Vol. 2

Illustrated Handbook

BOOKLET to Provide Basic Information Regarding Health Effects of Radiation

Accident at TEPCO's Fukushima Daiichi NPS and Thereafter (Initiatives by Ministries and Agencies)

Radiation Health Management Division, Ministry of the Environment, Government of Japan
National Institutes for Quantum Science and Technology

The booklet is also available on the website.

▶ https://www.env.go.jp/en/chemi/rhm/basic-info/

Introduction

Eleven years have passed since the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi Nuclear Power Station. In order to enable residents returning to areas where evacuation orders have been removed to rebuild their lives and revitalize respective communities as early as possible, support both for realizing early return and for assisting returners' new lives is indispensable. With the lifting of the evacuation orders for Preparation Areas for Lifting of Evacuation Orders in Futaba Town in March 2020, all evacuation orders were lifted, except those for Restricted Areas. In addition, evacuation orders were also lifted for some Specified Reconstruction and Revitalization Base Areas, which were designated in Restricted Areas in Futaba Town, Okuma Town, and Tomioka Town. Thus, the reconstruction and recovery of Fukushima Prefecture have been steadily progressing.

The national government must ensure that residents who have returned home can rebuild their lives smoothly without worries about their health due to the radioactive materials discharged by the accident. For that purpose, the national government and the local government are committed to properly responding to their health problems and providing correct information in an easy-to-understand manner on a timely basis.

Based on the Policy Package on Radiation Risk Communication for Achieving Residents' Return (2014), the national government has endeavored to disseminate correct and easy-to-understand information and has strengthened risk communication among a small number of people.

The Radiation Health Management Division, Environmental Health Department, Minister's Secretariat, Ministry of the Environment has collected and compiled basic knowledge on radiation, and scientific expertise and initiatives of relevant ministries and agencies concerning health effects of radiation, and has prepared a booklet to provide basic information since 2012 and has updated the booklet with the latest information and statistical data, together with the National Institutes for Quantum Science and Technology. This booklet has been utilized in training sessions targeting people engaging in health and medical care, welfare, and education or on other occasions with the aim of fostering personnel who can respond to residents' worries and concerns about their health in Fukushima and neighboring prefectures.

The Radiation Health Management Division and the National Institutes for Quantum Science and Technology have jointly publicized the English version of the booklet, with cooperation of a group of experts, so that foreign nationals residing in Japan or visiting Japan or those interested in Japan can obtain basic knowledge on health effects of radiation and correctly understand changes in circumstances and efforts being made in Japan. As terms used in this field are highly professional and difficult, we also prepared a glossary. We would like to extend our gratitude to the people who offered cooperation in checking the translation and preparing the glossary.

The booklet is also available on the website of the Ministry of the Environment, from which you can download the content for use in training and classwork. We hope that this booklet will be utilized in diverse occasions.

March 2022
Radiation Health Management Division,
Environmental Health Department,
Minister's Secretariat,
Ministry of the Environment,
Government of Japan
&
National Institutes for Quantum Science and Technology

Whole Picture of the "BOOKLET to Provide Basic Information Regarding Health Effects of Radiation"

Vol. 1 Basic Knowledge and Health Effects of Radiation

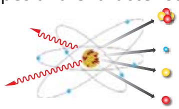
Basic Knowledge on Dose Assessment

Chap. 5 Assessments by International Organizations

- Status of Radiation Exposure due to the TEPCO's Fukushima Daiichi NPS Accidents
- Assessments of Health Effects due to Radiation Exposure

Chap. 1 Basic Knowledge on Radiation

- Radiation and Radioactive Materials
- Types and Characteristics of Radiation



Reference Information for Establishing Radiation Protection Standards

Mechanism of Radiation Exposure

Knowledge on Radiation Safety

Chap. 4 Concept of Radiological Protection

- Framework for Radiological Protection
- Dose Limits
- Dose Reduction
- Long-term Behavior of Radioactive Cesium in the Environment

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- Internal Exposure
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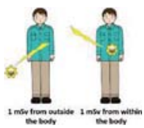
- Radiation around Us
- Representative Radionuclides Discharged upon a Nuclear Accident



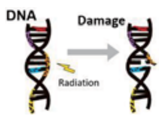
Basis for Dose Assessment

Mechanism of Radiation Health Effects

Knowledge on Radiation Health Effects

Chap. 3 Health Effects of Radiation

- Effects due to Radiation Exposure
  - Effects on Fetuses
  - Heritable Effects
  - Cancer and Leukemia
- Effects due to Worries over Radiation (Psychological Effects)



Scientific Basis for Health Management after Exposure

This BOOKLET compiles basic knowledge on radiation, scientific knowledge on health effects of radiation, and initiatives by relevant ministries and agencies into one page for each item.

Vol. 2

Accident at TEPCO's Fukushima Daiichi NPS and Thereafter (Initiatives by Ministries and Agencies)

Information for Assessment

Chap. 6 Situation concerning the Accident

- Accident at TEPCO's Fukushima Daiichi NPS
- Efforts Immediately after the Accident
- Efforts for Decommissioning

Background for Efforts

Responses and Measures Following the Accident

Grounds for Standards, Guidelines, Laws and Regulations

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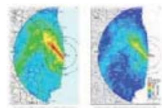
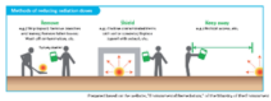


- Impacts of the Accident and Spread of Contamination
- Distribution of Ambient Dose Rates
- Deposition of Radioactive Materials

Chap. 8 Radioactive Materials in Foods

- Standard Limits and Inspection Results
- Efforts for Reducing Radioactivity Concentrations

Chap. 9 Efforts toward Recovery from the Accident



- Efforts for Environmental Restoration
  - Decontamination
  - Treatment of Removed Soil and Waste and Interim Storage Facility
- Transition of Areas under Evacuation Orders

Chap. 10 Health Management

- Fukushima Health Management Survey
  - Basic Survey (Estimation of External Doses)
  - Thyroid Ultrasound Examination
  - Comprehensive Health Checkup
  - Mental Health and Lifestyle Survey
  - Pregnancy and Birth Survey
- External Counting Survey

Please select and refer to sections according to your interests.

Outline of Each Chapter

Vol. 1 Basic Knowledge and Health Effects of Radiation

Chap. 1 Basic Knowledge on Radiation

Chapter 1 explains radiation, its difference from radioactivity and radioactive materials, and the types and characteristics of radiation.
You can learn basic knowledge on familiar terms such as "radiation," "radioactivity," and "radioactive materials," and can deepen your knowledge and understanding of radiation itself.

Chap. 2 Radiation Exposure

Chapter 2 explains the mechanism of radiation exposure and measurement and calculation methods for exposure doses, and also provides explanations about radiation around us and representative radionuclides discharged upon a nuclear accident.
You can learn about radiation exposure, and on what occasion and to what extent you may be exposed to radiation. This chapter helps you understand what measuring devices and what calculation methods are used for obtaining radiation doses and exposure doses.

Chap. 3 Health Effects of Radiation

Chapter 3 explains radiation effects on the human body and mechanism of generating effects.
You can understand the health effects of radiation based on scientific grounds, including data on the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, atomic bomb survivors, and the Chernobyl NPS Accident.
You can also understand the relation between types of exposure (affected body parts, exposure dose and period) and health effects and psychological effects due to worries over radiation.

Chap. 4 Concept of Radiological Protection

Chapter 4 explains the framework of radiological protection, dose limits and dose reduction.
You can obtain knowledge on principles for protecting human health against radiation effects and methods for reducing exposure doses. Please refer to this chapter when you want to understand the concept of dose limits that served as the basis for standards for distribution restrictions for foods and designation of Areas under Evacuation Orders after the accident at TEPCO's Fukushima Daiichi NPS or the concept of radiological protection.

Chap. 5 Assessments by International Organizations

Chapter 5 outlines the assessments on radiation exposure made by the World Health Organization (WHO) and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) after the accident at TEPCO's Fukushima Daiichi NPS.
You can grasp an outline of how the status and effects of radiation exposure due to the accident are assessed internationally, including the latest reports by international organizations.

Vol. 2 Accident at TEPCO's Fukushima Daiichi NPS and Thereafter (Initiatives by Ministries and Agencies)

Chap. 6 Situation concerning the Accident

Chapter 6 explains the accident at TEPCO's Fukushima Daiichi NPS, responses immediately after the accident, and efforts for decommissioning.
You can understand what happened at the NPS at the time of the accident, and the current status of the NPS. In particular it goes into details about management of decommissioning, contaminated water and treated water.

Chap. 7 Environmental Radiation Monitoring

Chapter 7 explains environmental radiation monitoring being conducted after the accident at TEPCO's Fukushima Daiichi NPS and the results thereof.
You can understand how impacts of the accident spread and the status of contamination in the surrounding environment near the NPS, and changes over time after the accident.

Chap. 8 Radioactive Materials in Foods

Chapter 8 explains the standard limits for radioactive materials in foods, results of inspections, and efforts for reducing radioactive concentrations in foods.
You can understand the framework to ensure the safety of foods distributed on the market and concrete measures being taken after the accident at TEPCO's Fukushima Daiichi NPS, and inspection results regarding to what extent there have been foods with radioactive concentrations exceeding the standard limits after the accident up to the present.

Chap. 9 Efforts toward Recovery from the Accident

Chapter 9 explains efforts toward recovery from the accident, such as measures against environmental contamination by radioactive materials discharged due to the accident at TEPCO's Fukushima Daiichi NPS and transition of Areas under Evacuation Orders.
You can understand how to recover areas contaminated with radioactive materials, how to treat waste, and what measures are being taken at present in Areas under Evacuation Orders and surrounding areas.

Chap. 10 Health Management

Chapter 10 outlines the Fukushima Health Management Survey and other surveys and examinations that are conducted for the purpose of promoting the health of the residents of Fukushima Prefecture and ensuring their safety in light of the effects of radiation due to the accident at TEPCO's Fukushima Daiichi NPS.
You can understand Fukushima Prefecture's efforts for health management in order to promote and maintain residents' good health toward the future.

Vol. 1 Basic Knowledge and Health Effects of Radiation
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Vol. 2 Accident at TEPCO’s Fukushima Daiichi NPS and Thereafter (Initiatives by Ministries and Agencies) Contents

7.2 Deposition of Radioactive Cesium and Radioactive Iodine

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7.4 Radiation Monitoring in Forest

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7.6 Radiation Monitoring of Clean Water

7.7 Radiation Monitoring of Public Water Areas

7.8 Radiation Monitoring of Ocean

Chapter 6

Situation concerning the Accident

Chapter 6 explains the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, responses immediately after the accident, and efforts for decommissioning.

You can understand what happened at the NPS at the time of the accident, and the current status of the NPS. In particular it goes into details about management of decommissioning, contaminated water and treated water.

Fukushima Daiichi Nuclear Power Station (NPS) Accident

Damage due to the Great East Japan Earthquake

- A 9.0-magnitude earthquake occurred off the coast of Sanriku at 14:46 p.m. on Friday, March 11, 2011. The Earthquake and subsequent tsunami caused severe damage mainly to the Tohoku region.
- The earthquake was the largest ever recorded in Japan and the fourth biggest in the world since 1900.

Human damage	
Dead	15,899
Missing	2,527
Injured	6,157

Damage to buildings	
Completely destroyed	121,992
Half destroyed	282,920
Partially destroyed	730,392

(Surveyed by the National Police Agency; as of December 10, 2020)

Disaster victim support	
Evacuees nationwide	41,781

(Surveyed by the Reconstruction Agency; as of January 29, 2021)

A big earthquake centered off the coast of Sanriku occurred, at 14:46 p.m. on Friday, March 11, 2011. The seismic intensity of 7 on the Japanese earthquake scale was measured in Kurihara City, Miyagi Prefecture. This 9.0-magnitude earthquake was the biggest recorded in Japan since 1923 and the highest level in the world, equivalent to the 2010 Chili Earthquake (M8.8).

