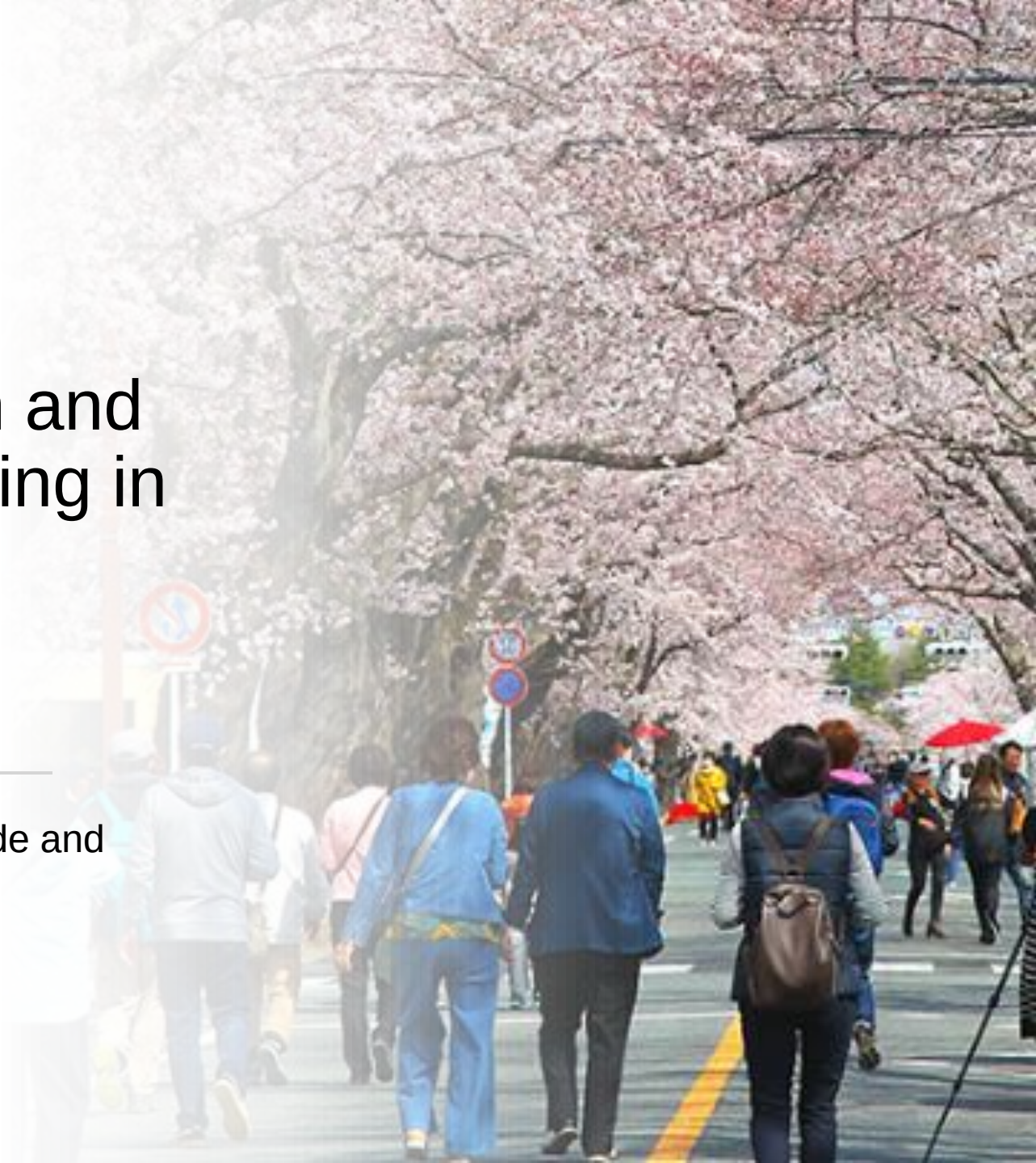
Reconstruction and Decommissioning in Fukushima



Ministry of Economy, Trade and Industry (METI)

October 2022

Today’s presentation

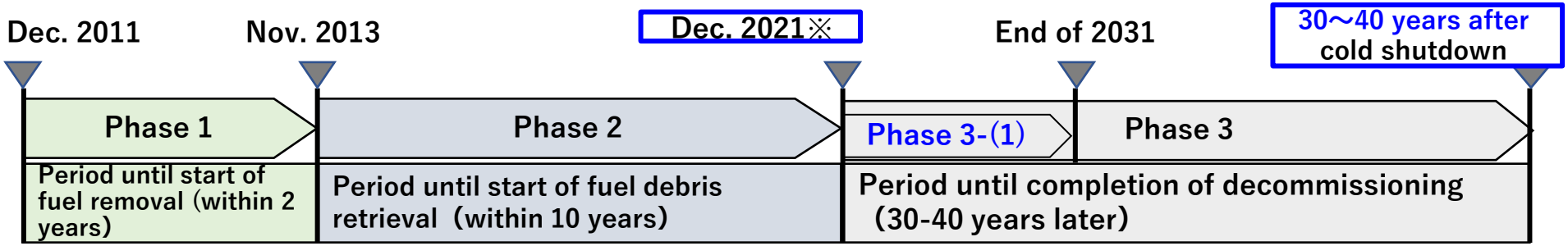
1. Progress of Decommissioning in Fukushima
2. ALPS Treated Water Discharge
   (Radiological Environmental Impact Assessment)
3. Lift of Evacuation Order
4. Restoration of Infrastructure
5. Restoration of Industry
6. Abolishment of Import Restrictions

1. Progress of Decommissioning

Mid-and-Long-Term Decommissioning Roadmap

- First adopted in December 2011, the Mid-and-Long-Term Decommissioning Roadmap clarified that the Government of Japan (GOJ) lead the entire decommissioning effort.
- Since then, GOJ revised the roadmap several times to set appropriate milestones and timeline.
- **Fukushima Daiichi Decommissioning is a continuous risk reduction activity** to protect the people and the environment from the risks associated with radioactive materials.
- **Safe and steady decommissioning is a prerequisite for reconstruction of Fukushima.**

Status in Mid-and–Long-Term Roadmap
(revised in Dec.2019)



※ Based on the development status of the robot arm required for the trial retrieval of fuel debris, it is assumed that retrieval will start in the second half of FY2023.

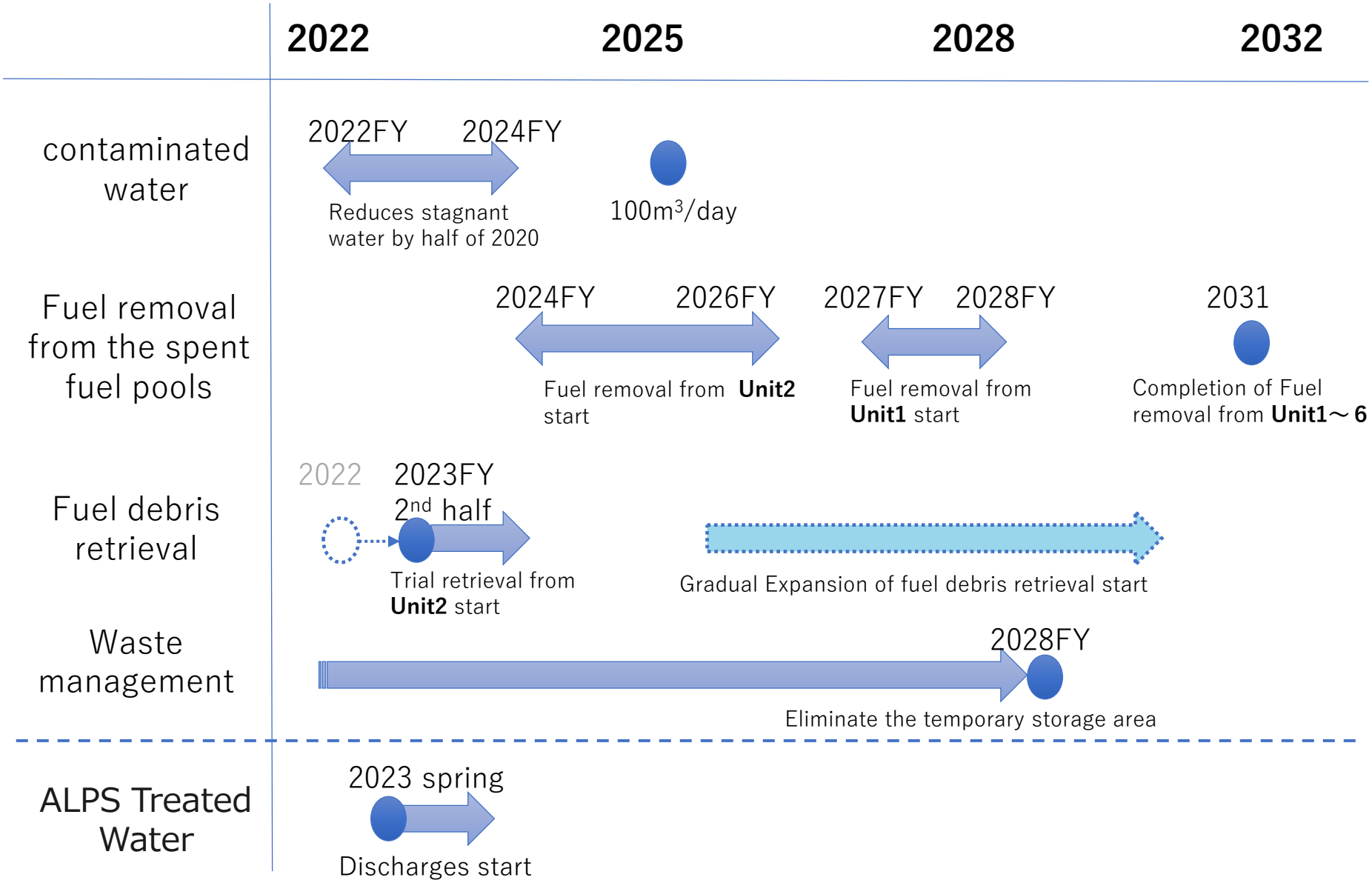
Major milestones of Mid-and-Long-Term Roadmap

