Important Stories on Decommissioning

Fukushima Daiichi Nuclear Power Station, now and in the future

2022

METI
Agency for Natural Resources and Energy

Introduction

More than 10 years have passed since the accident at the Fukushima Daiichi Nuclear Power Station. Thanks to the daily efforts of on-site personnel, decommissioning work is progressing step by step with safety as the top priority. On the other hand, the decommissioning is an unprecedented work which will take a long time. Therefore, it is essential to proceed this work with the understanding of the local community and society. This brochure answers your concerns and questions in an easy-to-understand manner, and provides information on the present and future of decommissioning, including recent topics.

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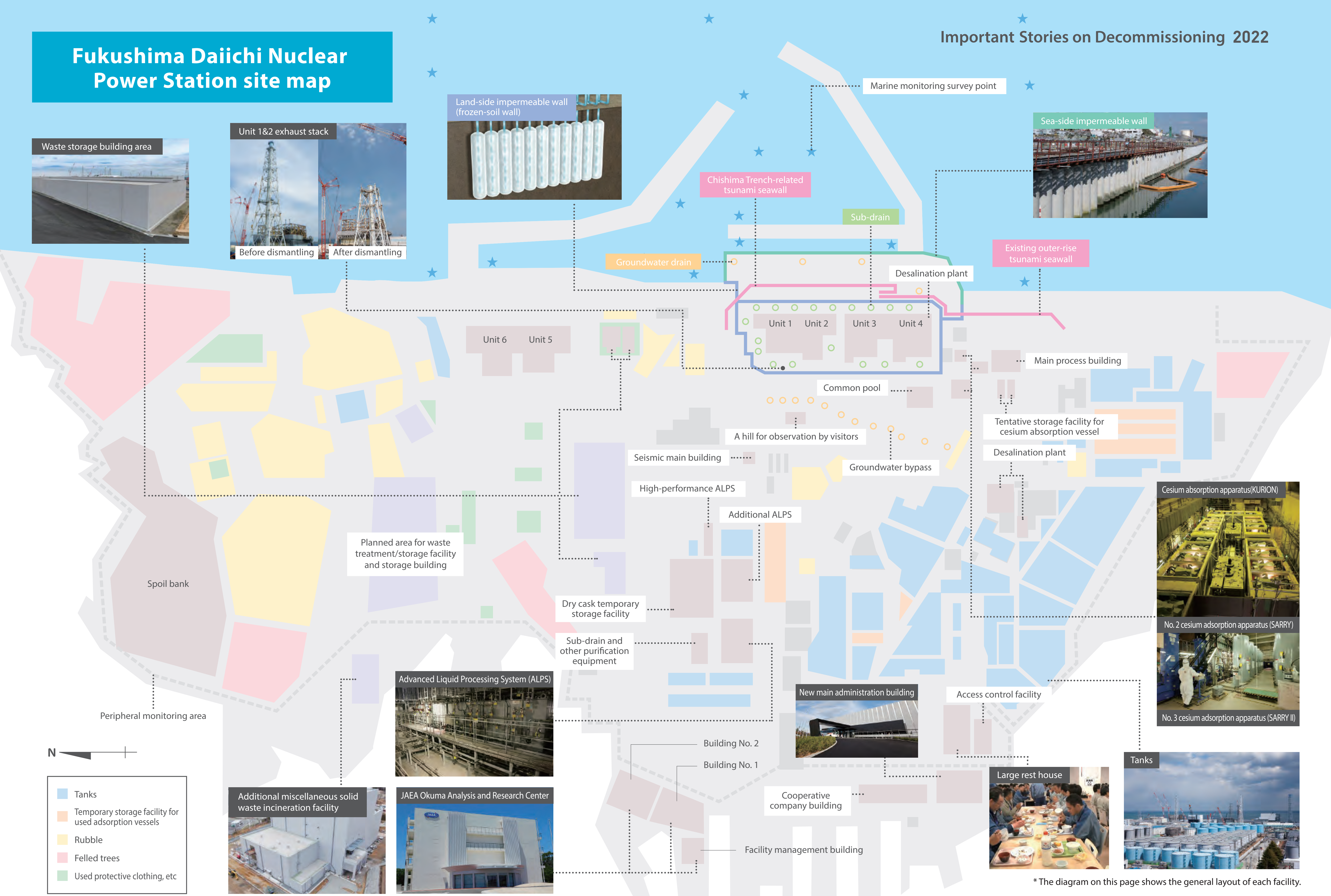
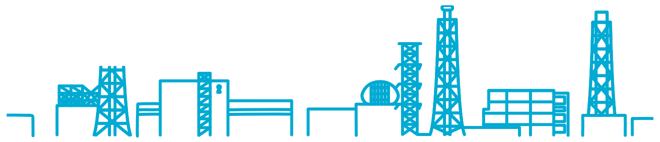
Fukushima Daiichi Nuclear Power Station site map



* The diagram on this page shows the general layout of each facility.

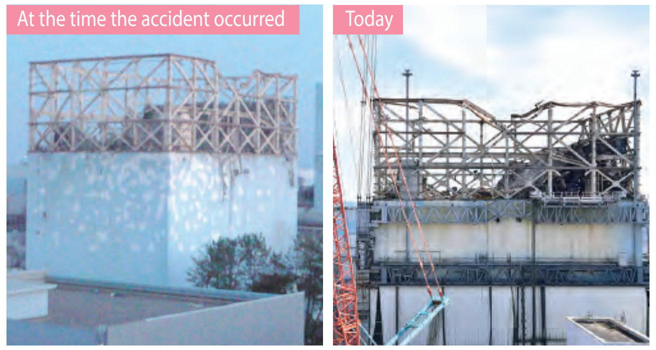
Current status at the Fukushima Daiichi Nuclear Power Station

More than 10 years have passed since the accident. Decommissioning work is steadily progressing, and the effects of radioactive material on water and air quality in the surrounding area have also greatly improved.

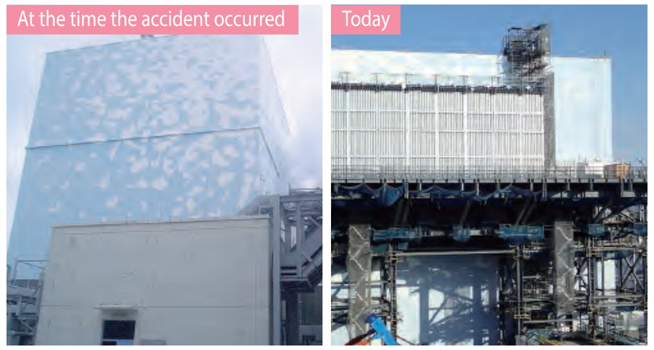


The status of the reactor buildings

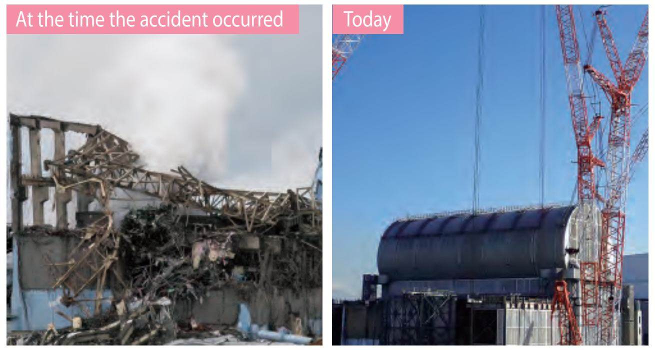
Unit 1 A cover that is large enough to spread over the entire building will be installed to prevent dust scattering during planned fuel removal.


At the time the accident occurred / Today

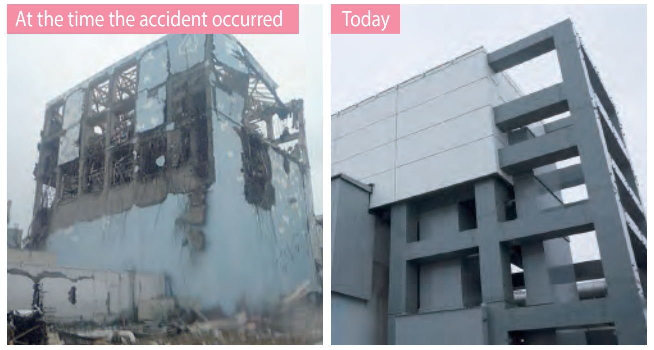
Unit 2 Preparations are underway to install a gantry on the south side prior to fuel removal.


At the time the accident occurred / Today

Unit 3 Fuel removal began in 2019 and finished in February 2021, marking the first completion of the task for a reactor left with fuel debris.


At the time the accident occurred / Today

Unit 4 All fuel assemblies have been removed and transferred to the common pool or other places, and they are stored and managed safely.


At the time the accident occurred / Today

Working environment for workers

Radiation levels of the premises have greatly decreased, and workers can now work in regular work clothes in about 96% of the site.


A cafeteria and a convenience store available at the large rest house


Emergency physicians are on duty 24/7

Effects on the surrounding sea area

Sea

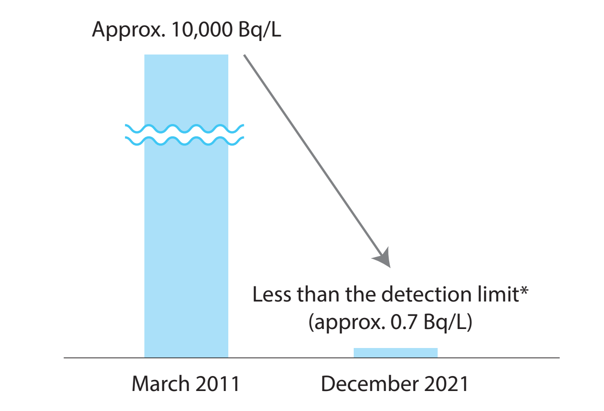
From the efforts that have been made so far, water quality in the surrounding sea area has greatly improved, and it has been confirmed to fully meet the international quality standards for drinking water.

The surrounding sea area


Use of quay for mooring ships resumed in February 2017 (Namie Town)


Matsukawaura fishing port in October 2019

Concentration of radioactive materials in the waters around the plant (Cs-137)



* The concentration of radioactive materials in the sea around the site refers to the Cs-137 level near the south discharge channel
* The international standard for drinking water quality is 10 Bq/L

Effects on the surrounding area

Air

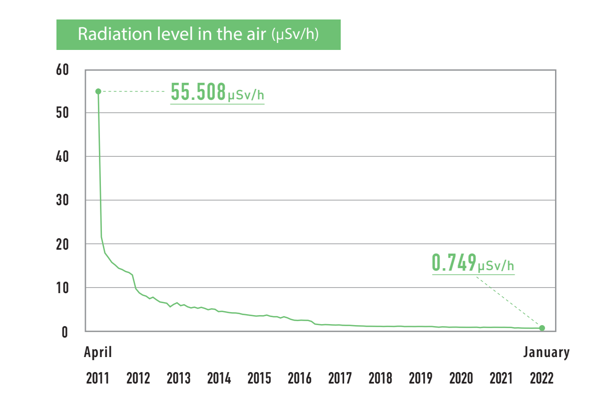
Levels measured at monitoring posts at the site boundary have sufficiently decreased compared to levels immediately after the accident, and levels are stable condition.