Included in this reference material on March 31, 2013
Updated on March 31, 2021

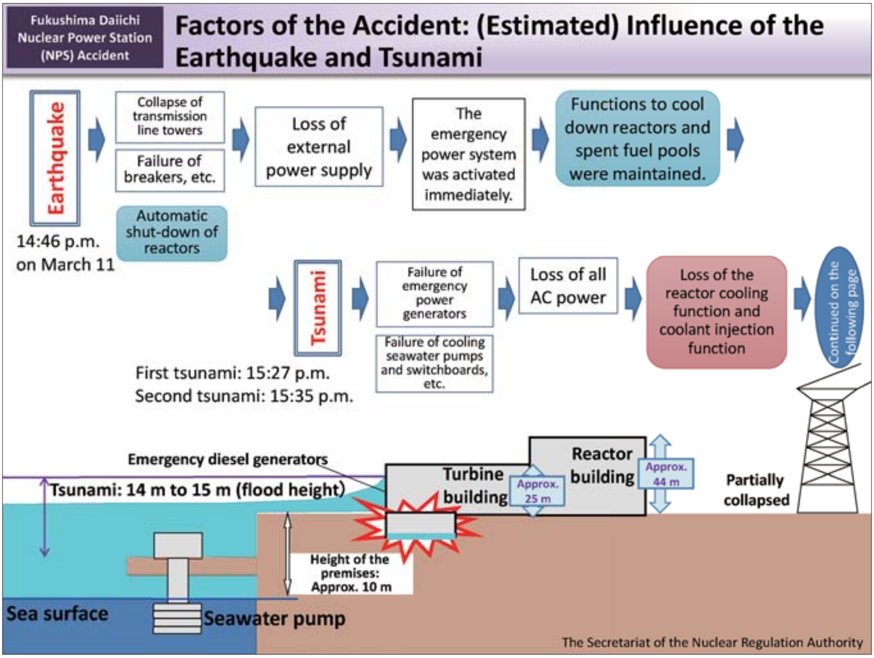
Fukushima Daiichi Nuclear Power Station (NPS) Accident

Accident at the Nuclear Power Station

Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS Unit 3 (shot from the air)
(Shot on March 16, 2011; Provided by TEPCO)

Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS Unit 1, 2 and 3, which were in operation at the time of the earthquake, lost all AC power due to the earthquake and subsequent tsunami. This led to the stop of the cooling system and loss of means to cool down nuclear fuels, eventually resulting in the melt of nuclear fuel. In the process of the melt, a large amount of hydrogen gas was generated, and hydrogen gas accumulated in reactor buildings caused an explosion at Unit 1 on March 12 and at Unit 3 on March 14. Additionally, at Unit 4 adjacent to Unit 3, a hydrogen explosion occurred due to hydrogen gas that is considered to have flowed into it from Unit 3.

Included in this reference material on March 31, 2013



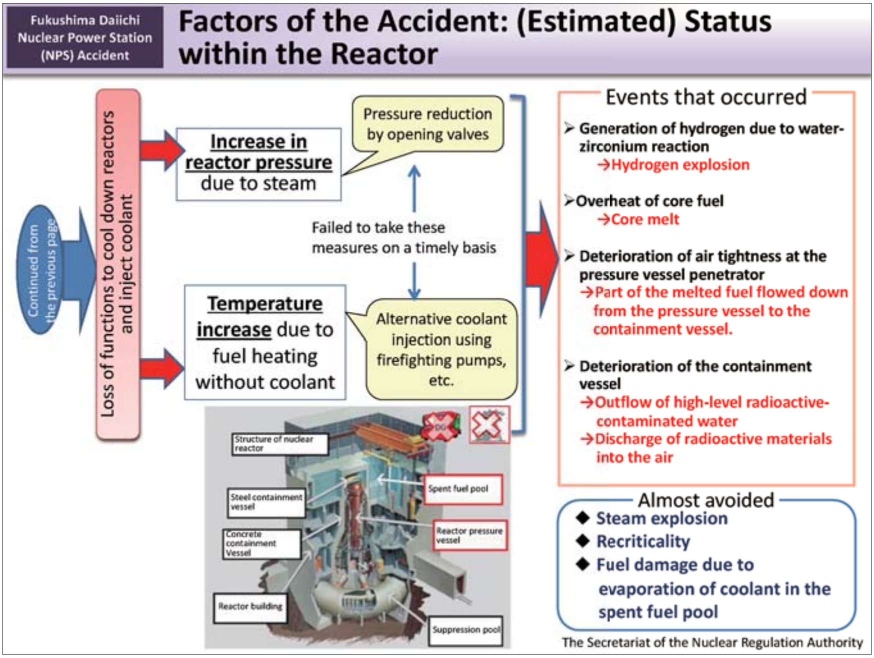
Immediately after the earthquake, at Units 1, 2 and 3 at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, which were in operation, all reactors were shut down automatically.

Even after reactors are shut down, it is necessary to remove the decay heat of core fuel. At the NPS, after external electrical power supply was lost due to the collapse of transmission line towers, etc., emergency diesel generators were automatically activated and procedures for normal cold shutdown were commenced.

However, the subsequent tsunamis hit the NPS and flooded those emergency diesel generators, switchboards and other equipment. All Units except for Unit 6 lost all AC power and cooling seawater pumps stopped functioning. Unit 1 thus lost all functions to cool down the reactor. While Units 2 and 3 continued cooling reactors for some time using the Reactor Core Isolation Cooling System (RCIC) and the High Pressure Coolant Injection System (HPCI), respectively, which can work without AC power, these systems also stopped soon and both Units eventually lost the means to remove the decay heat of core fuel.

Under such circumstances, NPS staff worked to activate alternative coolant injection routes using fire pumps or other equipment at Units 1, 2 and 3, but partly due to the possibility of another tsunami hitting, until those alternative measures were commenced, reactor cores were left uncooled. Coolant injection is considered to have been suspended for around 14 hours at Unit 1 and for around 6.5 hours at Units 2 and 3. Additionally, many hidden bypasses in the alternative coolant injection system made it difficult to supply injected water effectively to the reactor cores for cooling, and the reactors went into meltdown.

Included in this reference material on March 31, 2013
Updated on March 31, 2019



As coolant injection to the reactor core was suspended, the water level in the reactor declined and the fuel was exposed. This caused overheating of core fuel, triggered core melt and damaged a part of the pressure vessel. Melted fuel leaked from the pressure vessel into the inside of the containment vessel, and at the same time, cesium and other radioactive materials discharged from the fuel assembly was discharged within the containment vessel. Additionally, under high temperature due to core damage, steam and zirconium of the fuel cladding reacted to generate hydrogen, which was discharged within the containment vessel from the damaged part of the pressure vessel together with steam.

In the meantime, core damage increased the temperature and pressure in the containment vessel and deteriorated its confinement function, causing gaps in such parts as the penetrator that extends to the outside of the containment vessel. Radioactive materials discharged from such gaps to the outside of the containment vessel and diffused into the environment. Hydrogen generated due to the reaction of the steam and metal of the fuel cladding leaked through the gaps into the reactor building and accumulated there, and led to a hydrogen explosion.

Coolant injected into the reactor leaked from the pressure vessel and containment vessel and a large amount of high-level radioactive-contaminated water accumulated underground below the reactor building and turbine building and partially flowed out into the ocean.

The damage to the pressure vessel and deterioration of the confinement function of the containment vessel caused a leak of steam containing radioactive materials. In addition, radioactive materials were also discharged into the air due to containment vessel vent operations, etc.

In this manner, radioactive materials were discharged into the environment in the forms of outflow of high-level contaminated water into the ocean and discharge of radioactive materials into the air.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Outline of the Accident

Responses Immediately after the Accident

Time	Event	Responses by Tokyo Electric Power Company (TEPCO)	Responses by the national government (Nuclear and Industrial Safety Agency)
March 11 14:46	The Great East Japan Earthquake occurred. (Seismic intensity 6 upper at Fukushima Daiichi Nuclear Power Station (NPS))	Fukushima Daiichi NPS Unit 1, Unit 2 and Unit 3 are automatically shut down by earth quake. Unit 4, Unit 5 and Unit 6 were under suspension due to periodic inspection.	The government established the Headquarters for Emergency Disaster Control, assembled officials at the Emergency Response Center, and dispatched officials to disaster-stricken areas by helicopter.
15:15			The Nuclear and Industrial Safety Agency held a press conference and provided information online.
15:27 15:35	The first tsunami (4m in height) arrived. The second tsunami (15m in height) arrived.		
15:42	Aftershocks with seismic intensity 5 upper or less occurred several times. (15:42 – March 12 18:25)	Report under Article 10 of the Act on Special Measures Concerning Nuclear Emergency (Emergency generators activated at Units 1 to 5, which had lost all AC power, were damaged due to the tsunami.)	The government established the Nuclear Accident Vigilance Headquarters.
16:36		TEPCO judged that the events fall under Article 15 of the Act on Special Measures Concerning Nuclear Emergency.	
19:03			The government issued a Declaration of a Nuclear Emergency Situation and established the Nuclear Emergency Response Headquarters.
21:23			The government issued an evacuation order to residents within a 3-km radius of the NPS and ordered those within a 10-km radius to shelter indoors.
March 12 5:44			The government issued an evacuation order to residents within a 10-km radius of the NPS.
18:25			The government issued an evacuation order to residents within a 20-km radius of the NPS.

From the report by the Aomori Prefecture Nuclear Safety Measure Verification Committee
Prepared by the Nuclear and Industrial Safety Agency

The Secretariat of the Nuclear Regulation Authority

As the emergency core cooling system stopped at Unit 1 and Unit 2 of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, the government issued, based on the Act on Special Measures Concerning Nuclear Emergency, a Declaration of a Nuclear Emergency Situation and established the Nuclear Emergency Response Headquarters at 19:03 p.m. on March 11, 2011.

At 21:23 p.m. on the same day, based on the same Act, the government issued an evacuation order to residents within a 3-km radius of the NPS and ordered those within a 10-km radius to shelter indoors.

Thereafter, the government expanded the coverage of the evacuation order, which was targeted to residents within a 3-km radius of the NPS, to cover those within a 10-km radius. As a result, a total of 51,207 residents in four towns within a 10-km radius were placed under the evacuation order.

As a hydrogen explosion occurred within the reactor building at Unit 1 at 15:36 p.m. on March 12, the coverage of the evacuation order was further expanded from residents within a 10-km radius to those within a 20-km radius of the NPS.

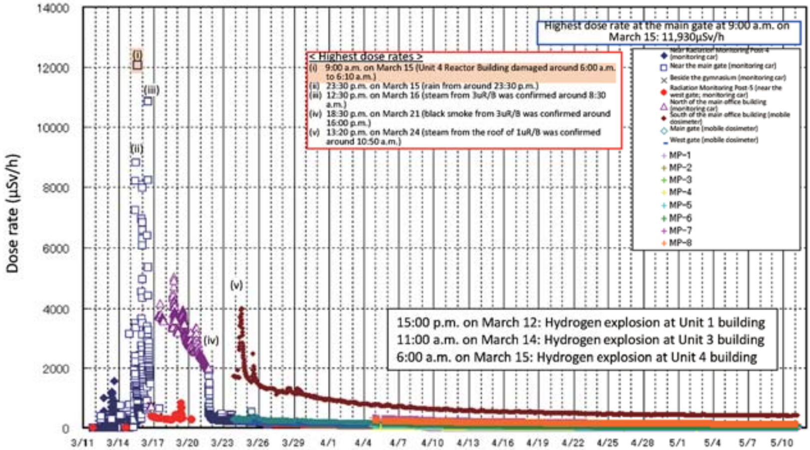
(Related to p.107 of Vol. 2, "Designation of Areas under Evacuation Orders," and p.108 of Vol. 2, "Designation of Restricted Areas and Areas under Evacuation Orders and Removal Thereof")

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Outline of the Accident

Ambient Dose Rates during Two Months after the Accident (Within and around of the premises of TEPCO's Fukushima Daiichi NPS)

Hydrogen explosions occurred at buildings, etc. at Unit 1 to Unit 4 and the highest dose rates were measured in the morning of March 15.



Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety, June 2011
Nuclear Emergency Response Headquarters, Attachment V-9

μSv/h: micro sievert per hour, u: unit, R/B: Reactor Building

The Secretariat of the Nuclear Regulation Authority

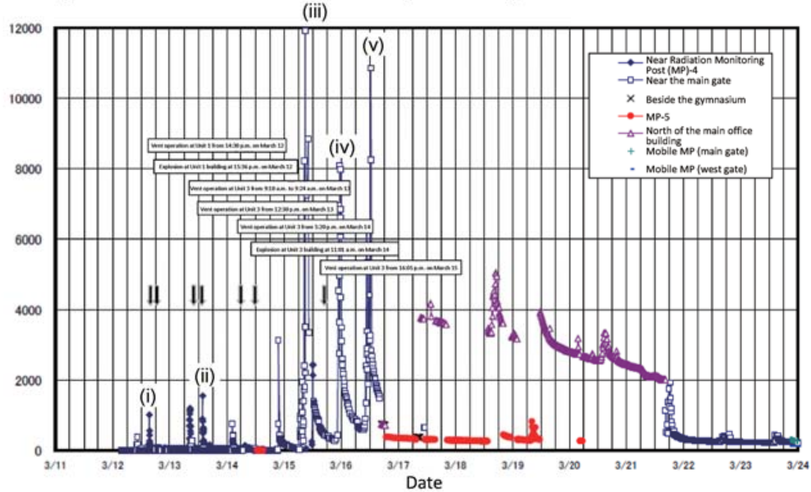
In the early morning of March 12, 2011, monitoring cars measured higher ambient dose rates within the premises of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS and the discharge of radioactive materials was first confirmed after the earthquake. At Unit 1, after an abnormal pressure rise in the containment vessel was observed, the pressure declined slightly. Therefore, it is considered that radioactive materials discharged from the containment vessel at Unit 1 and were discharged into the air. Thereafter, temporary rises of ambient dose rates were observed several times after the vent operations and explosions at the buildings. The highest ambient dose rate was measured at 9:00 a.m. on March 15. A monitoring car near the main gate measured the highest rate of approx. 12 mSv/h.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Outline of the Accident

Ambient Dose Rates during Two Weeks after the Accident (Within and around of the premises of TEPCO's Fukushima Daiichi NPS)

● **Changes in ambient dose rates measured by monitoring cars within and around the NPS**



Additional Report of the Japanese Government to the IAEA - The Accident at TEPCO's Fukushima Nuclear Power Stations - (Second Report)

μSv/h: micro sievert per hour

The Secretariat of the Nuclear Regulation Authority

In accordance with the progress of events, fuel melted and a large amount of radioactive materials was discharged from the pressure vessel to outside of the reactor. As a result of containment vessel vent operations and damage to reactor buildings, part of the melted fuel and radioactive materials were discharged from the reactor core into the air. Vent operation at Unit 1 was considered to be successful as the pressure in the containment vessel declined at 14:30 p.m. on March 12. Due to the radioactive plume discharged at that time, an ambient dose rate of approx. 1 mSv/h was detected [(i)]. On March 13, the following day, the ambient dose rate clearly increased again [(ii)]. This is considered to have been caused by vent operation at Unit 3 conducted after the water level in the reactor declined and the fuel was exposed from cooling water. At 9:00 a.m. on March 15, the highest rate of approx. 12 mSv/h was observed [(iii)]. Early in the morning at around 6:00 a.m. of that day, the pressure of the pressure suppression chamber declined at Unit 2 with the sound of an explosion. Therefore, the high dose rate on March 15 is considered to have been caused by the discharge of radioactive materials from Unit 2.

Ambient dose rate increases were also measured at 23:00 p.m. on March 15 and at 12:00 p.m. on March 16 [(iv) and (v)]. Pressure decline in the containment vessel was observed in Unit 3 and Unit 2, respectively, and these ambient dose rate increases are considered to have been caused by the discharge of radioactive materials from Unit 3 and Unit 2.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Outline of the Accident

International Nuclear and Radiological Event Scale(INES)

	Level	Accident examples
Accident	7 Major accident	Former Soviet Union: Chernobyl Nuclear Power Plant accident (1986) Japan: Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi Nuclear Power Station (NPS) accident (2011)
Accident	6 Serious accident	Provisionally evaluated as Level 7 on April 12, 2011
Accident	5 Accident with wider consequences	UK: Windscale Nuclear Power Plant fire accident (1957) US: Three Mile Island Nuclear Power Plant accident (1979)
Accident	4 Accident with local consequences	Japan: JCO criticality accident (1999) France: Saint-Laurent Nuclear Power Plant accident (1980)
Abnormal incident	3 Serious incident	Spain: Fire at Vandellos Nuclear Power Plant (1989)
Abnormal incident	2 Incident	Japan: Damage to steam generator heat exchanger tube at Unit 2, Mihama NPS (1991) Japan: Workers' radiation exposure due to an accident of scattering nuclear fuel materials at the Fuel Research Building, Oarai Research & Development Institute (2017)
Abnormal incident	1 Anomaly	Japan: Sodium leak accident at Monju (1995) Japan: Primary coolant leak at Unit 2, Tsuruga NPS (1999) Japan: Pipe rupture in the residual heat removal system at Unit 1, Hamaoka NPS (2001) Japan: Pipe failure in the secondary system at Unit 3, Mihama NPS (2004)
Below scale	0 Below scale	(No safety significance)
Below scale	Not covered	(Events unrelated to safety)

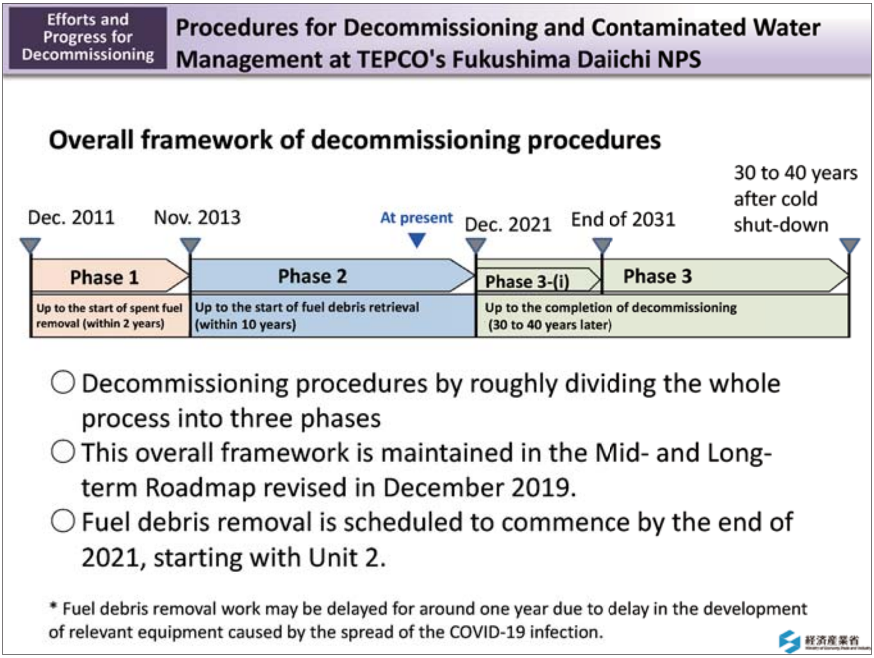
Prepared based on "The International Nuclear and Radiological Event Scale User's Manual" (IAEA) and "Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety" (June 2011; Nuclear Emergency Response Headquarters)

The International Nuclear and Radiological Event Scale (INES) is the international indicator to show the level of the seriousness in terms of safety of accidents or trouble at nuclear power plants.

The accident at TEPCO's Fukushima Daiichi NPS was evaluated as Level 7 (radiation impact converted to the amount of I-131 exceeds several tens of thousands TBq (10^{16} Bq)), equivalent to the level of the Chernobyl NPS Accident.

(Related to p.28 of Vol. 1, "International Nuclear and Radiological Event Scale")

Included in this reference material on March 31, 2013
Updated on March 31, 2019



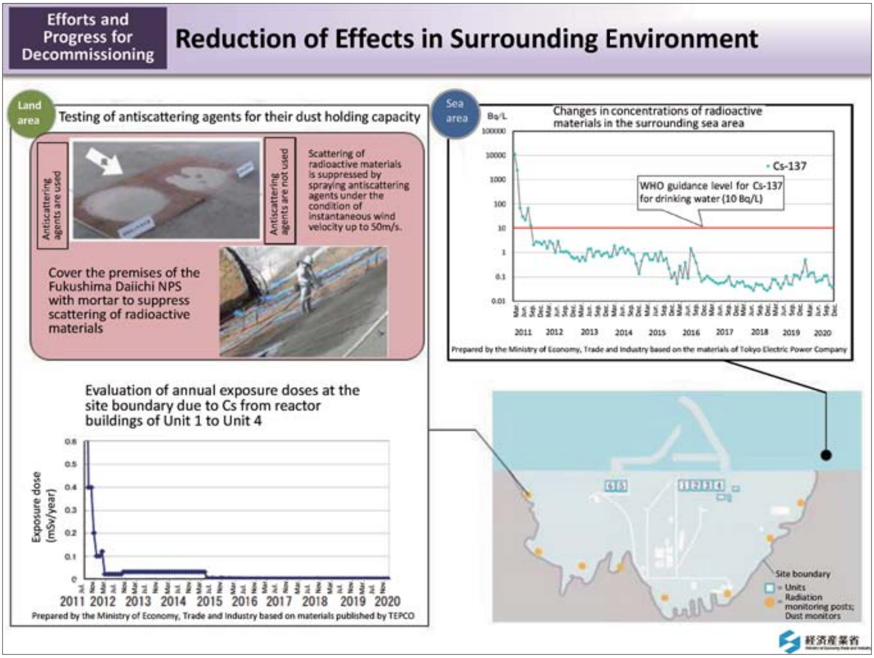
Efforts to decommission damaged nuclear reactors have been continued at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. At present, cooling of reactors is continued at all Units and they are all being kept stable and under control.

Procedures for decommissioning Fukushima Daiichi NPS are unprecedentedly challenging and the Government of Japan takes the initiative to carry out measures stably and steadily in line with the Mid- and Long-term Roadmap towards the Decommissioning of Tokyo Electric Power Company Holdings' Fukushima Daiichi NPS (Mid- and Long-term Roadmap).

In December 2019, the Mid- and Long-term Roadmap was revised and it was decided to commence with taking out the fuel debris of Unit 2 first, and the method was also determined. For completing the decommissioning in 30 to 40 years, decommissioning procedures will continuously be implemented while placing top priority on ensuring safety. (Note 1)

(Note 1) Fuel debris removal work may be delayed for around one year due to delay in the development of relevant equipment caused by the spread of the COVID-19 infection.

Included in this reference material on February 28, 2018
Updated on March 31, 2021



During work, not only monitoring of changes in radiation doses at work sites but also monitoring of water and air around the premises of the NPS has been conducted regularly and it has been confirmed that influence on people's lives is sufficiently low. In preparation for any event of an abnormal increase in ambient dose rates or concentrations of radioactive materials in dust, a system for prompt reporting and responses has been put in place.

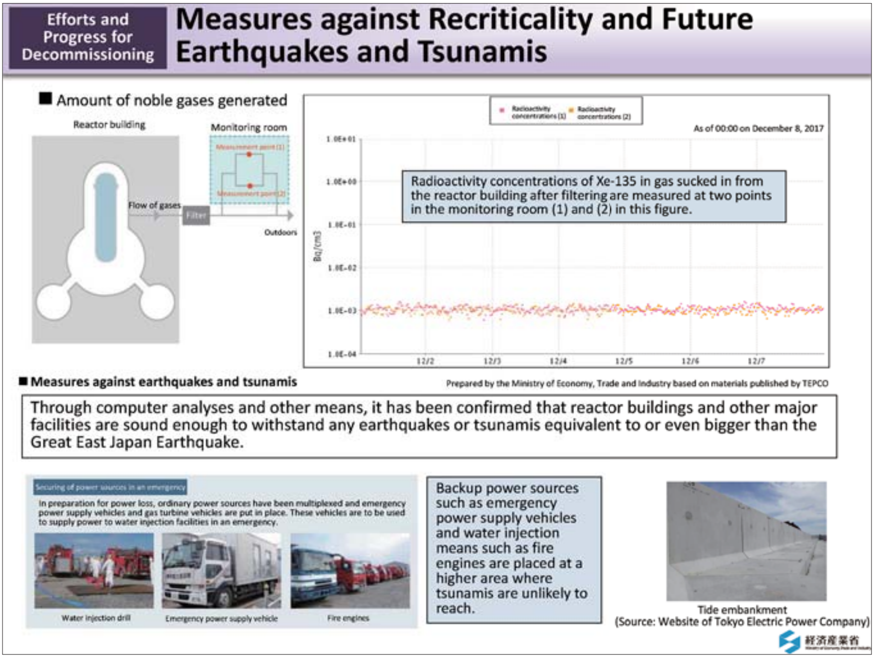
< Sea area monitoring >

By the sea-side impermeable wall consisting of driven steel piles, which was completed in October 2015, and other various measures (for details, see p.13 of Vol. 2, "Measures against Contaminated Water"), concentrations of radioactive materials in the surrounding sea area were reduced and have maintained levels far below the World Health Organization (WHO)'s guidance level for drinking water quality.