- **Some of the milestones that were set in 2019 have already been achieved.**

Major milestones

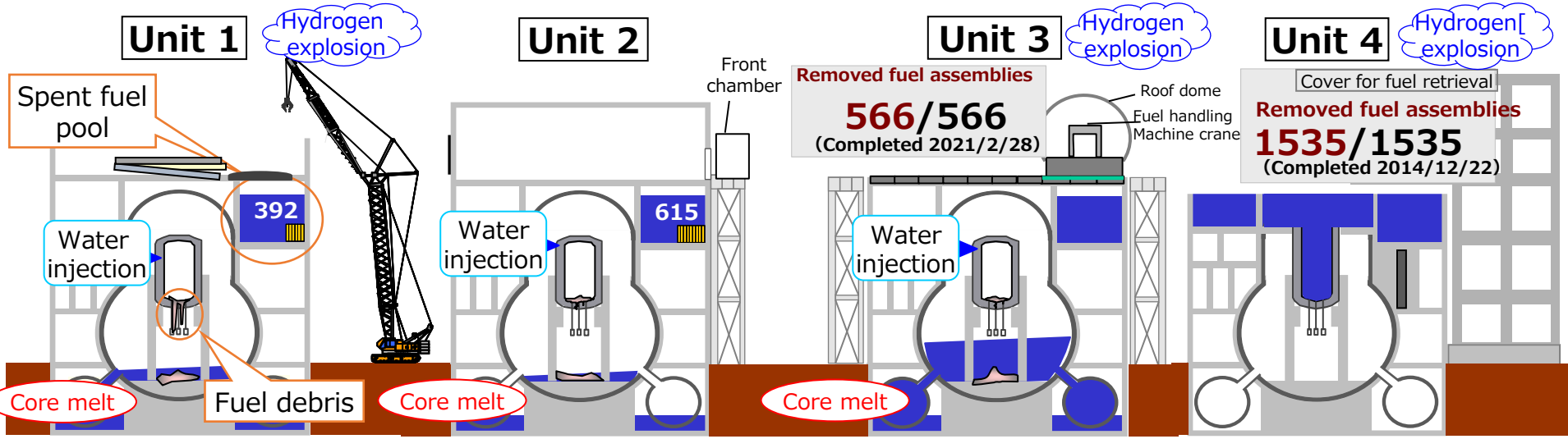
		Revised Roadmap	
Contaminated water management	Reduce to about 150 m^3/day Reduce to about 100m^3/day or less	**Within 2020** Within 2025	**achieved**
Stagnant water removal / treatment	Complete stagnant water removal / treatment in buildings* Excluding the reactor buildings of Units 1-3, Process Main Buildings, and High Temperature Incineration building. Reduce the amount of stagnant water in reactor buildings to about a half of that in the end of 2020	**Within 2020** FY2022 - 2024	**achieved**
Fuel removal	Complete of fuel removal from Unit 1-6 Complete of installation of the large cover at Unit 1 Start fuel removal from Unit 1 Start fuel removal from Unit 2	Within 2031 Around FY2023 FY2027 – 2028 FY2024 - 2026	
Fuel debris retrieval	Start fuel debris retrieval from the first Unit (Start from Unit 2, expanding the scale gradually)	Within 2021	**Revised to second half of FY2023**
Waste management	Technical prospects concerning the processing/disposal policies and their safety Eliminating temporary storage areas outside for rubble and other waste	**Around FY2021** Within FY2028	**achieved**

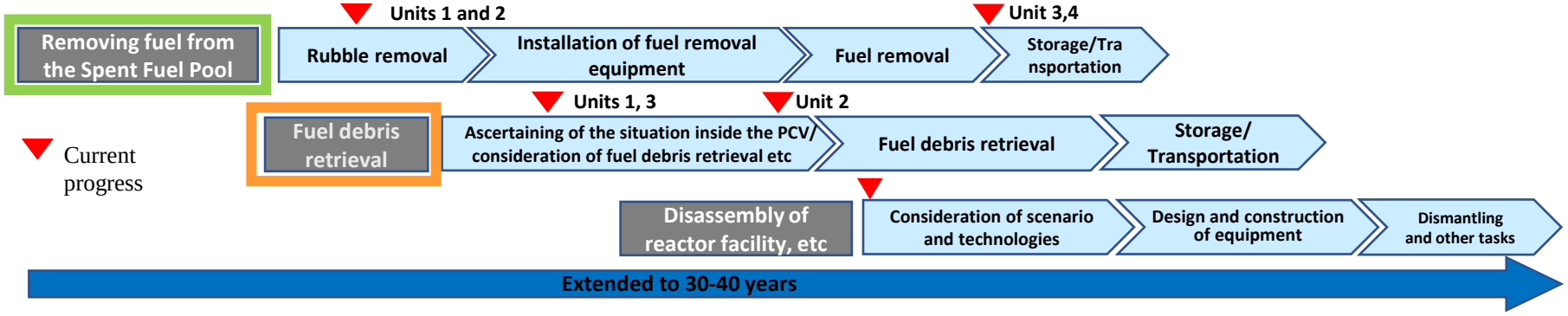
Major Milestone in Next 10 Years



State of TEPCO Fukushima Daiichi NPS (FDNPS)

- **Spent fuel removal**
  - For Unit 3, fuel removal was completed on 2021/2/28.
  - For Unit 1 and 2, preparation works (rubble removal or installation of cover etc.) are ongoing.
- **Fuel debris retrieval**
  - Trial retrieval will start from Unit 2.
  - The equipment for retrieval arrived in Japan on 2021/7/10, and transferred to Fukushima on 2022/1/31.



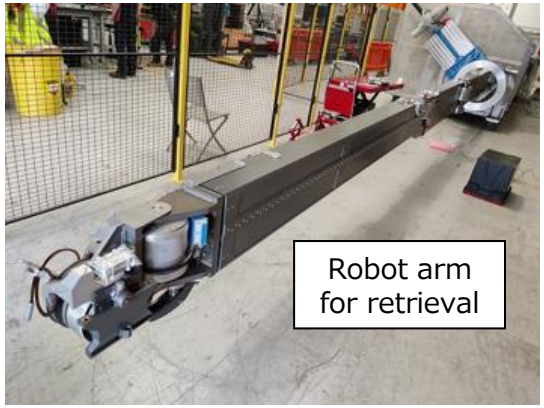


Fuel Removal & Fuel Debris Retrieval

- Fuel removal from the Unit 3 was completed in February 2021.
- Next step is to retrieve fuel debris, which is more technically challenging.
- Since February 2022, internal investigation of Unit 1 is conducted using an underwater robot.
- Manufactures from Japan and the U.K. have been working together for developing and testing the robot arm used for safely accessing and retrieving debris.

Internal Investigation of Unit 1

Robot Arm for Fuel Debris Retrieval



Fuel debris collecting device

Metallic brush

Vacuum vessel

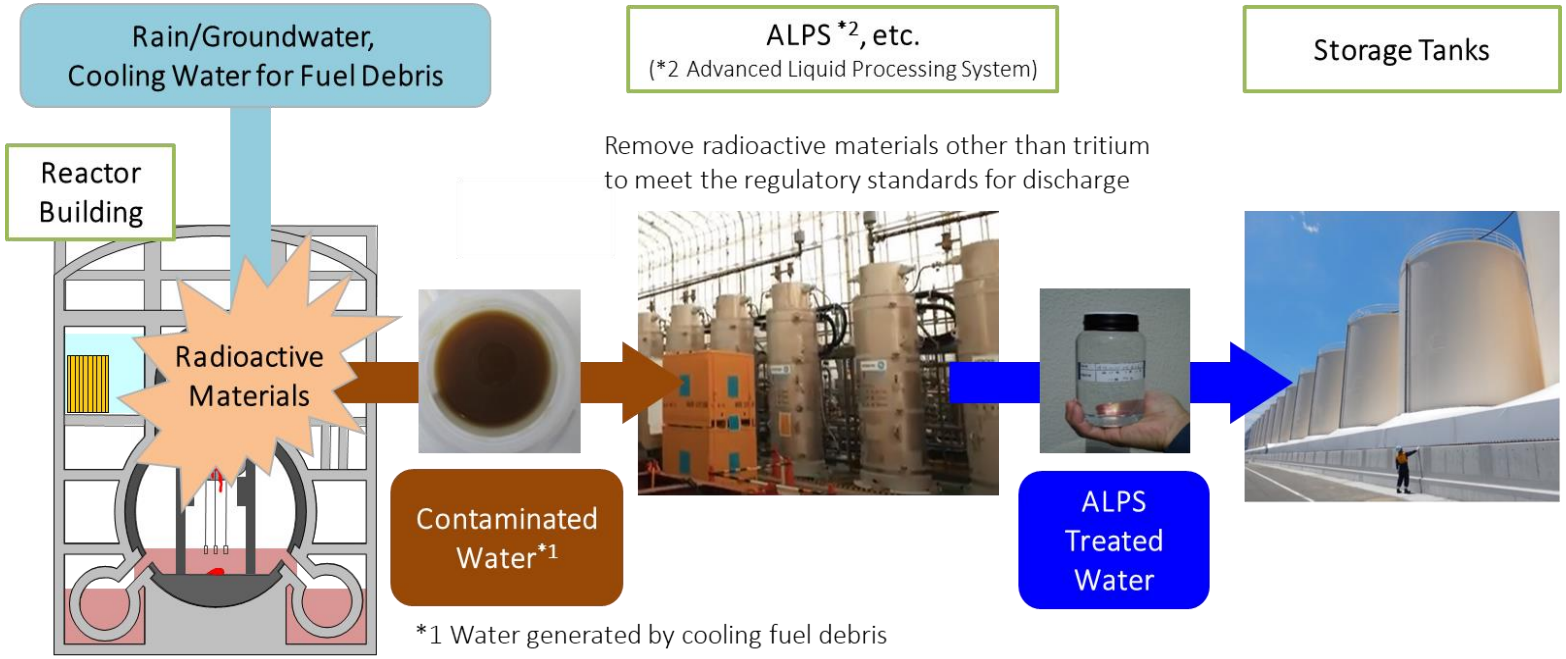
- Not bend when being stretched up to 22 meters.
- In a trial, retrieved fuel debris by the scale of a couple of grams with its collecting device.