The surrounding area


Evacuation order lifted for part of Okuma and Futaba in March 2020


Joban Line train service fully resumed in March 2020

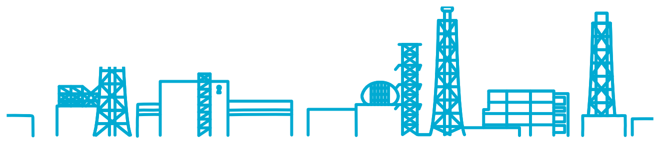
Measurements from a monitoring post (West gate) at the site boundary of the Fukushima Daiichi NPS



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

What is decommissioning of the Fukushima Daiichi Nuclear Power Station?

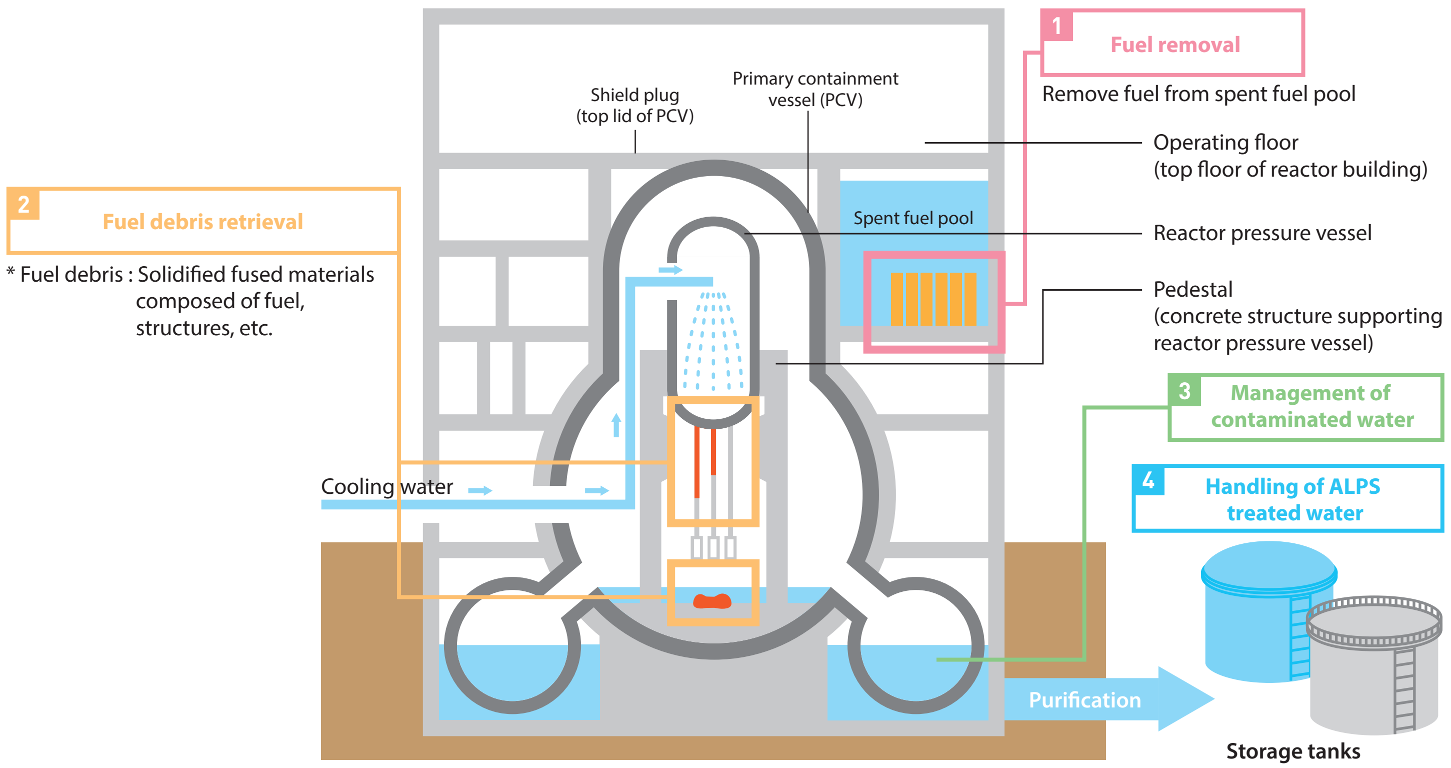
The decommissioning work is to reduce the risk from radioactive material to local people and the environment. The work is progressing safely and steadily, and it is intended to conclude between 2041 and 2051.



5 main tasks

1. Fuel removal
2. Fuel debris retrieval
3. Management of contaminated water
4. Handling of ALPS treated water
5. Treatment and disposal of radioactive waste/ Dismantling of reactor facilities, etc.

Reactor building (schematic)



Overall decommissioning process

Decommissioning will be carried out safely and steadily over 30 to 40 years.

Efforts to achieve stabilization	Phase 1	Phase 2	Phase 3
•Achievement of cold shutdown state •Significant suppression in emissions	Period up to start of fuel removal (within 2 years)	Period up to start of fuel debris retrieval (within 10 years)	Period up to end of decommissioning (within 30-40 years)
December 2011	November 2013 (Unit 4)	Today Within 2021*	

* The development of trial retrieval equipment has been delayed due to the COVID-19 situation. Efforts will be made to minimize the delay to one year or so.

1 Fuel removal: Rubble removal → Installation of fuel removal equipment → Fuel removal → Storage / Transportation (Units 1 and 2; Units 3 and 4)

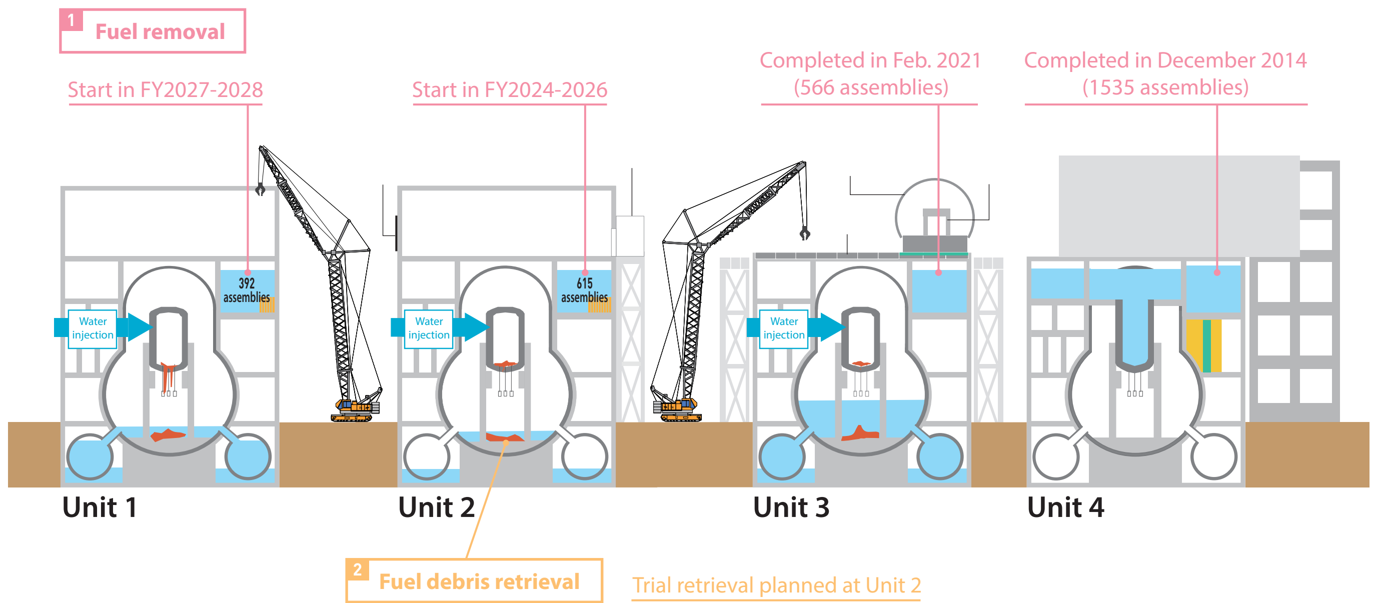
2 Fuel debris retrieval: Understanding of the situation inside the PCV / Consideration of retrieval methods, etc. → Fuel debris retrieval → Storage / Transportation (Units 1 and 3; Unit 2)

4 Handling of ALPS treated water: Subcommittee on Handling of the ALPS Treated Water → Obtaining opinions from the local community and many other stakeholders and determining the policy for handling → Preparations to start handling → Start of handling

5 Treatment and disposal of radioactive waste/ Dismantling of reactor facilities, etc.: Consideration of scenarios and technologies → Treatment, disposal, dismantling, etc. (Unit 1to4)

Status of each unit

The implementation procedure for measures and the progress vary between reactors because each unit is in a different status.

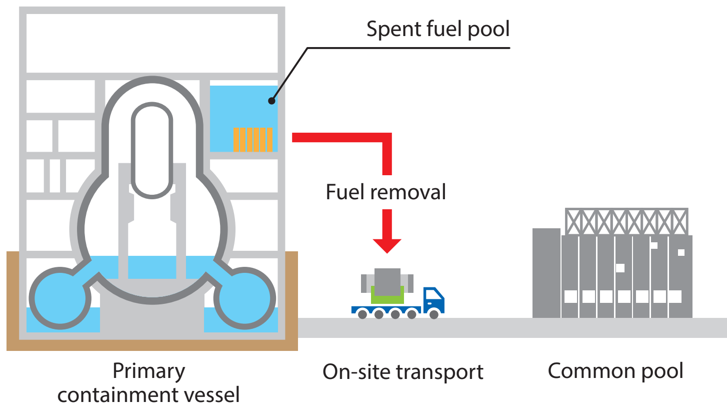


* Fuel removal and other work will be carried out as soon as ready at Units 5 and 6, where no accident has occurred.

Fuel removal

Fuel removal from Units 3 and 4 has been completed. Work will proceed to the fuel removal from other units.

