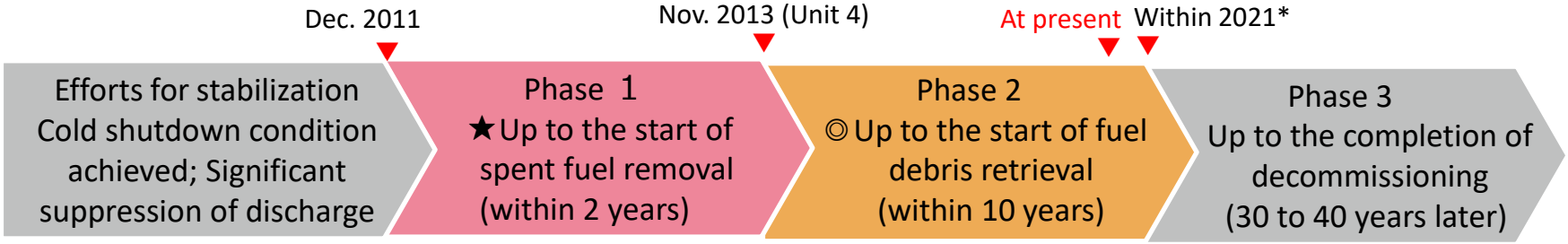
Efforts and Progress for Decommissioning

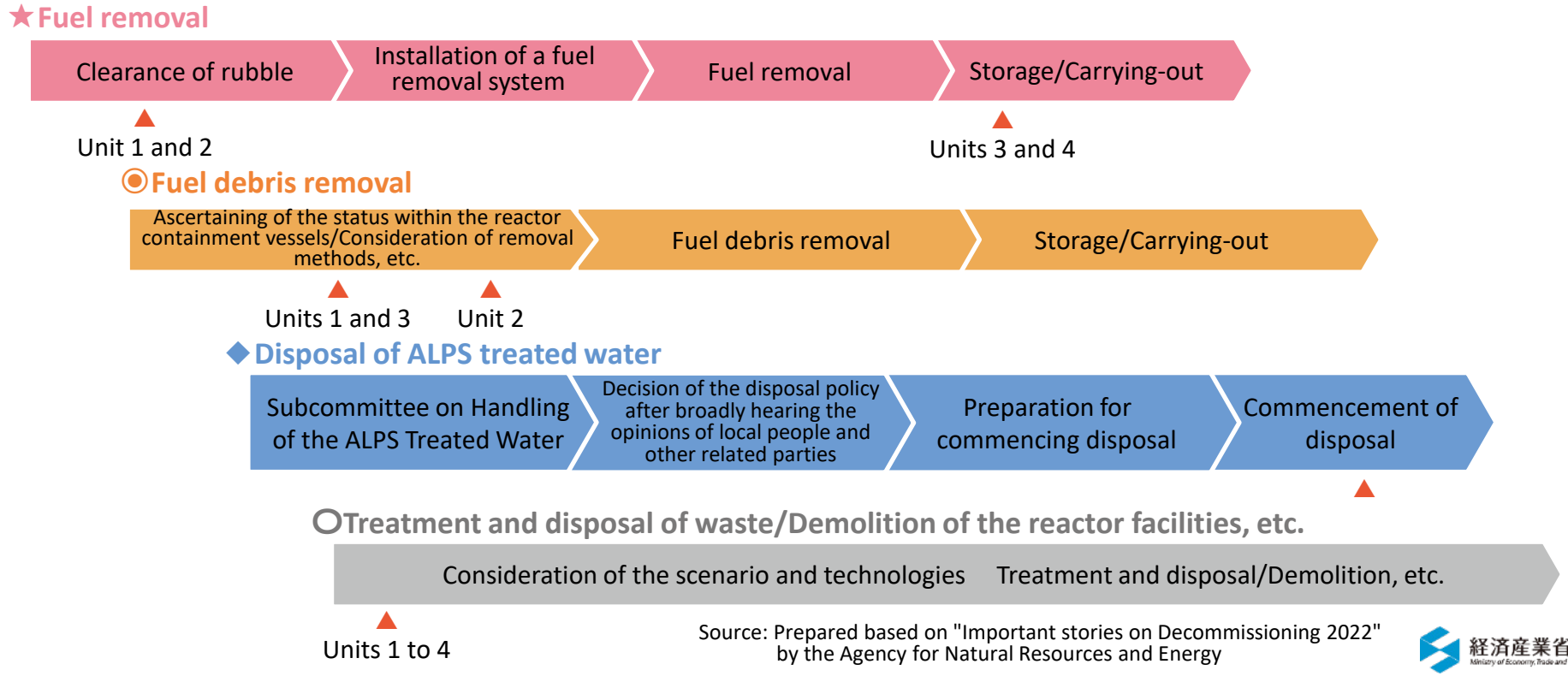
Procedures for Decommissioning and Contaminated Water and Treated Water Management at TEPCO's Fukushima Daiichi NPS

Overall framework of decommissioning procedures



* Based on the status of the development of robot arms, which are necessary for trial removal of fuel debris, the plan will be reviewed in around the latter half of FY2023.

Decommissioning procedures



Source: Prepared based on "Important stories on Decommissioning 2022" by the Agency for Natural Resources and Energy