< Surrounding area monitoring >

At Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, various measures are taken to prevent scattering of radioactive materials to outside of its premises. Representative measures being taken are spraying of antiscattering agents and covering the ground with mortar. These measures have worked to reduce dose rates, compared with those immediately after the accident, and to stabilize the rates at radiation monitoring posts installed at the boundary of the premises.

Included in this reference material on February 28, 2018
Updated on March 31, 2021



< Recriticality >
When criticality occurs (a status where chain fission reaction occurs and continues), Xe-135 and other noble gases increase in an unexpected fashion. At Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, generation of noble gases is being monitored at all hours. At present, the amount of noble gases generated has been stable, which suggests that recriticality has not occurred. However, in preparation for any risks of recriticality, a boric acid water system to suppress nuclear fission in the event of criticality has been installed.

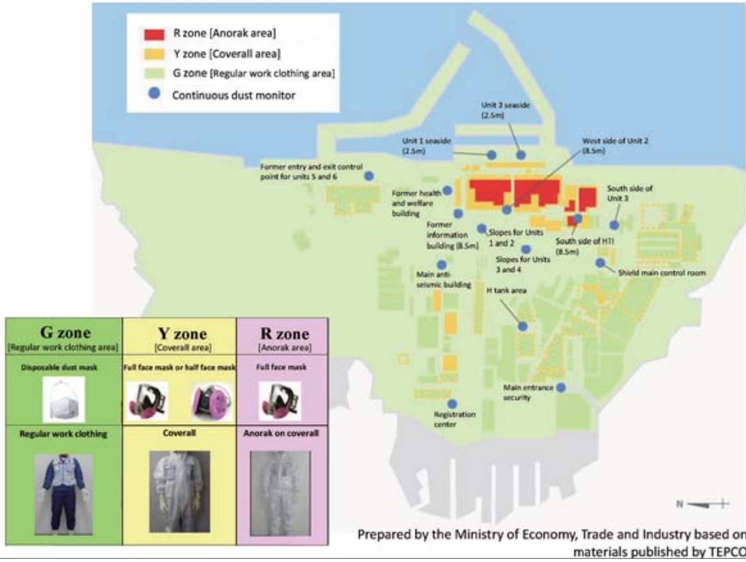
< Measures against earthquakes and tsunamis >
■ Measures against earthquakes
It has been confirmed that important buildings in the premises are sound enough not to fall down even in the event of an earthquake of the same level as the Great East Japan Earthquake. For securing a seismic safety margin, the demolition of the upper part (approximately 60 m) of the common exhausted stack for Units 1 and 2 was implemented in May 2020.

■ Measures against tsunamis
As measures against earthquakes and tsunamis, a tide embankment against Chishima Trench Tsunami was installed in September 2020. Measures against Japan Trench Tsunami, which is expected to be larger, have also been deliberated. While the work to block openings of the buildings has been underway to prevent inflow of seawater in the event of a tsunami, backup power sources such as emergency power supply vehicles and water injection means such as fire engines are placed at a higher area where tsunamis are unlikely to reach.

Included in this reference material on February 28, 2018
Updated on March 31, 2021

Efforts and Progress for Decommissioning

Improvement of Working Environment at TEPCO's Fukushima Daiichi NPS



Prepared by the Ministry of Economy, Trade and Industry based on materials published by TEPCO

In order to improve safety and workability by reducing workers' load, efforts to improve the working environment, for such work as debris removal and paving of roads, have been made at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. As a result, areas where workers can work in regular work clothing expanded to approx. 96% of the entire premises in June 2018.

Furthermore, in October 2018 onward, it became possible to move around in some areas without wearing specific protective gear.

In May 2015, a large rest house was opened and workers are served with hot meals prepared at the food service center and can take a shower and buy things at a convenience store. They can thus work under normal working conditions, except for a certain zone, at present.

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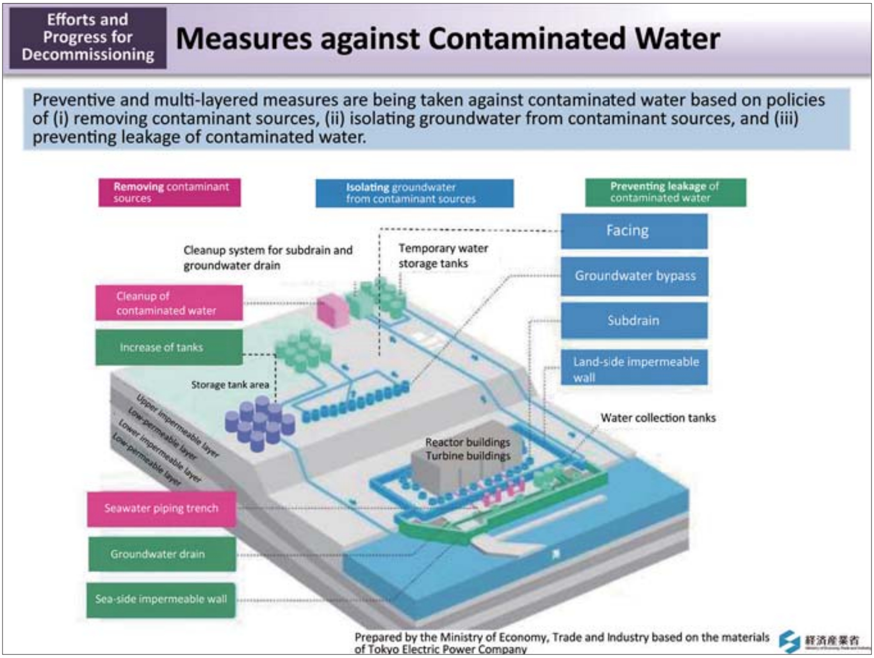

Water contaminated with radioactive materials has been treated based on the following three policies.
< Policy 1: Removing contaminant sources >
(i) Clean up contaminated water by removing 62 types of radionuclides therefrom
(ii) Remove highly contaminated water that remains in the trench, etc.

< Policy 2: Isolating water from contaminant sources >
(i) Pump up groundwater on the mountain side of the buildings to suppress inflow of groundwater around the buildings
(ii) Pump up groundwater using the well near the buildings (subdrain) to lower the groundwater level, thereby suppressing inflow of groundwater into the buildings
(iii) Construct a frozen soil wall around the buildings to suppress inflow of groundwater into the buildings
(iv) Suppress infiltration of rainwater into soil by paving the surface (facing)

< Policy 3: Preventing leakage of contaminated water >
(i) Construct a sea-side impermeable wall made of steel pipes to reduce outflow of groundwater containing radioactive materials into the sea
(ii) Construct a groundwater drain in the area between the sea-side impermeable wall and the land-side impermeable wall and pump up groundwater to suppress outflow of groundwater into the sea
(iii) Secure tanks in a planned manner to store highly contaminated water and decontaminated water newly generated every day

These efforts have brought about the following outcomes:
・The amount of newly generated contaminated water decreased from approx. $540m^3$/day in May 2014 to approx. $140m^3$/day in 2020, and the goal of approx. $150m^3$/day set in the Mid- and Long-term Roadmap has been achieved.
・Treatment of the accumulated water in the buildings, except for reactor buildings, etc. for Unit 1 to Unit 3, was completed and the goal set in the Mid- and Long-term Roadmap has been achieved.
・Concentrations of radioactive materials in the port decreased significantly.

As a remaining challenge, the amount of the decontaminated water that still contains tritium is increasing in storage tanks, and some countermeasures are being required.

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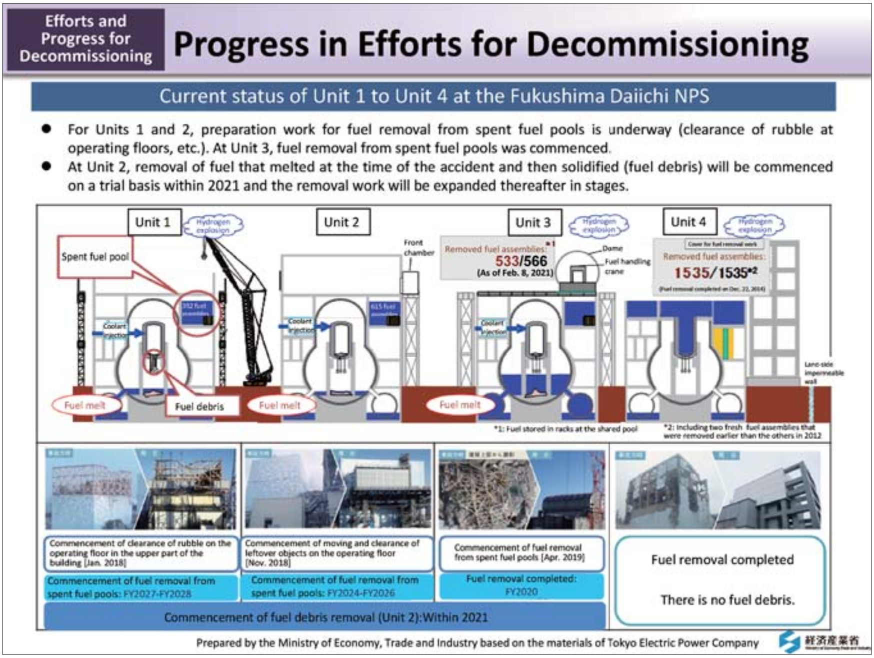

< Removal of spent fuel >
Removal of all 1,535 fuel assemblies from the spent fuel pool was completed at Unit 4 in December 2014 and the risk of discharge of radioactive materials caused by the breaking down of spent fuel due to failure to cool it down was significantly reduced.

At Unit 3, removal of fuel was commenced in April 2019 and removal work was continued steadily and safely, aiming to achieve completion within FY2020.

At present, preparations are being steadily progressed at Units 1 and 2 for clearance of rubble. From now on, preparatory work will be carried out while placing top priority on ensuring safety, such as through adopting new methods of installing large covers at working sites in order to further suppress scattering of dust.

< Removal of fuel debris >
The Mid- and Long-term Roadmap revised in December 2019 decides the method of removing fuel debris. The removal work will be commenced at Unit 2 first on a trial basis, and the scale will be sequentially expanded in stages.(Note 1)

Investigations of the inside of containment vessels by using robots that were developed based on cutting-edge technologies have been conducted so far. Efforts will be continued to develop technologies necessary for those investigations and fuel debris removal, and systems to confine radioactive materials.

(Note 1) Trial removal work may be delayed for around one year (initially scheduled to be commenced within 2021) due to delay in the development of relevant equipment caused by the spread of the COVID-19 infection.

Included in this reference material on February 28, 2018
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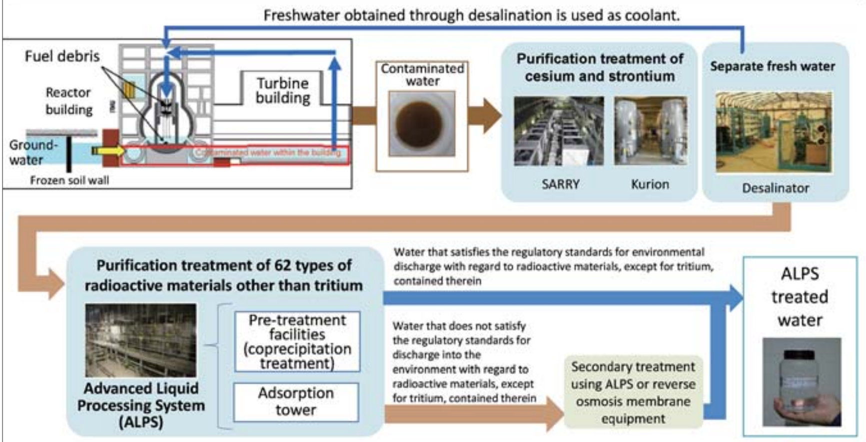
Efforts and Progress for Decommissioning

ALPS Treated Water – Purification of Contaminated Water –

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



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

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

At the NPS, as water is being injected continuously in order to cool melted and solidified fuel left within the reactor (fuel debris) and due to the inflow of rainwater and groundwater into the reactor building, water containing radioactive materials at high concentrations continues to be generated.

For such contaminated water, purification is conducted to remove radioactive materials using multiple types of equipment for the purpose of reducing the risks posed thereby. First, cesium and strontium are purified by the use of devices called SARRY and Kurion. Then, the water goes through a desalinator and clean water is separated and later used for cooling the reactor. The concentrated water is purified using ALPS to a level where the targeted 62 types of radioactive materials, except for tritium, satisfy their regulatory standards. Radioactive materials such as cesium, strontium, and iodine are purified by ALPS through co-precipitation treatment using solutions and adsorption on activated carbon and adsorbents. Almost all radioactive materials are removed through repeated treatment by ALPS, but tritium, which is a radioisotope of hydrogen, exists as a part of the water molecule and cannot be removed through treatment by ALPS and other equipment.

