other than tritium, **fulfill the regulatory standards.**	When event of **occurrence of an abnormality etc. is detected**, the discharge will be stopped using two emergency valves.	**Long-term effects including bioaccumulation, etc. are evaluated for all nuclides using the IAEA's evaluation method.** **Marine dispersion simulation is conducted.**



IAEA Review 2
Adequacy of the Regulatory Process

Review by Regulatory Agencies, etc.

Installation of the discharge facilities and operation of the facilities have been authorized by NRA

IAEA Review 3 Independent sampling and data corroboration and analysis

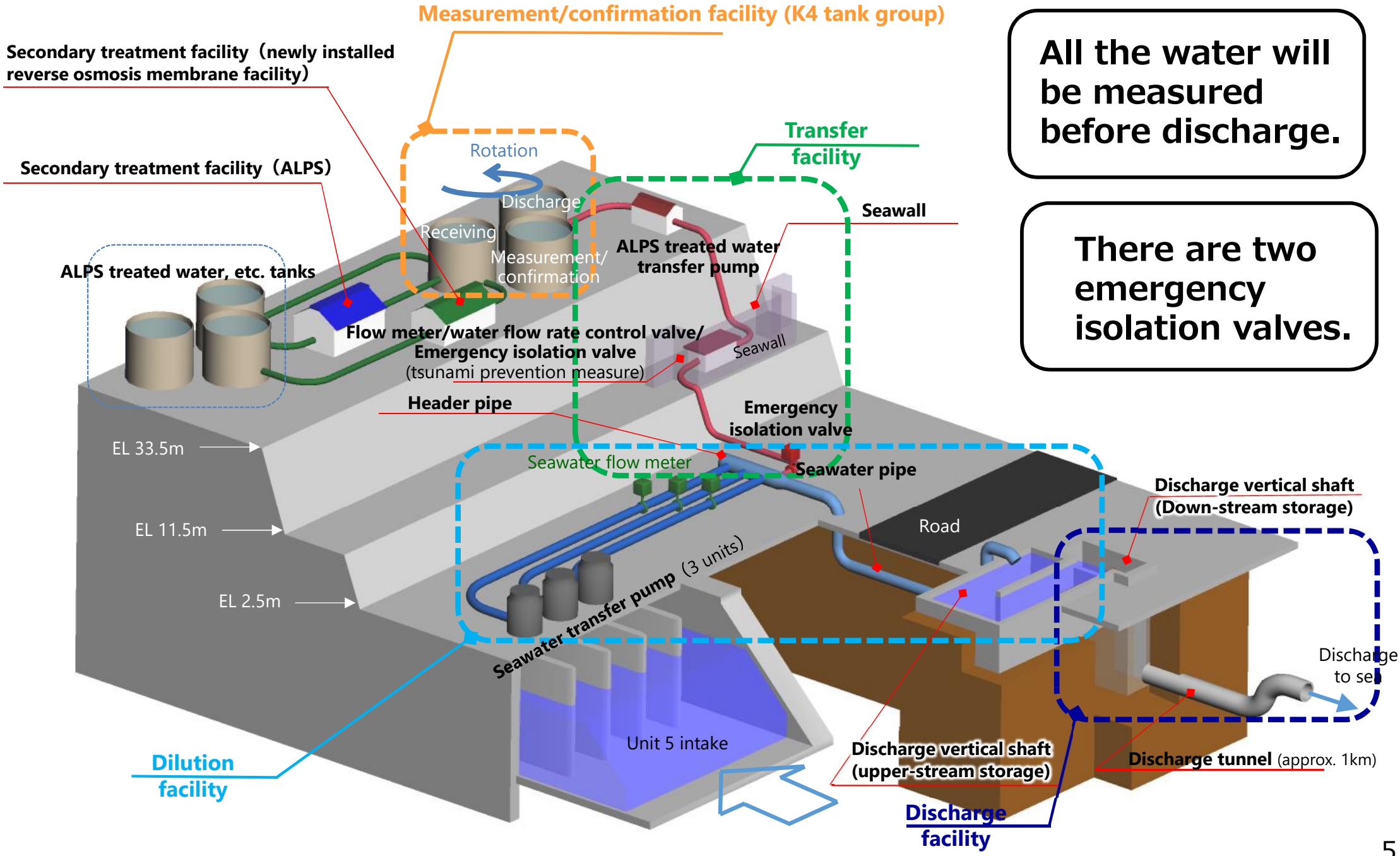
Source (ALPS treated water) monitoring before the discharge

It will be confirmed that nuclides other than tritium are **below regulatory standards** before the discharge
(If not, the treated water will not be discharged and will be re-purified.)

Monitoring in the sea area

Monitoring of seawater, seabed and marine food will be conducted to confirm no significant changes before and after ocean discharge

Discharge related facilities
①Measurement → ②Transfer → ③Dilution → ④Discharge



All the water will be measured before discharge.

There are two emergency isolation valves.

Safety of the Discharge Related Facility

- For the discharge into the sea

  1) The water that needs to be purified will be **purified by ALPS until the concentrations of nuclides other than tritium, fully satisfy the regulatory standards**.
  2) Water after the purification (ALPS treated water) **is agitated and homogenized in the" Measurement/Confirmation Facility** " and **the concentration *1 will be confirmed**.
  3) The treated water will be **diluted more than 100 times *2 at the "Dilution Facility" to meet the regulatory standard for tritium** and **only the water meeting the regulatory standard will be discharged into the sea***3.

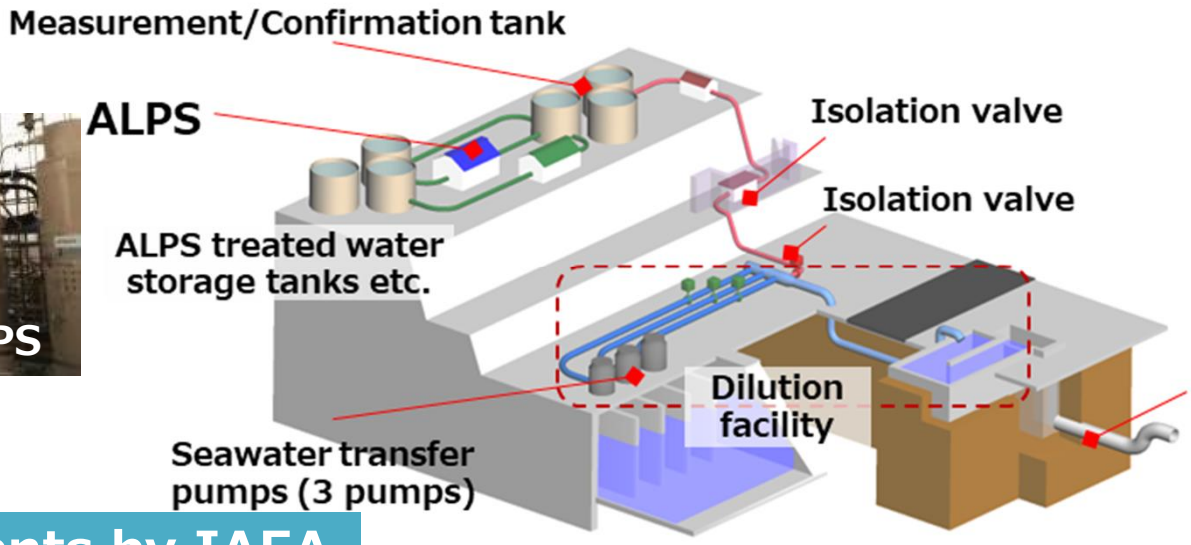
- If **an abnormality etc., is detected**, **the discharge will be stopped by closing the two emergency valves**.