Source: TEPCO

2. ALPS Treated Water Discharge
(Radiological Environmental Impact Assessment)

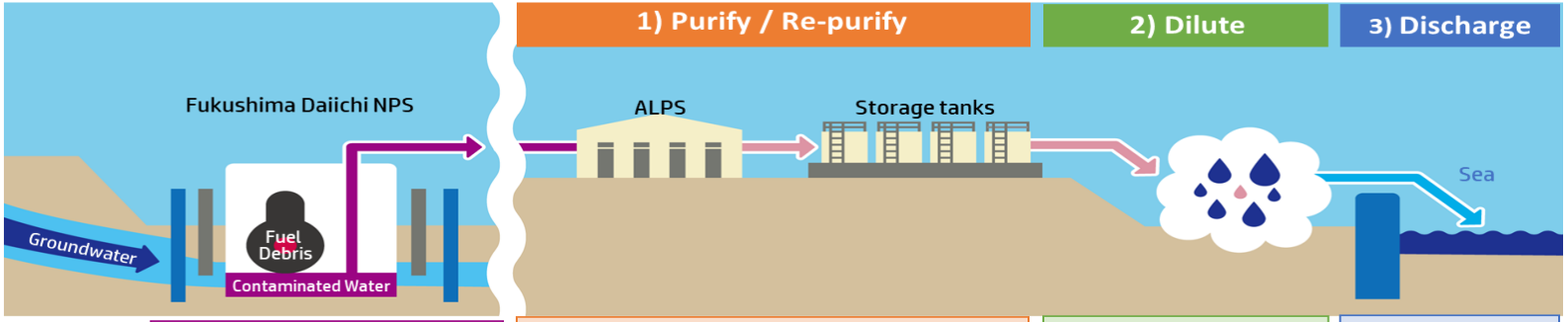
Why ALPS treated water must be discharged into the sea ?

- 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 exceed a thousand could be an obstacle to secure a 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.



Safety discharge of ALPS treated water

- "ALPS treated water" is the water purified from contaminated water. The radioactive materials other than tritium are removed by ALPS to meet the regulatory standards for safety.
- After confirming concentrations of the radioactive materials will be far below the regulatory standard other than tritium, the water will be diluted more than 100 times by sea water.
- The total annual amount of tritium released into the sea is less than 22 trillion Bq/year. This is the upper limit of the tritium discharged from TEPCO's FDNPS before the accident.
- On July 22, 2022, the implementation plan for the installation of facilities for discharging ALPS-treated water into the sea was approved by the regulatory authority as meeting the domestic law and the basic policy of the GOJ.
- Before TEPCO can start the discharge of ALPS treated water, remaining processes, such as NRA's Pre-Service Inspections to check and confirm the installation status of the discharge facilities, will continue. The discharge will not start until after these steps are duly taken.



Contaminated Water is generated when groundwater touched the damaged reactors and debris.

Remove almost all kinds of nuclides other than tritium to the maximum extent, and meet the national regulatory standards set based on the ICRP recommendations

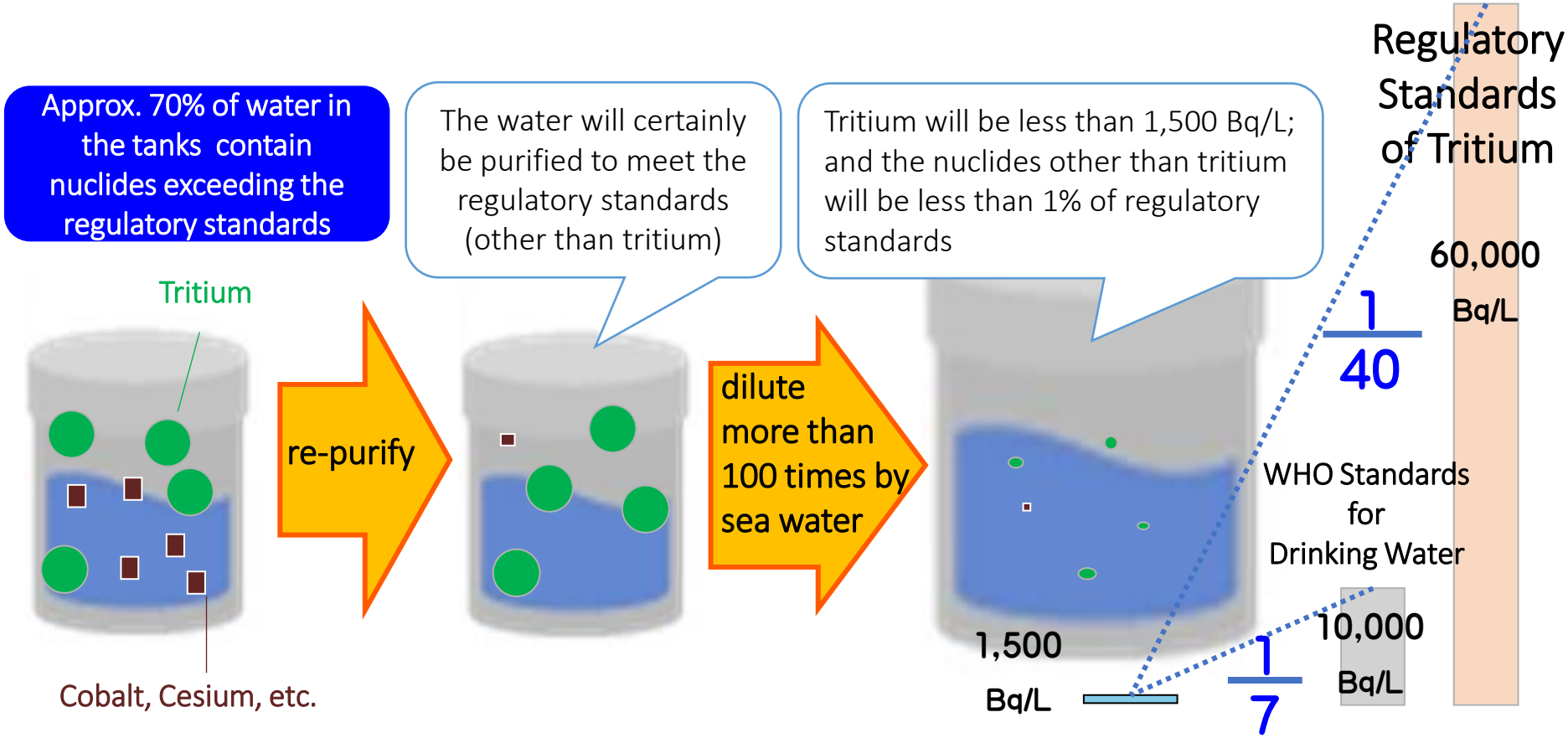
ALPS Treated Water

Dilute more than 100 times to make tritium to at the most 1/40th of the national regulatory standards (1,500Bq/L)

Subject to the approval of NRA, discharge will be started (envisaged after two years)

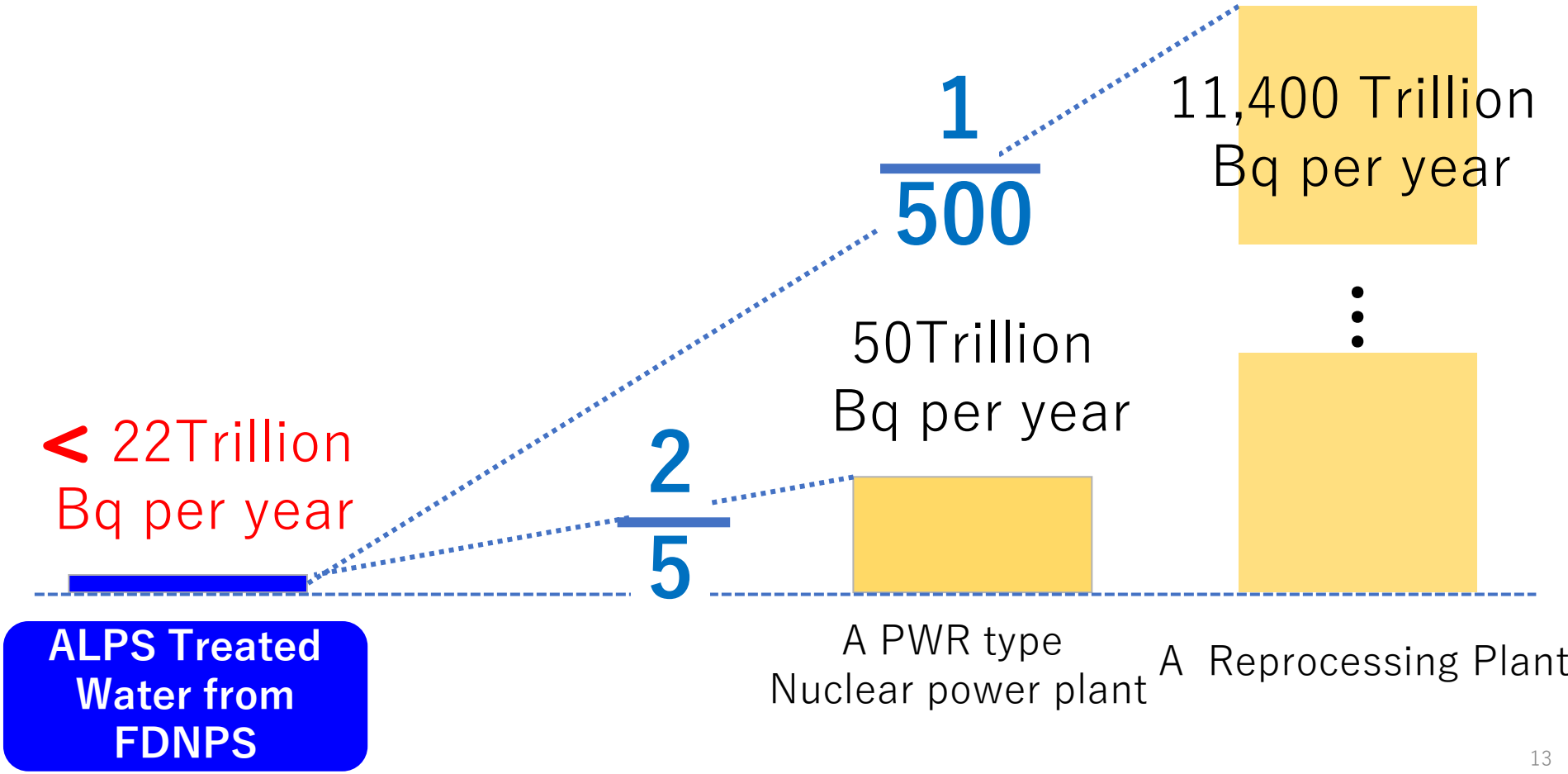
Ref; How to discharge the ALPS treated water into the sea

- Concentrations of the radioactive materials will be far below the regulatory standard values by 1) purifying/re-purifying the radionuclides other than tritium; and 2) diluting by sea water.
- Discharge into the sea at the FDNPS will be monitored/reviewed by third parties such as International Atomic Energy Agency (IAEA).