Water treated in this manner has been stored in tanks installed within the premises of TEPCO's Fukushima Daiichi NPS. However, as of January 2022, approximately 70% of the water stored in tanks still contained radioactive materials at concentrations exceeding the regulatory standards, in addition to tritium, due to such reasons as failures in purification equipment that occurred in the past and emergency purification treatment prioritizing the treatment amount in order to promptly reduce the impact of contaminated water on the surrounding areas. For such approximately 70% of the stored water, further treatment is to be conducted using ALPS or using reverse osmosis membrane equipment till it meet the definition of "ALPS treated water" which satisfies the regulatory standards for discharge into the environment other than tritium.

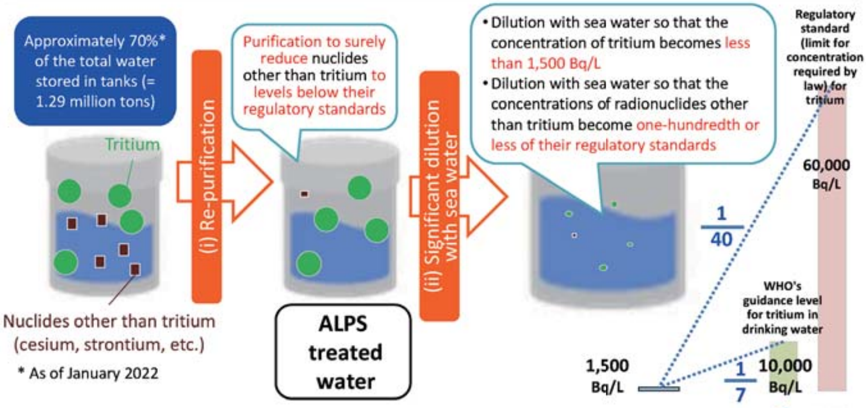
(Related to p.16 of Vol. 2, "Treatment Method for Water Stored in Tanks")

Included in this reference material on March 31, 2022

Efforts and Progress for Decommissioning

Treatment Method for Water Stored in Tanks

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



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

On April 13, 2021, the Government of Japan defined "ALPS treated water" as water wherein radionuclides other than tritium satisfy their regulatory standards for discharge into the environment, and announced its basic policy to discharge ALPS treated water into the sea. The basic policy provides that ALPS treated water is to be discharged into the sea after diluting it by more than 100 times with sea water to reduce the concentration of tritium contained therein to less than 1,500 Bq/L. This value of 1,500 Bq/L is one-fortieth of the regulatory standard (limit for concentration required by law) for tritium that is applied to NPSs under operation, and is around one-seventh of the WHO's guidance level for tritium in drinking water (Guidelines for Drinking-Water Quality). Through this dilution, nuclides other than tritium are also diluted to below 0.01 in terms of the regulatory standards for discharge into the environment (the sum of ratios of concentrations required by law).

(Related to p.17 of Vol. 2, "Regulatory Standards for Discharging Radioactive Materials into the Environment")

Water treated by ALPS and other equipment has been stored in tanks installed within the premises of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS after the accident. However, as of January 2022, approximately 70% of the water stored in tanks still contained radioactive materials at concentrations exceeding the regulatory standards, in addition to tritium. Such water does not meet the definition of "ALPS treated water." This is because in around 2013, when the operation of ALPS commenced, (i) its purification function was inferior, and (ii) as an enormous amount of contaminated water was generated, the priority was placed on first satisfying the regulatory standards for the storage within the NPS premises in order to reduce radiation risks as promptly as possible.

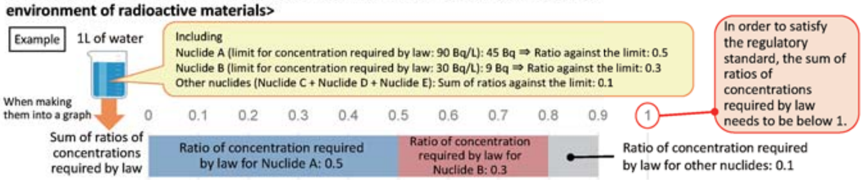
Accordingly, in line with the basic policy, for discharging the water stored in tanks into the sea, purification by using ALPS or reverse osmosis membrane equipment is to be conducted again (secondary treatment) so as to satisfy the regulatory standards for environmental discharge, which are stricter than the regulatory standards for the storage within the NPS premises. The performance test on secondary treatment, which Tokyo Electric Power Company Holdings conducted from September 2020, revealed the fact that nuclides other than tritium can be purified to levels below the regulatory standards for environmental discharge.

Included in this reference material on March 31, 2022

Regulatory Standards for Discharging Radioactive Materials into the Environment

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

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



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

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

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

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

Regulatory standards for radioactive materials contained in liquid and gaseous waste that are discharged into the environment from nuclear power stations, etc. in Japan are set in light of the recommendations of the International Commission on Radiological Protection (ICRP) on the basis that an annual public exposure dose additionally caused by discharged radioactive materials (effects on human bodies) will not exceed 1 mSv. More specifically, the maximum concentration for a radioactive material is set so that, supposing that a person continues to drink 2L of water containing that type of radioactive material every day until becoming 70 years old, the resulting dose rate becomes 1 mSv per year on average. The limit thus set for each radioactive material is called the "limit for concentration required by law."

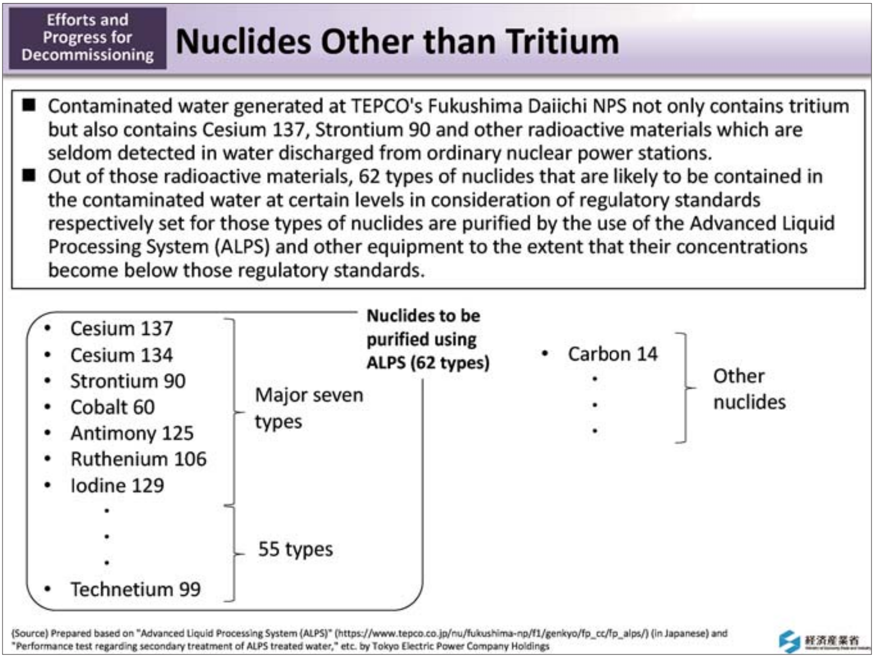
Generally, liquid and gaseous waste discharged from a nuclear power station, etc. contains multiple radionuclides. Therefore, when effects of multiple radionuclides are supposed, the concept of the sum of ratios of concentrations required by law as described in Ministerial Notice is adopted in comprehensive consideration of the effects of all radionuclides contained in the waste. Concentration levels are regulated so that the sum does not exceed 1.

When disposing of ALPS treated water, whether the sum of ratios of concentrations required by law thus obtained is below 1 is to be checked in the same manner as for other nuclear power stations, etc. currently under operation. At Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, treatment using ALPS and other equipment is conducted to reduce concentrations of radioactive materials excluding tritium but including those unique to the damaged reactors (such as cesium and strontium) so that their concentrations do not exceed the regulatory standards. The performance test on repurification using ALPS and other equipment, which Tokyo Electric Power Company Holdings conducted from September 2020, revealed that the sum of ratios of concentrations required by law for nuclides other than tritium was 0.35.

Also with regard to tritium, which is difficult to remove by ALPS or other equipment, dilution for reducing its concentration (by 100 times or more with sea water) is conducted in order to ensure that the sum of ratios of concentrations required by law for all radioactive materials, including tritium, remains below 1. Through the dilution, concentrations of nuclides contained in ALPS treated water other than tritium, which are already reduced to below their regulatory standards, are also reduced by 100 times or more and safety can be further ensured.

Annual radiation effects when discharging ALPS treated water into the sea after dilution were assessed to be approx. 1/120,000 to approx. 1/1,000 of the radiation effects that Japanese people receive from nature for one year. (Related to p.20 of Vol. 2, "Assessment of the Potential Radiological Impact of Discharge of ALPS Treated Water into the Sea")

Included in this reference material on March 31, 2022



Contaminated water generated at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS contains not only tritium but also Cesium 137, Strontium 90 and other radioactive materials. These types of radioactive materials normally remain in nuclear fuel rods at ordinary nuclear power stations and are seldom detected in water discharged therefrom. (Related to p.30 of Vol. 1, "Products in Nuclear Reactors")

Regarding these radioactive materials, purification using the Advanced Liquid Processing System (ALPS) and other equipment is conducted prior to discharge into the sea to reduce their concentrations to levels below their regulatory standards, and then, dilution by 100 times or more is conducted together with tritium. Through these procedures, concentrations of radioactive materials that were contained in contaminated water are reduced to less than 1/100 of the regulatory standards when the water is actually discharged.

In ALPS treated water after purification using ALPS and other equipment but before dilution, concentrations of many of the contained nuclides other than tritium are reduced to levels below detection limits. There remains the possibility that Cesium 134/137, Cobalt 60, Ruthenium 106, Antimony 125, Strontium 90, Iodine 129, Technetium 99, Carbon 14, etc., may be detected but at concentrations below the regulatory standards.

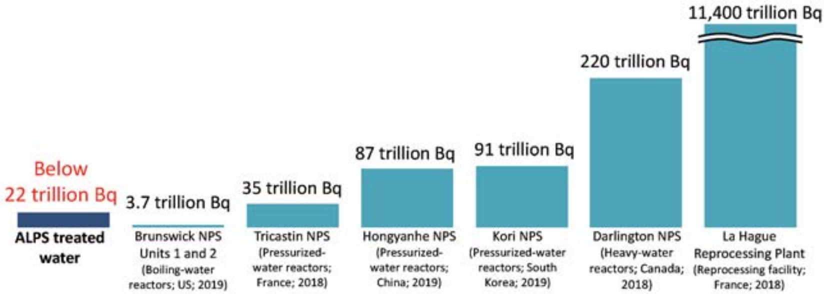
Regulatory standards for radioactive materials contained in liquid and gaseous waste that are discharged into the environment from nuclear power stations, etc. in Japan are set based on the total effects by all radioactive materials contained in waste, not based on the types of contained nuclides, and even if some types of these nuclides are detected, they do not necessarily have effects on human bodies and the environment. Incidentally, other nuclear power stations and reprocessing facilities inside and outside Japan also discharge waste containing radioactive materials into the sea or rivers or into the air through ventilation, etc. in compliance with the laws and regulations of respective countries.

Included in this reference material on March 31, 2022

Efforts and Progress for Decommissioning

Annual Discharge Amounts of Tritium - International Comparison -

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



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

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

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For discharging ALPS treated water into the sea, the Government of Japan has published the policy of maintaining the annual total discharge of tritium at a level below the operational target value that was adopted at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS prior to the accident (22 trillion Bq per year).

Tritium is also generated at other nuclear power stations and reprocessing facilities inside and outside Japan and is discharged as liquid waste into the sea or rivers or into the air through ventilation, etc. in compliance with laws and regulations of respective countries.

As shown in the graph above, the limit for the total annual discharge of tritium upon discharge of ALPS treated water, 22 trillion Bq or lower, is at a low level, compared with the amounts discharged from many of the nuclear power stations, etc. outside Japan.