*1 The third-party laboratories are also conducting analysis to ensure the objectiveness.

*2 Tritium concentration after the dilution will be less than 1,500 Bq/L (1/7 of the WHO Guidelines for drinking water quality value).

*3 Total annual amount of the tritium to be discharged will be less than the operational target of the FDNPS before the accident(22 TBq) .

Discharge related facilities for ALPS Treated Water



Assessments by IAEA

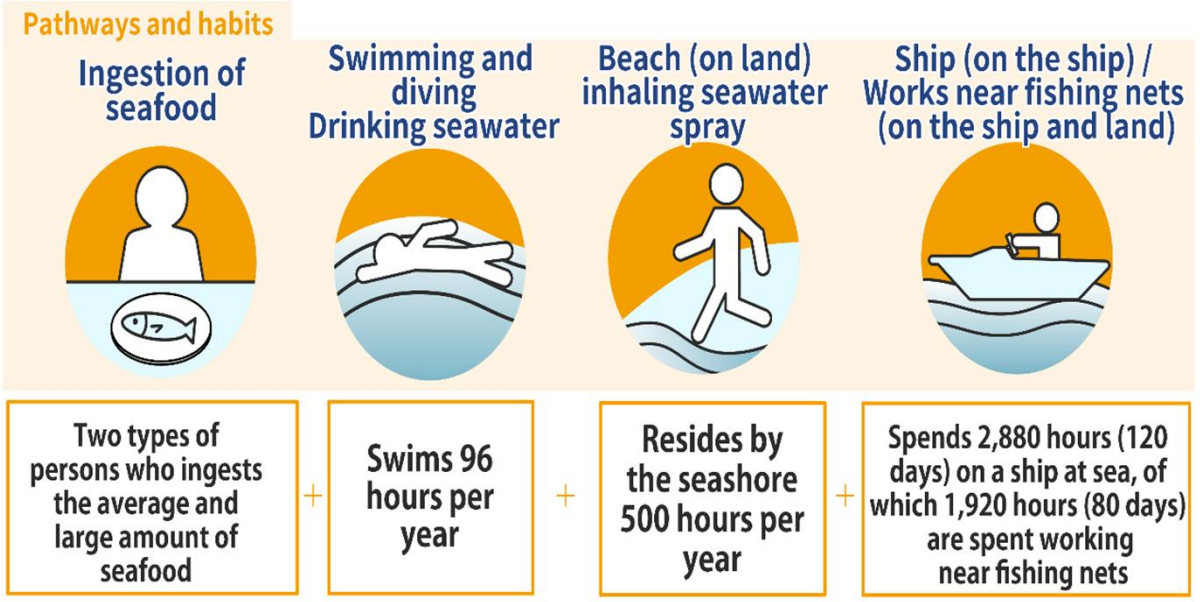
- ✓ **The systems and processes** in place **to control the discharges** of ALPS treated water **are robust and more than adequate for the expected low doses and the low risk arising** from the discharge process.
- ✓ **Redundancy was built into the system for some components**, such as emergency isolation valves and detectors.
- ✓ The pre-service inspections conducted by the NRA are sufficient to ensure the installation and operation of relevant **facilities and equipment is consistent with the NRA-approved Implementation Plan**.

Assessment of Radiation Impacts Using International Methods

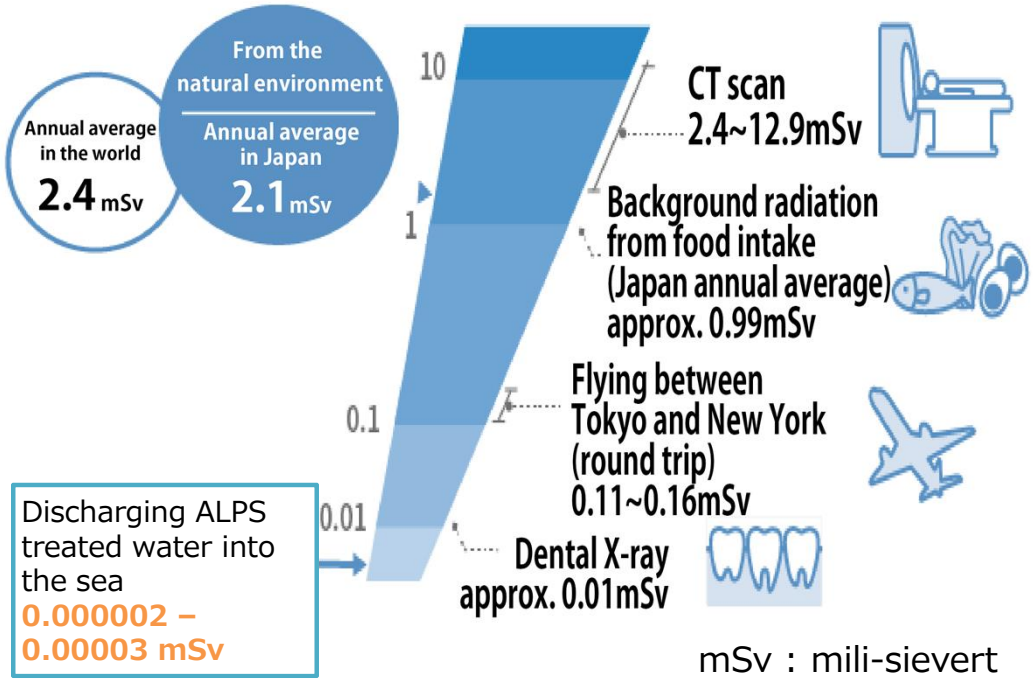
- **"The most affected person"** who frequents the sea area around the discharge point (10km×10km) is assessed.
- All radionuclides including tritium are assessed according to the IAEA evaluation method **considering the effect from food chain and bioaccumulation.**
- **The exposure dose on the public** is approx. 1/1,000,000 to 1/70,000 of natural radiation exposure (average in Japan:2.1mSv/y).
- **The exposure dose on animals and** plants is approx. 1/3,000,000 to 1/1,000,000 of the level defined by ICRP.