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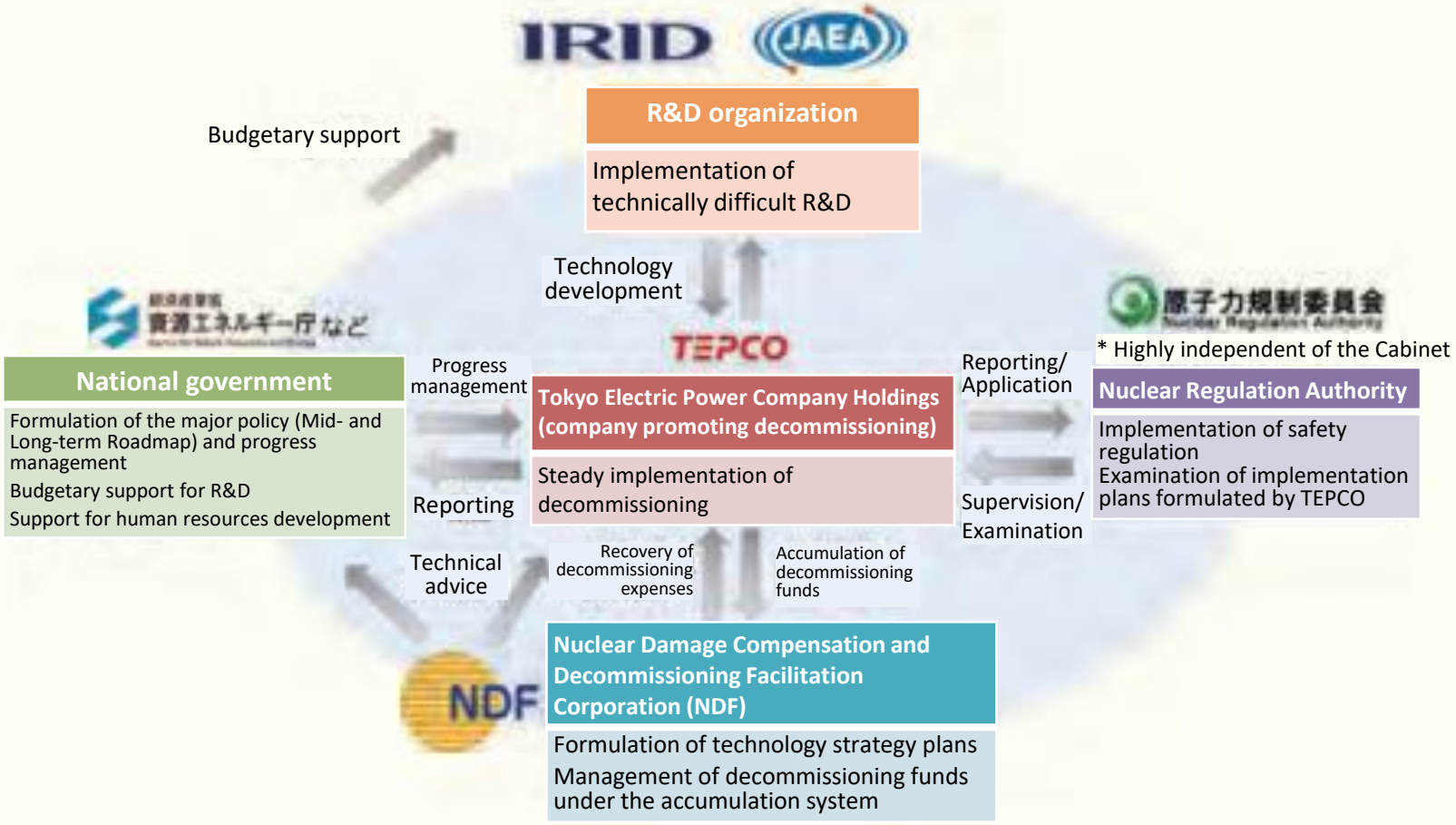
Efforts and Progress for Decommissioning

Organizations and Tasks

Decommissioning work is being carried out in cooperation with local companies and other organizations, as well as with the collective wisdom from Japan and abroad.

Division of roles among organizations involved in decommissioning of the Fukushima Daiichi NPS



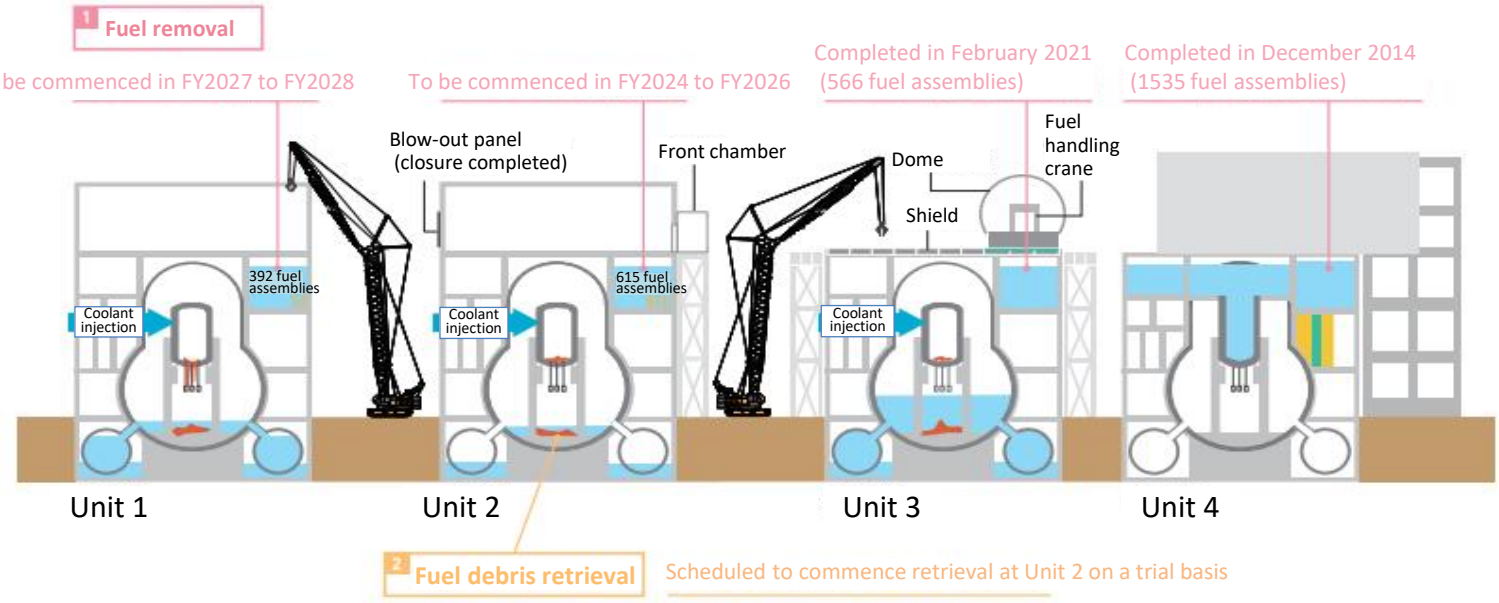
Source: Prepared based on "Important Information on Decommissioning 2022" by the Agency for Natural Resources and Energy

Efforts and Progress for Decommissioning

Progress in Efforts for Decommissioning

Current status of Units 1 to 4

◯ Situation differs by unit, and methods of carrying out measures and progress are also different.

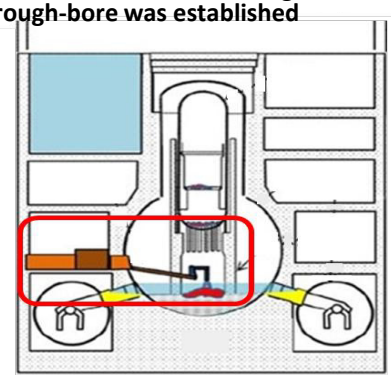


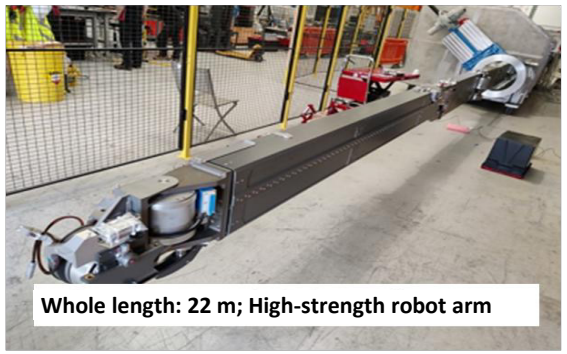
* No accident occurred in Units 5 and 6, but fuel removal work will be conducted sequentially for these units as well.