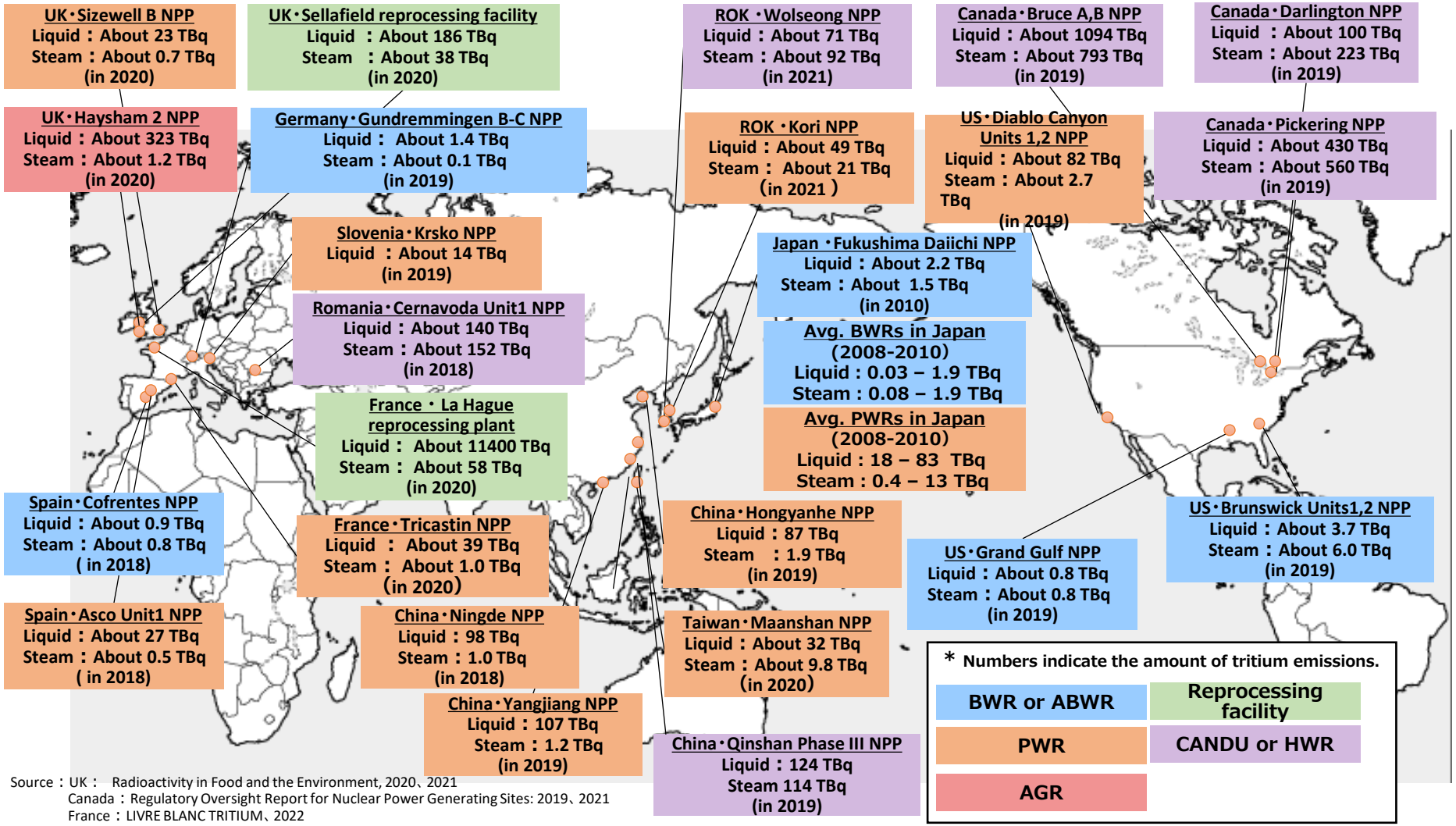
Annual amount of tritium discharge: comparison with other countries

- The total annual amount of tritium to be discharged will be at a level below the operational target of the TEPCO's FDNPS before the 2011 nuclear accident (22 Trillion Bq/year), which is lower than the ones of many nuclear facilities both at home and abroad (see the diagram below).



Can ALPS treated water be safely discharged into the sea ?

➢ Liquid radioactive waste is discharged into the sea at various nuclear facilities around the world based on the common international understanding of safety.



Source：UK： Radioactivity in Food and the Environment, 2020、2021
Canada：Regulatory Oversight Report for Nuclear Power Generating Sites: 2019、2021
France：LIVRE BLANC TRITIUM、2022
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）

Purification of radionuclides other than tritium

- The existence of radionuclides itself is not an issue. What matter is the total radiation impact from all kinds of radioactive materials in the water. The radiation level will be maintained below the regulatory standards to ensure the safety of people and the environment.
- Regardless of the type of the facility (accident plants or operational reactors), the regulatory standards are set to control the type of the total radiological impact of all the nuclides. (It is not a matter of nuclides or number of nuclides, but the total radiological impact to human should be considered).
- Before 2018, purified water contains radionuclides of the water which exceed the regulatory limit due to operational condition(around 70% of all the tanks at the FDNPS (around 0. 87 M tons/1. 30M tons)). After 2019, all of the water falls under the category i). These radionuclides other than tritium will be re-purified to below the regulatory standard by using ALPS again before the discharge.

i) 30%: Purified below the regulatory standards except for tritium

ii) 70%: Radioactive materials in addition to tritium exist more than regulatory standard values*

*All of the water purified after 2019 falls under the category i).

Nuclides other than tritium

Nuclides also found in water from operating NPPs	Cobalt, Manganese, etc.
Nuclides found in water from accident plants (or reprocessing plants)	Cesium, Strontium, Iodine, etc.

All of the above nuclides including nuclides found only in accident plants will be re-purified to meet the regulatory standards other than tritium. Furthermore, it will be diluted more than 100 times before discharge.

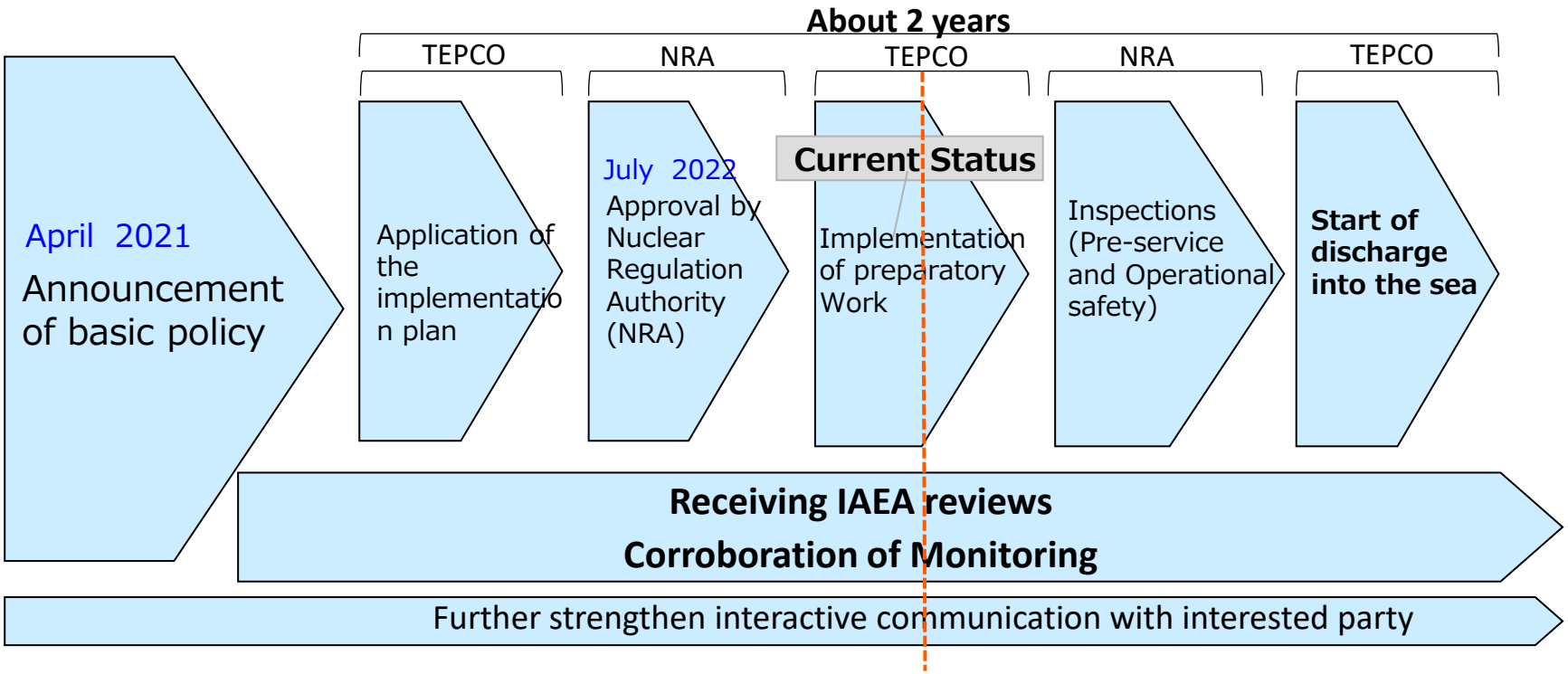
Ref. The results of re-purification performance test (TEPCO, 2020)

Type of nuclides	Ratio to each regulatory standard value	
	Before Re-purify	After Re-purify
Cobalt-60	0.18	0.0017
Cesium-137	6.7	0.0021
Strontium-90	2155	0.0012
Iodine-129	3.3	0.13
Sum of the all nuclides other than tritium	**2406**	0.35

To be diluted more than 100 times further: ~0.0035

Procedure of controlled discharge

- In light of the Government's Basic Policy, **TEPCO applied, in December 2021, to NRA for its approval** to amend some items in the implementation plan in order to install the facilities for discharging the ALPS treated water into the sea.
- On May 18, the NRA published a draft review results document on TEPCO's application. After soliciting public comments on the document, **the NRA approved the amendment of the implementation plan on July 22**.
- **TEPCO will receive NRA's Pre-Service Inspections** to confirm the installation status of the discharge facility. TEPCO will revise the REIA report in response to relevant observations from the IAEA's independent review. **IAEA review will be conducted before, during and after** the discharge of the water.



