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 a visual 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

There are also other videos focusing on people working behind the scenes toward decommissioning.

People offering technology to support the decommissioning at the Fukushima Daiichi NPS

People serving food to support the decommissioning at the Fukushima Daiichi NPS

Companies supporting the decommissioning at the Fukushima Daiichi NPS

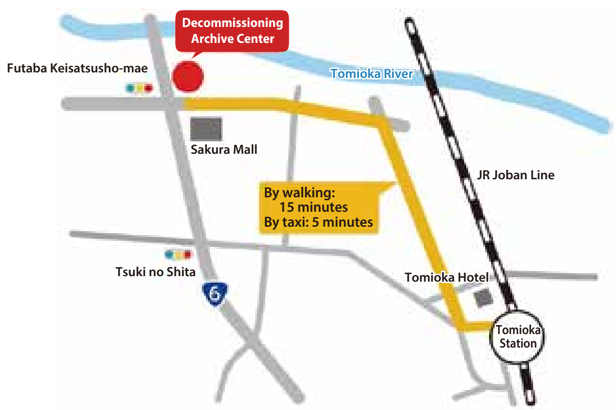
You can view these videos only in Japanese.

Decommissioning portal | Search

Please use the QR code to access it

TEPCO Decommissioning Archive Center

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.



Address: 378 Aza-Chuo, Oaza-Kobama, 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.

METI Agency for Natural Resources and Energy

Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry Nuclear Accident Response Office
TEL: +81-(0)3-3580-3051 (direct line)
FAX: +81-(0)3-3580-0879
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Field Office for Decommissioning and Contaminated/Water Management, Cabinet Office
TEL: +81-(0)240-22-9390
FAX: +81-(0)240-22-9400

Photographs:
Courtesy of Tokyo Electric Power Company Holdings, Incorporated (TEPCO) (Fukushima Daiichi NPS decommissioning magazine Hairo Michi and other materials), Japan Atomic Energy Agency, International Research Institute for Nuclear Decommissioning, and others

Important Stories on Decommissioning

Fukushima Daiichi Nuclear Power Station, now and in the future

2021

METI Agency for Natural Resources and Energy

Introduction

At the TEPCO 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.

This booklet provides answers to questions regarding Fukushima in an easy-to-understand manner, as well as information about the current status and future actions regarding the decommissioning process, together with recent topics.

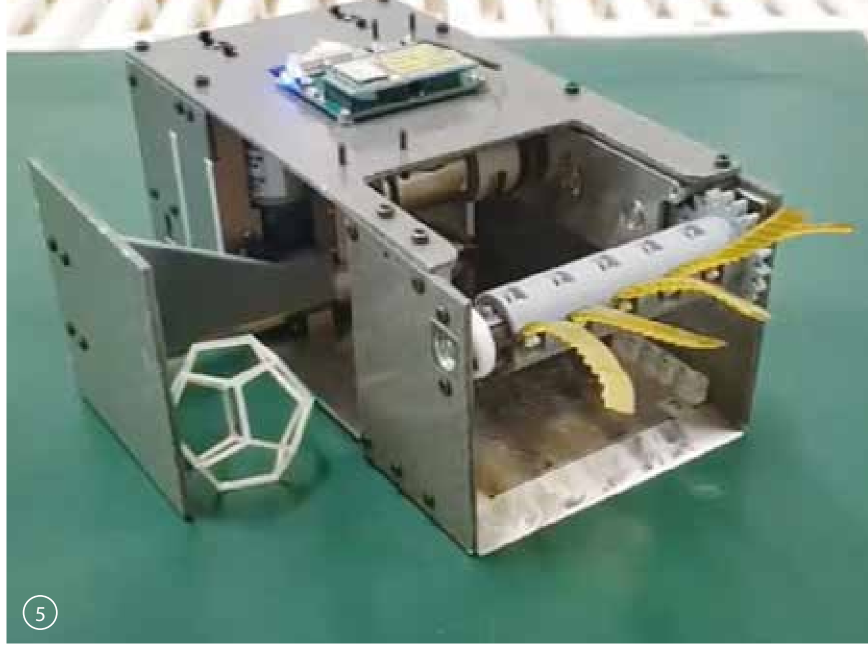


Table of Contents

① **Visit by local people**
About 4,000 local people visited the site for observation in FY2020 (as of the end of February 2021).

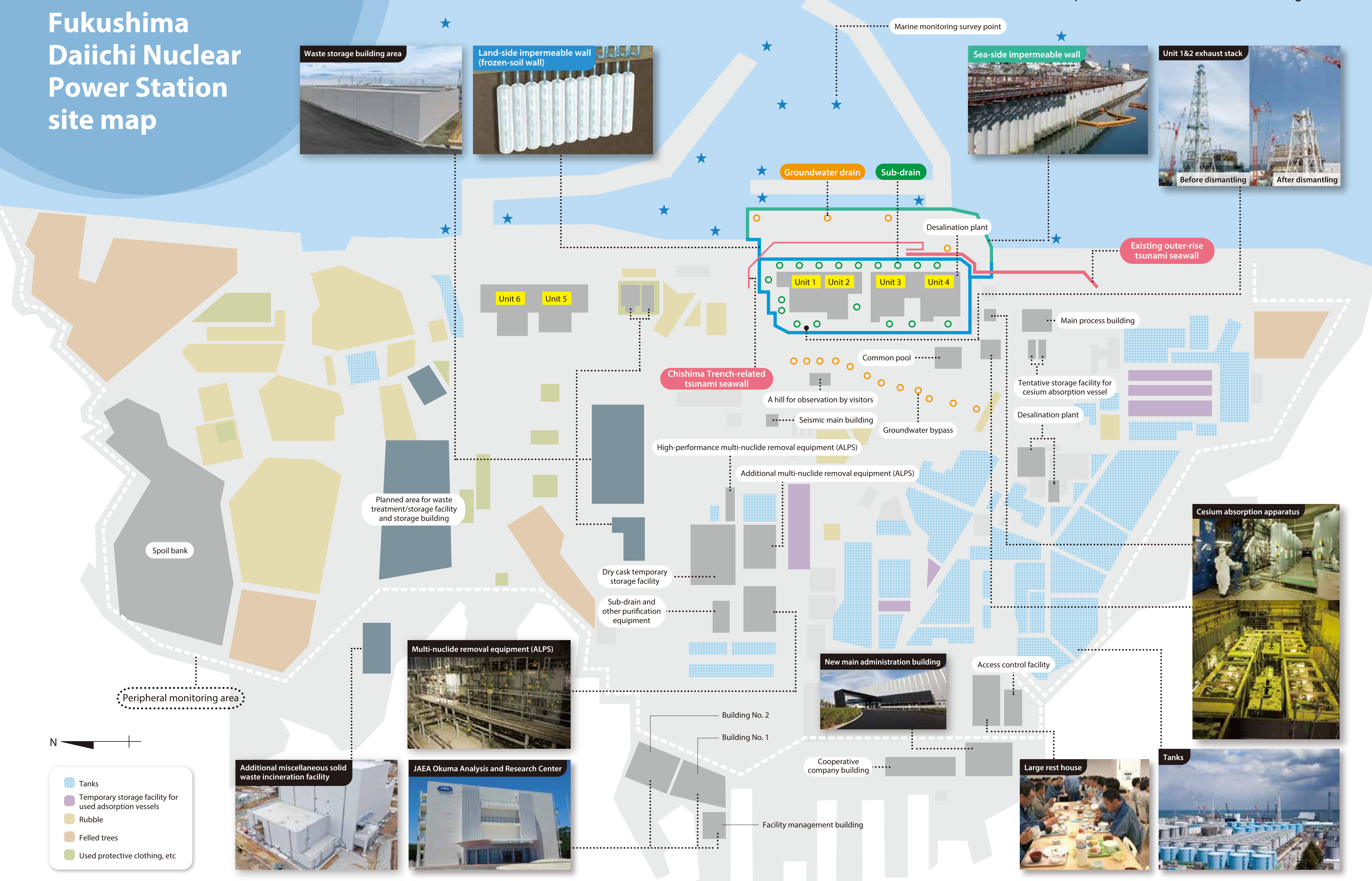
② **Gifts to on-site personnel**
Thousands of origami cranes were sent from different parts of Japan.
Many people have shown warm support.