Future plan for fuel debris retrieval

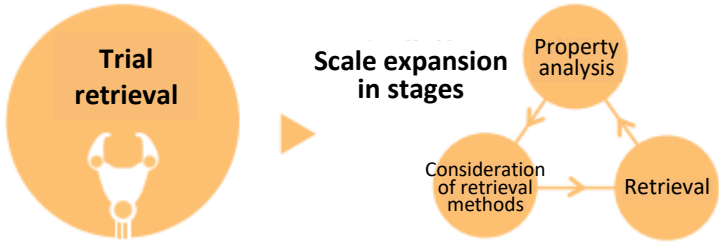
◯ Retrieval work on a trial basis will be commenced at Unit 2 first and the scale of the retrieval work will be expanded in stages.

Retrieval method of inserting a robot arm into a containment vessel through a small through-bore was established





Whole length: 22 m; High-strength robot arm



Source: Prepared based on "Important Information on Decommissioning 2022" by the Agency for Natural Resources and Energy

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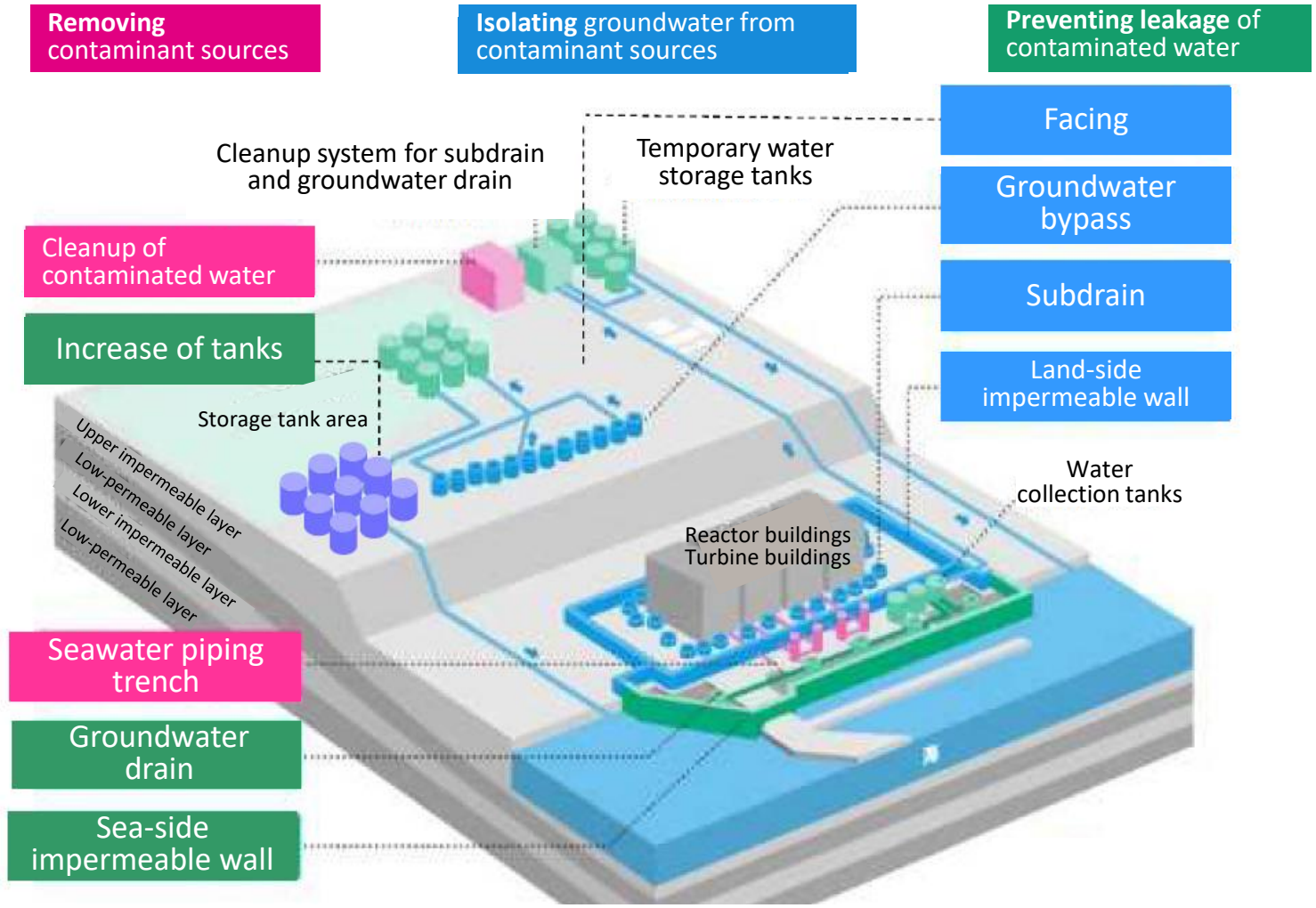
Efforts and Progress for Decommissioning

Measures against Contaminated Water

Preventive and multi-layered measures are being taken against contaminated water based on policies of (i) removing contaminant sources, (ii) isolating groundwater from contaminant sources, and (iii) preventing leakage of contaminated water.



Prepared by the Ministry of Economy, Trade and Industry based on the materials of Tokyo Electric Power Company

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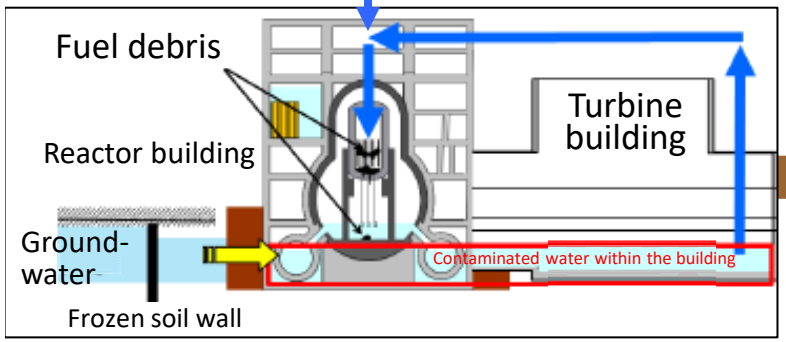
Efforts and Progress for Decommissioning

ALPS Treated Water – Purification of Contaminated Water –

■ Contaminated water with radioactive materials is being generated after the accident at TEPCO's Fukushima Daiichi NPS. "ALPS treated water" refers to the water that has been treated by the Advanced Liquid Processing System (ALPS) and other equipment and has been purified to a level where contained radioactive materials, except for tritium, satisfy the regulatory standards for discharge into the environment.