Assume "most affected case" as the target of assessment

Evaluated by people who are active and consume marine products in the surrounding waters.



Comparison with radiation impacts in daily life



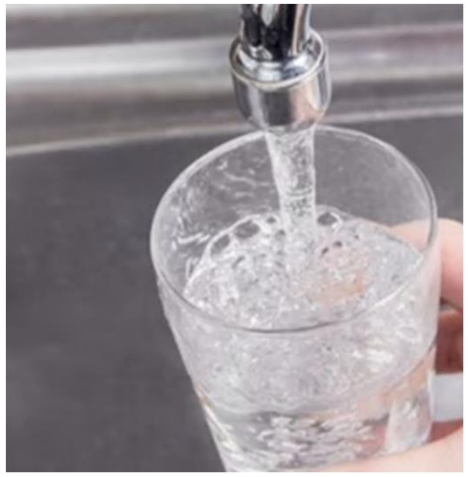
mSv : mili-sievert

Assessments by IAEA

- ✓ The discharge of the ALPS treated water will have **a negligible radiological impact on people and the environment**.
- ✓ **A REIA has been produced and is compliant with the international safety standards**.

Tritium is familiar and weak radionuclide

- **As a relative of hydrogen, tritium** is generated 70,000 Trillion Bq/year and **exists in rain, sea and tap water, as well as inside of our body**.
- Tritium emits weak radiation, which can be blocked by a sheet of paper. It is **not accumulated in human body and is excreted together with water from the body**.
- It is very difficult to remove tritium from water due to the same properties as hydrogen.

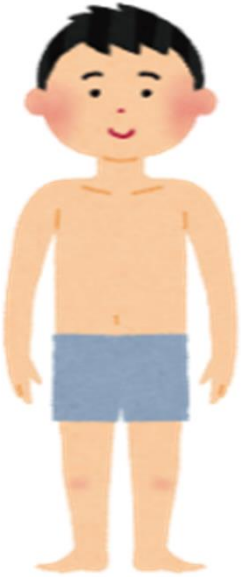


Tap water

≃ 1 Bq/L

Rain in Japan

= 220 Trillion Bq/year



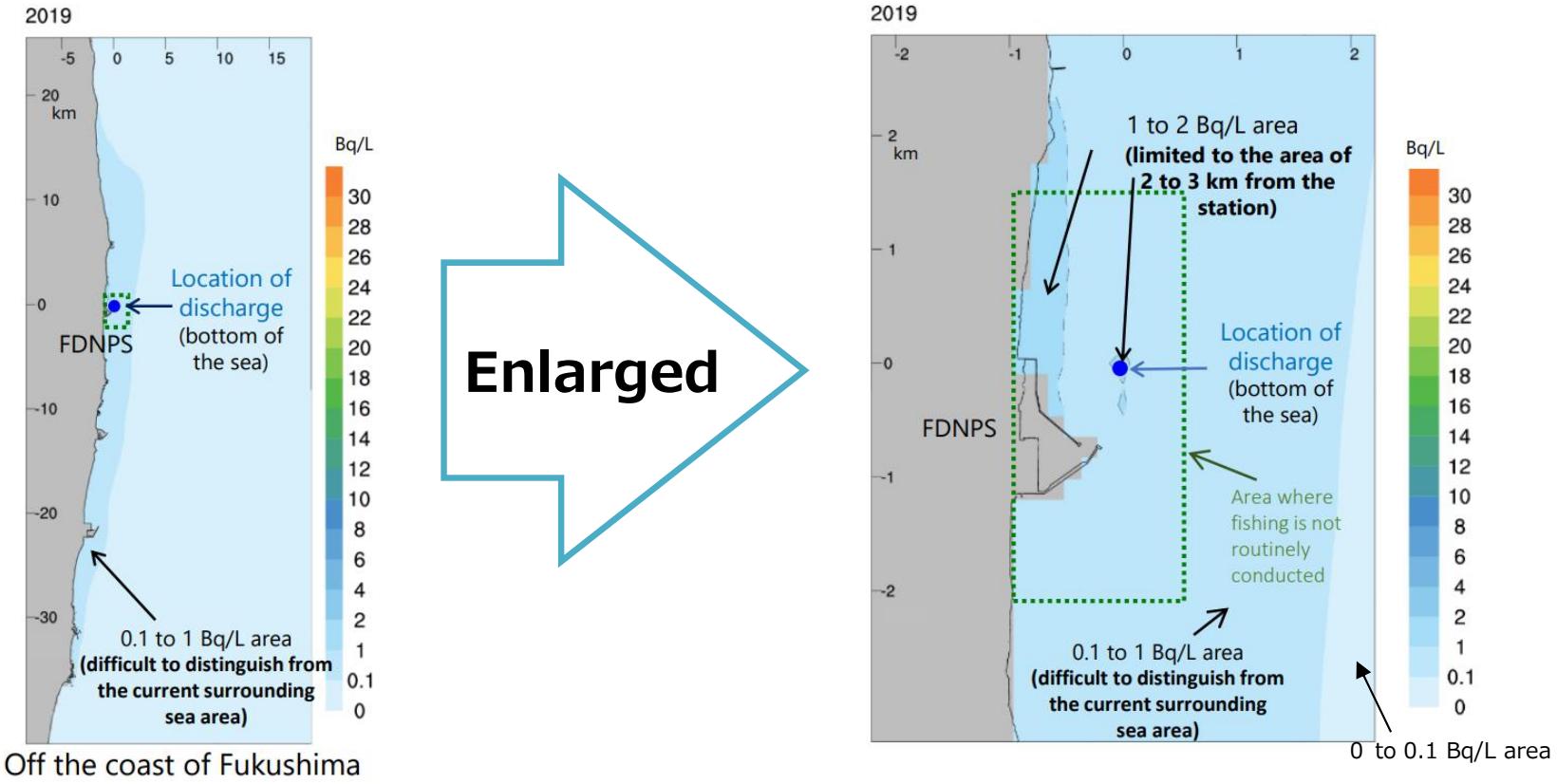
Human body

Tens of Bq

Results of dispersion simulation at sea

- Results of the simulation by TEPCO, the area assessed to have higher tritium concentration than current levels in the surrounding sea area (0.1 to 1Bq/L) will **be limited to the area of 2 to 3km from the FDNPS** for the annual average.
- It is **not distinguishable from the 'background' values**, at distances of **a few km from the FDNPS**.