Discharge related facilities for securing safety by TEPCO

Measurement/confirmation facility (K4 tank group)

Comprised of three sets of tank groups each with the role of receiving, measurement/confirmation, and discharge. In the measurement/confirmation stage, water that has been made homogenized through circulation and agitating is sampled and analyzed (approx. 10,000m³ × 3 groups)

Secondary treatment facility（newly installed reverse osmosis membrane facility）

Secondary treatment of treated water to be re-purified (sum of the ratios of nuclides, excluding tritium, is between 1 and 10)

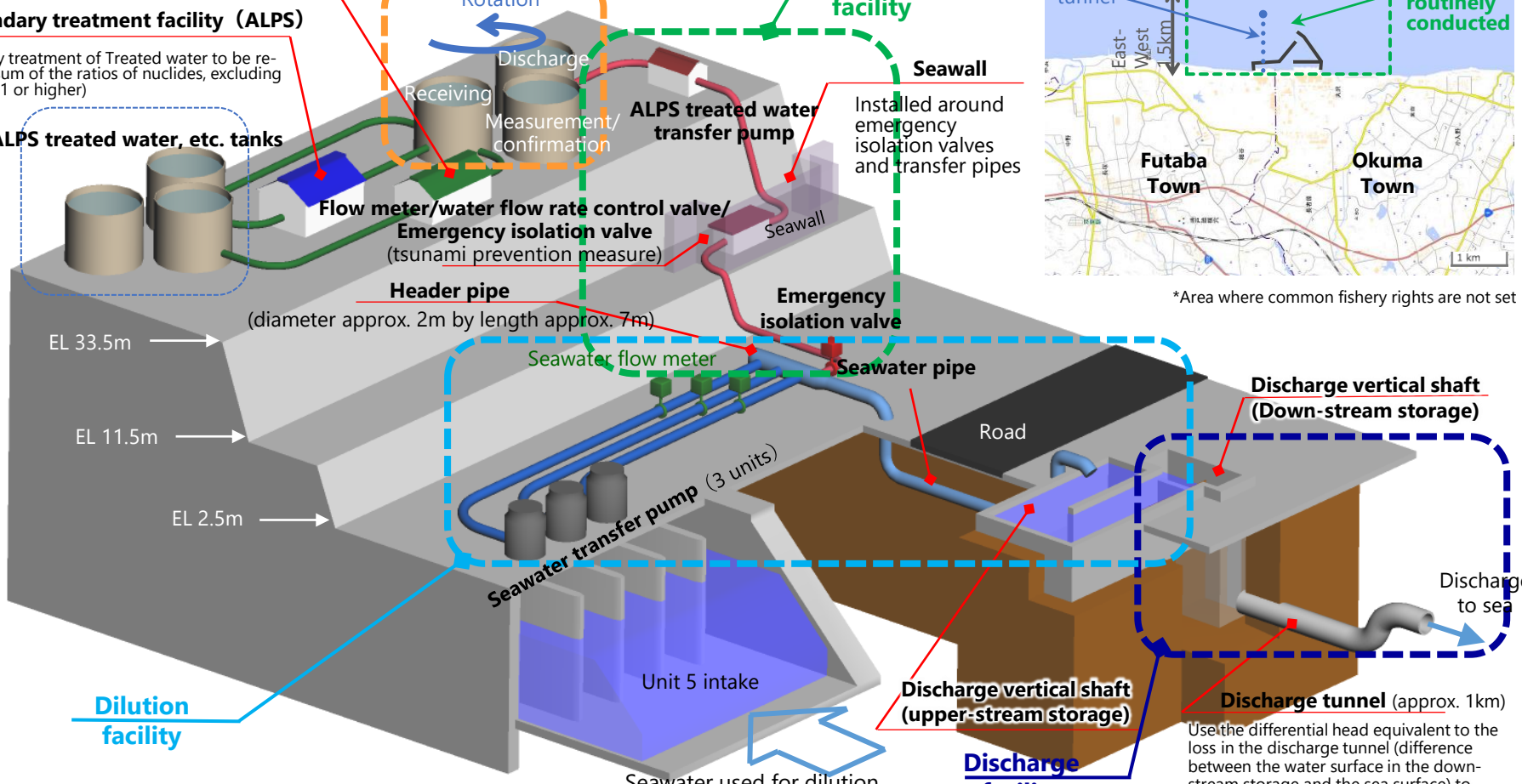
Secondary treatment facility（ALPS）

Secondary treatment of Treated water to be re-purified (sum of the ratios of nuclides, excluding tritium, is 1 or higher)

Transfer facility

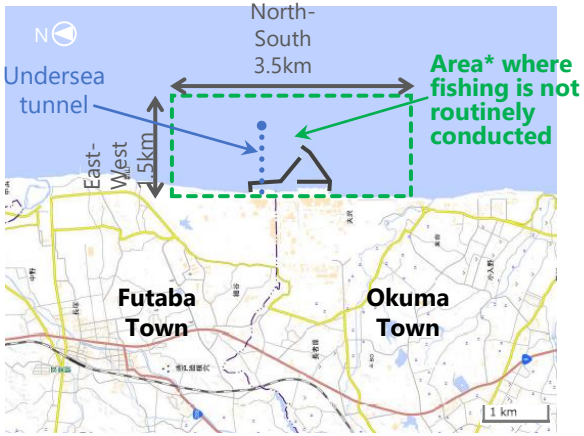
Seawall

Installed around emergency isolation valves and transfer pipes



Use the differential head equivalent to the loss in the discharge tunnel (difference between the water surface in the down-stream storage and the sea surface) to discharge water naturally.

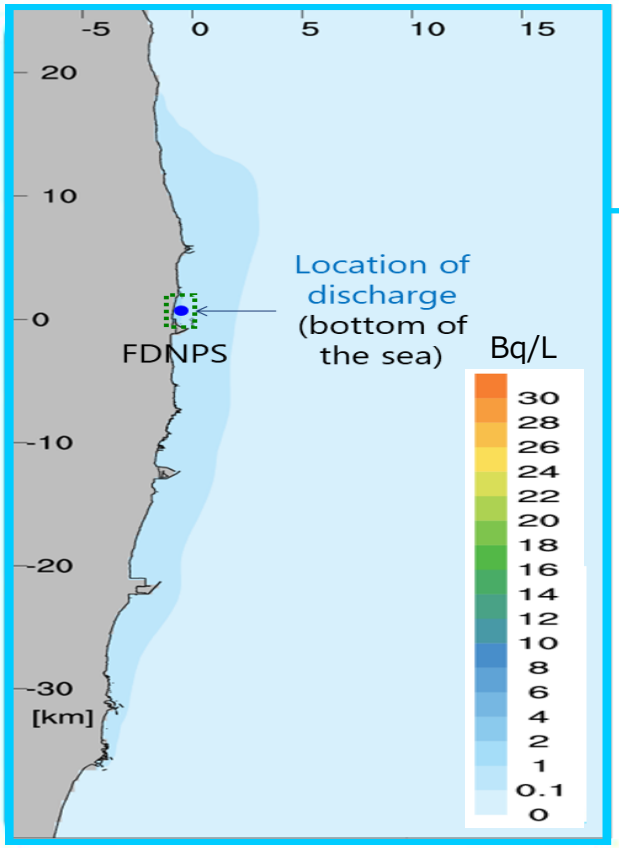
Source: Developed by Tokyo Electric Power Company Holdings, Inc. based on the map developed by the Geospatial Information Authority of Japan (electronic territory web)
https://maps.gsi.go.jp/#13/37.422730/141.044970/&base=std&ls=std&disp=1&vs=c1j0h0k0l0u0t0z0r0s0m0f1



*Area where common fishery rights are not set

Assessment of Radiological Impact on public and environment ①
～ Effect on the environment is quite limited ～

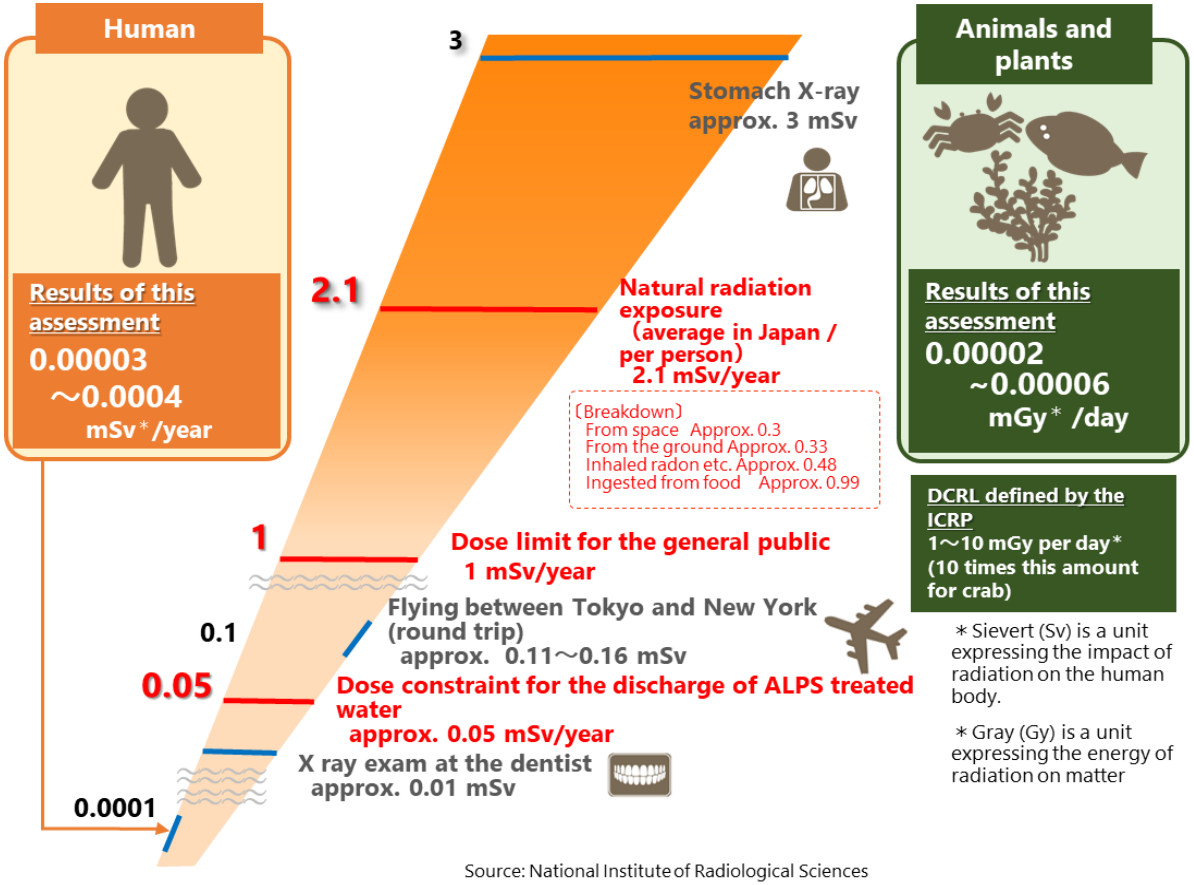
- According to the diffusion simulation, the concentration of tritium will be almost the same as the level of the natural sea water (< 0.1Bq/L).