③ **Tanks storing water produced through purification of contaminated water**
There are more than 1,000 of them on the premises.

④ **120 m high exhaust stack**
The dismantling work finished in May 2020, with the upper half removed in cooperation with local company.

⑤ **A robot presented at a decommissioning robotics competition in which high school students across Japan gathered to demonstrate their technologies useful for decommissioning**
In FY2020, a robot of a local technical school, National Institute of Technology (Kosen), Fukushima College, won the top prize.
(The photo shows the robot created by the college.)

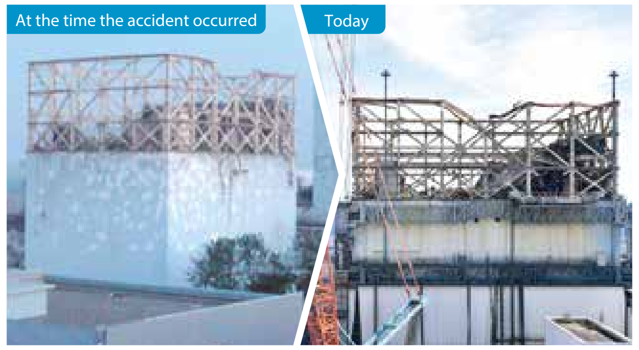
Fukushima Daiichi Nuclear Power Station site map



Current status at the Fukushima Daiichi Nuclear Power Station

Status of the site

Unit 1

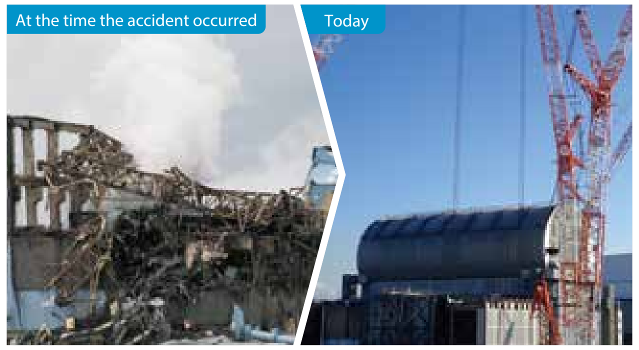


A cover that is large enough to spread over the entire building will be installed to prevent dust scattering during planned fuel removal.

Unit 2

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

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.

Unit 4

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

Working conditions for workers

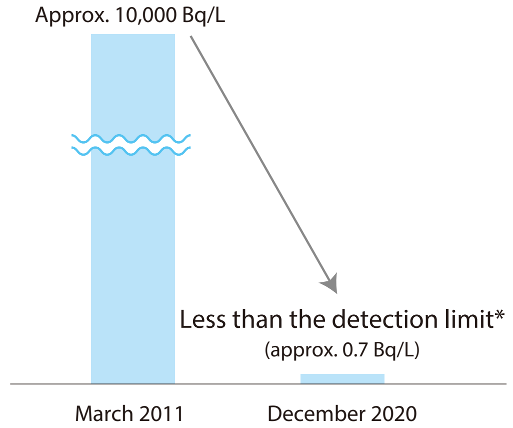
A cafeteria and a convenience store available at the large rest house

Emergency physicians are on duty 24/7

Effects on surrounding areas

Sea From the efforts that have been made so far, major progress has been made in management of contaminated water, and water quality in the sea around the plant has been greatly improved. Contamination levels have been confirmed to fully meet the international quality standards for drinking water.

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

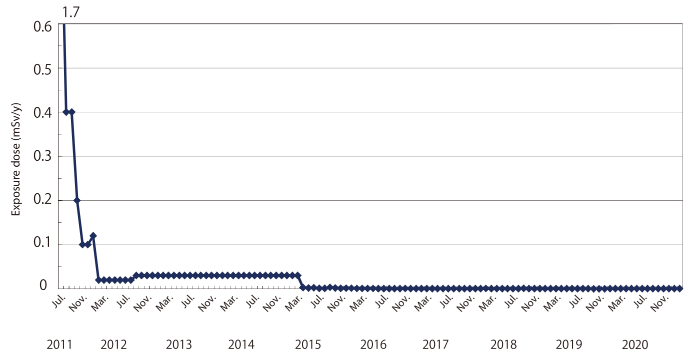
In the sea around the plant

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

Matsukawaura fishing port in October 2019

Air The amount of emissions of radioactive materials from reactor buildings are limited, and there are no effects even at the site boundary. Dust is also constantly measured at the site boundary, and is far below the standard value where an alert is issued.

Evaluation of annual exposure dose at the site boundary due to radioactive materials (cesium) from the reactors buildings of Units 1-4



Site inspection is available from a hill near the buildings without wearing protective clothes.

In surrounding areas

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

Joban Line train service fully resumed in March 2020

What is decommissioning of the Fukushima Daiichi Nuclear Power Station?

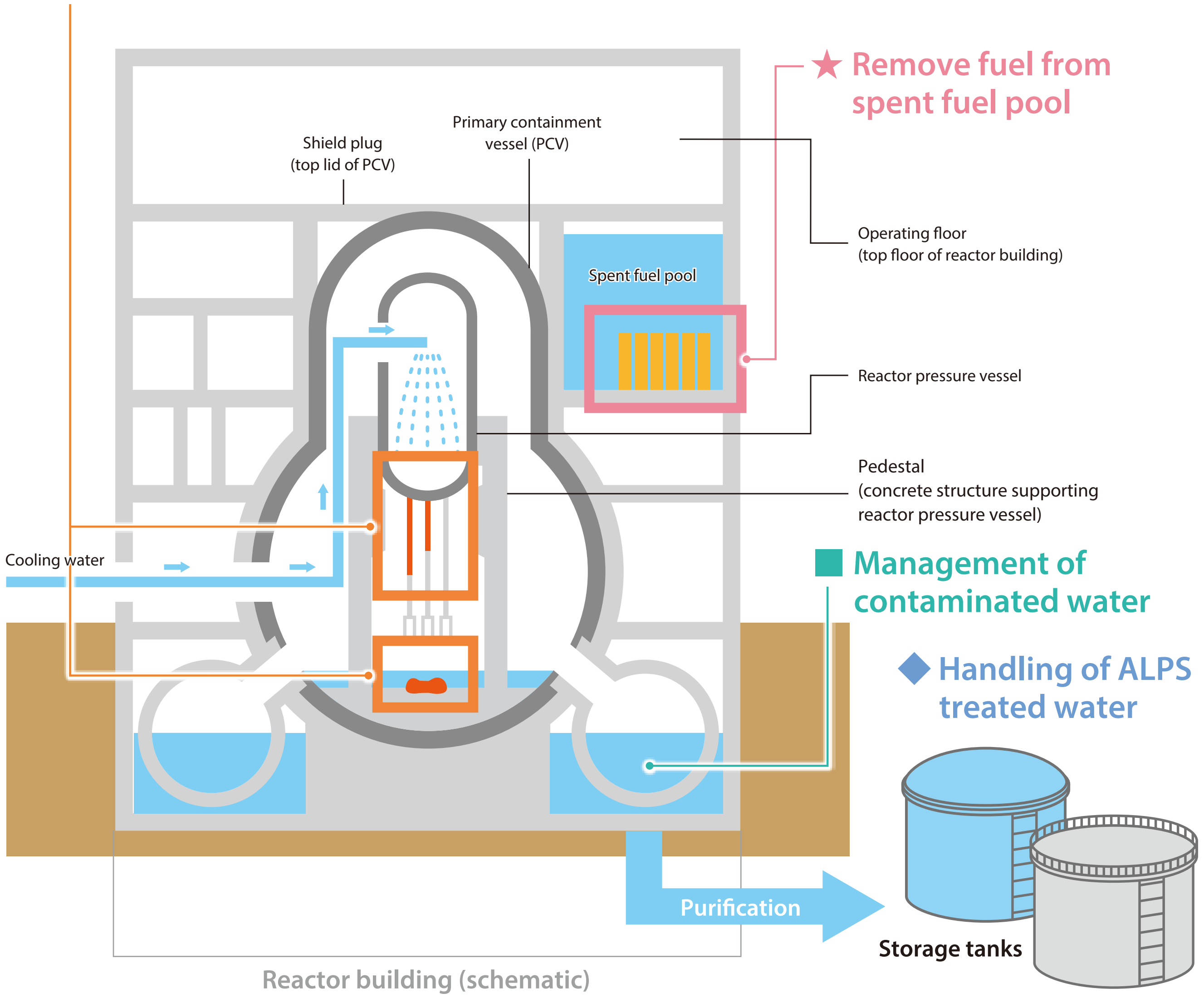
The process of lowering risks to the local community and the environment caused by radioactive materials, etc., and dismantling of reactor facilities, and other tasks.