Fuel removal



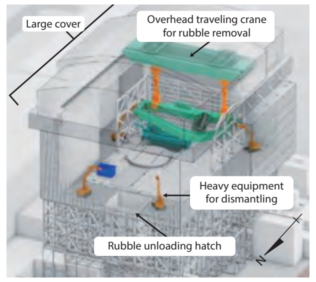
There are fuel assemblies remaining in the reactor buildings. Removing them requires the tasks of recovering them with handling equipment from the spent fuel pool where they are stored and transporting them to the common pool at the site.

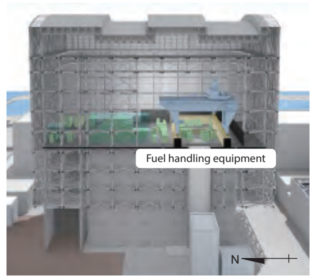
Progress of work

The work must be performed carefully to prevent radioactive material from scattering. Considering the difference in the internal situation of each reactor, the removal work is being carried out through a process optimized for each reactor.

Unit 1
- Large cover installation to be completed in FY2023
- Fuel removal to start in FY2027-2028.

Aiming to finish removal in about two years

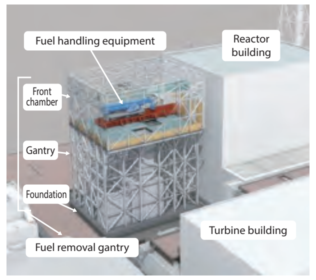


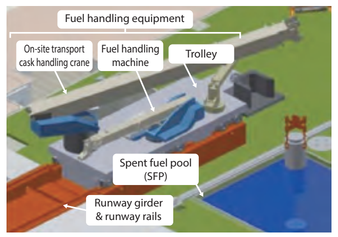


Rubble deposited inside the building needs to be removed before fuel removal can be started. To prevent dust scattering during rubble removal, work to cover the entire building is in progress.

Unit 2
- Fuel removal to start in FY2024-2026.

Aiming to finish removal in about two years





The planned method involves drilling a small hole on the south side of the building and removing fuel through the hole using a crane-type removal machine, without dismantling the building.

Unit 3
- Removal completed in February 2021

Unit 4
- Removal completed in December 2014

Unit 5 and 6
- Removal to be carried out as soon as ready while considering the progress at Units 1 and 2

Work schedule

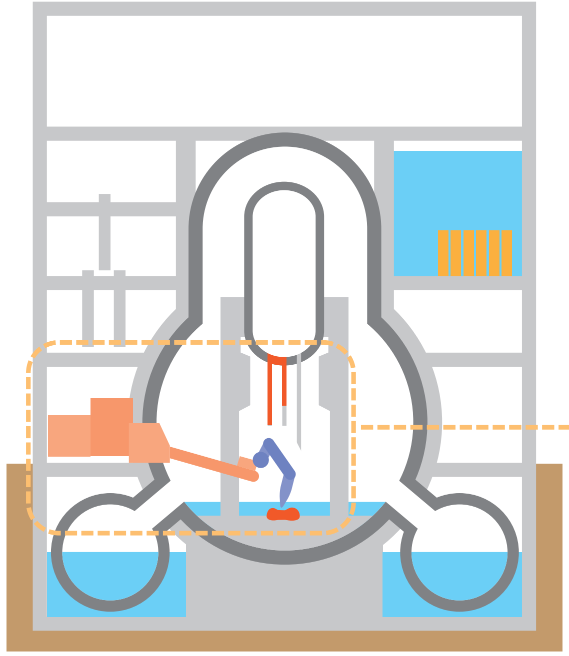
- Activities will continue with the goal of completing fuel removal from all the reactors by the end of 2031.
- The removed fuel will be stored at the site for the time being and assessed for long-term integrity to determine optimal treatment and disposal methods.

Fuel debris retrieval

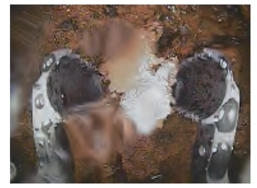
Retrieval of fuel debris is one of the most difficult challenge. Efforts are underway for trial retrieval, drawing on the collective wisdom of domestic and abroad.

Results of an internal investigation of the primary containment vessel

The radiation dose rate inside the primary containment vessel is too high for people to go inside to work. Fuel debris retrieval under these conditions is an unprecedented challenge. Internal investigations have been conducted by using remote control robots to obtain details of the situation inside.



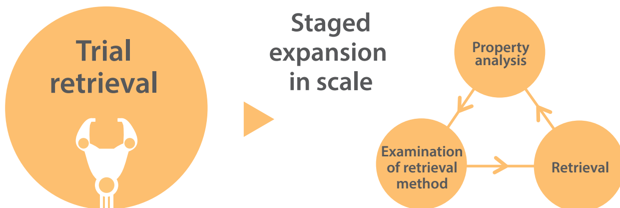
Investigations that have been made so far have clarified the fuel debris distribution* and the structural damage situation inside the primary containment vessel, and conditions such as the presence of deposits believed to be fuel debris have been confirmed. In an investigation of Unit 2 carried out on February 2019, we were able to grip deposits believed to be fuel debris and lift it up.



* The distribution situation differs depending on each unit.

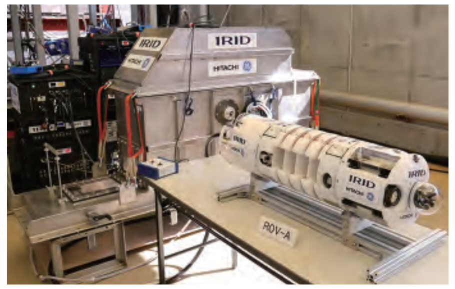
Plans for the future

Fuel debris retrieval will be carried out with safety as the top priority, using a phased approach in which work is flexibly reviewed based on investigation results. Trial retrieval will start from Unit 2, and the scale will be expanded gradually.



Robotic arm for trial retrieval

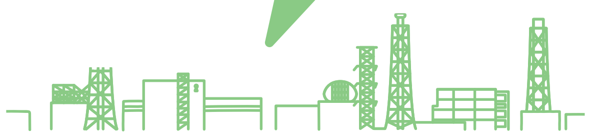
Okuma Analysis and Research Center (will analyze debris' characteristics)



Marine robot for internal investigation of Unit 1

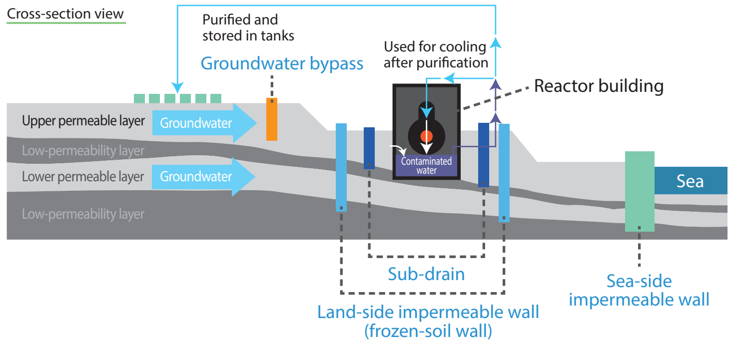
Management of contaminated water

Various measures have been implemented based on three basic principles. As a result, the risk of radiation from contaminated water has greatly reduced.



Mechanism of generation of contaminated water

Water for cooling fuel debris comes into contact with that debris and thereby becomes contaminated with highly concentrated radioactive materials. New contaminated water is generated due to mixing of this highly contaminated water with groundwater and rainwater that flow into buildings.

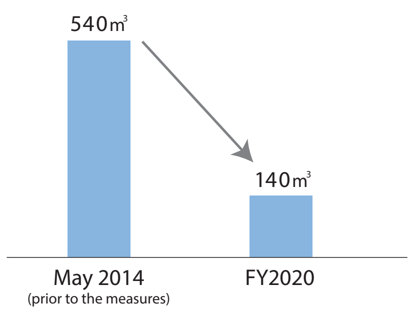


Three principles and the effectiveness of countermeasures

1 Redirecting groundwater from contamination sources

Major reduction in the amount of contaminated water generated

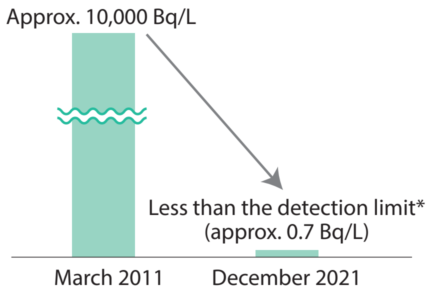
Amount of contaminated water generated (daily average)



2 Preventing leakage of contaminated water

Meets drinking water standards

Concentration of radioactive materials in the sea around the plant

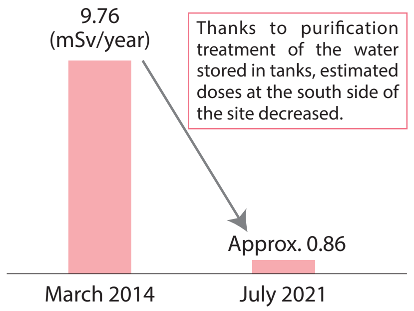


* The concentration of radioactive materials in the sea around the site refers to the Cs-137 level near the south discharge channel
* The international standard for drinking water quality is 10 Bq/L

3 Removing contamination sources

1mSv / year attained at the site boundary

Estimated doses from facilities at the south side of the site*



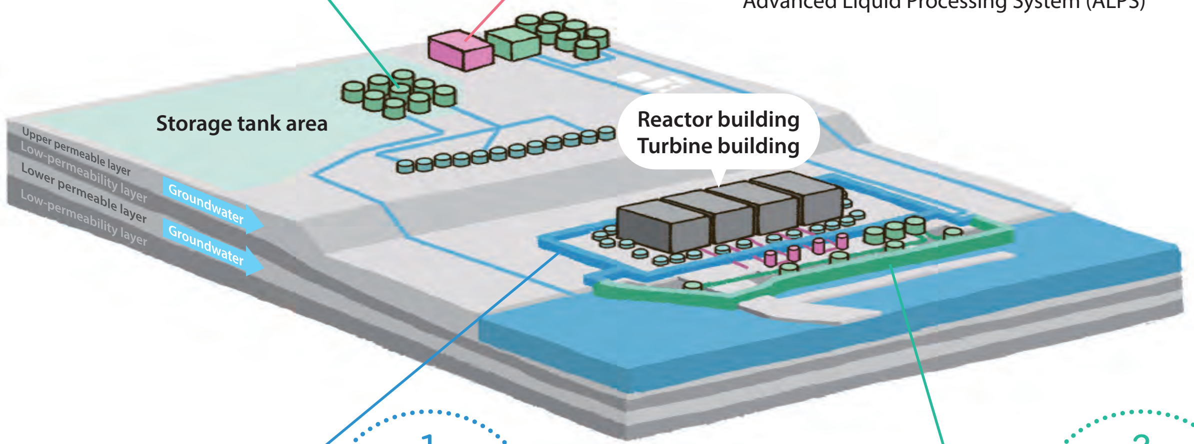
* Storage tank area

Examples of key countermeasures under the three principles

2 Preventing leakage of contaminated water — Changing from flanged tanks to welded-joint tanks

3 Removing contamination sources — Purifying water by removing most of the radionuclides except tritium (hydrogen-3)

Advanced Liquid Processing System (ALPS)



1 Redirecting groundwater from contamination sources — Installation of Frozen-soil wall in the ground

*Conceptual drawing

2 Preventing leakage of contaminated water — Installation of Sea-side steel impermeable wall

Plans for the future

Efforts to further reduce the risk of radiation from contaminated water

- We will further reduce the amount of contaminated water generated, which is a source of risk, through continuous implementation of countermeasures for rainwater.
- The goal is to control the amount of contaminated water generated to less than 100 m³/day by 2025.