Tritium concentrations have changed only slightly, and changes have been observed only in the sea area around the FDNPS.

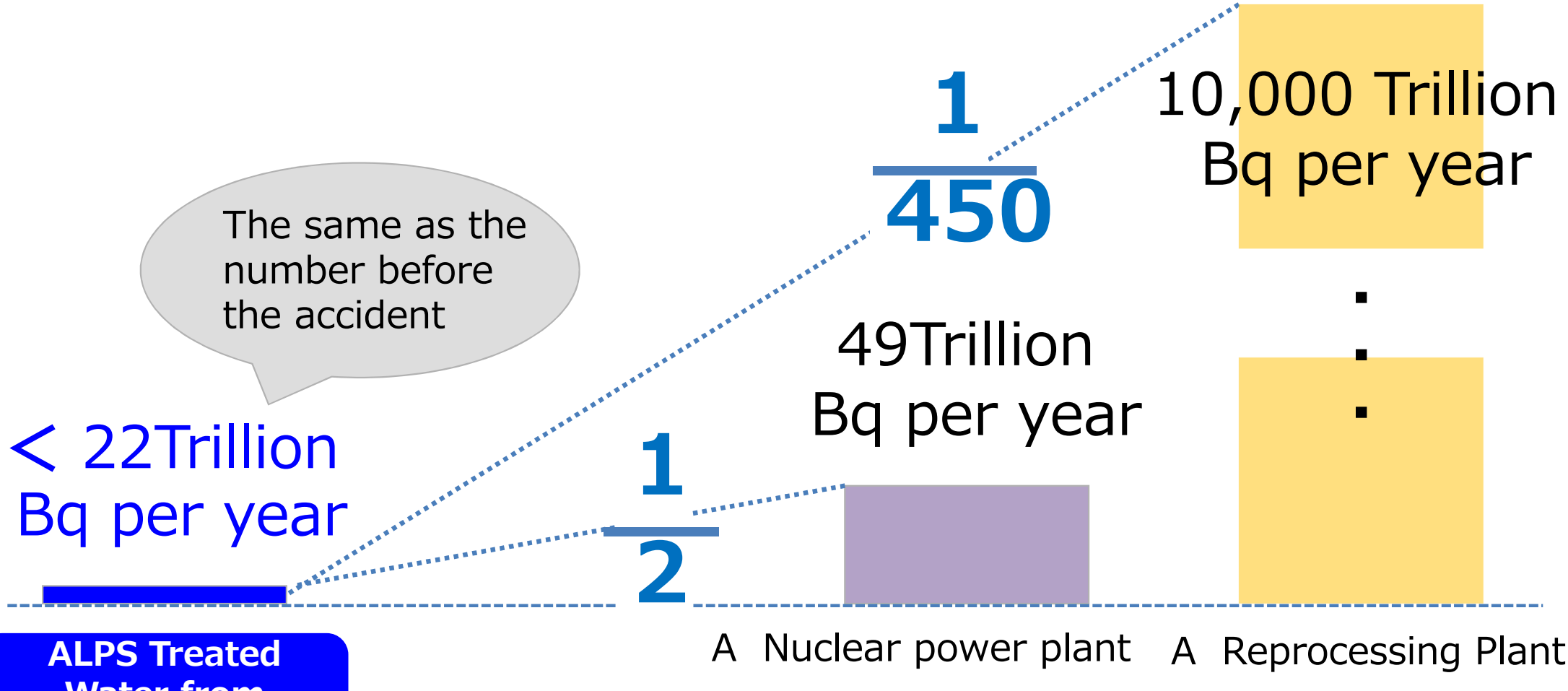


Assessments by IAEA

✓ Based on the results of the marine dispersion model, activity concentrations in international waters will not be influenced by the discharge of ALPS treated water into the sea and **the transboundary impacts are therefore negligible**.

Annual discharge limit of tritium is less than many nuclear facilities over the world

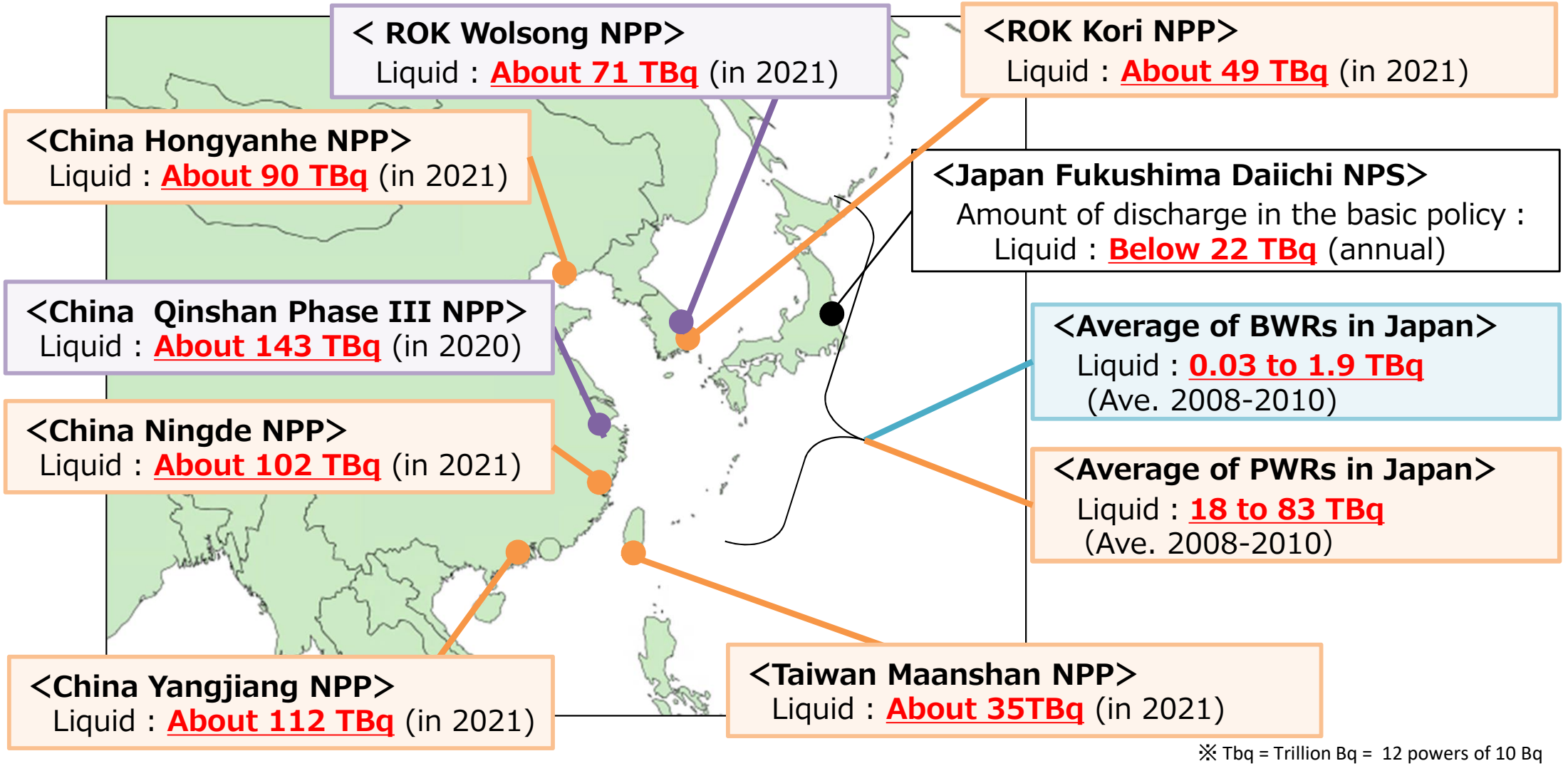
- **The annual amount of tritium to be discharged will be at a level below the operational limit of FDNPS before the 2011 accident** (22 Trillion Bq/year).
- It is lower than the ones of many nuclear facilities both at home and abroad.