Efforts are focused primarily on the following 5 types of work.

- ★ Fuel removal → P.9
- ◉ Fuel debris retrieval → P.10
- ■ Management of contaminated water → P.11-12
- ◆ Handling of ALPS treated water → P.13-14
- ● Treatment and disposal of radioactive waste/Dismantling of reactor facilities, etc.

◉ Retrieve fuel debris

* Fuel debris: Solidified fused materials composed of fuel, structures, etc.



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

December 2011 | November 2013 (Unit 4) | Today | Within 2021*

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)

* 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.

Overall process of decommissioning

★ Fuel removal

Rubble removal → Installation of fuel removal equipment → Fuel removal → Storage / Transportation

Unit 1, Unit 2 (Rubble removal); Units 3 and 4 (Storage / Transportation)

◉ 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

◆ 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

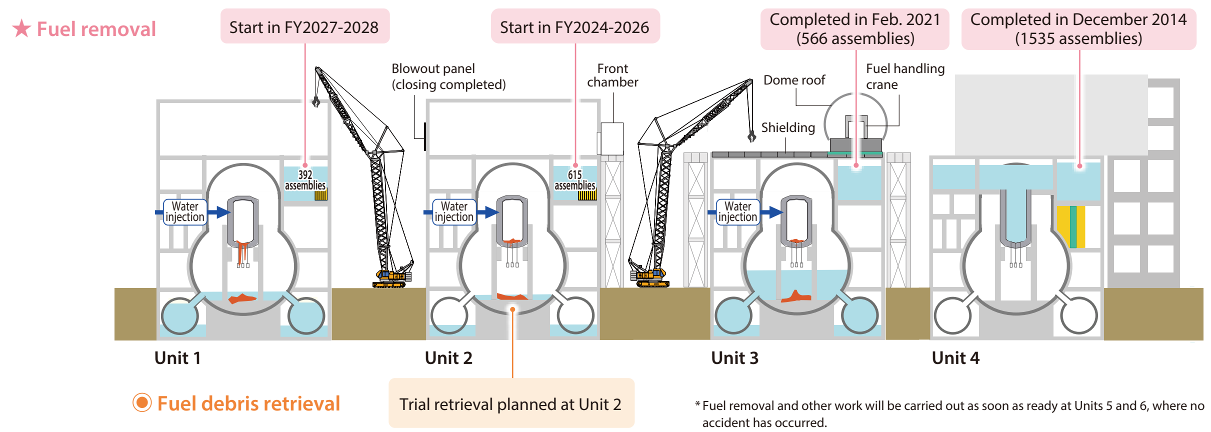
● Treatment and disposal of radioactive waste/Dismantling of reactor facilities, etc.

Consideration of scenarios and technologies → Treatment, disposal, dismantling, etc.

Units 1 to 4

Status of each unit

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



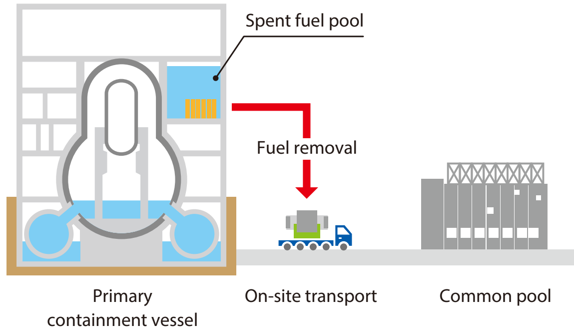
* Fuel removal and other work will be carried out as soon as ready at Units 5 and 6, where no accident has occurred.

Fuel removal

Removal of all fuel was completed at Units 3 and 4 by FY2021. Preparations to start fuel removal are underway at the remaining reactors.

Fuel removal method

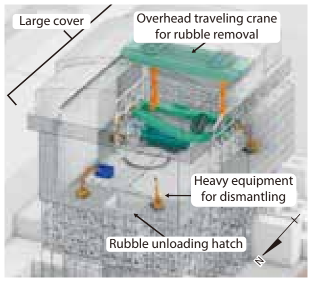
There are fuel assemblies remaining in the reactor buildings. Removing them requires **the tasks of recovering them with handling equipment from the spent fuel pool where they are stored and transporting them to the common pool at the site**.

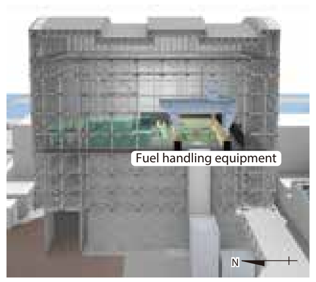


Progress of fuel removal work

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.** While the removed fuel is stored at the site and analyzed in terms of properties, methods to treat and dispose of them will be studied.

Unit 1

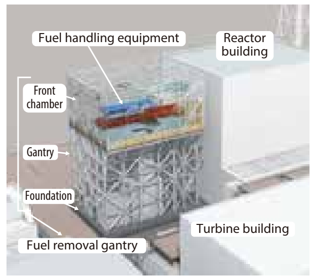


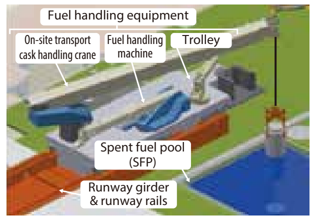


- Large cover installation to be completed in FY2023
- Fuel removal to start in FY2027-2028. Aiming to finish removal in about two years

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

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

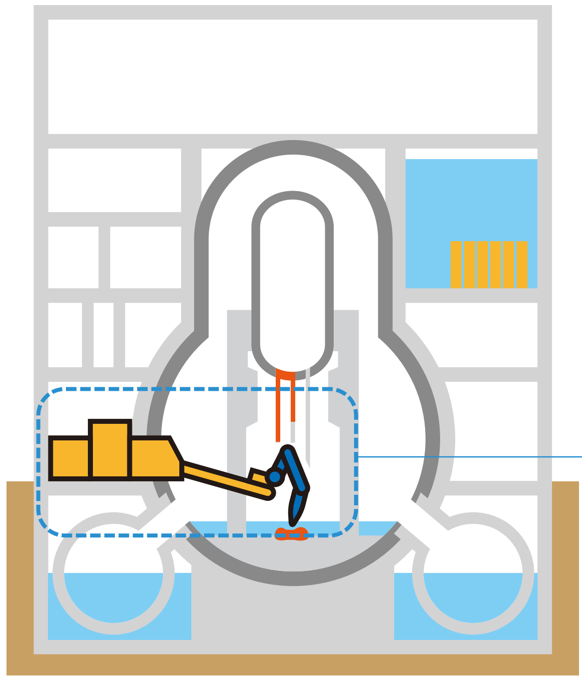
Work schedule

- 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

Fuel debris retrieval is one of the most challenging tasks in decommissioning. Activities are underway to conduct trial retrieval first while bringing together wisdom from Japan and abroad.

Findings from past investigations for fuel debris retrieval



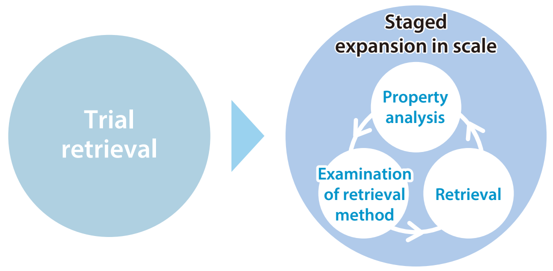
The radiation dose rate inside the primary containment vessel is too high for people to go inside to work. **Fuel debris retrieval under these conditions is an unprecedented challenge.** Internal investigations have been conducted by using remote control robots to obtain details of the situation inside.