Discharged amount:
22 trillion becquerels/year

Assessment of Radiological Impact on public and environment ②
～ Effects on the public and the environment were minimal～

- Results of the assessment on the public found that the exposure dose was **approx. 1/70,000 to approx. 1/5,000 of natural radiation exposure** (average in Japan : 2.1 mSv/year).
- Results of the assessment on animals and plants (flatfish, brown seaweed) found that the exposure dose was **approx. 1/50,000 to approx. 1/20,000 of the derived consideration reference level (DCRL)** defined by the ICRP. (In the case of crab, approx. 1/500,000 to approx. 1/200,000)



Source: National Institute of Radiological Sciences

Reference : Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (design stage)

Message by IAEA DG Grossi

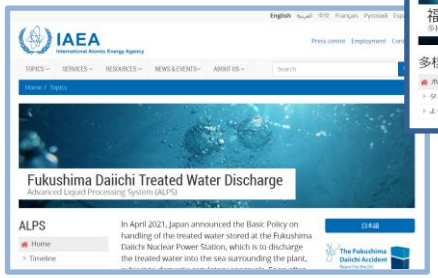
Posting on SNS by IAEA Director General Grossi

IAEA Director General Grossi's Comments on SNS
(May 19th, 2022)

"The discharge of processed water goes into the Pacific Ocean, that is right behind us, it will be done in full conformity with the international standards, and therefore it will not cause any harm to the environment."

【The IAEA official page related to the ALPS treated water】

Official page ⬇



Japanese page ⬆

Example of the web topics

- Overview of the review mission
- Publication of the report of the review
- Explanation of construction of the ALPS facility
- Monitoring methods of ALPS treated water by the IAEA etc.

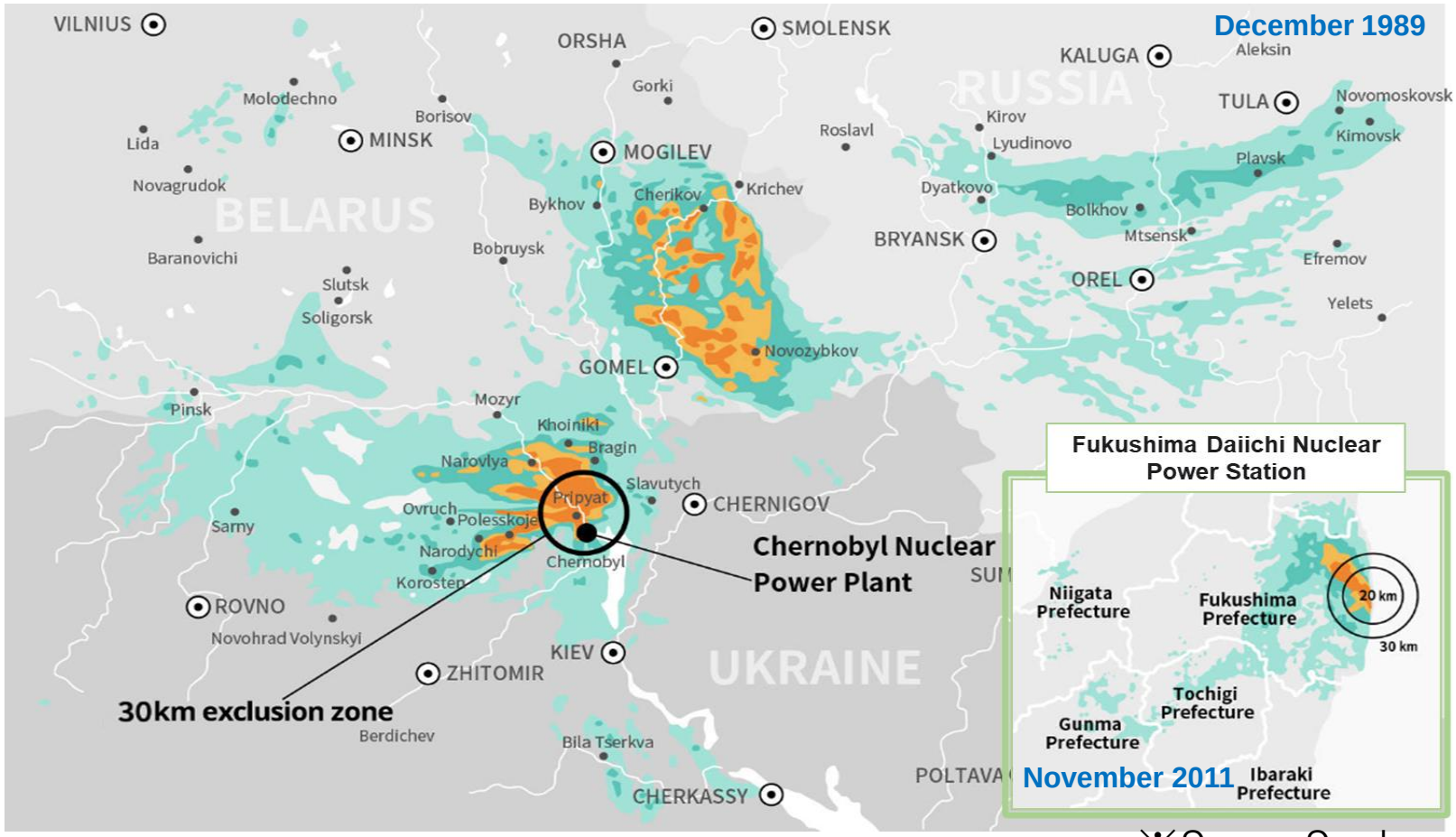
⬅ The IAEA official page

The IAEA official page in Japanese ➡

3. Lift of Evacuation Order

Comparison of the Scale of Nuclear Power Plant Accidents Between Chernobyl & Fukushima Daiichi NPS

- The amount of cesium and iodine released at Fukushima Daiichi were around 10–40% of Chernobyl. Radionuclides with long half-lives such as plutonium were only around 0.02–0.1%.
- Compared to the Chernobyl, the Fukushima Daiichi has a small-scale high-concentration contaminated area.



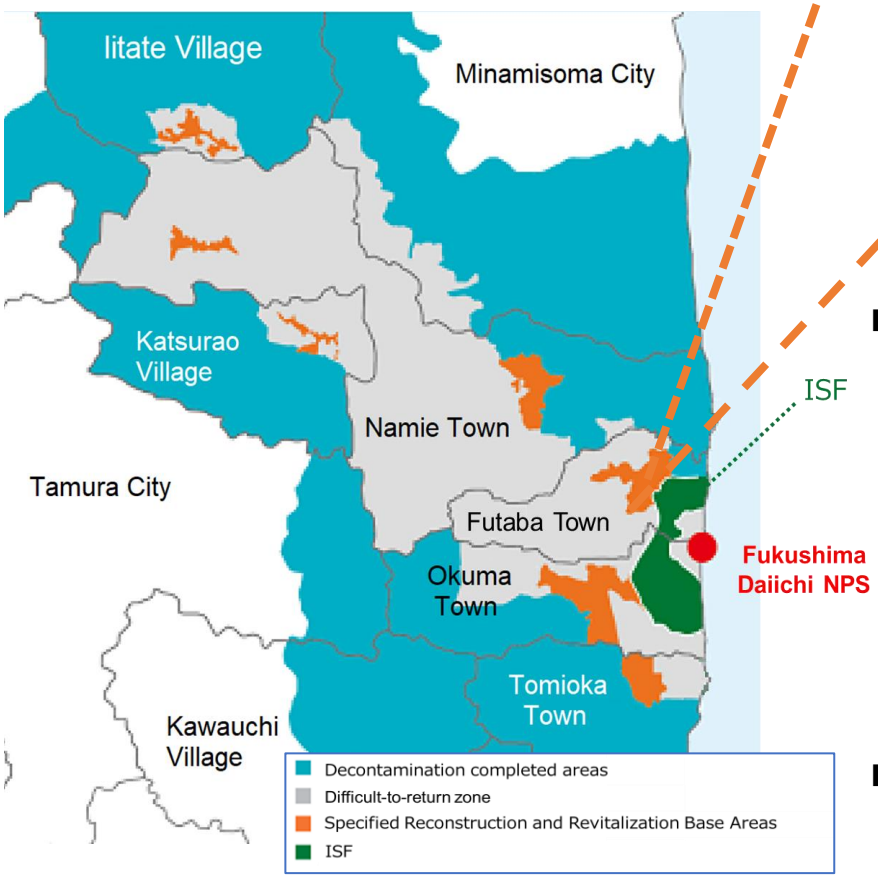
※Same Scale

Referenced from: Reconstruction Agency website
https://fukushima-updates.reconstruction.go.jp/en/faq/fk_200.html

Progress of Disaster Recovery

Decontamination Work and Construction of interim storage facility(ISF)

- ISF is installed to manage and store the soil and waste generated from off site decontamination work as well as the specified waste (> 100,000 Bq /kg) intensively and safely until the final disposal.