Freshwater obtained through desalination is used as coolant.



Contaminated water

Purification treatment of cesium and strontium

SARRY

KURION

Separate fresh water

Desalinator

Purification treatment of 62 types of radioactive materials other than tritium

Advanced Liquid Processing System (ALPS)

Pre-treatment facilities (coprecipitation treatment)

Adsorption tower

Water that satisfies the regulatory standards for environmental discharge with regard to radioactive materials, except for tritium, contained therein

Water that does not satisfy the regulatory standards for discharge into the environment with regard to radioactive materials, except for tritium, contained therein

Secondary treatment using ALPS or reverse osmosis membrane equipment

ALPS treated water

(Source) Prepared based on "Fukushima Daiichi Nuclear Power Station: Contaminated water management: What is 'slurry'? Why is it generated? How is it stored?" by the Agency for Natural Resources and Energy (https://www.enecho.meti.go.jp/en/category/special/article/detail_157.html)

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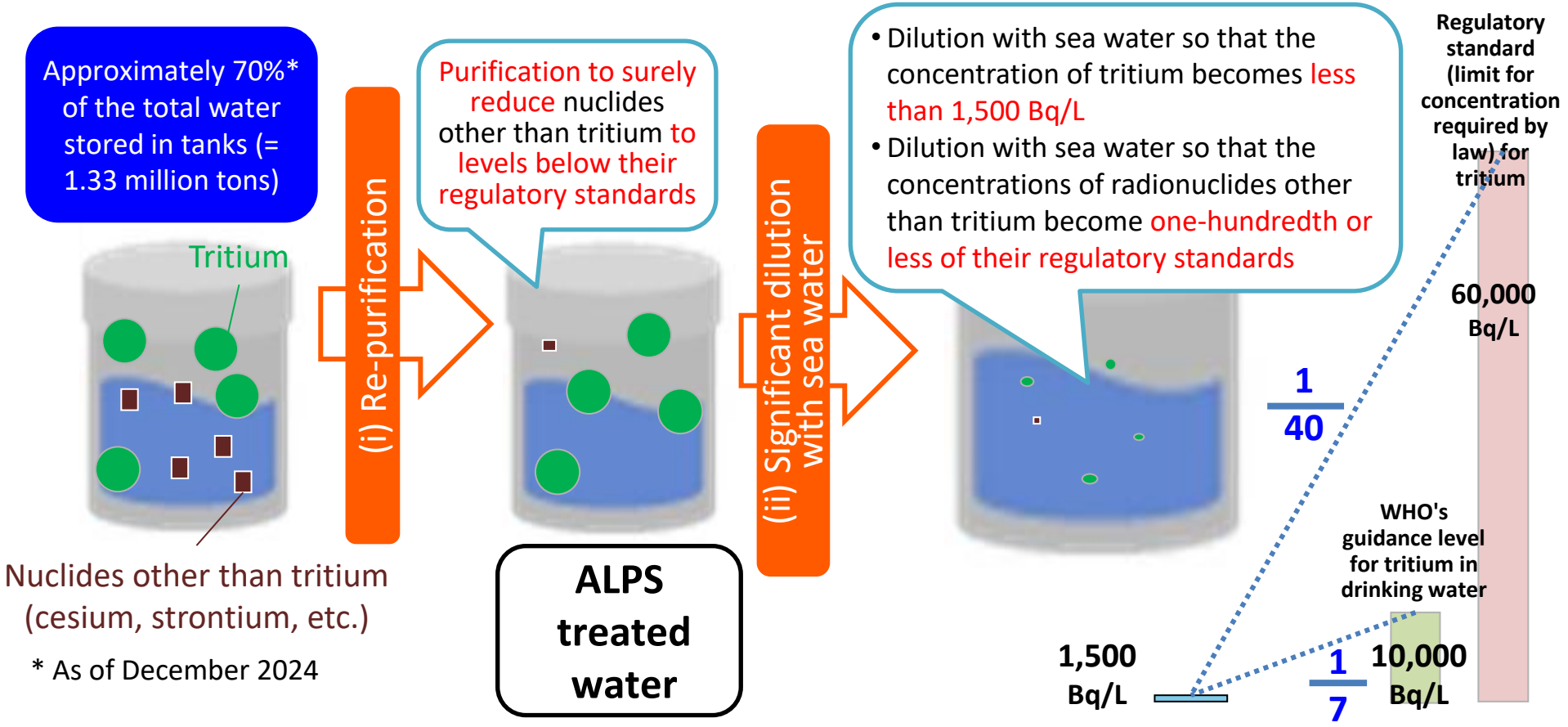
Efforts and Progress for Decommissioning

Treatment Method for Water Stored in Tanks

- Reduce concentrations of the radioactive materials contained in treated water far below the regulatory standards through 1) re-purification of radionuclides other than tritium; and 2) dilution by more than 100 times with sea water.
- Discharge water into the sea from TEPCO's Fukushima Daiichi NPS, and conduct monitoring before and after the discharge (evaluation and review by third parties, such as an international organization).



* As of December 2024

(Source) "ALPS Treated Water" (website of the Ministry of Economy, Trade and Industry) (https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/atw.html)

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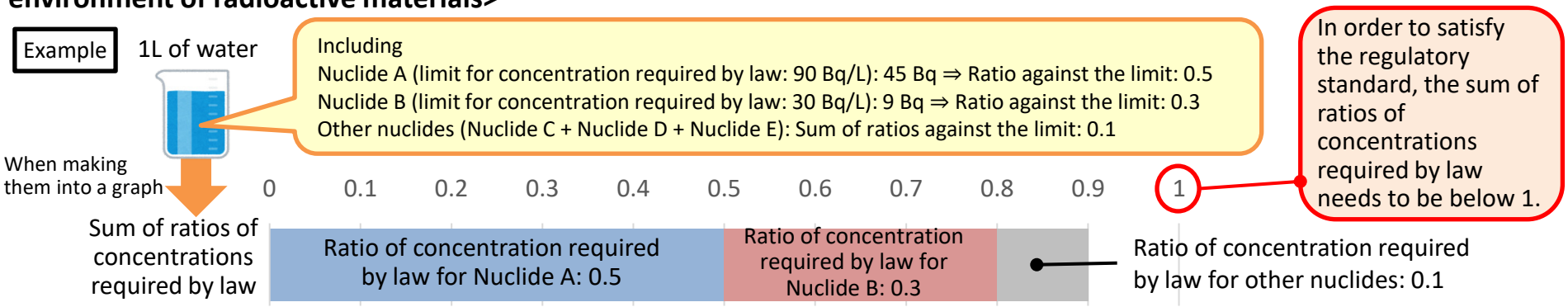
Efforts and Progress for Decommissioning

Regulatory Standards for Discharging Radioactive Materials into the Environment

- Whether the regulatory standard is satisfied or not is evaluated based on the sum of radiation effects caused by all types of contained nuclides, irrespective of whether the reactor is an operating one or a damaged one (evaluations are based on the sum of the values converted to the effects on human beings, not simply based on types or amounts of nuclides).
- Contaminated water at TEPCO's Fukushima Daiichi NPS contains radioactive nuclides unique to the broken-down reactors (such as cesium and strontium), but these are surely removed to levels below the regulatory standards by the use of the Advanced Liquid Processing System (ALPS) and other equipment.