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 at Unit 2 and then be gradually expanded in scale.**



Robotic arm

Property analysis * at research labs

Robot development

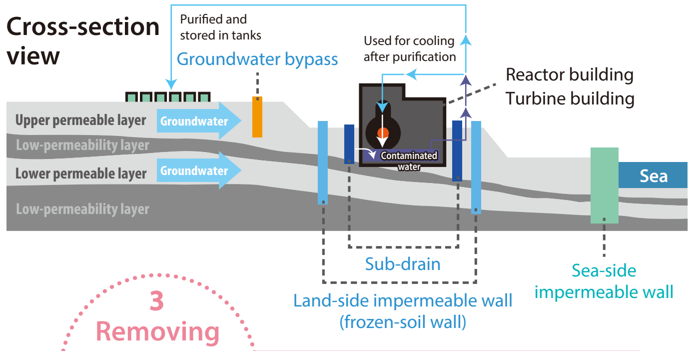
Management of contaminated water

Due to various efforts we have made so far, significant progress has been made in management of contaminated water as well as in improvement of sea water quality around the plant.
In line with three basic principles, various measures will continue to be taken, in order to further reduce risk.

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.

Cross-section view



2 Preventing leakage of contaminated water

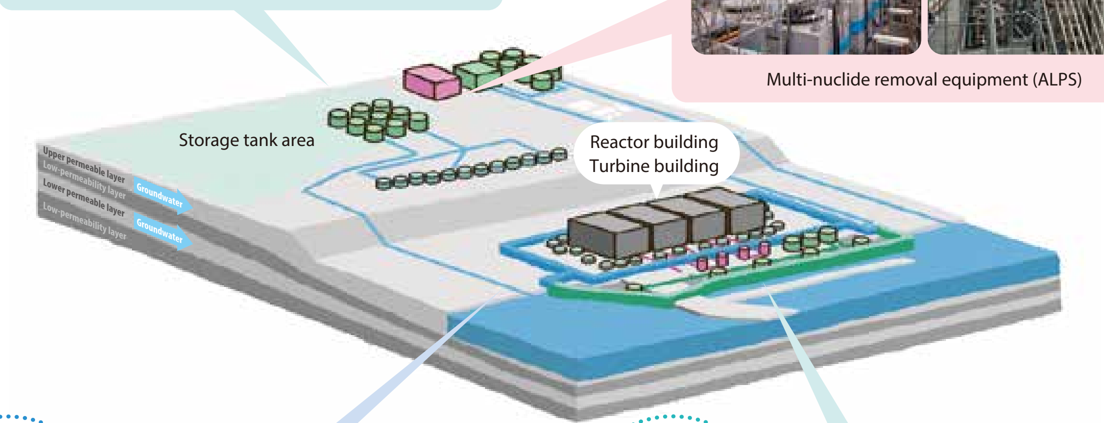
Changing tanks

Changing from flanged tanks to welded-joint tanks

3 Removing contamination sources

Purifying water by removing most of the radionuclides except tritium (hydrogen-3)

Multi-nuclide removal equipment (ALPS)



1 Redirecting groundwater from contamination sources

Conceptual drawing of the frozen-soil wall in the ground

2 Preventing leakage of contaminated water

Sea-side steel impermeable wall

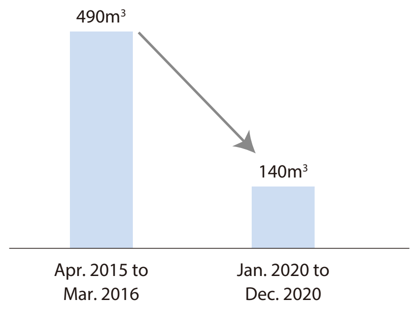
Examples of key countermeasures under the three principles

Three principles and the effectiveness of countermeasures

1 Redirecting groundwater from contamination sources

Major reduction in the amount of contaminated water generated

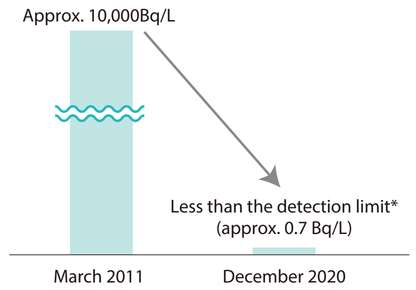
Amount of contaminated water generated (daily average)



2 Preventing leakage of contaminated water

Meets drinking water standards

Concentration of radioactive materials in the sea around the plant

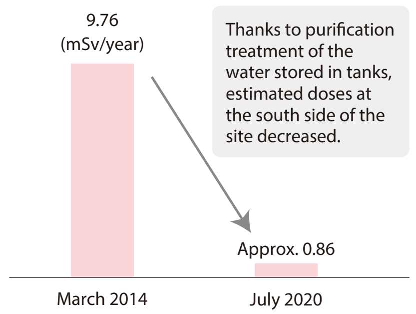


* The concentration of radioactive materials in the sea around the site refers to the Cs-137 level near the south discharge channel
* The international standard for drinking water quality is 10Bq/L

3 Removing contamination sources

1 mSv/year attained at the site boundary

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



* Storage tank area

Plans for the future

We will work to reduce radiation risk 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 **reduce the amount of contaminated water generated per day to 100 m3 by the end of 2025**.

Handling of ALPS* treated water

* Advanced Liquid Processing System

ALPS treated water refers to water generated by the purification equipment by removing most of radioactive materials from contaminated water coming from the reactor buildings every day. The government has decided to discharge it into the sea because of the need to secure land space, and the discharge will be carried out after a preparation period. Various measures will be taken to prevent reputational damage associated with discharges.

What is ALPS treated water? Where does it come from?

Contaminated water is generated at the reactor buildings of the Fukushima Daiichi Nuclear Power Station every day (see pages 11 to 12 for management of contaminated water). The contaminated water is purified by the multi-nuclide removal equipment called ALPS and water treated with this purification process is called "ALPS treated water."

ALPStreatment process

* **Water containing any radioactive materials other than tritium is purified again until their concentrations meet the regulatory standards.**

Why does ALPS treated water have to be handled?

Although safely handling ALPS treated water is technically possible, the water has been stored in the tanks at the site to wait for discussions on reputational damage and other social impacts.

In the meantime, the number of tanks has continued to increase and today they take up a large part of the site. The site is expecting the main steps of decommissioning coming into full operation, such as fuel debris retrieval and fuel removal. **Making the most of the available land space is essential in these activities, and it highlights the importance of handling ALPS treated water and reducing the number of tanks.**

Some people also say that the presence of the large number of tanks has a negative impact on reputation.

Examples of facilities needed to be built at the site

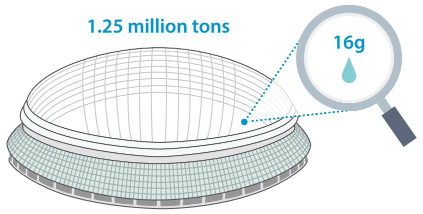
- Storage facilities for spent fuel
- Storage and analysis facilities for fuel debris and radioactive waste
- Mockups and training facilities for work simulations

Is ALPS treated water safe?

Purification by ALPS removes most of radioactive materials contained in water. Therefore, contaminated water and ALPS treated water are two different things in terms of safety.

Meanwhile, purification by ALPS is unable remove a radioactive material called tritium (hydrogen-3) and it remains in ALPS treated water.

However, it is believed that tritium is unlikely to affect human health and the environment as long as its level meets the regulatory standards.

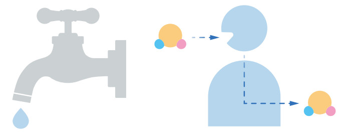


The amount of tritiated water is
only 16 grams in 1.25 million tons of treated water.