Referenced from: http://josen.env.go.jp/chukanchozou/facility/effort/
Referenced from: https://www.town.fukushima-futaba.lg.jp/item/14202.htm#pagetop

Development of Specified Reconstruction and Revitalization Base Areas

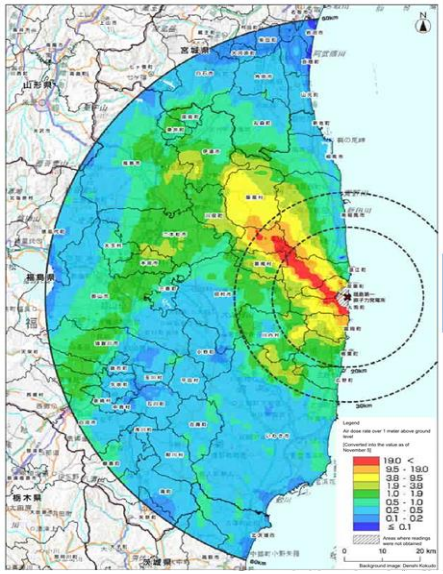
The Base area in Futaba Town where the Fukushima Daiichi NPS is located

- As radiation doses have decreased in some Restricted Areas, the GOJ has developed "Specified Reconstruction and Revitalization Base Areas" with the aim of lifting evacuation orders and permitting inhabitation.

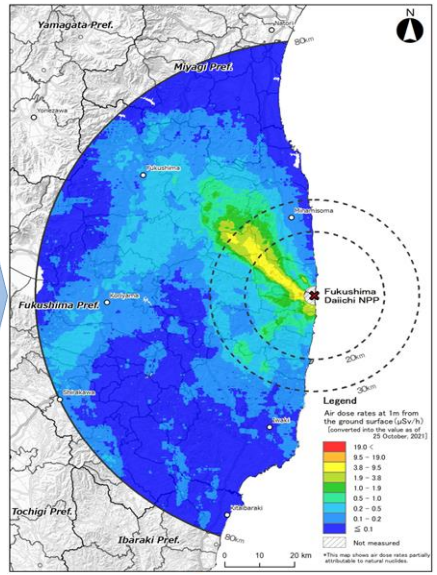
< 2022 >
Katsurao Village, Okuma Town, Futaba Town
< 2023 spring >
Tomioka Town, Namie Town, Iitate Village

- GOJ will continue to work with an awareness that it is the Government's responsibility to lift the evacuation orders in the all Restricted Areas in the future and to reconstruct and revitalize the affected areas.

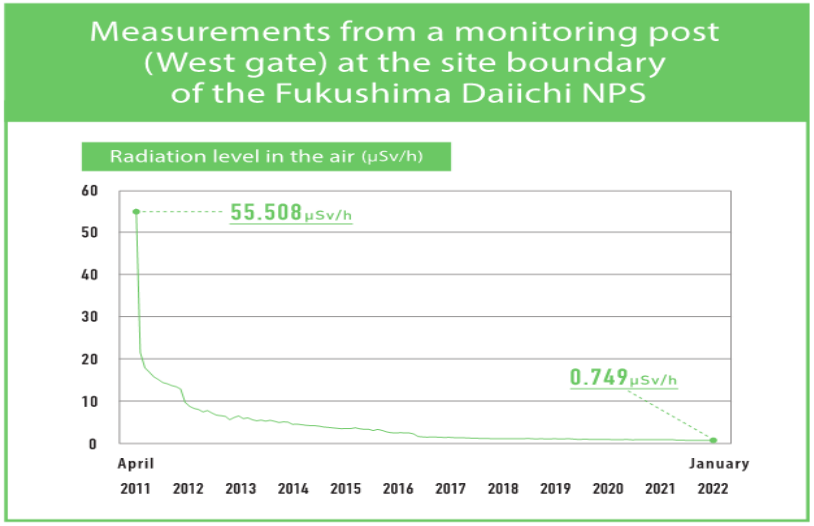
Changing Air Dose Rate and Lifting Evacuation Order



November 2011



October 2021



* Changes in monthly average levels measured at a monitoring post (MP.5) at the site boundary of the Fukushima Daiichi NPS

- Average air dose rate decreased by 80% compared to in November 2011. (within 80km from Fukushima Daiichi NPS)
- Radiation levels at the site boundary have sufficiently decreased compared to levels immediately after the accident.

	maximum figures		Current status
Areas under evacuation orders	1,150 km^2 August 2013	→	327 km^2(28%) As of June 2022
The number of evacuees in Fukushima Prefecture	164,865 May 2012	→	30,231 As of May 2022

Referenced from :https://www.reconstruction.go.jp/english/topics/Progress_to_date/English_August_2022_genjoutorikumi.pdf

4. Restoration of Infrastructure

Progress of Reconstruction (2012～2013)

Decommissioning Roadmap

Period up to start of fuel removal → Period up to start of fuel debris retrieval → Period up to start of end of decommissioning

2012 — 2013

- Unit 4: Removal of rubble on reactor building roof completed (Oct)

- Unit 4: Fuel removal from spent fuel pool and transfer to common pool started (Nov)
- Test operation of multi-nuclide removal equipment (ALPS) started (Mar)

➢ First commercial fishing resumed in Fukushima offshore

Snow crab

Yanagi octopus

Japanese flying squid

➢ First normal rice growing resumed in previously restricted areas

Photo: Paddy fields in Tamura City
(Shooting date: June 4, 2013)

Referenced from: https://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/committtee/takakusyu/pdf/003_04_00.pdf
Referenced from: https://www.pref.fukushima.lg.jp/uploaded/attachment/266089.pdf

Referenced from:
https://www.mext.go.jp/b_menu/shingi/chousa/kaihatu/016/shiryo/__icsFiles/afieldfile/2013/09/10/1339417_1_2.pdf

Progress of Reconstruction (2014～2015)

Decommissioning Roadmap

Period up to start of fuel removal → Period up to start of fuel debris retrieval → Period up to start of end of decommissioning

2014 — 2015

- Unit 4: Fuel removal (1,535 assemblies) from spent fuel pool completed (Dec)

- Sub-drain pumping and discharge started (Sep)
- Sea-side impermeable wall closed (Oct)
- Unit 3: Removal of large rubble (fuel handling machine) from spent fuel pools completed (Aug)

➢ Evacuation order lifted for the first time in some areas (Tamura City)

Reopening of school

➢ Joban Expressway is fully reopened (major arterial road in the disaster area)

Referenced from:
https://www.reconstruction.go.jp/portal/chiiki/2014/20140421100603.html

Referenced from:
https://www.reconstruction.go.jp/portal/chiiki/2015/20150319152955.html

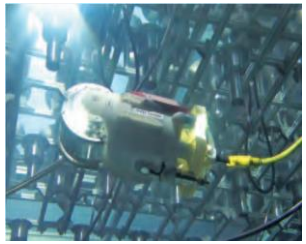
Progress of Reconstruction (2016～2018)

Decommissioning Roadmap

Period up to start of fuel removal → Period up to start of fuel debris retrieval → Period up to start of end of decommissioning

2016 — 2017 — 2018

- Unit 1: Removal of wall panels of the building cover completed



- Unit3:Lower part of RPV surveyed (Jul)
- Frozen-soil land-side impermeable wall Completed. 5–6 m gap in groundwater level created on the mountain side
- Generation of contaminated water reduced to one-third of the amount before (from 540 m3 to 170 m3/day)

➢ Fukushima Robot Test Field in service

(fully opened in 2020 after a phase-in)

➢ J-Village reopened

(fully opened in 2019)

Referenced from: https://www.facebook.com/robottestfield/photos/pb.100063135885143.-2207520000../335919594999936/?type=3

Progress of Reconstruction (2019～2021)

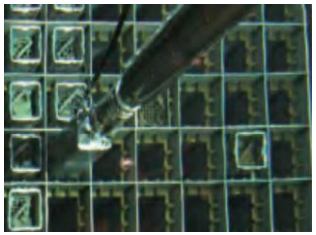
Decommissioning Roadmap

Period up to start of fuel removal → Period up to start of fuel debris retrieval → Period up to start of end of decommissioning

2019 | 2020 | 2021

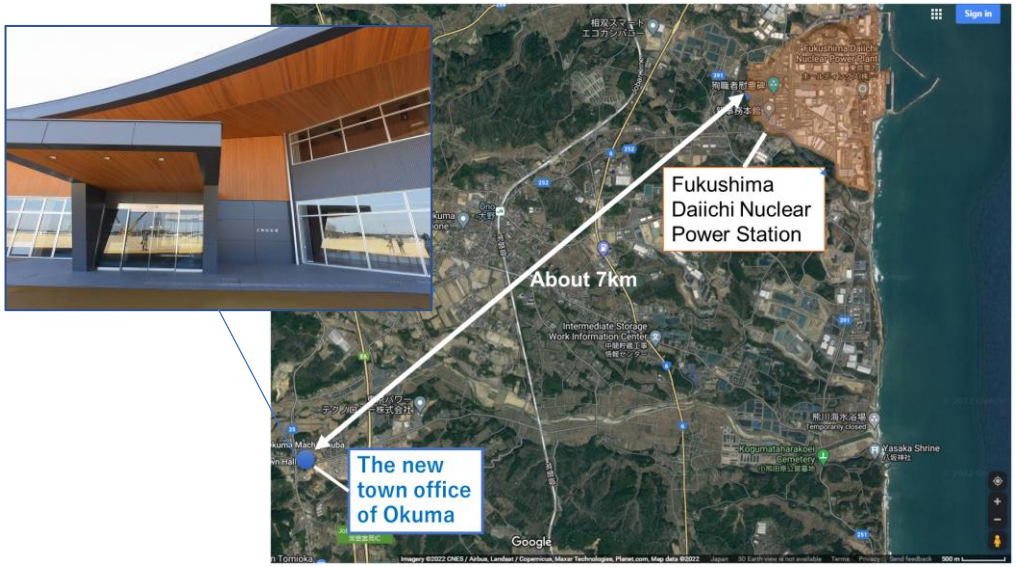
- Unit 3: Fuel removal from spent fuel pool started (Apr)