Included in this reference material on March 31, 2022

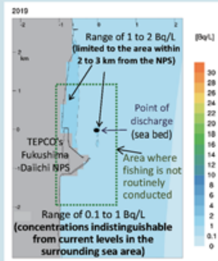
Efforts and Progress for Decommissioning

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

■ When discharging ALPS treated water into the sea, dilution is to be surely conducted and the diffusion and potential radiological impacts on humans and marine environment are to be scientifically assessed. Monitoring before and after the discharge will also be strengthened and enhanced.

< Assessment of potential impact on the marine environment>

- <u>Results of the dispersion simulation</u>
  The surrounding sea area where the tritium concentration was assessed to increase from the current level (0.1 to 1 Bq/L) is limited to the area within 2 to 3 km from the NPS. Even in this sea area, the sea water sufficiently satisfies the regulatory standard for tritium in Japan and the WHO's guideline for drinking-water quality.
- <u>Assessment on exposure doses of the general public</u>
  The impact on people who consume marine products at the national average was assessed to be approx. 1/120,000 to approx. 1/1,000 of the average annual exposure doses of Japanese people due to natural radiation (2.1 mSv/y).



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

< Environmental monitoring>

- The Government of Japan and relevant sectors will strengthen and enhance sea area monitoring before and after the discharge so that concentrations of tritium etc. in the sea can be compared.
- The credibility of analysis is to be secured by obtaining cooperation from the IAEA.

(Source) Prepared based on the "Announcement of the Basic Policy on Handling of the ALPS Treated Water at TEPCO's Fukushima Daiichi Nuclear Power Station (FDNPS)" (https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/pr_bpalps.pdf) by the Agency for Natural Resources and Energy and the "Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (Design stage)" (November 2021) (https://www.tepco.co.jp/press/release/2021/1657175_8711.html) by Tokyo Electric Power Company Holdings

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Following the basic policy, which the Government of Japan announced in April 2021, Tokyo Electric Power Company Holdings conducted assessment on the radiological impact when discharging ALPS treated water into the sea, in accordance with internationally recognized methods (as found in the International Atomic Energy Agency (IAEA) Safety Standard documents and International Commission on Radiological Protection (ICRP) recommendations). As a result, it was found that the impact on humans and marine environment will be negligible enough.

■ Results of the dispersion simulation in the sea (using the meteorological and hydrological data for 2019; annual average)
・The area where the tritium concentration in seawater in the surrounding area was assessed to increase from the current level (0.1 to 1 Bq/L) is limited to the area within 2 to 3 km from the NPS.
・There were some points near the point of discharge where the tritium concentration was assessed to be around 30 Bq/L, but the concentration would decrease promptly in and around those points. The tritium concentration of 30 Bq/L is still far below 10,000 Bq/L, the WHO Guidelines for drinking-water quality.
■ Results of potential radiological impact on human and plants and animals
・The impact on persons who consume marine products at the national average was assessed to be approx. 1/120,000 to approx. 1/1,000 of the average annual exposure doses of Japanese people due to natural radiation (2.1 mSv/y).
・The impact on plants and animals (flatfish, crabs, and brown algae) was assessed to be approx. 1/60,000 to approx. 1/120 of the standard values that may cause an impact on living organisms as specified by ICRP.

The Government of Japan and relevant sectors will strengthen and enhance sea area monitoring before and after the discharge of ALPS treated water into the sea, so that concentrations of tritium etc. can be compared. In conducting sea area monitoring, the credibility of analysis capabilities is to be secured by obtaining cooperation from the IAEA.

(Source) Prepared based on the "Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (Design stage)" (November 2021) (https://www.tepco.co.jp/press/release/2021/1657175_8711.html) by Tokyo Electric Power Company Holdings

Included in this reference material on March 31, 2022

Chapter 7

Environmental Radiation Monitoring

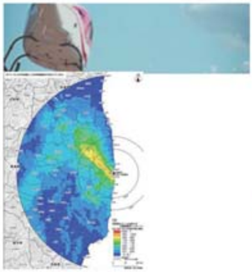
Chapter 7 explains environmental radiation monitoring being conducted after the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS and the results thereof.

You can understand how impacts of the accident spread and the status of contamination in the surrounding environment near the NPS, and changes over time after the accident.

Spatiotemporal Distribution of Ambient Dose Rates

Comprehensive Radiation Monitoring Plan and Information Disclosure

Radiation dose measurement map
Results of radiation monitoring nationwide are shown in a map.



Airborne monitoring
Monitoring using airplanes is conducted on a regular basis, centered on Fukushima Prefecture. The results are compiled into ambient dose rate maps and released.

Sea area monitoring
Relevant ministries and agencies conduct monitoring of seawater, marine soil and marine organisms and release measurement results.

Prepared based on Nuclear Regulation Authority; Monitoring information of environmental radioactivity level: https://radioactivity.nsr.go.jp/ja/ (in Japanese)
Comprehensive Monitoring Plan: https://radioactivity.nsr.go.jp/ja/list/204/list-1.html (in Japanese)

The Monitoring Coordination Meeting established in the Nuclear Emergency Response Headquarters formulated Comprehensive Radiation Monitoring Plan to ensure detailed monitoring of a large amount of radioactive materials released into the environment due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. Based on this plan, relevant organizations and nuclear operators are collaboratively conducting monitoring, respectively focusing on the following.

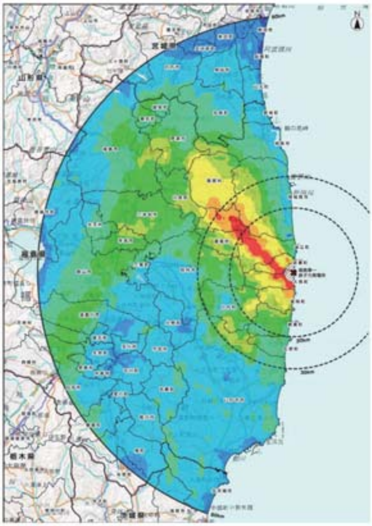
1) General environment (soil, water, and atmosphere, etc.), water environment, sea areas, etc.
2) Schools, etc.
3) Ports, airports, and sewage, etc.
4) Wild fauna and flora, and waste
5) Cultivated soil, forests, and pasture grass, etc.
6) Tap water
7) Foodstuffs (agricultural products, forestry products, livestock products, and fishery products)

Monitoring results are released on the websites of the respective organizations and are updated as needed.

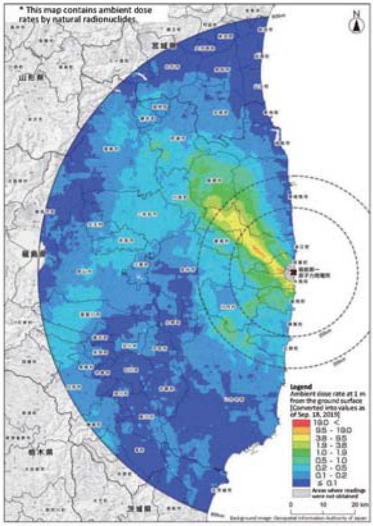
Included in this reference material on February 28, 2018
Updated on March 31, 2019

Spatiotemporal Distribution of Ambient Dose Rates

Distribution of Ambient Dose Rates within the 80-km Zone of TEPCO's Fukushima Daiichi NPS



Released by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) on Dec. 16, 2011



Released by the Nuclear Regulation Authority on Feb. 13, 2020

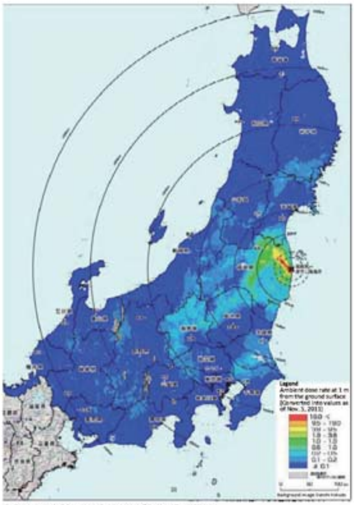
In order to ascertain the changes in the effect of radioactive materials, the airborne monitoring survey has been conducted continuously within the 80-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, and the distribution of ambient dose rates and deposition of radioactive cesium have been surveyed. Additionally, the effect of radioactive materials outside the 80-km zone has also been ascertained through the airborne monitoring survey.

It was confirmed that ambient dose rates within the 80-km zone decreased over time both in areas showing higher dose rates (areas extending to the northwest of the NPS) and areas showing lower dose rates.

Included in this reference material on March 31, 2014
Updated on March 31, 2021

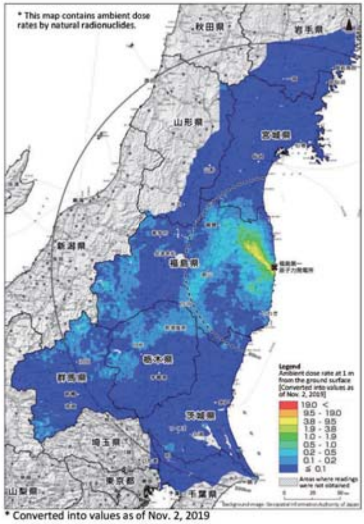
Spatiotemporal Distribution of Ambient Dose Rates

Distribution of Ambient Dose Rates in Fukushima Prefecture and Neighboring Prefectures



* Converted into values as of Nov. 5, 2011

Released by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) on Dec. 16, 2011



* Converted into values as of Nov. 2, 2019

Released by the Nuclear Regulation Authority on Feb. 13, 2020

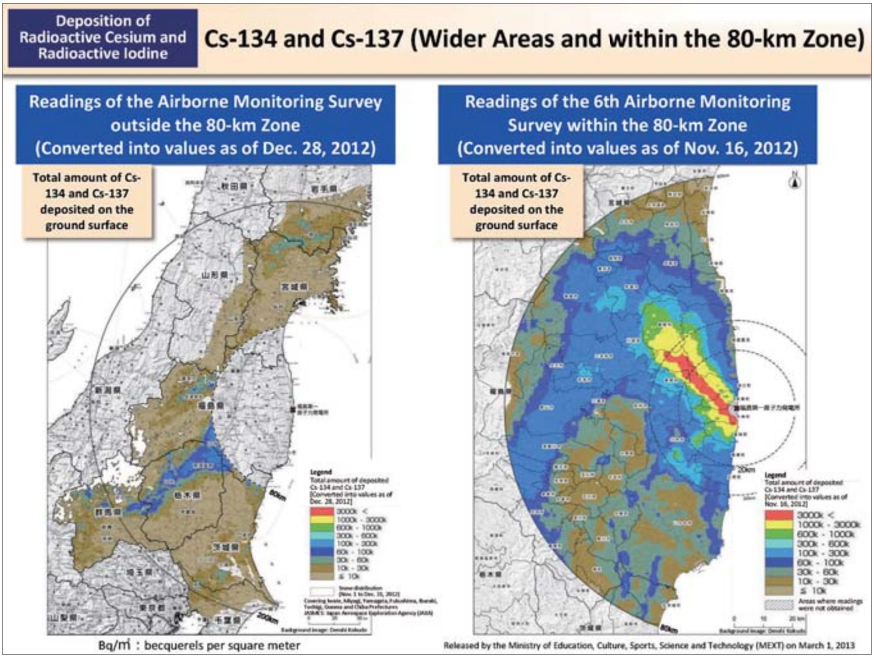
An airborne monitoring survey was conducted within the 80-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS and outside this zone, mainly in the western area of Fukushima Prefecture, and in Ibaraki, Gunma, Tochigi and Miyagi Prefectures.

The left figure shows the airborne monitoring survey results as of November 2011, seven months after the accident, and the right figure shows those as of November 2019.

Readings of the Airborne Monitoring Survey in Fukushima Prefecture and Neighboring Prefectures (February 13, 2020)

https://radioactivity.nsr.go.jp/ja/contents/15000/14890/24/200213_14th_air.pdf (in Japanese)

Included in this reference material on March 31, 2013
Updated on March 31, 2021



These maps show deposition of radioactive cesium on the soil surface in Fukushima and neighboring prefectures based on the readings of the airborne monitoring survey.

The survey was conducted in October to December 2012 for the purpose of ascertaining the changes in the situation regarding the effect of radioactive materials including influence of rainfall or other natural environments. When creating these maps, values were all converted into those as of the last day of the relevant airborne monitoring survey, November 16, 2012, and December 28, 2012, respectively.