1.25 million t = Volume of the Tokyo Dome stadium
16 g = About a tablespoonful

Characteristics of tritium

1 Tritium emits very weak radiation and it normally exists in nature.

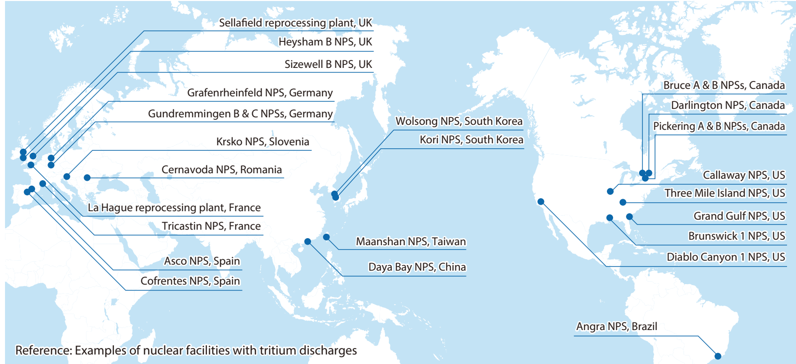


The emitted radiation is so weak that it can be blocked with only a sheet of paper and cannot go through human skin. Tritium normally exists in nature because it can be produced by radiation from space.

For this reason, people take in tritium through water and food.

2 Tritium is actually discharged from nuclear facilities in Japan and elsewhere.

Tritium is routinely discharged from nuclear facilities in Japan and abroad in accordance with the regulatory standards. **No impact attributable to tritium has been commonly seen** among these nuclear facilities.



Reference: Examples of nuclear facilities with tritium discharges

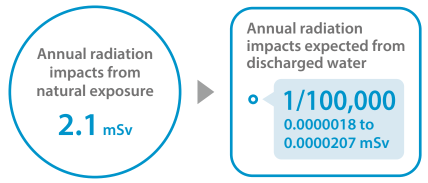
The handling of ALPS treated water

Japan has been studying the issue for about seven years, taking into account social aspects, such as potential impacts on reputation, and **decided to discharge it into the sea.** Discharge into the sea is a method that has been used in Japan and elsewhere and is regarded as a reliable means of handling such water. **If carried out in accordance with regulatory standards, it will not affect the safety of human health and the environment.**

Find more about the study process

How does the discharge into the sea work?

1. Many nuclear facilities worldwide discharge tritiated water into the sea after diluting it to concentrations that meet the regulatory standards.
2. The spread of tritium after discharge is relatively easy to monitor because ocean currents are less likely to fluctuate than the climate.
3. The International Atomic Energy Agency (IAEA) acknowledges the discharge into the sea as technically feasible and in line with international practice.



Discharge into the sea would have a very small impact.

With the determination not to cause additional adverse impacts on reputation due to the discharge of the ALPS treated water into the sea, the Government will **take every measures** to **respond to all issues** that may arise.

Thorough implementation of safety-oriented procedure

Before discharge, the water will be sufficiently diluted until its tritium concentration becomes well below the regulatory standard.
The total annual amount of discharged tritium will be kept below the control values set before the accident.
Monitoring will also be enhanced in cooperation with international agencies.

Actions to prevent reputational damage

- Provide easy-to-understand information based on scientific evidence
- Support fisheries and other industries potentially affected by reputational damage in their efforts to cultivate and expand markets
- Provide a safety net in the form of compensation if reputational damage occurs

Q1 What is the current situation at the Fukushima Daiichi Nuclear Power Station?

A The environment at the site has improved so much that workers may wear ordinary working clothes in most areas. Even visitors do not have to change their clothes.

Moving around in ordinary clothes at the site

- As decommissioning progresses, the environment at the site has improved so much that workers **may wear ordinary working clothes in 96% of the on-site area**.

Visit by local people

- Since November 2018, local people visiting the site have **no longer been required to change their clothes and wear masks** while staying on the hill overlooking Units 1 to 4. Visitors totaled about 18,000 in FY2019 and about 4,000 in FY2020, including local people.

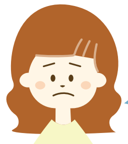
* As of the end of February 2021. In FY2020, the scale and frequency of visits by local people were reduced from the levels in the previous year due to the impact of COVID-19.

- On-site workers are served hot meals at the **cafeteria and given access to a convenience store, a large rest house, and even emergency treatment facilities and teams** as a result of improvements in the working environment.

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

Emergency physicians are on duty 24/7

Find more about the Fukushima Daiichi NPS



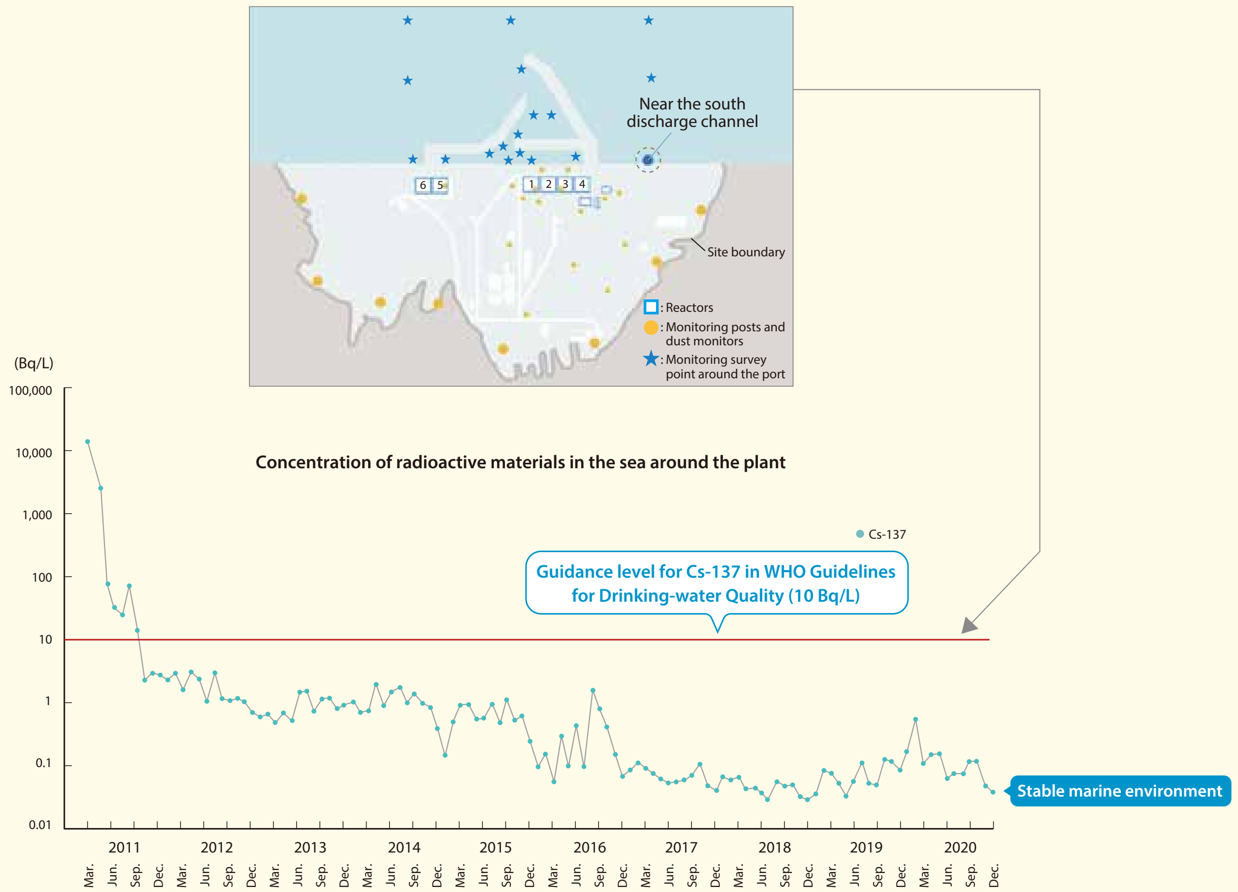
Q2 Are there any effects on people's living environment in areas surrounding the Fukushima Daiichi Nuclear Power Station?

A Radiation leakage is very limited and unlikely to affect the surrounding environment. Thorough radiation monitoring is implemented just in case.