Ref. Annual amount of tritium discharged in East Asia

- At nuclear facilities both at home and abroad, tritium is discharged as liquid waste into rivers and the sea etc.*, and also into the atmosphere through the ventilation process, in compliance with the domestic laws and regulations.

*Discharge from vessels etc. into the sea is prohibited by the London Convention.



※ Tbq = Trillion Bq = 12 powers of 10 Bq

Source：JNES, NRA Japan, KHNP website, China Nuclear Energy Association, Taiwan Power Company website

BWR: Boiling Water Reactor

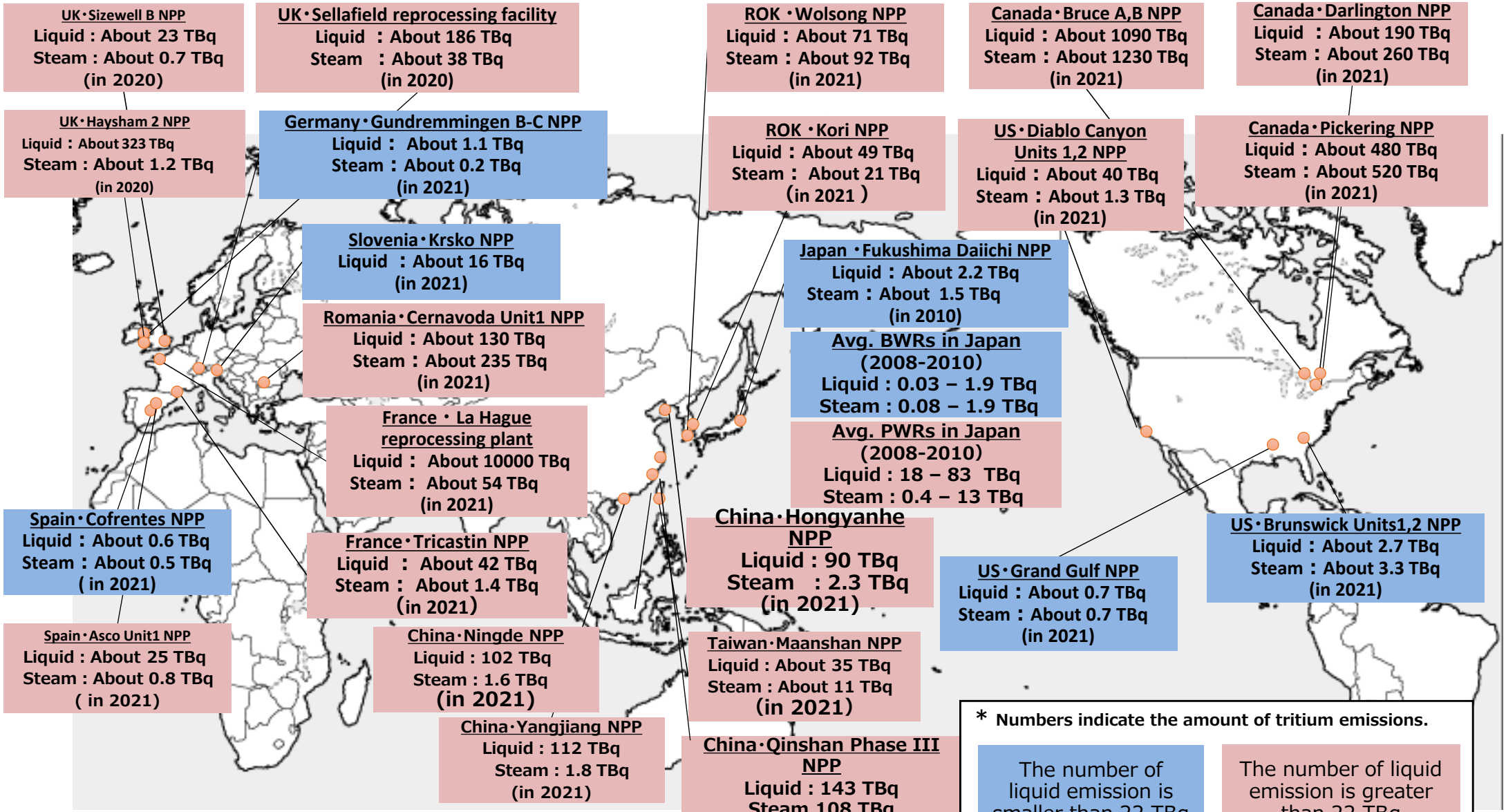
PWR: Pressurized Water Reactor

CANDU: Canada Deuterium Uranium

Ref. Annual amount of discharge of tritium over the world

- **At nuclear facilities in the world, tritium is discharged in compliance with the laws and regulations of each country and region.**

*Discharge from vessels into the sea is prohibited by the London Convention.



Source : UK : Radioactivity in Food and the Environment, 2021
Canada : CNSC, Radionuclide Release Datasets
Other countries and regions : Prepared from reports published by electricity providers in various countries and regions.

<Ref.> 1×10^{12}Bq≒ about0.019g (Tritiated water)

Reasons for selecting of the Discharge into the sea

Select the safest and most risk-manageable method in accordance with IAEA safety standards.