Handling of ALPS treated water

Important Stories on ALPS Treated Water

In April 2021, the government of Japan announced its policy on discharging ALPS treated water into the sea. Answers to people's questions and information that were not adequately conveyed will be explained here in easy-to-understand manner.

Scan here for more detailed information. ▶

1. Handling of ALPS treated water is essential for decommission and reconstruction of Fukushima.
2. After a long period of consideration, the policy was set to discharge ALPS treated water into the sea.
3. ALPS treated water is the water which has been removed most of the radioactive materials from contaminated water.
4. Water in tanks containing a lot of radioactive materials other than tritium will be re-purified.
5. Concentration of tritium when discharged into the sea will be far below the safety standards of national and international organization (WHO).
6. As a relative of hydrogen, tritium is widely exists in nature.
7. It is very difficult to remove tritium from water, and there is no tritium separation technology at this time.
8. At nuclear facilities in the world, tritium is discharged in compliance with safety standards.
9. The impact of radiation from discharging ALPS treated water into the sea is far less than the impact of radiation from nature.
10. The International Atomic Energy Agency (IAEA) will review thoroughly the discharge of ALPS treated water into the sea.
11. All possible measures will be taken to ensure safety and to conduct thorough marine monitoring before and after the discharge ALPS treated water into the sea.
12. Various efforts are being made locally, nationally, and internationally to avoid creating new reputational damage.

Important Stories on ALPS Treated Water

1 Handling of ALPS treated water is essential for decommission and reconstruction of Fukushima.

Decommissioning of the Fukushima Daiichi NPS is a major prerequisite for reconstruction of Fukushima. However, there are already over 1,000 massive storage tanks on-site, leading to concerns about a lack of space to build the facilities required for future decommissioning work. In addition, the opinions exist that there is a risk of collapse in the event of a disaster, and that the presence of the large tanks itself is a cause of adverse impacts on reputation. Thus, handling of ALPS treated water and reducing the number of tanks are essential tasks for decommissioning and reconstruction.

Examples of facilities required for decommissioning

- Storage facilities for spent fuel
- Maintenance and training facility for fuel debris retrieval
- Storage and analysis facilities for fuel debris and radioactive waste

2 After a long period of consideration, the policy was set to discharge ALPS treated water into the sea.

Handling of ALPS treated water has been studied with experts for over 6 years. As a result, it was evaluated that discharge into the sea is the most reliable method, taking into account that there are precedents in Japan and abroad and that monitoring is easy. After hearing opinions in public and solicitation of public comments in writing, the policy of discharging ALPS treated water into the sea was set.

Consideration of expert perspectives (Committee of experts (2014-)) → Recommendations to the government (Report of the ALPS subcommittee (February 2020)) → Hearing the opinions of wide range of parties concerned, such as local people → Set Basic policy (The Inter-Ministerial Council for Contaminated Water, Treated Water and Decommissioning issues (April 2021))

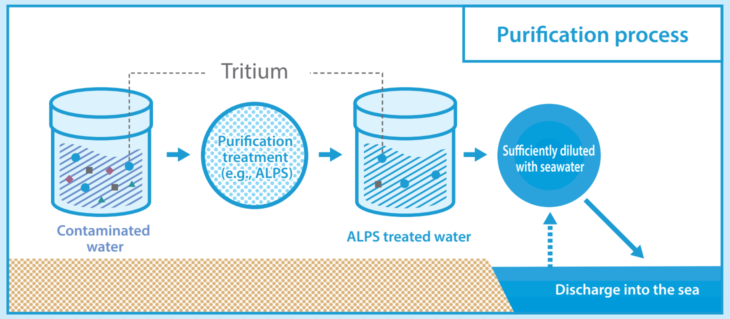
Hearing the opinions of wide range of parties concerned, such as local people:

- About 700 meetings to exchange opinions and briefings
- Opinions shared by 29 organizations and 43 relevant parties in public (7 meetings)
- Solicitation of public comments in writing for over 4 months (4,011 opinions)

3 ALPS treated water is the water which has been removed most of the radioactive materials from contaminated water.

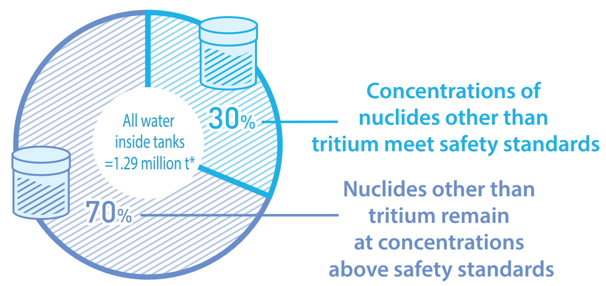
ALPS treated water is the water which has been purified from "contaminated water" to meet the safety standards with an exception of tritium. Tritium will be sufficiently diluted with seawater before discharge to meet the safety standards, through these measures, health and safety of people as well as environment will be protected.

Advanced Liquid Processing System (ALPS)



4 Water in tanks containing a lot of radioactive materials other than tritium will be re-purified.

The water stored in tanks contains some radioactive materials other than tritium in concentrations exceeding safety standards. However, these radioactive materials can be removed through re-purification (secondary treatment). Secondary treatment tests have already been conducted, confirming that those materials can be removed without problems.



*As of February 2022

The reason why the water in tanks does not meet safety standards

(1) The ALPS' processing performance when it first went into operation was not as good as it is now.
(2) In early years, the ALPS treatment has been carried out by prioritizing the volume of water treatment to quickly reduce the radiation impact to outside the site.

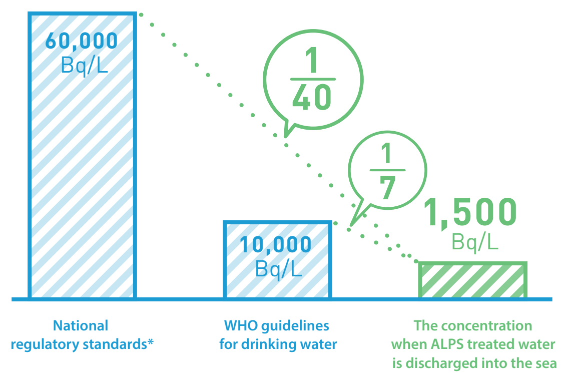
*Now, water treated with the ALPS meets all safety standards.

Important Stories on ALPS Treated Water

5 Concentration of tritium when discharged into the sea will be far below the safety standards of national and international organization (WHO).

When ALPS treated water is discharged into the sea, concentration of tritium is stipulated to be less than 1,500 Bq/L. This standard is 1/40 of 60,000 Bq/L, which is the regulatory standard (based on international standards) and about 1/7 of 10,000 Bq/L in the WHO guidelines for drinking water quality value.

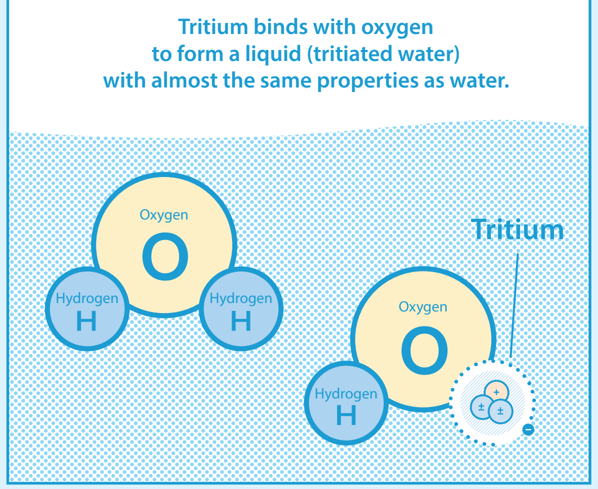
Comparison of tritium concentrations



* The concentration at which the average dose rate would reach 1 mSv / year if a person continued to drink about 2 liters of water containing tritium at the concentration at the discharge site every day from birth until the age of 70

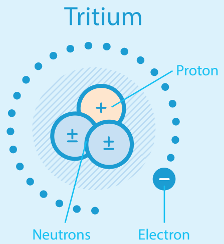
7 It is very difficult to remove tritium from water, and there is no tritium separation technology at this time.

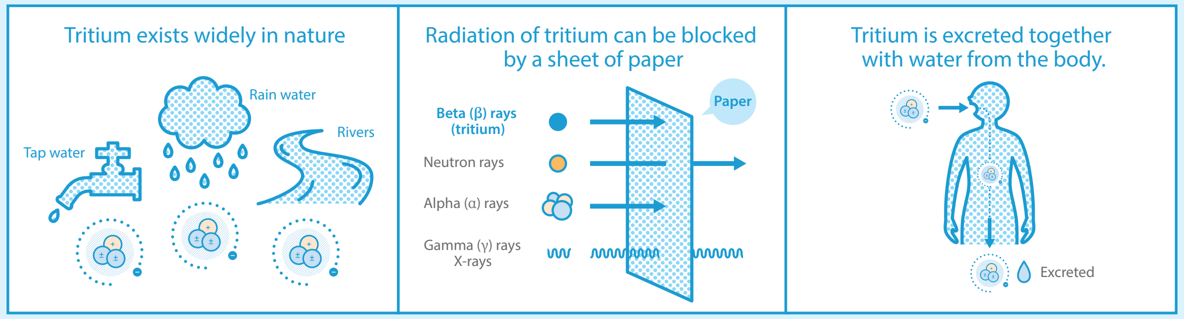
Tritium binds with oxygen to form a liquid (tritiated water) with almost the same properties as water. Thus, removing tritium from water is very difficult, and there is no tritium separation technology at this time. The IAEA has the same acknowledgement.



6 As a relative of hydrogen, tritium is widely exists in nature.

As a relative of hydrogen, tritium exists in nature, and is found in rain, sea and tap water, as well as inside of our body as a form of tritiated water. 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.