- Radiation leaking outside the reactors is very limited, and **no effects are expected from radiation exposure even at the site boundary**.
- Changes in radiation doses are monitored at each work site. **The state of water and air is also constantly monitored at the site boundary.** A system is in place to ensure immediate reporting in the event of a rise in the concentration of radioactive material.
- **The generation of contaminated water has reduced significantly.** With strict measures taken to prevent leakage, water quality in the sea around the plant has improved so much that it meets the world standards for drinking water.

Sea-side impermeable wall

Monitoring locations at the site boundary and the surrounding sea area



In Fukushima Prefecture, TV channels broadcast figures every day for the dose measured in various parts of the prefecture and the concentration of radioactive materials in surrounding sea areas.

View analysis results on radioactive materials around the Fukushima Daiichi NPS

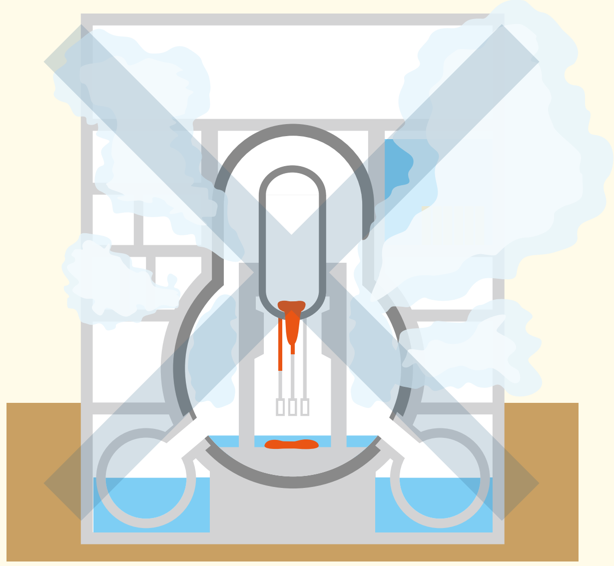
Q3 Is there any possibility of another accident?

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

- All the reactors achieved a cold shutdown state in December 2011 and have remained stable to date. The probability of another accident is thought to be exceedingly low.
- Even in the unlikely event that fuel inside the reactor reaches recriticality, the plant is fully ready to respond with equipment in place to suppress nuclear fission.

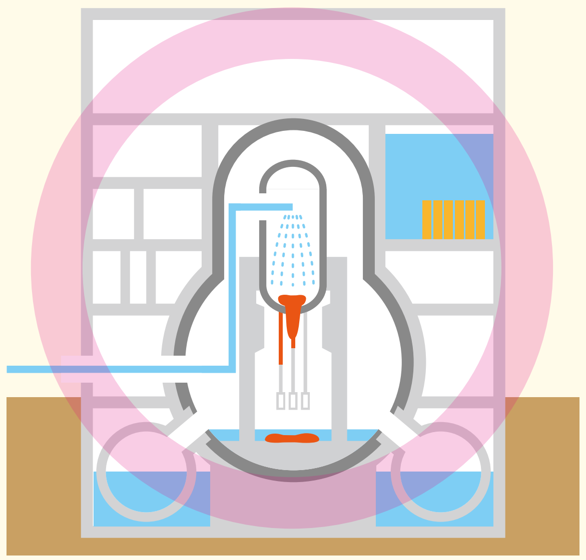
At the time of the accident

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



Today

Reactors are kept stable.



Q4 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.
- We will continue efforts to ensure safety and relentlessly review our public communication to disseminate information with speed and transparency, based on lessons learned from the earthquake off Fukushima Prefecture in February 2021.

Tsunami

- An additional seawall was built in 2020. Further measures are planned, such as elevating the seawalls, to enhance safety.
- Works are also underway to build doors to close the openings of the buildings to prevent the entry of water.

Measures against flooding due to tsunami

Installation of doors to prevent entry of water

Chishima Trench-related tsunami seawall / Before measures taken / After measures taken

Equipment 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

Q5 Who is responsible for the decommissioning?

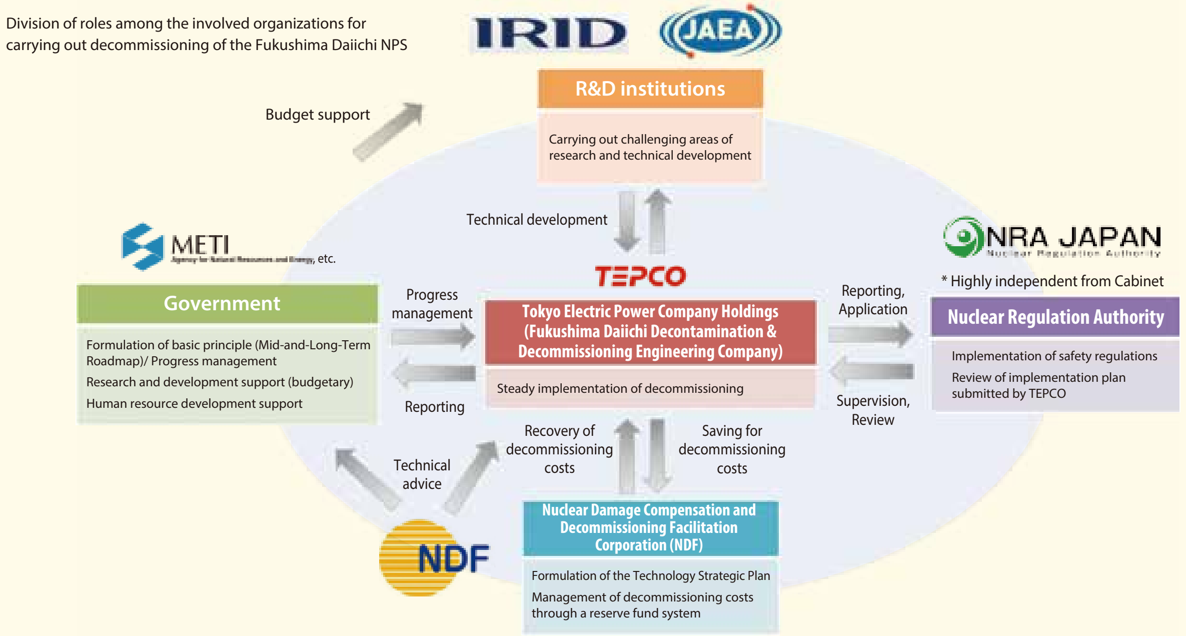
A TEPCO is responsible, but the government is also fully committed.

- To reconstruct Fukushima as early as possible, and to ensure safe and steady progress of decommissioning, the government of Japan has formulated an overall decommissioning schedule, and checks the decommissioning processes accordingly. The government is also committed to updating local people on developments and disseminating information in Japan and abroad.

Q6 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 four 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)

Q7 What will eventually be done with the retrieved fuel debris and radioactive waste?

A The government of Japan will consider this, taking full responsibility.

- The retrieved fuel debris and radioactive waste are stored safely within the premises of the Fukushima Daiichi Nuclear Power Station for the time being. How to treat or dispose of them will be discussed in depth through further investigations and studies, based on a better understanding of their properties.
- This discussion will **take into account opinions from local communities**.


Talks with local people


A presentation booth opened for a local event

Q8 What will happen after the decommissioning is completed?

A Studies will continue on what will happen after the completion of the decommissioning, fully taking into account opinions of local people.

- **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.

History of 10 years of decommissioning

Ten years have passed since the accident at the Fukushima Daiichi Nuclear Power Station. In this section, the history of the decommissioning work over these ten years is provided in a chronological table. The project has been carried out safely and steadily to achieve both reconstruction and decommissioning.

Dec. 2011 **Cold shutdown state reached at all reactors**

After more than nine months since the accident occurred, all the reactors reached a cold shutdown state. They have remained in stable condition since then.