< Concept of the sum of ratios of concentrations required by law, the regulatory standard for discharge into the environment of radioactive materials>



[Reference] Results of the performance test regarding re-purification by the use of ALPS and other equipment (sum of ratios of concentrations required by law and ratios against the limits for major nuclides)

	Cobalt 60	Cesium 137	Strontium 90	Iodine 129	Other nuclides	Sum for nuclides other than tritium (sum of ratios of concentrations required by law)
Ratio against the limit for concentration required by law	0.0017	0.0021	0.0012	0.13	0.215	**0.35**

Dilution by more than 100 times so that the sum of the ratios of concentrations required by law for all radioactive materials including tritium becomes less than 1

(Source) Prepared based on "First priority is given to safety and security; Measures related to contaminated water in Fukushima (iv): Regulatory standards for radioactive materials" (https://www.enecho.meti.go.jp/about/special/johoteikyo/osensuitaisaku04.html) (in Japanese) and "Safe and secured disposal of treated water for reconstruction and decommissioning (ii): Secondary treatment and other nuclides contained in treated water" (https://www.enecho.meti.go.jp/about/special/johoteikyo/shorisui02.html) (in Japanese) by the Agency for Natural Resources and Energy, and "Performance test regarding secondary treatment of ALPS treated water" by Tokyo Electric Power Company Holdings

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Efforts and Progress for Decommissioning

Nuclides Other than Tritium

- Contaminated water generated at TEPCO's Fukushima Daiichi NPS not only contains tritium but also contains Cesium 137, Strontium 90 and other radioactive materials which are seldom detected in water discharged from ordinary nuclear power stations.
- The Advanced Liquid Processing System (ALPS) has the ability to remove 62 types of nuclides. Radioactive materials other than tritium contained in the contaminated water are purified by the use of the ALPS to the extent that their concentrations become below the regulatory standards that were set respectively by type.

Nuclides to be purified using ALPS (62 types)

Major seven types:
- Cesium 137
- Cesium 134
- Strontium 90
- Cobalt 60
- Antimony 125
- Ruthenium 106
- Iodine 129

55 types:
- ・
- ・
- ・
- Technetium 99

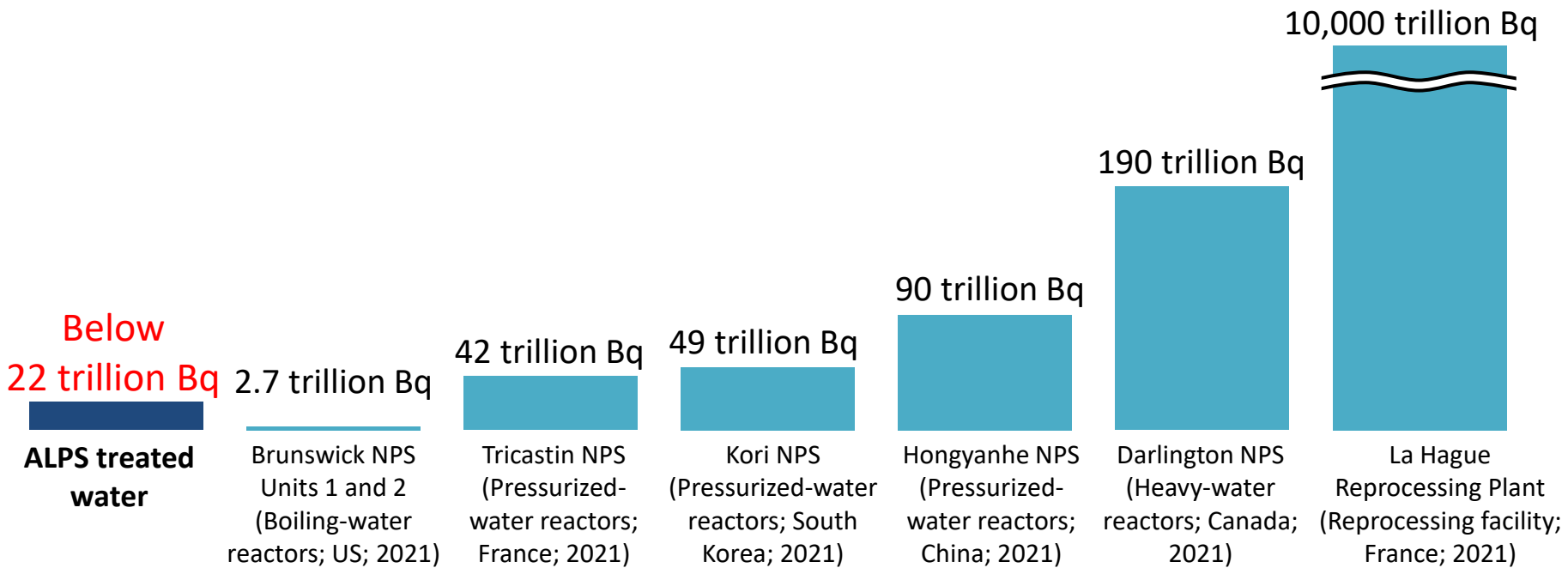
Other nuclides:
- Carbon 14
- ・
- ・
- ・

(Source) Prepared based on "Performance test regarding secondary treatment of water treated by the use of the ALPS and other equipment," etc. by Tokyo Electric Power Company Holdings

Efforts and Progress for Decommissioning

Annual Discharge Amounts of Tritium - International Comparison -

- The total amount of tritium at the time of discharge of ALPS treated water is below 22 trillion Bq per year (operational target value prior to the accident).
- Tritium is discharged as liquid waste into the sea or rivers or as gaseous waste into the air also at other nuclear power stations and reprocessing facilities inside and outside Japan in compliance with the laws and regulations of respective countries.