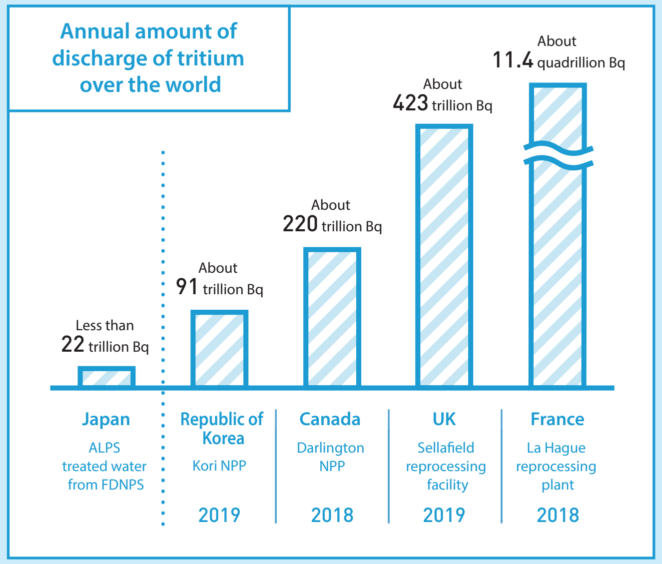




8 At nuclear facilities in the world, tritium is discharged in compliance with safety standards.

At nuclear facilities in the world, tritium is discharged in compliance with safety standards. No tritium-caused effects have been found in the vicinity of these facilities.

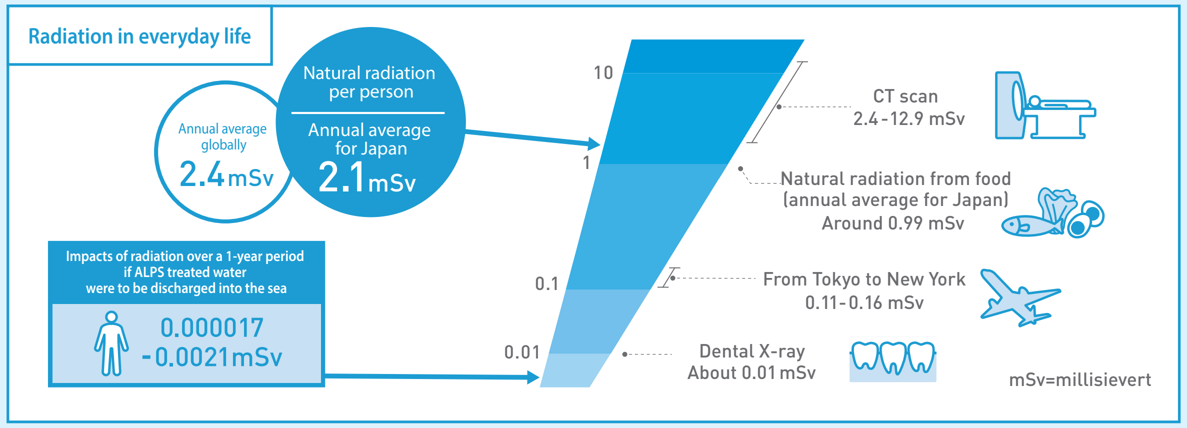
The total annual amount of tritium to be discharged will be at a level below the operational target of the FDNPS before the accident (22 Trillion Bq/year), which is lower than the ones of many nuclear facilities both in Japan and abroad.



Important Stories on ALPS Treated Water

9 The impact of radiation from discharging ALPS treated water into the sea is far less than the impact of radiation from nature.

The impact of radiation over a 1-year period if ALPS treated water were to be discharged into the sea would be minimal, and it would be far less than the impacts of radiation from nature.



Source : Prepared by the Agency for Natural Resources and Energy based on materials from the National Institute of Radiological Sciences, National Institutes for Quantum Science and Technology and Chapter 2, Exposure to Radiation in Consolidated Basic Information on the Health Effects of Radiation (FY2020) from the Ministry of the Environment

10 The International Atomic Energy Agency (IAEA) will review thoroughly the discharge of ALPS treated water into the sea.

The IAEA acknowledged that discharging ALPS treated water into the sea is based on scientific evidence and in line with international practice. Moreover, plans are to repeatedly visit the site and to review thoroughly to ensure that the discharge of ALPS treated water into the sea is in line with IAEA safety standards.

IAEA Director General Rafael Mariano Grossi during a visit to the Fukushima Daiichi NPS

International Atomic Energy Agency (IAEA)

The IAEA is the world's central forum for promoting scientific and technological cooperation with regard to the peaceful use of nuclear power. It was established as an independent agency under the auspices of the UN in 1957, and its headquarter is in Vienna.

Review mission in February 2022

11 All possible measures will be taken to ensure safety and to conduct thorough marine monitoring before and after the discharge ALPS treated water into the sea.

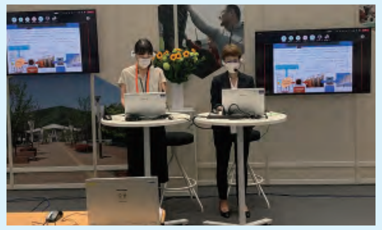
Thorough marine monitoring will be conducted before and after discharging ALPS treated water into the sea to make sure that there are no problems with water quality and to ensure safety. Moreover, plans are to begin monitoring tritium in marine products. Transparency will be ensured through the involvement of third-party organizations such as the IAEA in monitoring and by ensuring that people such as local government representatives and fishermen have the opportunity to see monitoring firsthand.

Seawater sampling (simulation)

12 Various efforts are being made locally, nationally, and internationally to avoid creating new reputational damage.

With the strong determination to prevent any adverse impacts on reputation, briefings and events are held for local people as well as nationally, and internationally.

A visit to the Fukushima Daiichi NPS



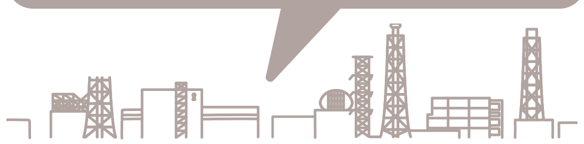
Media booth for the Olympics and Paralympics

Local event

Visiting lecture

Waste treatment and disposal

Waste from the Fukushima Daiichi NPS is currently stored in accordance with the dose rate. In order to further reduce the risk in the future, waste is reduced in volume as much as possible and consolidated into in-building storage.

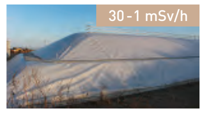


Classification and storage management of waste

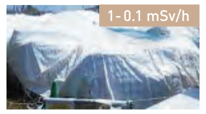
Radioactive waste and other rubble from the Fukushima Daiichi NPS are currently being stored in storage buildings and temporary outdoor storage facilities in accordance with the dose rate. These wastes will be consolidated into storage in the building after reducing their volume as much as possible for the purpose of shielding and controlling scattering. After that, the temporary storage area will be eliminated by FY2028.

Waste storage status

Solid waste storage building



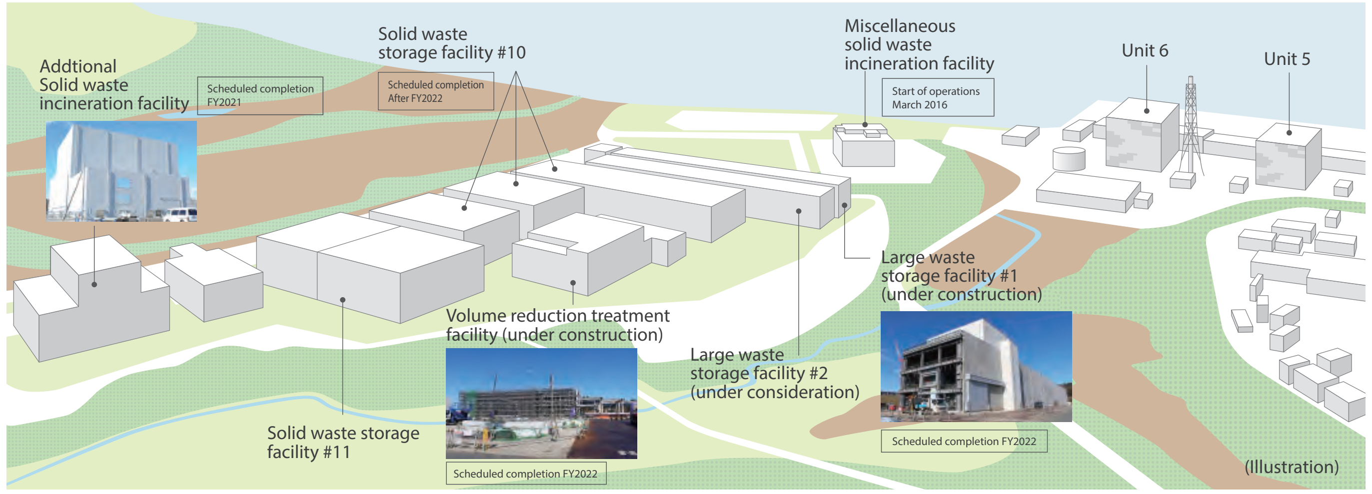
Soil-covered temporary storage facility, etc.



Sheet curing

Open storage

Branches and leaves : Temporary storage bunker
Trunks : Open storage



Anticipated waste generation for approximately the next 10 years

In order to systematically store and manage waste, each year TEPCO formulates "Storage and Management Plan" that anticipates the amount of waste that will be generated for approximately the next 10 years. As of July 2021, an estimated 790,000 m³ of waste will be generated over the next 10 years. However, that amount should be able to be reduced to about 1/3 through the use of waste incineration and reduction facilities that are currently under construction.

Amount of waste generated and stored for approximately the next 10 years

Amount stored as of March 2021	→	Anticipated amount generated for approximately the next 10 years	Incineration treatment / Reduction treatment →	Anticipated amount of stored after 10 years
About 480,000 m³		About 790,000 m³		About 270,000 m³

*Go to P26 for what it will look like after decommissioning is complete

Here are answers to your questions about decommissioning.

Decommissioning Q & A

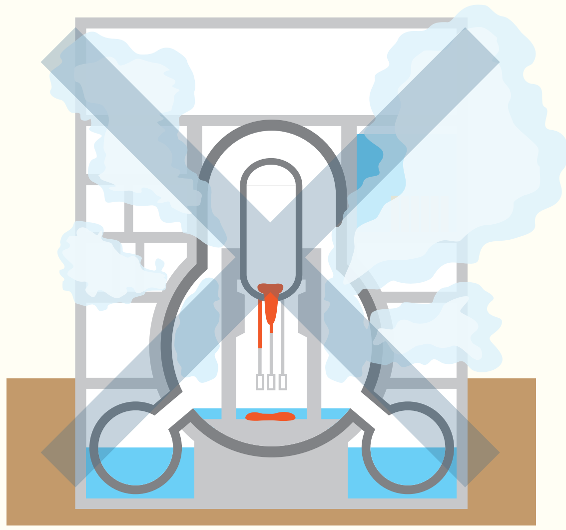
From next page!