- The IAEA safety standards require ①safe disposal, and ②continuous monitoring of environmental impact and safety.
- **Based on experts' assessment over 6 years, discharge into the sea was selected, because (1) it has a track record in domestic and overseas nuclear facilities and can be safety disposed, and (2) it is easiest to monitor and continue to confirm safety in the environment.** It is not selected due to economic costs.
- Continuous storage in tanks will hinder decommissioning work, so room for expansion is limited. In addition, there is a risk of leakage due to deterioration, etc. in long-term storage.

Options Considered	Consideration results
Discharge into the sea	It can be implemented more reliably because it has a track record in domestic and overseas nuclear facilities, it is easy to predict the spread, and it is the easiest to monitor.
Geosphere injection	There is no monitoring technology to understand the environmental impact, and there are no regulatory standards for suitable sites.
Vapor release	Poor certainty due to lack of track record, difficulty in predicting diffusion, and challenges in monitoring.
Hydrogen release	Technologies such as pretreatment and scale expansion have not been established.
Underground burial	Moisture containing tritium evaporates during solidification, and since it must be managed as radioactive waste, it interferes with decommissioning.
Long-term storage	Limited room for additional tanks to expand storage capacity on site. Risks of Leakage due to tank deterioration, etc.
Off-site storage	Risks of leakage due to tank deterioration, etc.

Evaluation by IAEA

- ✓ **D.G. Grossi said the discharge was "technically feasible and in line with international practice."**
- ✓ The IAEA notes that **the government of Japan has followed a decision-making process leading to the justification of its approach**.

Source monitoring before discharge

- In addition to the TEPCO, **the objectivity of data on radioactive nuclides in the ALPS treated water before discharge is thoroughly ensured by having the third-party laboratory to conduct independent analysis** to confirm that the water meets regulatory standards.
- **IAEA and the third-party laboratory* will also conduct analyses of the ALPS treated water to corroborate the TEPCO's source monitoring**.
  (On June 22, TEPCO published the analysis results of the ALPS treated water in the first tank to be discharged. **It has been confirmed that the concentration of nuclides other than tritium are below the regulatory standard before the discharge**.)

* In France, the U.S., Switzerland and Korea

The analysis result for the first discharge (sampled in March 2023)

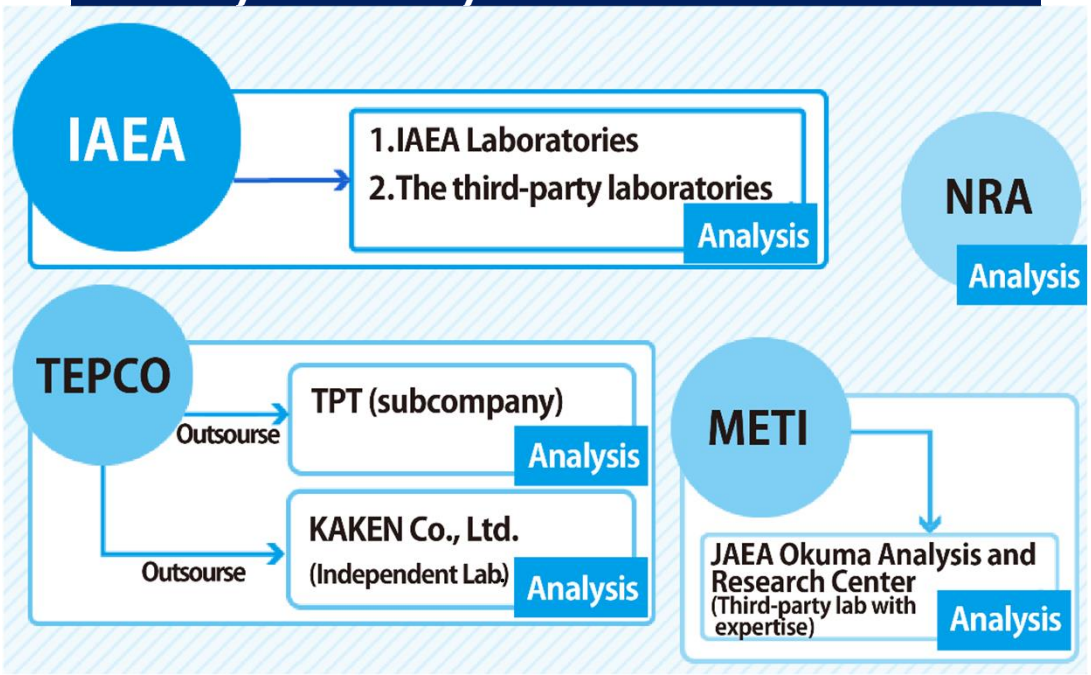
Percentage of Radiation Impact
(Regulatory Standards: The sum is less than 1)

Detected nuclides[*1] : **0.25**
Non-detected nuclides[*2] **: 0.026**
⇒ **Sum : 0.28 ＜ 1**

*1: Total of 7 detected nuclides this time
*2: Assessed **with the conservative assumption that the nuclides exist at the detection limit etc.**

At the discharge, the degree of the impact will be further reduced by **diluting the water more than 100 times.**
- **For tritium, less than 0.025**
- **For other nuclides, less than 0.0028**

Analytical entity for ALPS treated water



Assessments by IAEA

- ✓ The activities and approach taken by TEPCO and NRA are **consistent with the relevant international safety standards**.
- ✓ The results of the first ILC provide confidence in TEPCO's capability for undertaking **accurate and precise measurements**. Based on the observations of the IAEA, TEPCO has demonstrated that it has a **sustainable and robust analytical system**.
- ✓ **Neither the IAEA, nor the participating third-party laboratories, detected any additional radionuclides** (i.e., radionuclides beyond what is included in the source term) at significant levels.

Characteristics of ALPS treated water
(selection of nuclides to be confirmed before discharge, purification performance of ALPS, etc.)

- The ALPS has 62 nuclides to be removed, but **in response to the IAEA's suggestion**, **29 nuclides other than tritium that could realistically exist in the water before treatment were to be analyzed before the discharge**, taking half-lives and other factors into consideration. **(No nuclides other than the 29 nuclides have been detected so far, but measurement continues.)**
- **Only 9 out of 29 nuclides were detected after treatment by ALPS**, and these were also purified to well below the regulatory standard, indicating that ALPS has achieved stable purification with sufficient performance.
- **The reason why 70% of the total water exceeded concentration limits was because the frequency of replacement of adsorbent was reduced in order to increase the amount of water treated**, **prioritizing the reduction of the dose at the site boundary**. After 2019, ALPS will provide stable purification with sufficient performance.