Annual discharge amounts of tritium (liquid) from ALPS treated water and at nuclear facilities around the world

(Source) Prepared based on "ALPS Treated Water" on the website of the Ministry of Economy, Trade and Industry (https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/atw.html)

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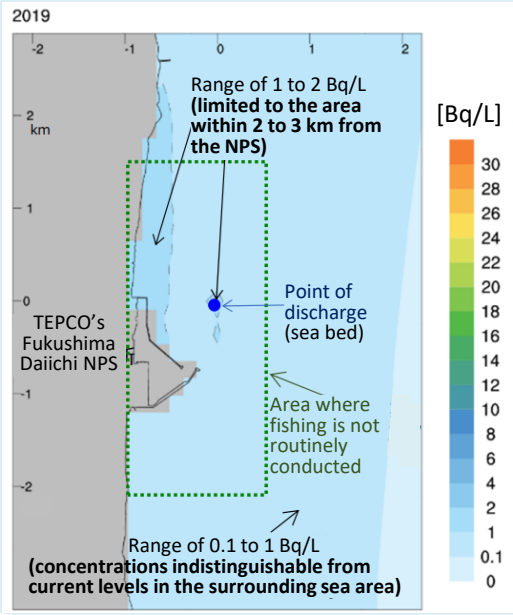
Efforts and Progress for Decommissioning

Assessment of the Radiological Impact of Discharge of ALPS Treated Water into the Sea

- When discharging ALPS treated water into the sea, dilution is to be surely conducted and the diffusion and potential radiological impacts on humans and the marine environment are to be scientifically assessed.
- The content of the assessment is to be reviewed as necessary based on the opinions of the IAEA and the Nuclear Regulation Authority.

Results of the dispersion simulation

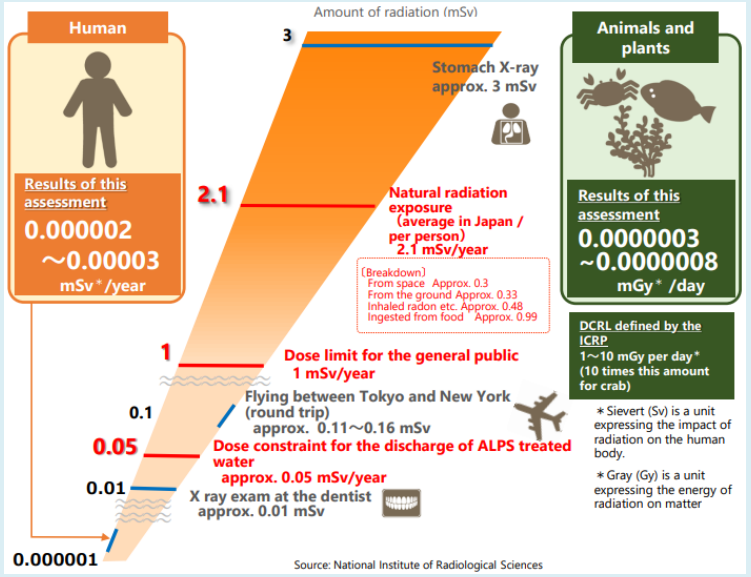
- The surrounding sea area where the tritium concentration was assessed to increase from the current level (0.1 to 1 Bq/L) is limited to the area within 2 to 3 km from the NPS.
- Even in this sea area, the sea water sufficiently satisfies the regulatory standard for tritium in Japan and the WHO's guideline for drinking-water quality.



Around the NPS [Enlarged]
(Largest value in scale at 30Bq/L)

Assessment of the public's exposure

- The impact on humans is assessed to be approx. 1/1,000,000 to 1/70,000 of the exposure doses (2.1 mSv/year) of Japanese people from natural radiation.



- Based on the discharge results and meteorological and oceanographic data for the one-year period from the commencement of discharge on August 24, 2023, to August 25, 2024, the impact on humans was assessed to be approx. 1/400,000 to 1/100,000 of that.

(Source) Prepared based on the " Report of Assessment of Radiological Impact on Public and Environment Regarding the Discharge of ALPS Treated Water into the Sea (Construction stage) " (May 2023) by Tokyo Electric Power Company Holdings, https://www.tepco.co.jp/en/decommission/progress/watertreatment/images/ria_202112e.pdf, etc.

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Efforts and Progress for Decommissioning

Sea Area Monitoring in Relation to ALPS Treated Water

- Since 2022, before commencing the discharge, relevant ministries and agencies, the nuclear operator, and others have conducted sea area monitoring in relation to ALPS treated water.
- The reliability of the analyses is being ensured with the assistance of the IAEA.
- As of December 2024, it was confirmed that tritium concentrations were sufficiently low and would have no adverse impact on human health and the environment.

< Monitoring of sea water, marine biota and fishery products regarding ALPS treated water >

Extract of monitoring plan for FY2024

[Sea water (conducted by the Ministry of the Environment and the Nuclear Regulation Authority)]

(i) Precise analysis of tritium
- Conduct analysis basically four times a year

(ii) Rapid analysis of tritium
- Conduct analysis twice during the discharge, and once a month while suspending the discharge
- Conduct analysis twice a year at six locations at the beach near the outlet

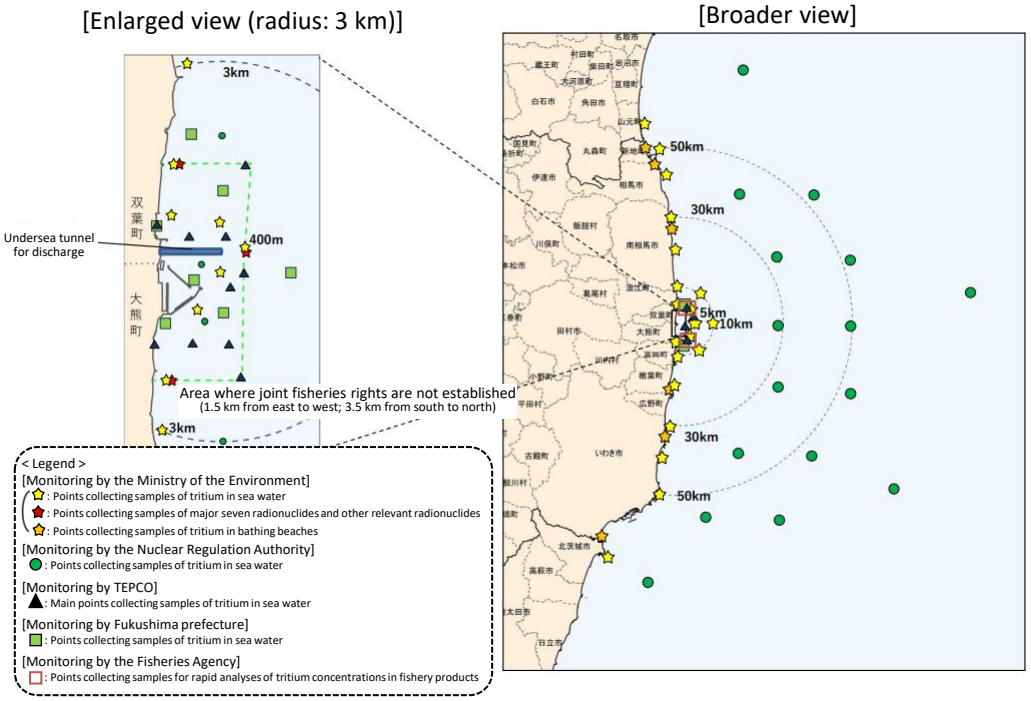
(iii) Analysis of radionuclides other than tritium
- Conduct analysis basically four times a year