Decommissioning Q & A

Q1 Is there any possibility of another accident?

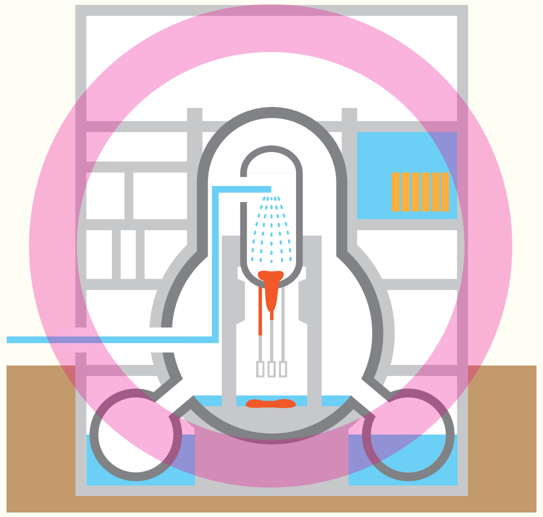
A **The reactors are kept in stable condition, and thus the probability of another accident is exceedingly low.**

- Currently, continuous water injection is underway in Units 1 to 3. As a result, the heat from fuel debris has been significantly reduced since the accident, and remains stable.
- Currently, the temperature inside the reactor is maintained at about 15-35°C . Even if water injection were to stop, it would take about 2 weeks to reach its temperature limit (80°C) of the reactor. Therefore, it is possible to respond in a timely manner.
- In addition, constant monitoring is conducted to detect “recriticality”. “Recriticality” is the reoccurrence of “criticality”, in which the uranium in the fuel undergoes a chain reaction of fissions. Even in the unlikely event of recriticality, facilities are in place to suppress nuclear fission.



At the time of the accident

The accident prevented water injection to the reactors. As a result, the fuel generated heat, and hydrogen explosions occurred.



Today

Reactors are kept stable.

Q2 How is the site prepared for natural disasters, such as earthquakes and tsunamis?

A **Various hard and soft measures have been taken. Expansion of the equipment will continue to ensure the effectiveness of the measures.**

Earthquake

A computer analysis has confirmed the ability of critical buildings to withstand an earthquake in the class of the Great East Japan Earthquake.

The equipment used for fuel removal from the spent fuel pool is also resistant to earthquakes to minimize the impact on the decommissioning work.

Based on lessons learned from the earthquake that occurred off the coast of Fukushima Prefecture in February 2021, safety will continue to be ensured, and prompt and transparent dissemination of information will be ensured.

Tsunami

An additional Chishima Trench Tsunami Seawall was constructed in 2020.Additional measures, such as raising the seawall, will continue to be implemented to prepare for Japan Trench Tsunami.

Work was completed on each building to create doors to block openings to prevent water from entering.

Measures against flooding due to tsunami

Chishima Trench-related tsunami seawall

Before measures taken

After measures taken

Installation of doors to prevent entry of water

Equipments and drills

Fire engines, power supply vehicles, and other equipment needed in an emergency are placed on a hill out of reach of tsunamis to enable quick response to a disaster situation.

Emergency drills are regularly conducted assuming various disaster scenarios, such as a loss of power at the site.

Securing the cooling function in an emergency

A drill for water injection

A power supply vehicle

Fire engines

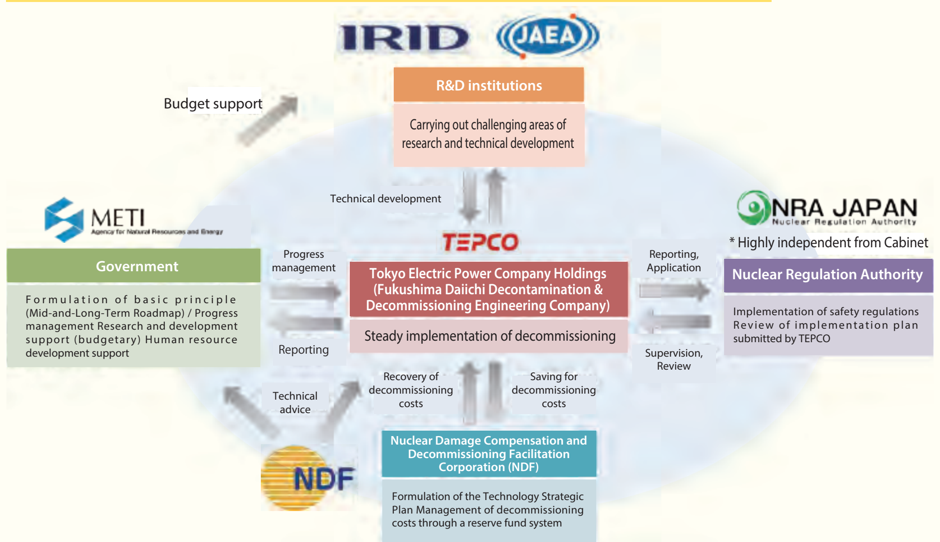
Decommissioning Q & A

Q3 Who is involved in the decommissioning?

A Wisdom has been gathered from experts in Japan and abroad, and local people have been cooperating, too.

- This decommissioning is an unprecedented challenge. To bring together wisdom from Japan and abroad, various organizations are involved in the project, including universities, research and development institutions, and overseas companies, in addition to the government of Japan and TEPCO.

Division of roles among the involved organizations for carrying out decommissioning of the Fukushima Daiichi NPS




Collaborative Laboratories for Advanced Decommissioning Science (Tomioka Town)


Okuma Analysis and Research Center (Okuma Town)


Naraha Center for Remote Technology Development (Naraha Town)

- The decommissioning work, a major precondition of Fukushima reconstruction, will continue over the period of 30-40 years, and therefore involvement of local people in various ways is essential, such as through nearby businesses supporting the decommissioning (lodging facilities, restaurants, etc.) or as on-site personnel and engineers.
- Local communities, including local companies, are also cooperating on decommissioning. The goal is to move the decommissioning project forward in tandem with Fukushima's reconstruction, where local communities are invigorated as technical expertise and other skills gained through the cooperation serve as a driving force.
- The project has also been working closely with IAEA and other international organizations to take advantage of their knowledge and experiences about decommissioning and actively disseminating information on the decommissioning of the Fukushima Daiichi Nuclear Power Station to the international community. IAEA has provided assessments and advice on decommissioning at five occasions to date.


ABLE Co., Ltd.
(Dismantled the exhaust stack for Units 1 and 2)


Canyonworks, Ltd.
(Produced protective clothes used at the Fukushima Daiichi NPS)

Q4 What will happen after the decommissioning is completed?

A What will happen after the decommissioning is completed?

- No specific vision has been developed on the state after the decommissioning is completed because of the many remaining uncertainties, such as the internal state of the reactors and the handling of waste.
- Having a vision about the state after decommissioning is an important issue related to the future of the local community and needs further studies. The government of Japan will continue such studies, fully taking into account views of local people.

Q5 What's going on inside the Fukushima Daiichi NPS?

A Conditions on the premises have improved greatly, and visits by local people and groups are opened. Moreover, virtual tour is also available so that more people can see the decommissioning site.


Visit by local people

- Since November 2018, local people and others visiting the site have no longer been required to change their clothes while staying on the hill overlooking Units 1 to 4. Visitors totaled about 60,000 people over the past 5 years.

To take a virtual tour of the decommissioning site, scan here

INSIDE Fukushima Daiichi
https://www.tepco.co.jp/en/insidefukushimadaiichi/index-e.html

Decommissioning efforts to date

2011 Earthquake occurred (Mar) / Cold shutdown state reached (Dec)

Management of contaminated treated water

2012
- Sea-side impermeable wall construction started (Apr) 800 min total length, with approx. 600 piles

2013
- Test operation of Multi-nuclide removal equipment (ALPS) started (Mar)
- Large amounts (approx. 300 t) of contaminated water leaked from flanged tanks (Aug)
- Three basic principles for contaminated water management decided: redirect, prevent leakage, and remove (Dec)

2014

- Groundwater bypass pumping and discharge started (Apr)
- Full-scale construction of frozen-soil type land-side impermeable wall started (Jun) 1,500 min total length, with approx. 1,568 freezing tubes, 30 min depth

2015

- Sub-drain pumping and discharge started (Sep)
- Sea-side impermeable wall closed (Oct)

2016

- Freezing of frozen-soil type land-side impermeable wall started (Mar)
- Wide-area paving (facing) of the site completed (Mar)

Fuel removal from the spent fuel pools

2012

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

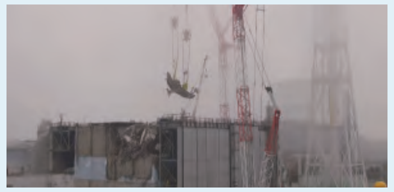
2013

- Unit 4 : Fuel removal from spent fuel pool and transfer to common pool started (Nov)

2014

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

2015



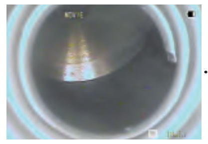
- Unit 3 : Removal of large rubble (fuel handling machine) from spent fuel pools completed (Aug)

2016

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

Fuel debris retrieval

2012

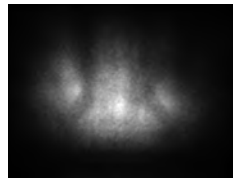


- Unit 1 : PCV inspected with video captured by endoscope (Oct)
- Unit 2 : PCV inspected with endoscope for the first time (Jan)

2015

- Unit 1 : Debris location survey based on cosmic ray muons ; No fuel found in the core (Feb)
- Unit 1 : 1st floor of PCV surveyed with robot (Apr)
- Unit 3 : Video images of PCV obtained (Oct)

2016



- Unit 2 : Debris location survey based on cosmic ray muons ; Most of fuel debris found to be present on the bottom of RPV (Mar)

Waste treatment

2016
- Miscellaneous solid waste incineration facility started operating (Mar)

Other activities, working environment etc.