Included in this reference material on March 31, 2013
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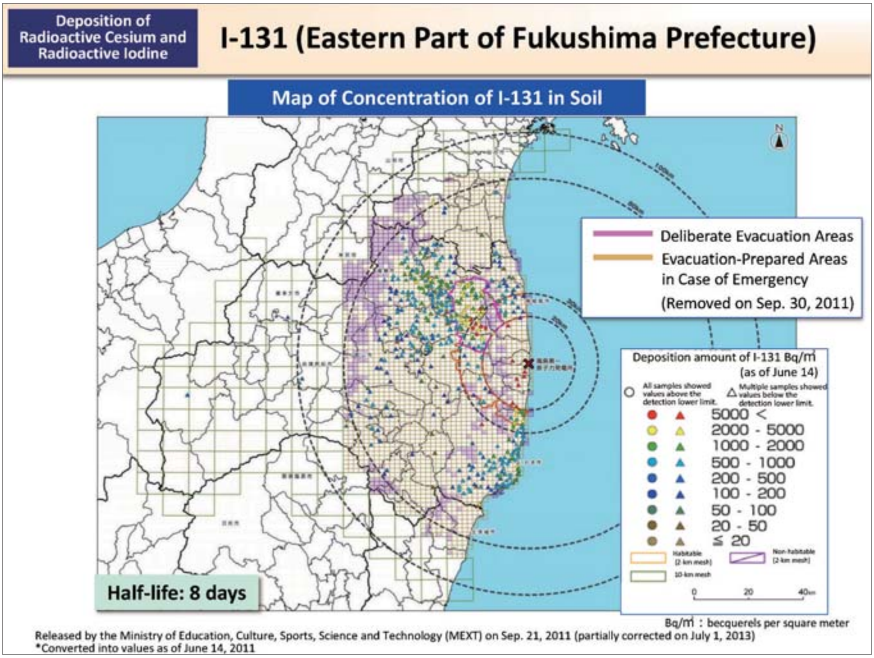


In the soil survey conducted by the national government in June 2011, three months after the accident, analysis of I-131 was conducted for soil samples collected within the 100-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS.

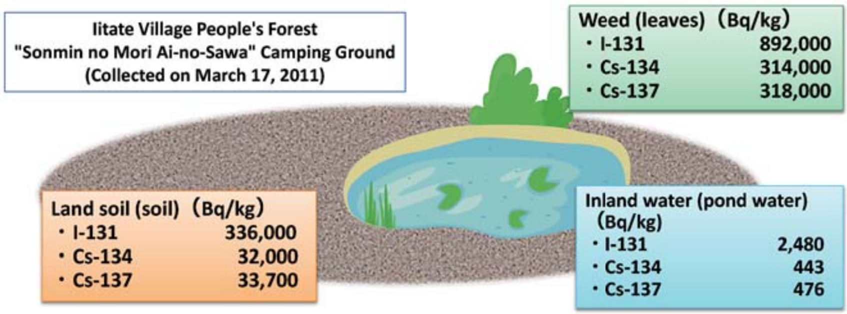
Areas showing high deposition amounts of iodine extended to the northwest of the NPS, in the same manner as in the case of cesium, and there are areas where the ratio of iodine against cesium is large in the southern areas of the NPS. I-131 and Cs-137 were thus deposited at different ratios in different areas probably because the ratio between I-131 and Cs-137 in radioactive plumes differed depending on the time when they were discharged. There is also the possibility that the ratio of I-131 against Cs-137 was relatively larger in plumes that flowed down to the south or that deposition was not even and a larger amount of Cs-137 was deposited in the north due to rainfall, resulting in increased concentrations of Cs-137 in soil in the north.*1

*1: "Concerning the Preparation of Distribution Map of Radiation Doses, etc. (Part 1)" (2012) by the Emergency Operation Center, Ministry of Education, Culture, Sports, Science and Technology

Included in this reference material on March 31, 2013
Updated on March 31, 2020

Deposition of Radioactive Cesium and Radioactive Iodine

Environmental Samples Collected in Fukushima Prefecture (Immediately after the TEPCO's Fukushima Daiichi NPS Accident)



Sampling location	Date	Weed (leaves) Bq/kg			Land soil (soil) Bq/kg		
		I-131	Cs-134	Cs-137	I-131	Cs-134	Cs-137
Towa branch municipal office, Nihonmatsu City	March 17	152,000	107,000	110,000	35,800	5,440	6,230
Swordsmanship dojo, Iitate Village	March 16	1,150,000	546,000	549,000	151,000	22,600	25,100
Ruins of Onami castle, Fukushima City	March 17	429,000	283,000	292,000	156,000	16,700	18,000

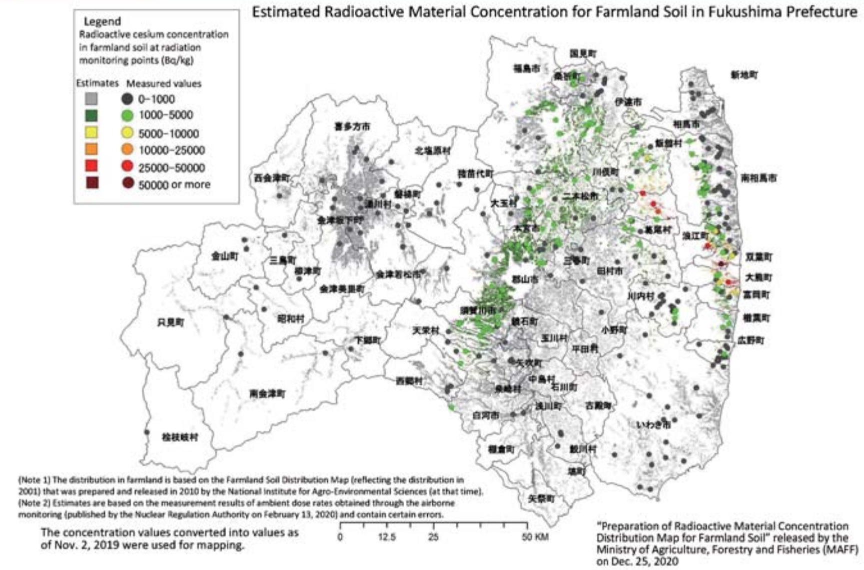
Bq/kg : becquerels per kilogram

Prepared based on "Measurement Readings for Environmental Samples" on June 7, 2011, by the Ministry of Education, Culture, Sports, Science and Technology (MEXT)

Through radiation monitoring of environmental samples conducted immediately after the accident, high level concentrations of radioactive iodine and radioactive cesium were detected from soil and plants.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Radioactive Cesium (Fukushima Prefecture)



In order to promote future agricultural activities at farmland in Fukushima Prefecture, which was severely affected by radioactive materials due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, measurements of radioactive materials in farmland soil have been conducted continuously. The above map shows radioactive material concentration distribution in farmland soil based on the results of the measurement conducted at 307 locations in Fukushima Prefecture in FY2019 (values are converted into those as of November 2, 2019).

In this farmland soil survey, soil to a depth of approx. 15 cm from the ground surface or a depth to be plowed was collected as samples in consideration of the depth of soil wherein radioactive materials are turned over in cultivation and in which crops take root.

Comparing the measured values of radioactive cesium concentration in targeted farmland soil in the previous survey (converted into values as of November 15, 2018) and the measured values for the same locations obtained in the most recent survey, it was confirmed that in around one year, radioactive cesium concentration decreased by 5% in paddies outside the Areas under Evacuation Orders, but there was scarcely any decrease observed in fields, pastures and orchards outside the Areas under Evacuation Orders. The decline in radioactive cesium concentration in soil due to physical attenuation during the same period was 4%.

Included in this reference material on March 31, 2013
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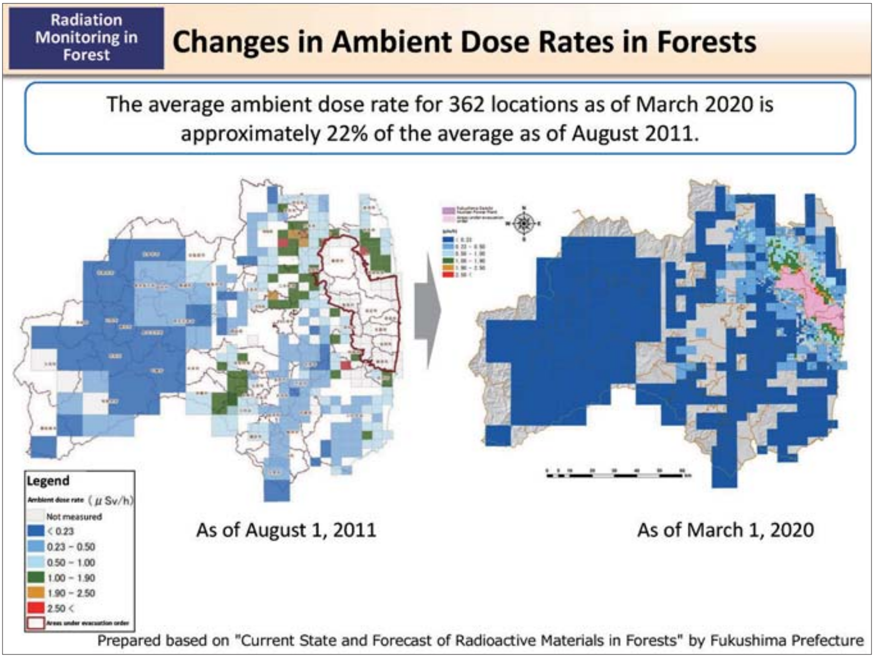


Fukushima Prefecture has been conducting monitoring of ambient dose rates in forests within the prefecture every year since FY2011. The monitoring targeted 362 locations in FY2011 but gradually expanded the coverage to target 1,300 locations in FY2018.

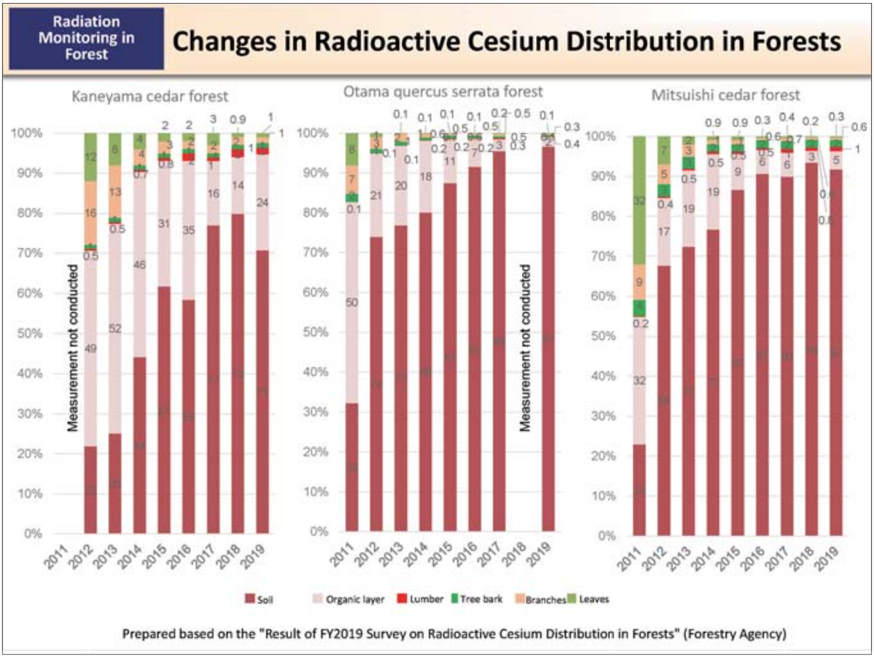
For the 362 locations, where monitoring has been continued from the beginning, the average ambient dose rate was 0.20 μSv/h as of March 2020, approximately 22% of the average as of August 2011 (0.91 μSv/h).

Measurement results by region as of March 2020 (minimum value - maximum value) are as follows.

- Ken-poku (northern pref.) (361 locations): 0.05 - 1.44 μSv/h
- Ken-chu (central pref.) (122 locations): 0.04 - 0.42 μSv/h
- Ken-nan (southern pref.) (38 locations): 0.05 - 0.24 μSv/h
- Aizu (33 locations): 0.03 - 0.08 μSv/h
- Minamiaizu (22 locations): 0.03 - 0.09 μSv/h
- Soso (653 locations): 0.10 - 3.30 μSv/h
- Iwaki (71 locations): 0.04 - 1.07 μSv/h

(Related to p.185 of Vol. 1, "Distribution of Radioactive Materials in Forests")

Included in this reference material on March 31, 2019
Updated on March 31, 2021



Regarding radioactive cesium in the surveyed forests, in the first one year after the accident from 2011 to 2012, the percentage of radioactive cesium found in leaves, branches and litter layers decreased significantly, while that found in soil increased significantly. This is considered to be because radioactive cesium deposited on leaves and branches, etc. of trees gradually transferred to the litter layer on the ground due to rain or leaf fall and then transferred to soil due to the decomposition of the litter layer. The percentage of radioactive cesium in soil is continuously increasing, and over 90% of the radioactive cesium in forests is found in soil or the litter layer as of 2019, mostly found in the soil surface layer at a depth between 0 cm and 5 cm.