Concept of selection of nuclides to be confirmed before discharge

Even taking into account the half-life could exist in 12 years (2023)

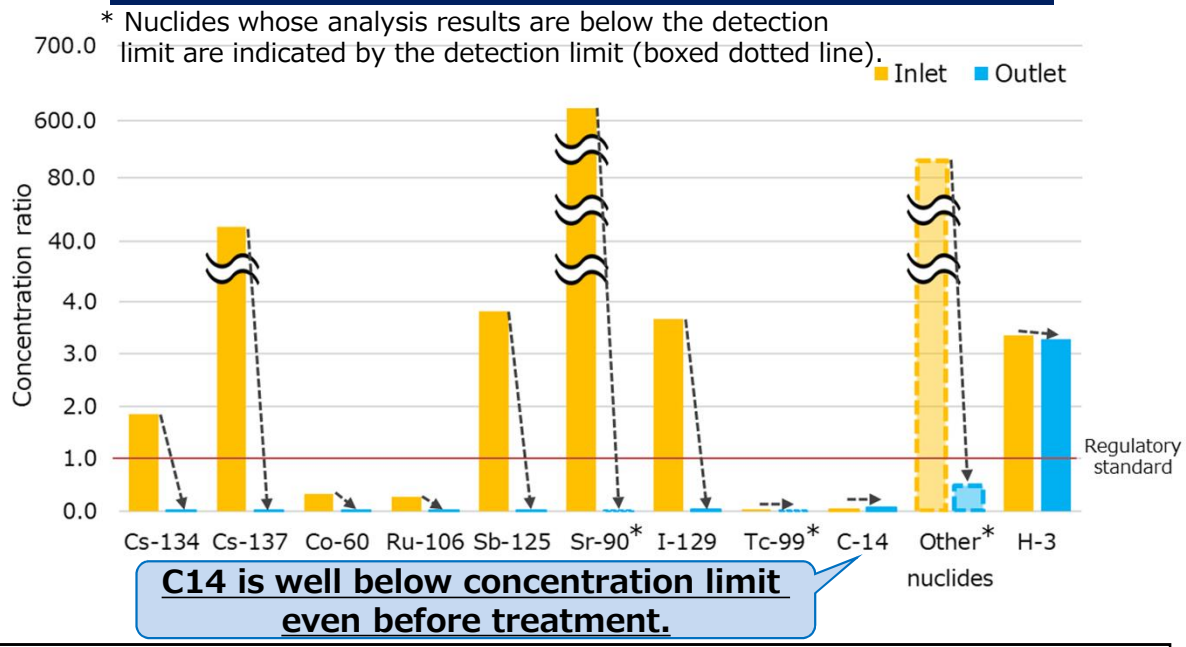
↓ 210 nuclides

Considering its solubility in water, etc. can realistically exist

↓ 30 nuclides

Selected "29 nuclides" excluding tritium

Example of ALPS treatment results (May 2022)



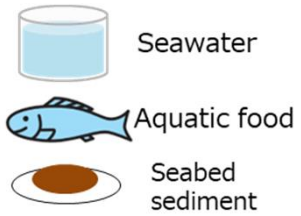
Assessments by IAEA

- ✓ The concept and results of selecting 29 nuclides are **sufficiently conservative, yet realistic**.
- ✓ **Many radionuclides** included in the source term **will never be detected in ALPS treated water**.

Monitoring in the Sea Area

- **Monitoring is conducted by the relevant ministries, agencies, local governments and TEPCO**, etc., based on the "Comprehensive Radiation Monitoring Plan," which was designed to systematically confirm the radioactive materials in the environment.
- **Monitoring in the sea area has been conducted even before the start of the discharge and it will be confirmed that there is no significant change after the start of the discharge.**
- **Strengthen and expand monitoring by increasing the frequency of the ordinally precise measurement as well as by adding the measurements using a method that provides results rapidly (Rapid Analysis Method).**

【Target】



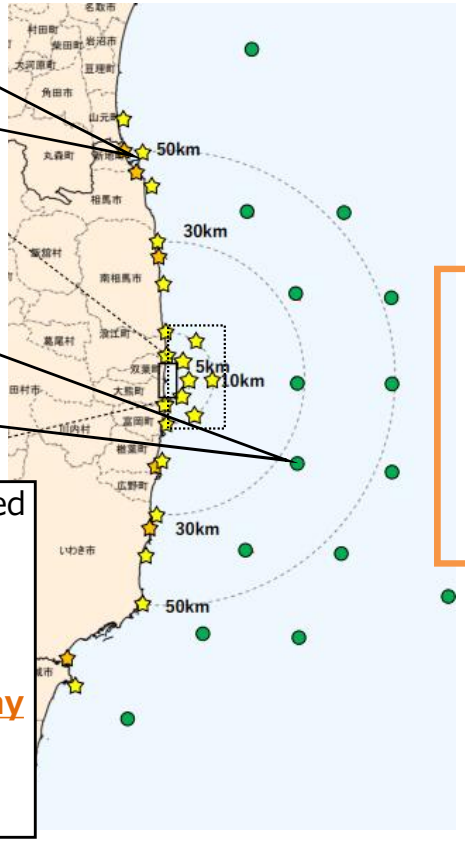
- Additional sampling points ☆ from FY 2022, mainly within 10km . (☆, the tritium is measured at the swimming beach)

- Tritium is also measured at the ● points, several tens of kilometers away (Points approx. 30 km and 50km away, Southern area of off sea from Miyagi Prefecture and Northern area of off-sea from Ibaraki Prefecture)

- For aquatic foods, tritium are measured for approximately 200 samples.
- Additionally, Rapid analysis (detection limit is approx. 10Bq/L) has been conducted **for 180 samples**, which data available the **next day or the day after that**.

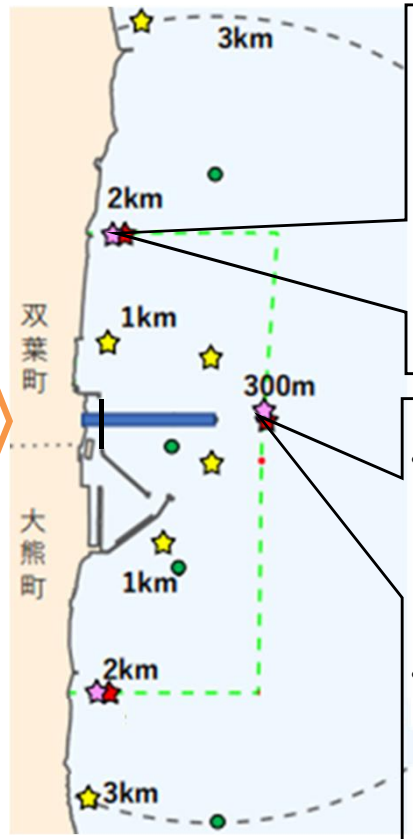
* The range of the are is the pacific side of eastern Japan (Hokkaido to Chiba Pref.)