[Marine biota (conducted by the Ministry of the Environment)]

(i) Fish
- Conduct analysis for fish collected at three locations closest to the outlet in the sea area where fisheries are conducted ordinarily
- Analyze the concentrations of tritium and Carbon-14 four times a year

(ii) Seaweeds
- Conduct analysis for seaweeds collected at two locations close to the outlet
- Analyze the concentrations of Iodline-129 two times a year

[Fisheries products (conducted by the Fisheries Agency)]
- Measure the concentration of tritium for approx. 450 samples per year



Points collecting samples for sea area monitoring by the relevant organizations

(Source) Prepared based on "Comprehensive Radiation Monitoring Plan (revised on March 21, 2024)" (Monitoring Coordination Meeting) (https://radioactivity.nra.go.jp/cont/en/plan/meetings/274_20240321.pdf) , and "Status of Monitoring by MOE" (MOE's website) (https://www.env.go.jp/content/000250315.pdf) (in Japanese), and "Sea Area Monitoring regarding ALPS Treated Water" (NRA) (https://www.nra.go.jp/data/000457798.pdf) (in Japanese)

Efforts and Progress for Decommissioning

Sea Area Monitoring in Relation to ALPS Treated Water (Announcement of Monitoring Results)

- Since FY2022, before commencing the discharge, relevant ministries and agencies, local governments, the nuclear operator, and others have conducted sea area monitoring in relation to ALPS treated water. Immediately after commencing the discharge in August 2023, they strengthened and expanded the structure for sea area monitoring by such means as increasing analysis frequencies and locations.
- The results of the monitoring are published on the websites of relevant organizations, etc.
- As of December 2024, it was confirmed through sea area monitoring that tritium concentrations were sufficiently low compared to the regulatory standards (limit for concentration required by law) and would have no adverse impact on human health and the environment.

＜MOE ALPS Treated Water Marine Monitoring Information＞
https://shorisui-monitoring.env.go.jp/en/

Results of the monitoring regarding tritium, etc. conducted by other relevant ministries and agencies are published, together with those by the MOE.

(Source) "ALPS Treated Water Marine Monitoring Information" (MOE's website) (https://shorisui-monitoring.env.go.jp/en/)

＜NRA Sea Area Monitoring in Relation to ALPS Treated Water＞
https://radioactivity.nra.go.jp/en/results/sea

Results of the monitoring conducted by the Nuclear Regulation Authority are published.

＜Fisheries Agency Results of the monitoring on radioactivity level in fishery products＞
https://www.jfa.maff.go.jp/e/inspection/index.html

Results of the tritium monitoring conducted on fishery products landed on Japan's Pacific coast from Hokkaido prefecture to Chiba prefecture are published.

＜Information held by other relevant organizations ＞

MOE's website "ALPS Treated Water Marine Monitoring Information" contains links to information on monitoring by other relevant organizations (Ministry of Foreign Affairs; Ministry of Economy, Trade and Industry; International Atomic Energy Agency (IAEA); Japan Atomic Energy Agency; and TEPCO).

Efforts and Progress for Decommissioning

Involvement of the IAEA in Discharge of "ALPS Treated Water"

- The IAEA conducts reviews as a third party in its professional capacity as an authoritative UN-related agency with specialized knowledge in the field of nuclear energy.
- On July 4th, 2023, the IAEA published its comprehensive report stating that discharges of the ALPS treated water to the sea are "consistent with relevant international safety standards" and "would have a negligible radiological impact on people and the environment."
- The IAEA will get involved in securing the safety of discharge of ALPS treated water over years even during and after discharge, not limited to reviews prior to discharge.

July 2021

Government of Japan and the IAEA signed the TOR (Terms of Reference) of the implementation of the safety reviews of the ALPS treated water.

September 2021 onward

Holding of meetings of the IAEA Task Force (12 times in total by June 2023)

February 2022 onward

Review missions to relevant organizations (five times in total by June 2023)

April 2022 onward

Publication of reports (eight reports published by July 2024)

July 2023

- Publication of the IAEA Comprehensive Report
- Establishment of the IAEA office at the Fukushima Daiichi NPS

Involvement of the IAEA after the discharge of ALPS treated water

- Provide data on discharge to the international community on a real-time basis
- Continue additional reviews and monitoring to provide transparency and reassurance to the international community
- Even after the discharge of ALPS treated water, the IAEA published reports based on its review missions. (two reports published by July 2024)

Outline of the reviews before commencing the discharge

(i) Safety of ALPS treated water (responded by TEPCO and METI)
⇒ Review missions on two occasions and two reports

(ii) Appropriateness of regulatory process (responded by the Nuclear Regulation Authority)
⇒ Review missions on two occasions and two reports

(iii) Independent sampling and analysis of supporting evidence (responded by TEPCO and relevant ministries and agencies)
⇒ Analyses on three occasions; Four reports (of which, two were published after the discharge)

(Source) Prepared based on "Fukushima Daiichi ALPS Treated Water Discharge - Timeline of IAEA Safety Reviews for ALPS-Treated Water Discharge" (IAEA) (https://www.iaea.org/interactive/timeline/105298) and "IAEA Comprehensive Report: Confirmation by the International Organization of the Safety of Discharge of ALPS Treated Water into the Sea" (METI) (https://www.meti.go.jp/earthquake/nuclear/hairo_osensui/shirou_alps/reports/02/)

Efforts and Progress for Decommissioning

IAEA Comprehensive Report on the Safety of "ALPS Treated Water"

- The IAEA conducted technical reviews (on five occasions) before discharge in order to evaluate whether the discharge of ALPS treated water into the sea complies with the international safety standards.
- In those reviews, TEPCO's assessment of radiological environmental impacts was verified and data were corroborated through comparison among analytical laboratories (Interlaboratory Comparison (ILC)) with the participation of third-party analytical laboratories* in addition to the IAEA.
- The comprehensive report published in July 2023 evaluates that "discharges of the ALPS treated water to the sea would have a negligible radiological impact on people and the environment."

  * Analytical laboratories of South Korea, France, the United States, and Switzerland participated.

Reviewed items	Major results
Radiological impacts on humans and the environment	• Assessment of radiological impacts on the environment is being conducted in compliance with international standards. • International waters are not affected by the discharge of ALPS treated water, and the cross-border impact is negligible.
Integrity of facilities and process for controlling discharge	• The system and process for controlling discharge are robust. • Emergency isolation valves and radiation detectors are incorporated in the system in a redundant manner.
Regulatory management and approval	• The Nuclear Regulation Authority has established and is enforcing appropriate legal and regulatory safety frameworks as an independent regulatory organization.
Analysis/source and environmental monitoring	• Monitoring activities by the government of Japan and TEPCO are in compliance with the international safety standards. • TEPCO has the ability to undertake accurate and precise analyses and has a sustainable and robust analytical system in place.