2013
- Full-face masks no longer needed except in areas around Units 1-4, tank area, and rubble storage area (May)
- Access to 1st floor in ordinary working clothes allowed (Jun)

2014
- New administration building put into service (work previously conducted in the back office on 2nd floor moved to 1st floor) (Oct)

2015

- Serving of hot meals started in cafeteria (Apr)
- Large rest house (seating 1,200 people) put into service (May)
- Areas not requiring full-face masks expanded to 90% from 65% (May)

2016

- A convenience store opened in the large rest house (Mar)
- Areas not requiring coveralls expanded due to the progress of measures to reduce environmental doses (Mar)
- Doses at site boundary reduced to 1 mSv/year (Mar)
- New main administration building put into service (Oct)

Reconstruction

2012
- Commercial shing resumed in thewaters off Fukushima for the first time since the earthquake

2013
- Non-experimental rice growing resumed in fields in previously restricted areas for the first time (Tamura City)

2014
- Government evacuation order lifted for the first time in some areas (Tamura City)

2015
- Joban Expressway fully opened

2016
- Fukushima Robot Test Field put into service (fully opened in 2020 after a phase-in)

Decommissioning efforts to date

Management of contaminated treated water

2017
- Unit 1 : Removal of stagnant water from turbine building completed (Mar)

2018
- Frozen-soil type land-side impermeable wall completed
  A 5–6 m gap in groundwater level created on the mountain side
  Generation of contaminated water reduced to one-third of the amount before countermeasures were taken
  (from 540 m³ to 170 m³ per day)

2019

- Multi-nuclide removal equipment
  Transfer of treated water to welded-joint tanks completed (Mar)

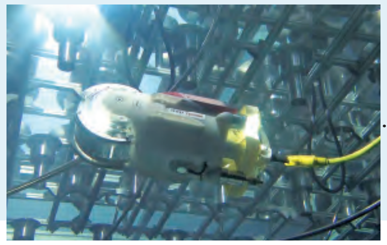
2020
- Multi-nuclide removal equipment
  Report by Subcommittee on Handling of the ALPS Treated Water (Feb)
- The following objectives set in Mid- and Long-term Roadmap achieved :
  - Complete the treatment of stagnant water in buildings*
  - Reduce the amount of contaminated water generated per day to 150 m³ or less (a daily average of 140 m³ achieved in 2020)

  * Excluding Units 1 to 3 reactor buildings, main process building, and high temperature incinerator building

2021
- Basic Policy on handling of ALPS treated water (Apr)
- Status of Review Regarding the Handling of ALPS treated water (Aug)
- Action Plan concerning the Continuous Implementation of the Basic Policy on handling of ALPS treated water (Dec)

Fuel removal from the spent fuel pools

2017

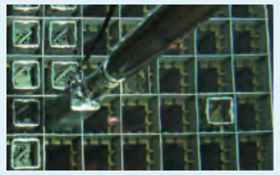


2018
- Unit 1 : Removal of rubble on north side of reactor building started (Jan)
- Unit 2 : Upper part of reactor building surveyed, rubble removal started (Jul)
- Unit 3 : Installation of the cover for fuel removal completed (Mar)

2019

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

2021



- Unit 3: Removal of all 566 fuel assemblies completed (Feb)

Fuel debris retrieval

2017
- Unit 1 : Basement of PCV surveyed with self-propelled robot (Mar)
- Unit 2 : Lower part of RPV surveyed with self-propelled robot (Feb)
- Unit 3 : Debris location survey based on cosmic ray muons ; No fuel present in the core (May)
- Unit 3 : Lower part of RPV surveyed (Jul)

2018
- Unit 2 : Lower part of RPV surveyed (Jan)

2019

- Unit 2 : Deposits believed to be fuel debris grabbed for the first time (Feb)
- Start of fuel debris retrieval decided (Unit 2 first in 2021)(Dec)

2021

- The robotic arm for trial retrieval of fuel debris arrived in Japan from the UK, and performance verification test started (Jul)
- Unit 1 : Investigation of the base of the primary containment vessel started (Feb 2022)

Waste treatment

2018
- Solid waste storage building No. 9 started operating (Feb)
- Heavy equipment decontamination facility started operating (May)

2020
- Preparatory construction for the waste reduction facility started <Sep>

2021
- Additional miscellaneous solid waste incineration facility starts operating (Mar 2022 (planned))

2017 | 2018 | 2019 | 2020 | 2021

Other activities, working environment etc.

2017

- G zone areas (ordinary clothing areas) expanded to 95% of the site area due to improved working environment (Mar)

2018

- Self-driving electric buses put into service (Apr)
- G zone areas expanded to 96% of the site area due to improved working environment (May)

2019

- Units 1 and 2 : Dismantling of exhaust stack started (completed in May 2020) (Aug)

Reconstruction

2018

- J-Village reopened (except for some facilities ; a fully opened in 2019)

2019
- Evaluation order lifted in some areas of Okuma Town, allowing municipal services to start at a new town hall building
- Fukushima Hydrogen Energy Research Field opened (Mar)

2020

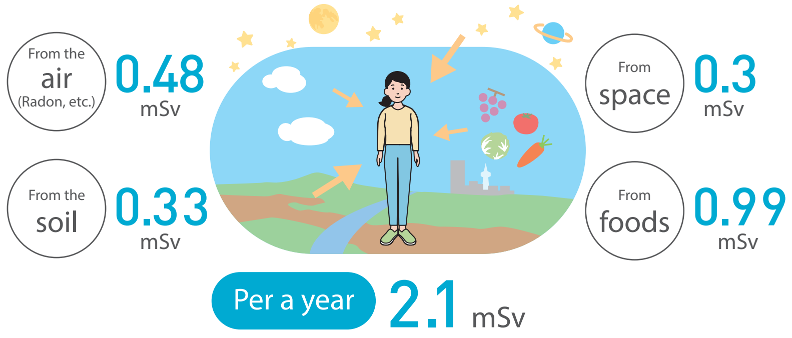
- Joban Line train service fully resumed (Mar)
- Evacuation order lifted in some parts of the towns of Futaba, Okuma, and Tomioka (evacuation order lifted in all areas except the difficult-to-return zones) (Mar)
- The Great East Japan Earthquake and Nuclear Disaster Memorial Museum opened

2021
- Preliminary accommodations open in conjunction with the lifting of the evacuation order for the Specified Reconstruction and Revitalization Bases (Village of Katsurao : Nov 2021, Town of Okuma : Dec 2021, Town of Futaba : Jan 2022)

Basic knowledge about radiation

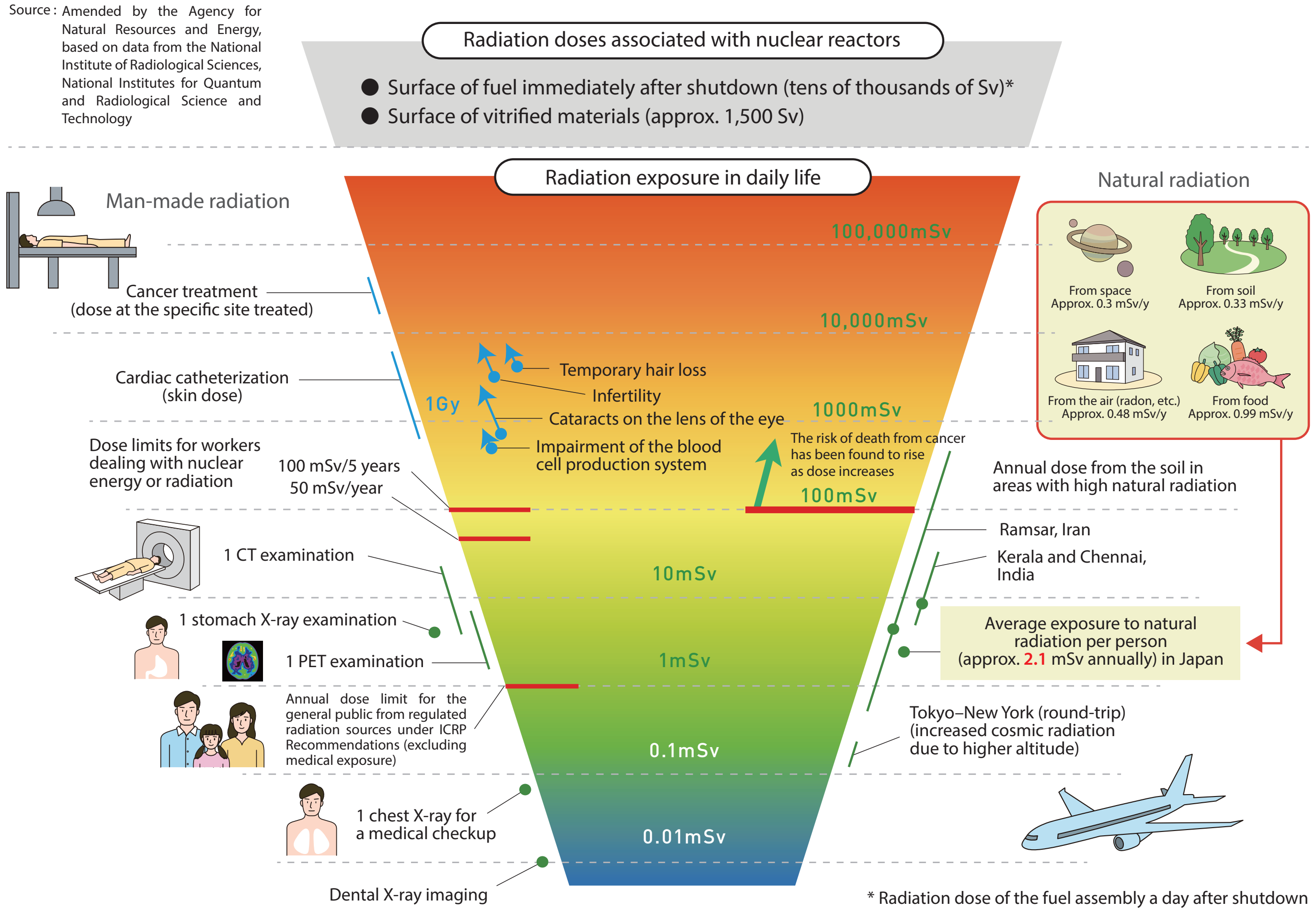
Radiation in daily life

In our daily lives, we are exposed to various types of radiation. It originally exists in nature, and does radiation exist not only in specific places such as nuclear power stations and hospitals. Health effects of radiation depend not on the existence of radiation itself but on the amount of radiation we are exposed to.



Quick reference chart for radiation exposure

Source: Amended by the Agency for Natural Resources and Energy, based on data from the National Institute of Radiological Sciences, National Institutes for Quantum and Radiological Science and Technology



* Radiation dose of the fuel assembly a day after shutdown

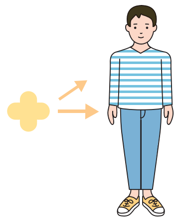
What's the difference between radioactive materials, radioactivity, and radiation? What are becquerels and sieverts?

The becquerel (Bq)

is a unit that shows the amount of radioactivity, which is the ability to emit radiation.