【Broad Map】



Enlarged

【Area of radius of 3 km】



- For the points ★,
  – Measurement to shorten the period of analysis will be conducted for the time being. (Weekly at maximum for about 10 sampling points)
  – **precise measurement** will be conducted **monthly**. (Basically 4 times a year, taking into account seasonal changes)

- For the points ★, nuclides other than tritium is measured
  - 7 main nuclides (Cesium etc.): 4 times a year
  - Even broader range of nuclides: Once a year
- **Aquatic organisms are also measured 4 times a year or less**
  - Tritium in fish (FWT, OBT), Carbon-14
  - Iodine-129 in seaweeds(Ukedo Fishing Port, Tomioka Fishing Port)

Assessments by IAEA

✓ The activities and approach taken by TEPCO and NRA are **consistent with the relevant international safety standards**.

✓ A clearly defined plan for **enhanced environmental monitoring** by **TEPCO and the Government of Japan** to address the discharges of ALPS treated water is in place.

Future involvement of the IAEA

- The IAEA is **committed to engaging with Japan** on the discharge of ALPS treated water **not only before, but also during, and after the treated water discharges occur**.
- The IAEA will maintain an onsite presence at FDNPS throughout its review and will publish available data for use by the global community, including the provision of real-time and near real-time monitoring data from FDNPS.
- **Additional review and monitoring activities are envisaged** that will continue and which will provide **additional transparency and reassurance to the international community**.

Future Activities

Assessment of Protection and Safety	○**Review TEPCO's implementation plan and supporting documentation** ※Focus on technical considerations such as source characterization, safety related aspects of the approach, occupational radiation exposure, radiological environmental impact assessment.
Regulatory Activities and Process	○**Review NRA actions and processes relevant to the project** ※Focus on safety objectives, regulatory requirements, regulatory assessment, regulatory inspections.
Independent Sampling, Data Corroboration and Analysis	○**Independent sampling and analysis to corroborate data from Japan** ○Perform analysis of source term and environmental samples ○Corroborate monitoring results for occupational exposure.
Additional Activities	○The IAEA has established **an IAEA site office at the FDNPS**. **IAEA experts will maintain** a constant presence on site **for a number of weeks before and after the discharges** of ALPS treated water. Outside of this timeframe, the IAEA experts will be on site for major activities and conducting monitoring as needed. ○The IAEA will **share the status of the ALPS discharge facilities** provided by TEPCO **on a real-time or near real-time** **for members of the public**.

Progress of Reconstruction in Fukushima

- Reconstruction and recovery from the nuclear accident in 2011 is steadily progressing.
- Industries including fisheries are also revitalized. Fish auction in the **Ukedo fishery harbor**, 6 km far from TEPCO's Fukushima Daiichi NPS (FDNPS) was resumed in April 2020.
- The safety of the discharge of ALPS treated water is important for us, too.

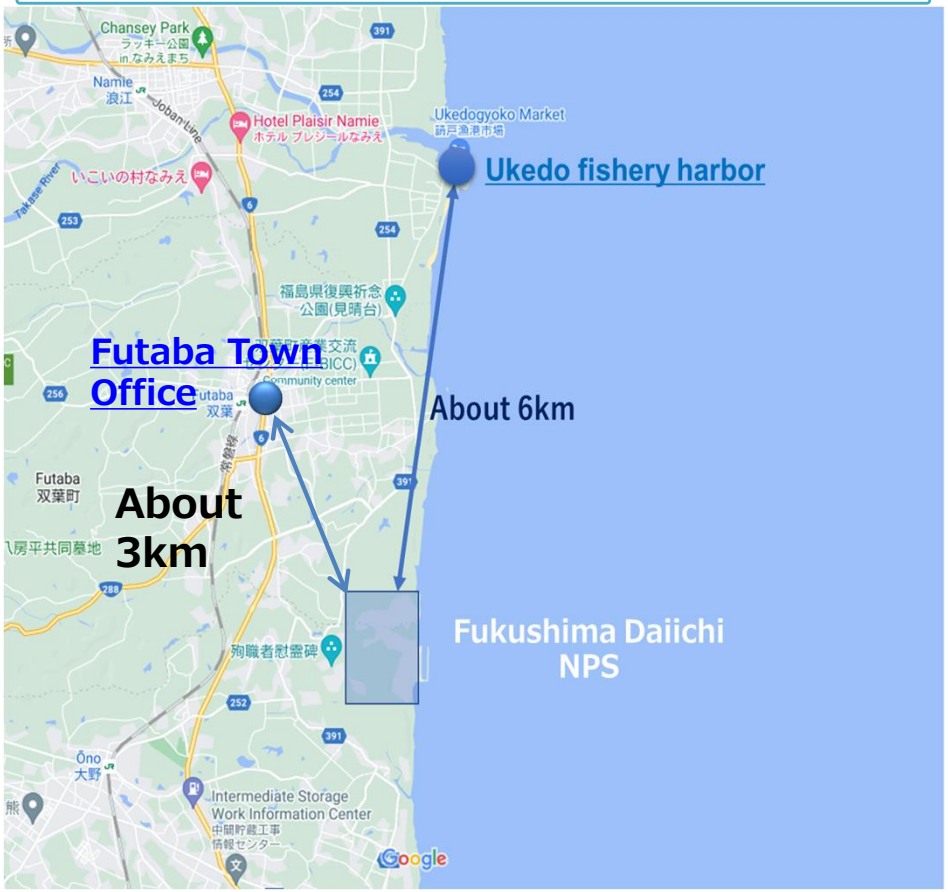
Auction at Ukedo fishery harbor

A short video of Ukedo Fishery Harbor:
https://www.youtube.com/watch?v=-lbUTeHqsx8

Reopening of Futaba town office

Yonomori Sakura Festival

Location of Ukedo fishery harbor and Futaba



Detailed information on handling ALPS treated water is as below.

(METI ALPS treated water portal site)
https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/atw.html

(IAEA website: Fukushima Daiichi Treated Water Discharge)
https://www.iaea.org/topics/response/fukushima-daiichi-nuclear-accident/fukushima-daiichi-treated-water-discharge#faq

(TEPCO portal site)
https://www.tepco.co.jp/en/decommission/progress/watertreatment/index-e.html