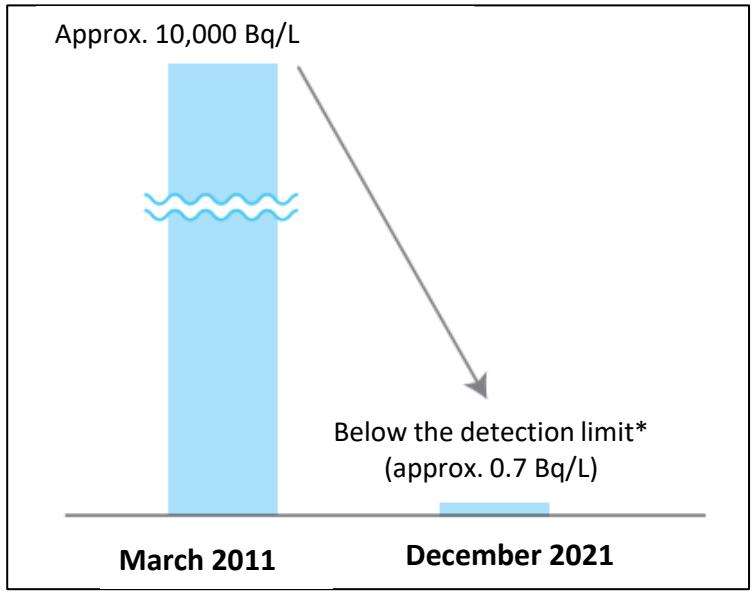
(Source) Prepared based on METI's website "Let's get to know and understand about ALPS treated water."
https://www.meti.go.jp/earthquake/nuclear/hairo_osensui/english/shirou_alps.html

経済産業省 Ministry of Economy, Trade and Industry

Efforts and Progress for Decommissioning

Reduction of Effects in Surrounding Environment and Preventive Measures against Earthquakes and Tsunamis

■ Radioactivity concentrations (Cesium 137) in Seawater near the NPS (around the south outlet)



■ Measures against earthquakes and tsunamis

Securing of power sources in an emergency

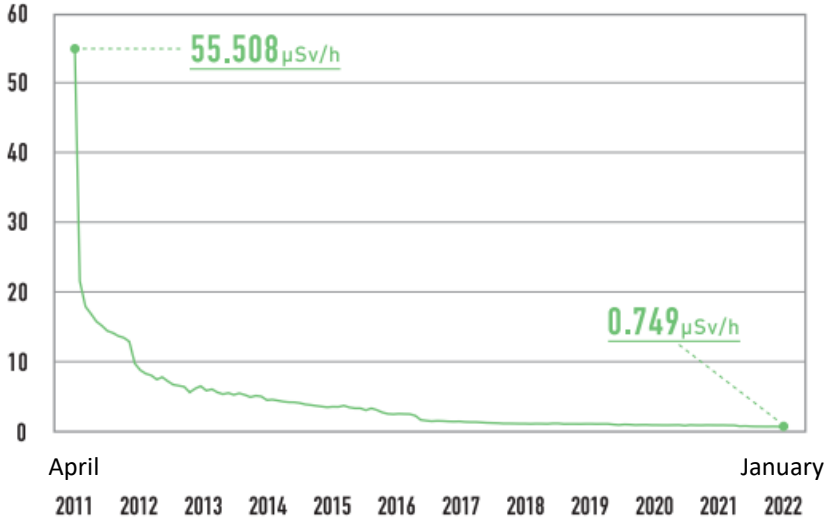
In preparation for power loss, ordinary power sources have been made multifaceted and emergency power supply vehicles and gas turbine vehicles are put in place. These vehicles are to be used to supply power to water injection facilities in an emergency.


Water injection drill


Emergency power supply vehicle


Fire engines

■ Results of the measurement by the monitoring post at the boundary of the premises of the Fukushima Daiichi NPS (west gate)



* Changes in the monthly average of results of measurement by the monitoring post (MP.5) at the boundary of the premises of the NPS

Source: Prepared based on "Important Information on Decommissioning 2022" by the Agency for Natural Resources and Energy

Backup power sources such as emergency power supply vehicles and water injection means such as fire engines are placed at a higher area where tsunamis are unlikely to reach.


Sea wall
(Source: Website of Tokyo Electric Power Company)

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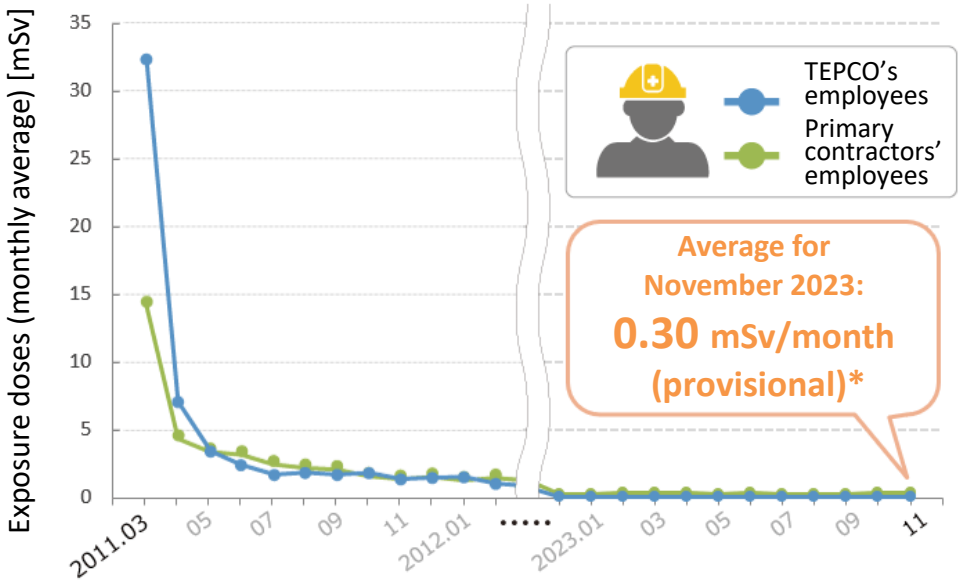
Ministry of Economy, Trade and Industry

Efforts and Progress for Decommissioning

Improvement of Working Environment at TEPCO's Fukushima Daiichi NPS

■ Changes in occupational workers' monthly personal exposure doses



Source (upper): Prepared based on the website of the Tokyo Electric Power Company (https://www.tepco.co.jp/decommission/progress/environment/)
Source (lower): Prepared based on "Important Information on Decommissioning 2022" by the Agency for Natural Resources and Energy

■ Workers' working environment

The large rest house has a dining room and a convenience store.

Emergency physicians are stationed at all hours.

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