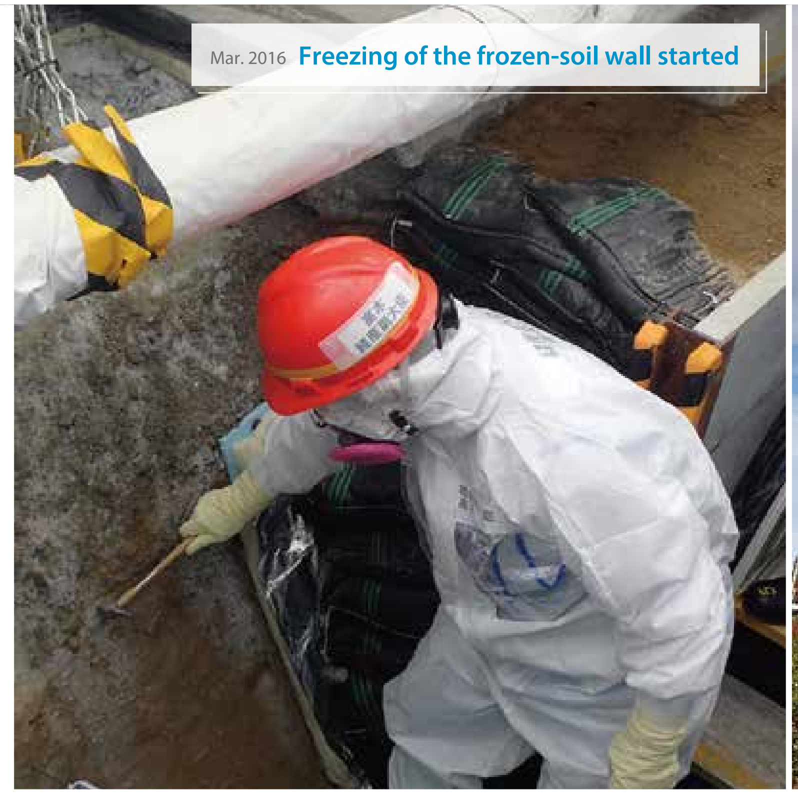
Mar. 2013 **Pilot operation started with multi-nuclide removal equipment (ALPS)**

Dec. 2014 **Fuel removal completed at Unit 4**

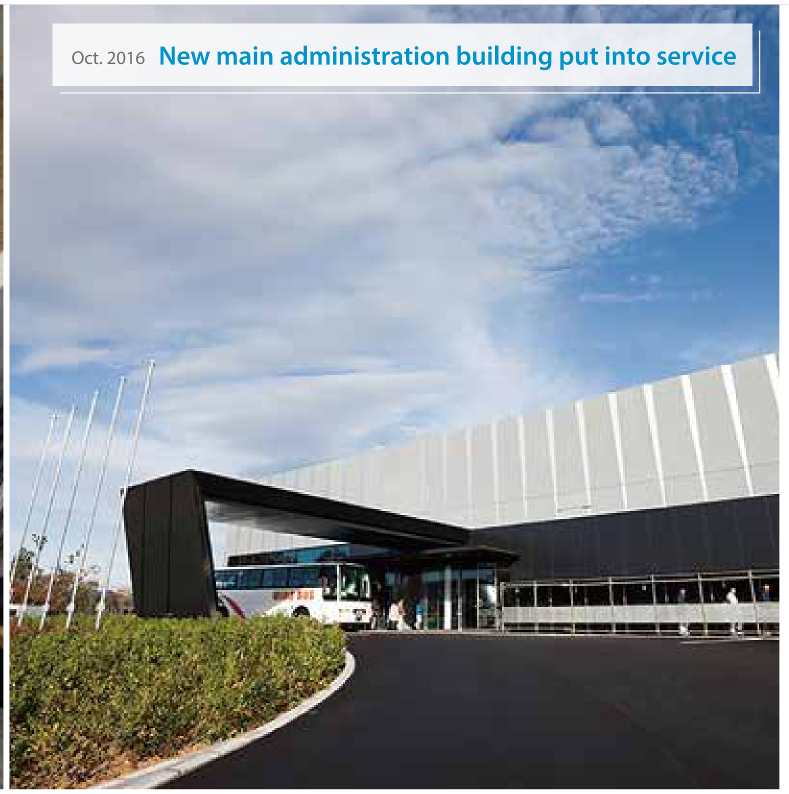
Fuel removal at Unit 4 began in November 2013. The work progressed steadily, with removal of the entire 1,535 fuel assemblies completed in December 2014.

Oct. 2015 **Sea-side impermeable wall completed**

The sea-side impermeable wall is important equipment that blocks contaminated groundwater flowing into the sea. It greatly contributes to the stability of the surrounding waters.



Mar. 2016 **Freezing of the frozen-soil wall started**

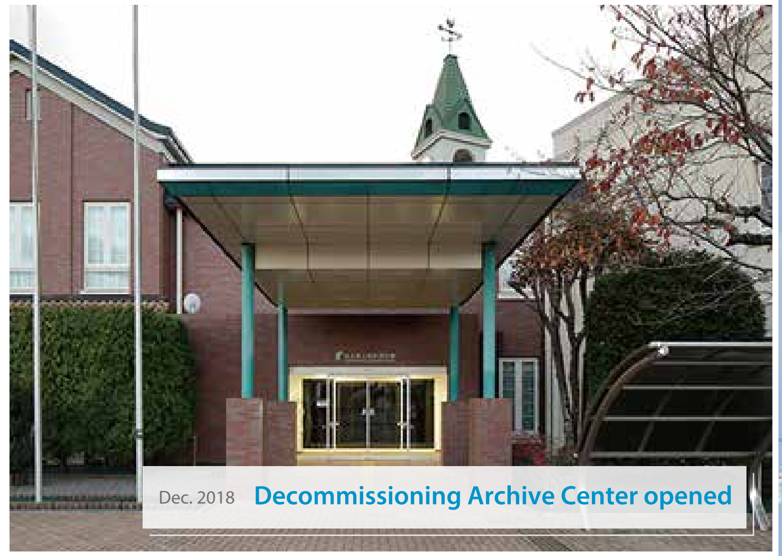


Oct. 2016 **New main administration building put into service**

Nov. 2018 **Visitors in ordinary clothes allowed on a hill**

Seven years after the accident occurred, the site environment of the Fukushima Daiichi Nuclear Power Station has become much better. Workers are allowed to work in ordinary working clothes in 96% of the on-site area. Visitors to the site are no longer required to change their clothes.

Mar. 2018 **Installation of the cover for fuel removal completed at Unit 3**



Dec. 2018 **Decommissioning Archive Center opened**

Feb. 2019 **Fuel debris successfully lifted at Unit 2**

During an internal investigation of Unit 2 in February 2019, deposits believed to be fuel debris were successfully lifted up. This marked a step closer to the critical phase of the decommissioning work.

May 2020 **Dismantling of the exhaust stack for Units 1 and 2 completed**

The dismantling work was very challenging, requiring remote equipment operation in strong winds. Local partner ABLE, based in Fukushima Prefecture, successfully completed the task. The decommissioning work is progressing step by step with the help of local people.

2011

- Earthquake occurred (Mar)
- Cold shutdown state reached (Dec)

Management of contaminated treated water

2012
- Sea-side impermeable wall construction started (Apr) 800 m in 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 m in total length, with approx. 1,568 freezing tubes, 30 m in 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)

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

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)

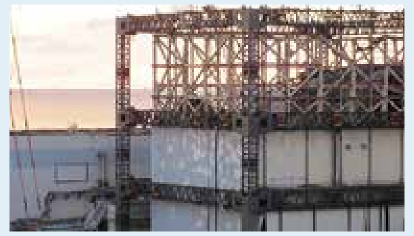
2014

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

2015

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

2016



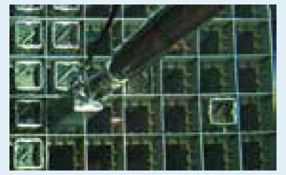
- Unit 1: Removal of wall panels of the building cover completed

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)

2020



- Unit 3: Removal of all 566 fuel assemblies completed (Feb 2021)

Fuel debris retrieval

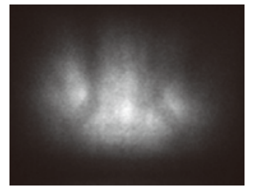
2012

- 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)

2017

- Unit 1: Basement of PCV surveyed with self-propelled robot (Mar)
- Unit 2: Lower part of RPV surveyed with self-propelled robot (Feb)
- 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)

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)

2017

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

2018

- Solid waste storage building No. 9 put into service (Feb)
- 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

2012
- Commercial fishing resumed in the waters 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)

2018

- J-Village reopened (except for some facilities; 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

2020

- Joban Line train service fully resumed (Mar)
- Evaluation order lifted in some areas of Futaba Town
- The Great East Japan Earthquake and Nuclear Disaster Memorial Museum opened

Step-by-step progress toward the future of Fukushima

Ten years have passed since the accident at the Fukushima Daiichi Nuclear Power Station.
The decommissioning work is progressing step by step, but we still have a long way to go.
We continue to work steadily toward the reconstruction of Fukushima while putting safety first.