The sievert (Sv)

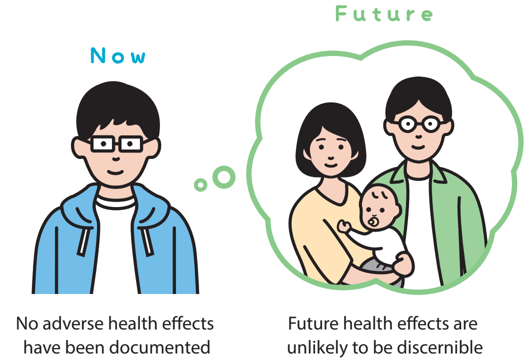
is a unit that shows the degree of impact of radiation on the human body. The imparted effect varies depending on the nuclide, even with the same becquerel value, and therefore it is important to make determinations using sieverts (effective dose) when comparing health effects.



The current state of Fukushima

Health effects

In a 2020 report, the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) stated that no adverse health effects have been documented that could be directly attributed to radiation exposure from the accident and future health effects directly related to radiation exposure are unlikely to be discernible.



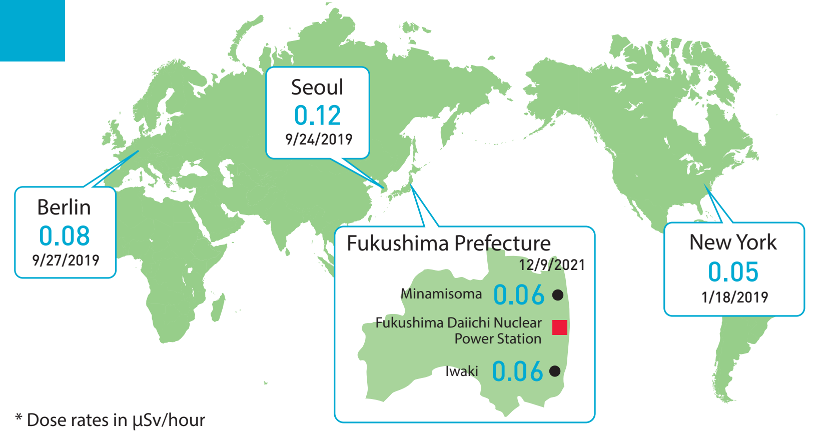
Food from Fukushima Prefecture

Based on the world's strictest standard of radioactive materials inspection on food and drinking water from Fukushima Prefecture, the safety is ensured and all products that are shipped to the market are within standard values. After the accident, 55 countries/regionsimposed import restrictions on food from Fukushima. The restrictions have gradually been eased since then, with 41 countries/regions having fully lifted them.

*As of February 2022

Air dose rates in Fukushima

Air dose rates in Fukushima are almost at the same level as those in major cities and at major sightseeing spots inside and outside Japan.



* Dose rates in μSv/hour

Source : Steps for Revitalization in Fukushima (30.2 th edition)

Terminology

① Operating floor
P.7

The uppermost floor of the reactor building, where tasks such as fuel exchange are carried out using the fuel handling machine during periodic inspections.

② Dry cask
P.3

A container for spent fuel and other materials. It is used to store fuel removed from the common pool on a hill.

③ Air dose rate
P.32

The radiation dose present in a certain space, converted to a value per unit time. This includes more than radiation derived from the accident. It is also affected by radioactive materials derived from nature. Therefore, due to geological diffence, there are rate gaps among regions, and weather condition also fluctuates the air dose rate.

④ Reactor pressure vessel (RPV)
P.7/P.28/P.29

A metal vessel housing fuel, control rods, and other components. This vessel is installed in the primary containment vessel. In the operating power station, heat is produced in this vessel due to the nuclear fission reaction.

⑤ Primary containment vessel (PCV)
P.7-10/P.27-29

A steel vessel housing the reactor and associated cooling system equipment, etc. Its function is to prevent diffusion of radioactive material to the surrounding are in case of fuel damage.

⑥ Sub-drain
P.3/P.4/P.11/P.28

A well installed near a building to lower the level of groundwater around the building and thereby suppress the influx of groundwater into the building and efflux of groundwater to the area on the sea side of the building. Groundwater pumped up from the sub-drain is purified and discharged after checking that the operational targets are met.

⑦ Spent fuel
P.7/P.9/P.24/P.27-30

Nuclear fuel which has been used in a nuclear reactor and whose fission ability has weakened. At the Fukushima Daiichi NPS, retrieval of fuel from spent fuel pools in reactor buildings has been proceeding in order to reduce future risk. (Retrieval from Units 3 and 4 has been finished.)

⑧ Shield plug
P.7

The top lid of the primary containment vessel. It has been found that the underside of the lid is highly contaminated. Although this is not considered to affect the decommissioning work directly, future decommissioning activities will be flexibly reviewed based on such findings.

⑨ Turbine building
P.9/P.29

A building housing the turbine generator. At the Fukushima Daiichi NPS, the building is located on the sea-side of the reactor building.

⑩ Groundwater drain
P.4

One of the measures for “preventing leakage” of contaminated water. The facility prevents contaminated water from leaking into the sea by pumping up the groundwater blocked by the sea-side impermeable wall and purifying it before discharging it into the sea.

⑪ Groundwater bypass
P.4/P.11/P.28

One of the measures for “redirecting” groundwater from contamination sources. The facility pumps up groundwater owing from the mountain side to the sea side through wells apart from reactor buildings and other facilities and checks that the discharge standards are met before discharging the water into the sea.

⑫ Frozen-soil wall
P.3/P.11/P.12

One of the measures for “redirecting” groundwater from contamination sources. It is built around the reactor buildings and turbine buildings for Units 1 to 4 and blocks the groundwater flowing from the mountain side to the sea side.

⑬ Tritium (T)
P.12-14/P.16-18/P.20

A radioisotope of hydrogen. This is produced not only by nuclear reactors, but also in nature by contact between cosmic rays and the earth’s atmosphere. It is present in rivers and the ocean in the form of “tritiated water” combined with oxygen. Tritium is also contained in rainwater, tap water, and water vapor in the atmosphere, but the radiation emitted by tritium has extremely low energy, and thus has little effect on the human body.

⑭ Fuel debris
P.2/P.5/P.7/P.8/P.10/P.11/P.15/P.23/P.27-30

Nuclear fuel melted down and mixed with various pieces from structures which solidified inside the reactor.

⑮ Blowout panel
P.8

Equipment that prevents building damage by automatically failing and releasing pressure when pressure in the reactor building has increased.

⑯ Main process building
P.4/P.30

A common facility for radioactive waste treatment and storage for all the reactors. Since the accident, it has been used as temporary storage for stagnant water that has been transferred from the reactor buildings before being treated.

⑰ Pedestal
P.7

A concrete structure supporting the reactor pressure vessel.

⑱ Radioactive cesium (Cs-134, Cs-137)
P.5/P.11

This is produced during fission of uranium fuel. One of the primary radioactive materials emitted into the environment due to the accident at the Fukushima Daiichi NPS. The half-life of Cs-134 is 2.1 years, and Cs-137 is 30 years. Food safety is measured using radioactive cesium as a standard. (The standard for general foods in Japan is100Bq/kg.)

⑲ Monitoring post
P.6

A system for continuously measuring the radiation dose in the atmosphere. These posts are mainly located on the site of the nuclear power station and surrounding municipalities. Real-time measurement data is publicly released on a website.

For more information on the Fukushima Prefecture Radiation Monitoring Office

⑳ Weld-joint tanks
P.12/P.30

Tanks storing purified water. Their joints are welded to reduce the risk of the stored water leaking out. Flanged tanks built from steel materials connected together with bolts were once used for storage, but they have been replaced with weld-joint tanks to lower the risk of leakage.

㉑ Criticality
P.23

The condition where ssion is ongoing in a sustained chain reaction. In a nuclear power station, electricity is generated by keeping this chain reaction in the nuclear reactor at a certain level (output).

㉒ Cold shutdown state
P.8/P.27

A state where temperature at the bottom of the RPV is roughly 100℃ or less, emission of radioactive materials is controlled, and medium-term safety of the cooling system can be ensured.

㉓ IRID
P.25

The abbreviation for the International Research Institute for Nuclear Decommissioning.The organization conducts research and development on the decommissioning of the Fukushima Daiichi NPS, promotes cooperation with international and domestic organizations, and develops human resources for associated research and development.

㉔ JAEA
P.3/P.25

The abbreviation for the Japan Atomic Energy Agency. Its activities include analyses and studies on treatment and disposal of fuel debris and other radioactive materials and the provision of opportunities for development and demonstration of remote control equipment for that purpose.

㉕ NDF
P.25

The abbreviation for Nuclear Damage Compensation and Decommissioning Facilitation Corporation. The organization was founded in September 2011 as the Nuclear Damage Compensation Facilitation Corporation to assume responsibilities such as granting compensation funds to nuclear operators. It was reorganized into Nuclear Damage Compensation and Decommissioning Facilitation Corporation in August 2014. With the additional objective of ensuring appropriate and steady implementation of decommissioning and other activities, the NDF conducts research and development of technologies needed for decommissioning, etc. and offers associated advice, guidance, and recommendations.

㉖ WHO Guidelines for Drinking-water Quality
P.17

Guidelines prescribing numerical targets and measures to be taken to ensure safety of drinking water, set forth by WHO (World Health Organization). A value of 10 becquerel / liter is used as an indicator for cesium-137, and water not exceeding that value is assessed to be suitable for drinking.

For those who want to know more about decommissioning

Videos on the present state of decommissioning

A video showing the progress of decommissioning at the Fukushima Daiichi Nuclear Power Station and developments expected in the future is available. It gives you avisual tour of the facilities in a way that makes you feel as if you were visiting the site.

- Management of contaminated/treated water
- Improvement of the working environment
- Removal of fuel from the spent fuel pool
- Fuel debris retrieval

[1FFACT Facts to be conveyed from the Fukushima Daiichi NPS]

3 clips showing on-site video and date at the Fukushima Daiichi NPS

[01 Discharging ALPS treated water into the sea]

[02 Toward fuel debris retrieval]

[03 The current state of the Fukushima Daiichi NPS]

Please use the QR code to access it

Decommissioning portal

TEPCO Decommissioning Archive Center

Address : 3-58 Chuo, Tomioka-machi, Futaba-gun, Fukushima
Hours : 9:30 - 16:30 (closed on the third Sunday of every month, and during the year-end and New Year's holidays)
Admission fee : Free (free parking)
Telephone : +81-(0)120-50-2957
Note : Reservations may be required to prevent the spread of COVID-19.

Here, people from areas around the power station in Fukushima Prefecture, and general public people can check facts about the accident at the Fukushima Daiichi NPS, the current state of decommissioning work, and other information.

METI
Agency for Natural Resources and Energy

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