- Complete the treatment of stagnant water in buildings
- Generation of contaminated water reduced to 140 m3/day



- Unit3: Removal of all 566 fuel assemblies completed (Feb)

- Evaluation order partially lifted in Okuma Town where the Fukushima Daiichi NPS is located, allowing municipal services to start at a new town hall building



- Fukushima Hydrogen Energy Research Field opened

Referenced from:
https://www.nedo.go.jp/news/press/AA5_101293.html

5. Restoration of Industry

Restoration of Industry ①

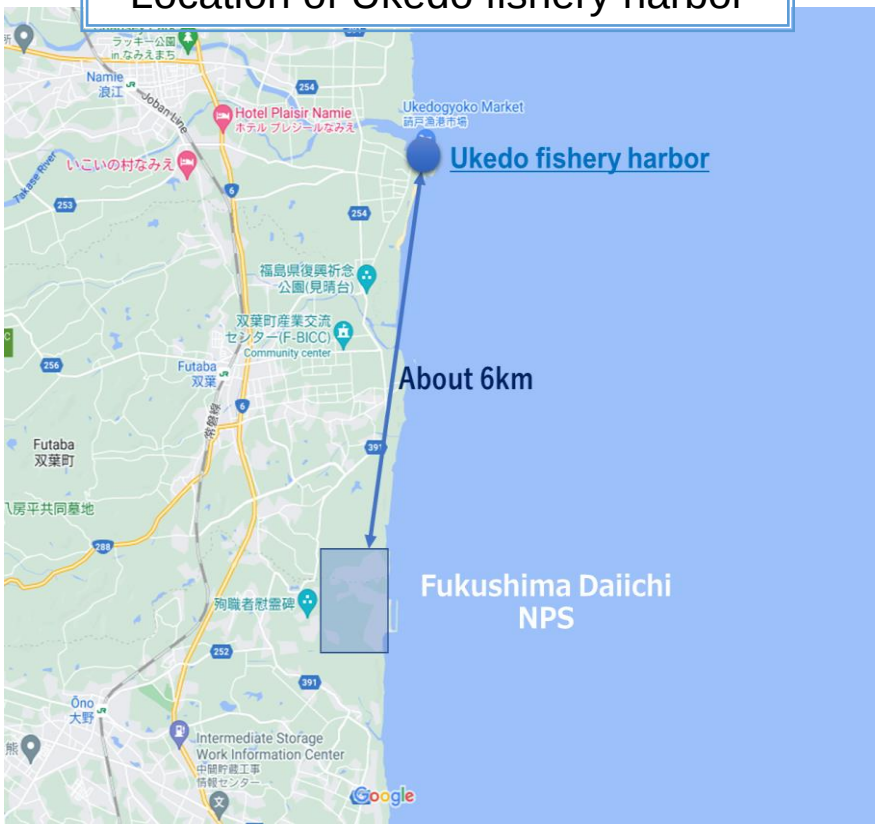
Revival of Ukedo fishery harbor

- Industries including fisheries are also revitalized. Fish auction in the Ukedo fishery harbor, 6 km far from Fukushima Daiichi NPS was resumed in April 2020.
- The restoration of the fishery harbor was completed in November 2021.

Auction at Ukedo fishery harbor

Ukedo fishing harbor New Year's Departure Ceremony

Location of Ukedo fishery harbor

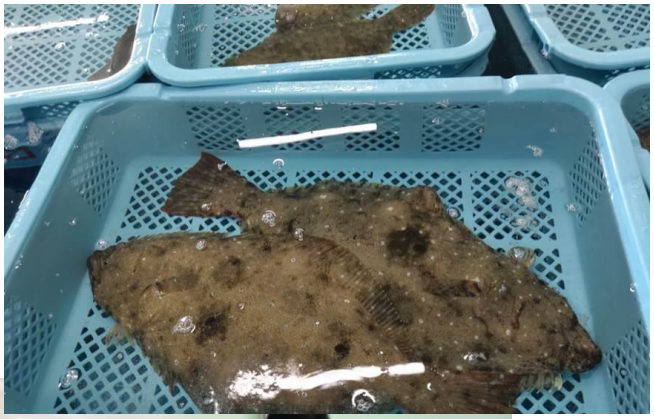


Referenced from: Namie Town Website https://www.town.namie.fukushima.jp/

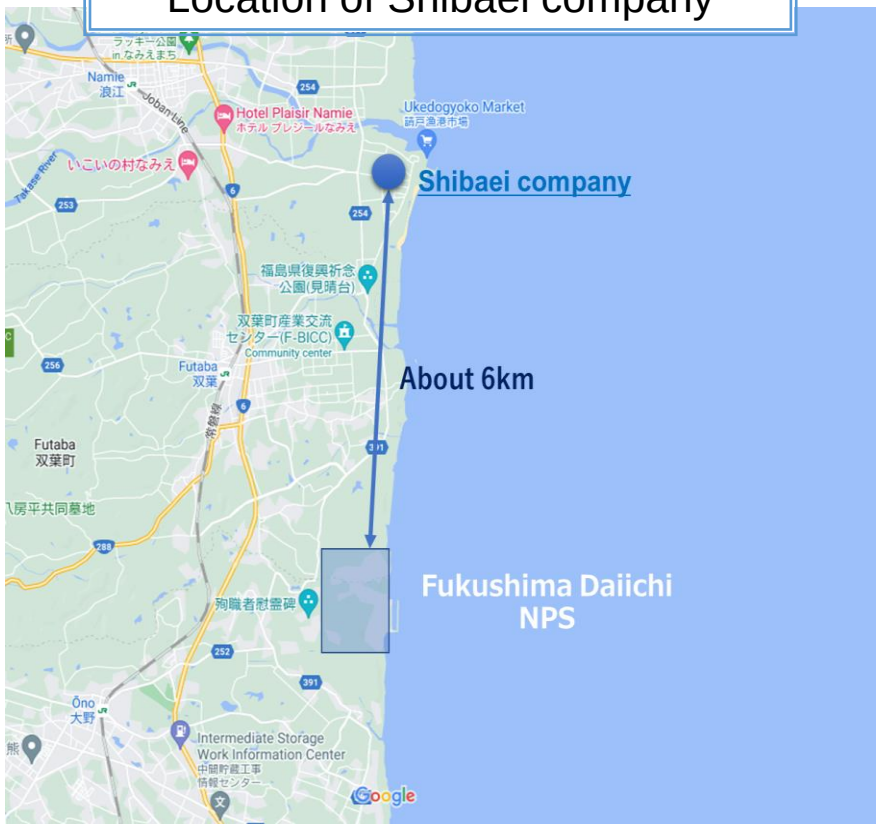
Restoration of Industry ②

Marine product processing Industries

- A marine product processing company, Shibaei, resumed its business in 2020. The new factory was constructed nearby Ukedo harbor in February 2020.



Location of Shibaei company



Referenced from: https://www.reconstruction.go.jp/s/2022/08/20220810100705.html

Referenced from: https://www.reconstruction.go.jp/s/2020/12/20201221164938.html

Restoration of Industry ③

Revival of Tradisional Sakura Festival and Gathering People

- In April 2022, Yonomori Sakura Festival was held in Tomioka, another town near the Fukushima Daiichi NPS.
- A row of beautiful cherry blossoms trees was loved by many people.

Referenced from: https://www.tomioka-town.jp/soshiki/kikaku/kochokoho/sakura/index.html

Promoting New Industries and Innovation (the Fukushima Innovation Coast Framework)

- According to the new policy concept, GoJ aims to create new industries (6 areas) and innovation in the coastal Fukushima (Hamadori).
- GoJ establish new research institute in coastal Fukushima in April 2023.

Fukushima Innovation Coast Framework

Decommissioning

Test Center in Naraha

Robot & Drones

Energy/Environment/ Recycling

Agriculture/Forestry / Fishery

Aerospace

Medical Care

Fukushima Institute for Research, Education and Innovation（F-REI）

Functions

(1) Research and development

① robotics
② agriculture, forestry and fisheries
③ energy
④ radiation sciences
⑤ collection/dissemination of knowledge/ data related to the nuclear disaster

(2) Human resources development

□ Promote human resources development for graduate students, etc. through cooperation with leading universities and international organizations, etc.

6. Abolishment of Import Restrictions

Status of countries and regions introduced import measures on Japanese food after the TEPCO Fukushima Daiichi NPS accident

Total 55 countries and regions have introduced import measures on Japanese food following the nuclear power station accident, and more than 75% of them, 43 have eliminated the measures.

(As of September 2022)

Type of measures and number of countries or regions				Name of countries or regions
Introduced additional measures after the accident	**Lifted all the measures**		**43**	Canada, Myanmar, Serbia, Chile, Mexico, Peru, Guinea, New Zealand, Colombia, Malaysia, Ecuador, Vietnam, Iraq, Australia, Thailand, Bolivia, India, Kuwait, Nepal, Iran, Mauritius, Qatar, Ukraine, Pakistan, Saudi Arabia, Argentina, Turkey, New Caledonia, Brazil, Oman, Bahrain, Congo DR, Brunei, Philippines, Morocco, Egypt, Lebanon, United Arab Emirates, Israel, Singapore, USA, UK, Indonesia
	Remaining the measures	Import ban	5	China, Korea, Taiwan, Hong Kong, Macau
		Test certificate requirement	7	EU*, Iceland, Liechtenstein, Norway and Switzerland (EFTA member states), French Polynesia, Russia *Including Northern Ireland
55	12			

Recent examples of Countries/regions that have (partially) lifted the import measures

2022	**July**	**Indonesia (all)**
	June	**UK (all)**
	February	**Taiwan (partially)**

2021	**October**	**EU (partially)**
	September	**US (all)**
	May	**Singapore (all)**
	January	**Israel (all)**

Promotional event for Fukushima foods in Countries where the import measures lifted

Reception with sake from Fukushima served (London, UK)

Referenced from:
https://www.minyu-net.com/news/news/FM20220909-727724.php

Customers and sales staff pick up Fukushima peaches at a supermarket (Jakarta, Indonesia)

Referenced from:
https://www.nikkei.com/article/DGXMZO62414290X00C20A8L01000/

- In countries where import restrictions have been lifted, people can buy and enjoy Fukushima foods freely.

Thank you for your support for Fukushima

More info from here

https://www.meti.go.jp/english/earthquake/index.html