Basic knowledge about radiation

Radiation in daily life

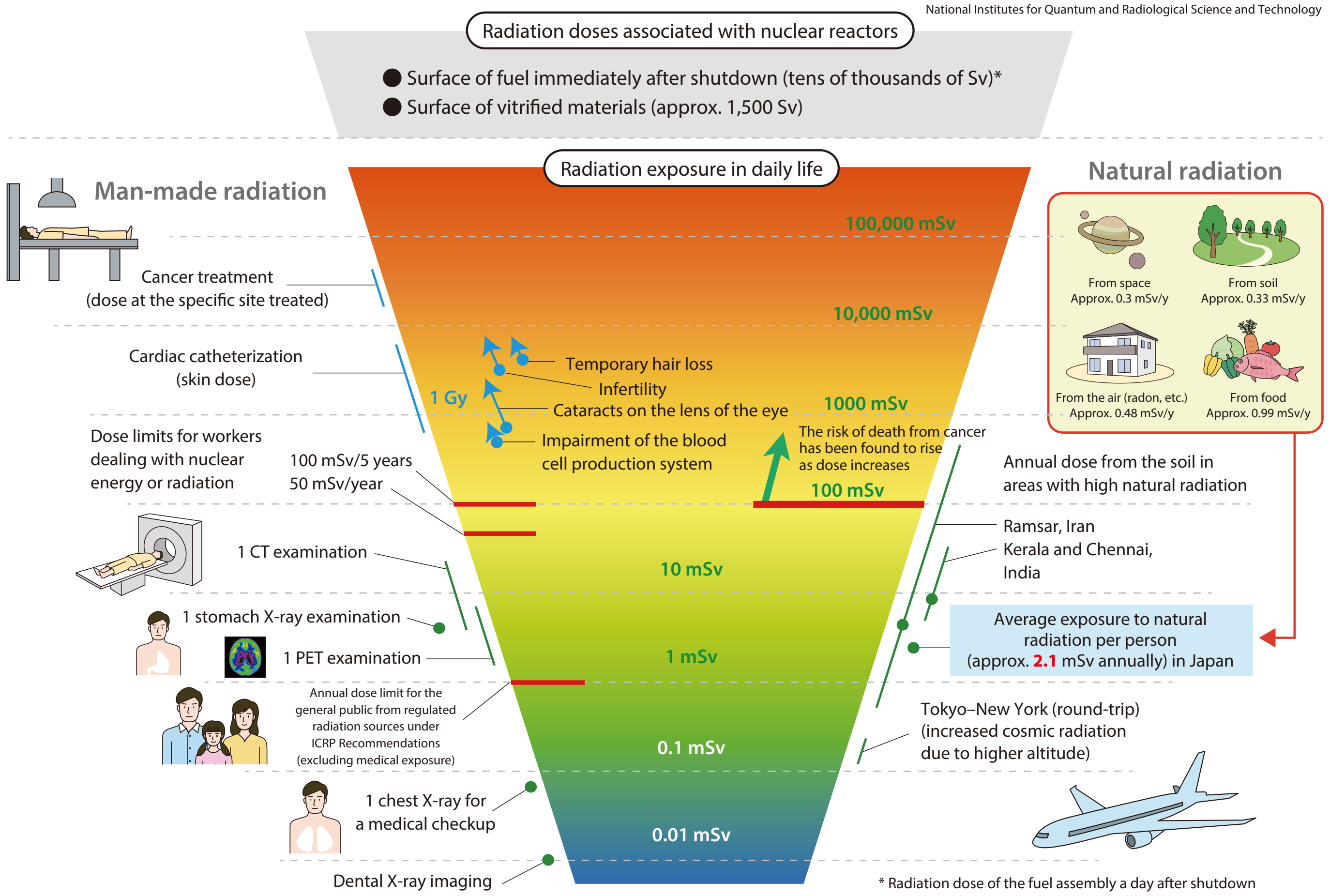
In our daily lives, we are exposed to various types of radiation. It originally exists in nature, and does radiation exist not only in specific places such as nuclear power stations and hospitals. Health effects of radiation depend not on the existence of radiation itself but on the amount of radiation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

Radiation is not infectious

No genetic effects on future offspring due to radiation exposure have been confirmed.

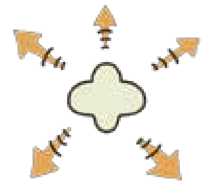
Quick reference chart for radiation exposure

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

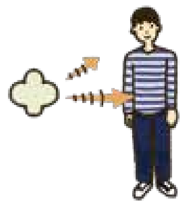


What's the difference between radioactive materials, radioactivity, and radiation? What are becquerels and sieverts?

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.

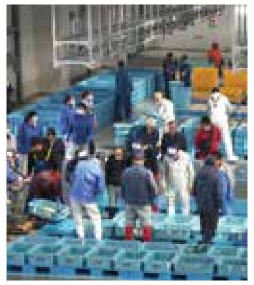


Current Situation of Fukushima

Safety of food from Fukushima Prefecture

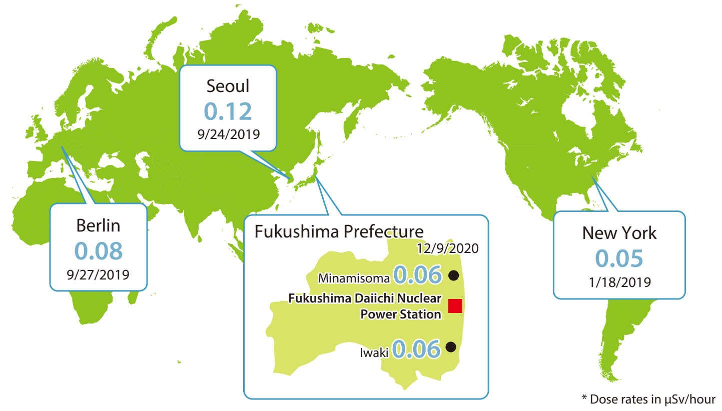
Based on the world's strictest standard of radioactive materials inspection on food and drinking water from Fukushima Prefecture, the safety is ensured and all products that are shipped to the market are within standard values. After the accident, 54 countries/regions imposed import restrictions on food from Fukushima. The restrictions have gradually been eased since then, with 39 countries/regions having fully lifted them.

* As of January 2021



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 (29th 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 difference, there are rate gaps among regions, and weather condition also fluctuates the air dose rate.

④ Reactor pressure vessel (RPV)
P.7/P.27

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/P.8/P.10/P.26/P.27

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.4/P.27

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

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.11

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.26

One of the measures for "redirecting" groundwater from contamination sources. The facility pumps up groundwater flowing 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

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.11/P.13/P.14

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 Blowout panel
P.8

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

⑮ Main process building
P.4

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.

⑯ Pedestal
P.7

A concrete structure supporting the reactor pressure vessel.

⑰ Radioactive cesium (Cs-134, Cs-137)
P.6/P.12

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 is 100Bq/kg.)

⑱ Monitoring post
P.16

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 →

⑲ Weld-joint tanks
P.11/P.28

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.

⑳ Criticality
P.17

The condition where fission 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).

㉑ Cold shutdown state
P.17/P.23

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

㉒ IRID
P.19

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.

㉓ JAEA
P.19

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.

㉔ NDF
P.19

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.

㉕ WHO Guidelines for Drinking-water Quality
P.16

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.