The percentage of radioactive cesium found in the litter layer is high in the Kaneyama cedar forest and is low in other forests. Each forest thus shows different tendencies. The survey will be continued into the future.

(Related to p.185 of Vol. 1, "Distribution of Radioactive Materials in Forests")

Included in this reference material on January 18, 2016
Updated on March 31, 2021

Radiation Monitoring in Forest

Readings of the Monitoring of Radioactive Cesium in Mountain Streams (2012)

Category	Snowmelt season (March 1 - April 30)		Rainy season (May 1 - July 31)		Autumn season (Aug. 1 - Oct. 31)
Total number of samples	118	(342)	184	(264)	175
Samples wherein Cs was not detected[1]	111	(333)	181	(260)	169
Samples wherein Cs was detected[2]	7	(9)	3	(4)	6
Concentration of Cs in samples wherein Cs was detected[3]: (minimum - maximum) (Bq/L)	1.1 - 5.9	(1.0 - 5.9)	1.0 - 13.1	(1.0 - 13.1)	1.1 - 6.8
Percentage of samples wherein Cs was not detected	94.4%	(97.4%)	98.4%	(98.5%)	96.6%

Source: Prepared based on the Readings of the Monitoring of Radioactive Cesium in Mountain Streams (press releases by the Forestry and Forest Products Research Institute on June 12, Sep. 21 and Dec. 20, 2012)

Forestry Agency

Water samples collected from streams from forests in Fukushima Prefecture were inspected but radioactive cesium was not detected in most of them. Radioactive cesium was detected only in some of the samples, such as those collected on days with rainfall. These samples contained suspended solids with insoluble particles. Measurement was conducted again after filtering them and radioactive cesium was not detected in any of those filtered samples.

This suggests that radioactive cesium was detected mainly due to temporary increases in suspended solids, which are often observed when forest streams increase after rainfall.

1. Detection lower limits for both Cs-134 and Cs-137 are 1 Bq/L.
2. Samples wherein radioactive cesium was detected all contained suspended solids. As a result of the second measurement of those samples after filtering, radioactive cesium was not detected in any of them.
3. Concentration of radioactive cesium is the total of Cs-134 and Cs-137 concentrations.
4. Monitoring points were as follows:

・Snowmelt season: Date City, Iitate Village, (Nihonmatsu City, Aizuwakamatsu City, Koriyama City and Hirono Town)
・Rainy season: Date City, Iitate Village, (Nihonmatsu City)
・Autumn season: Date City, Iitate Village

5. Values in the table are the readings for Date City and Iitate Village throughout these seasons. Values in the parentheses for the snowmelt season and rainy season contain the readings for the cities and the town in the parentheses indicated in 4. above.

Included in this reference material on January 18, 2016

Radiation Monitoring in Well Water

Results of Well Water Inspection in Fukushima Prefecture

	Aizu District (western part of Fukushima Prefecture)	Nakadori District (central part of Fukushima Prefecture)	Hamadori District (eastern part of Fukushima Prefecture)
	Aizuwakamatsu City, Kitakata City, Nishiaizu Town, Bandai Town, Inawashiro Town, Aizubange Town, Yanaizu Town, Mishima Town, Kaneyama Town, Aizumisato Town, Kitashiobara Village, Showa Village, Shimogo Town, Tadami Town, Hinoemata Village	Fukushima City, Nihonmatsu City, Date City, Motomiya City, Koori Town, Kunimi Town, Kawamata Town, Otama Village, Sukagawa City, Tamura City, Ishikawa Town, Asakawa Town, Furudono Town, Miharu Town, Ono Town, Tenei Village, Tamakawa Village, Hirata Village, Shirakawa City, Yabuki Town, Tanagura Town, Yamatsuri Town, Hanawa Town, Nishigo Village, Izumizaki Village, Nakajima Village, Samegawa Village	Soma City, Minamisoma City, Hirono Town, Naraha Town, Kawauchi Village, Katsurao Village, Iitate Village, Iwaki City
2011	All ND	All ND	All ND
2012	All ND	All ND	All ND
2013	All ND	All ND	All ND
2014	All ND	All ND	All ND
2015	All ND	All ND	All ND
2016	All ND	All ND	All ND
2017	All ND	All ND	All ND
2018	All ND	All ND	All ND
2019	All ND	All ND	All ND
2020 (up to Dec.22)	All ND	All ND	All ND

Measurement readings of radioactive materials in well water
ND (not detected; below the detection lower limit): The detection lower limits for radioactive cesium and radioactive iodine were both 5 Bq/kg in 2011 and have been 1 Bq/kg since 2012.

* All municipalities indicated above participate in the Fukushima Prefecture Monitoring Program for Radioactive Materials in Drinking Water. Some of the other municipalities conduct their own inspection.

Source: Prepared based on the "Results of Drinking Well Water Inspection (Dec. 22, 2020)," of the Fukushima Revitalization Station

Fukushima Prefecture's reconstruction information portal site, "Fukushima Revitalization Station," publicizes the results of the drinking well water inspection, which has been conducted since 2011, the year when the nuclear accident occurred. Based on the inspection system established under the Fukushima Prefecture Monitoring Program for Radioactive Materials in Drinking Water, the inspection has been conducted for municipalities upon their requests.

Fukushima Revitalization Station: "Drinking water"
http://www.pref.fukushima.lg.jp/site/portal/list280-888.html (in Japanese)

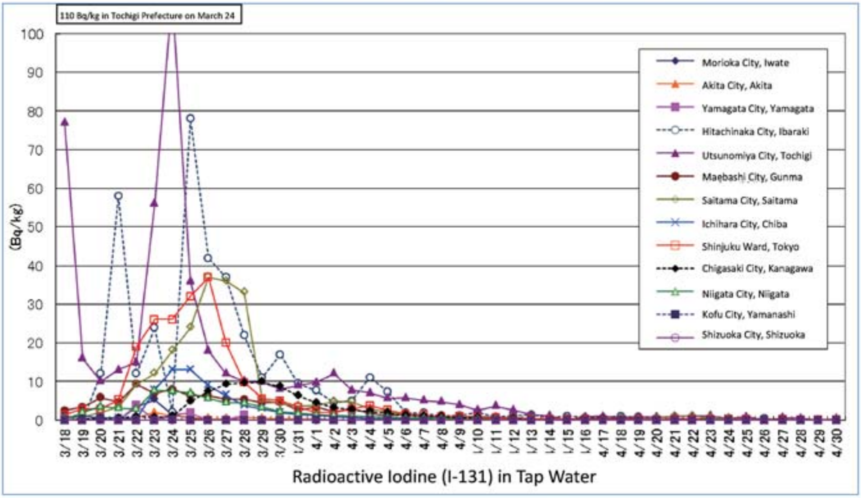
The national standard for drinking water including well water is 10 Bq/kg, but radioactive materials have never been detected from well water in the inspection conducted so far. Inspection results have been all "ND" (not detected; below the detection limit).

The detection lower limits for radioactive cesium and radioactive iodine were both 5 Bq/kg in 2011 and are 1 Bq/kg at present.

Included in this reference material on March 31, 2017
Updated on March 31, 2021

Radiation Monitoring of Clean Water

Radioactive Iodine (I-131) (the Tokyo Metropolis and 12 Prefectures)



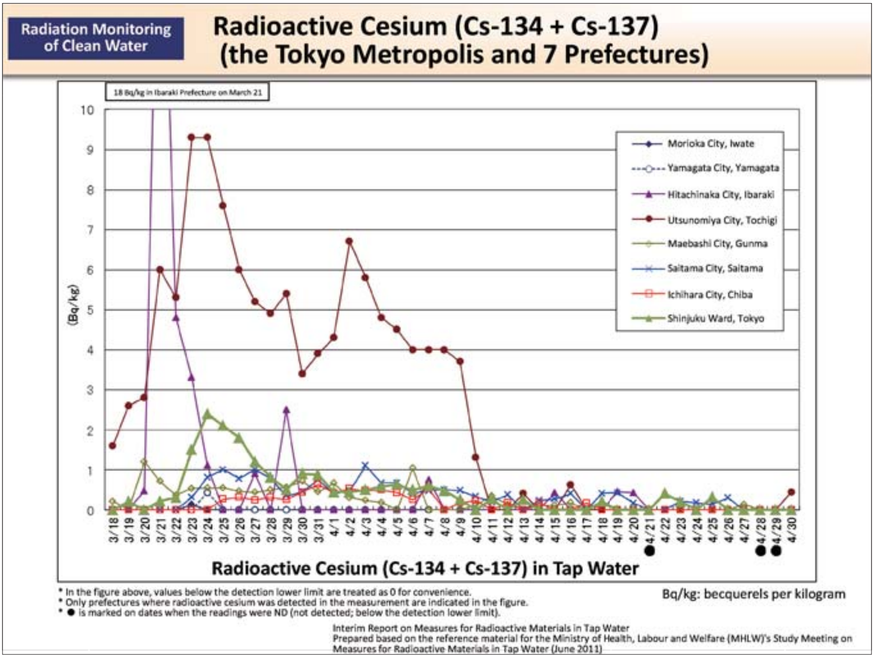
Bq/kg: becquerels per kilogram

* In the figure above, values below the detection lower limit are treated as 0 for convenience.
* Only prefectures where radioactive iodine was detected in the measurement are indicated in the figure.

Interim Report on Measures for Radioactive Materials in Tap Water
Prepared based on the reference material for the Ministry of Health, Labour and Welfare (MHLW)'s Study Meeting on Measures for Radioactive Materials in Tap Water (June 2011)

As a result of the inspection of radioactive materials in tap water conducted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), radioactive iodine was detected in the Tokyo Metropolis and 12 prefectures out of 47 prefectures nationwide. Highest concentrations were detected at the respective locations from March 18 to 29, 2011, but I-131 concentrations turned to decrease in many locations in the latter half of March 2011. In and after April 2011, only small amounts of I-131 were detected at some of these locations.

Included in this reference material on March 31, 2013
Updated on January 18, 2016

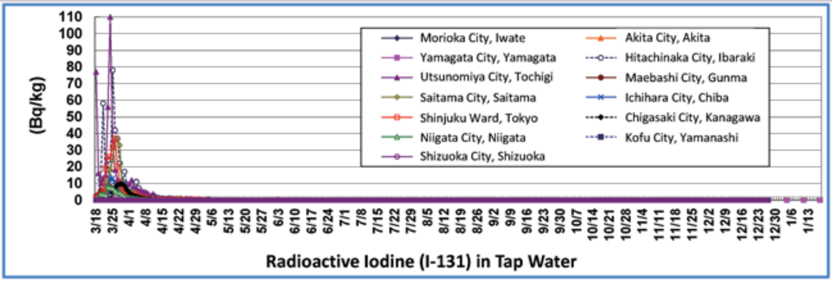


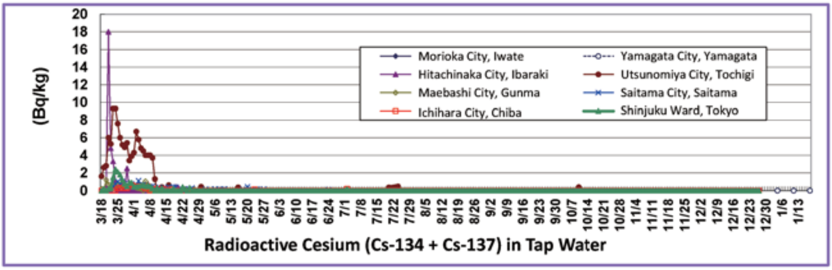
As a result of the inspection of radioactive materials in tap water conducted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), radioactive cesium was detected in the Tokyo Metropolis and 7 prefectures out of 47 prefectures nationwide. Highest concentrations were detected at the respective locations from March 20 to early April 2011, but radioactive cesium concentrations were relatively smaller than radioactive iodine concentrations. In and after April 2011, only small amounts of radioactive cesium were detected at some of these locations.

Included in this reference material on March 31, 2013
Updated on January 18, 2016

Radiation Monitoring of Clean Water

Results of Radiation Monitoring of Tap Water (until Jan. 2012)





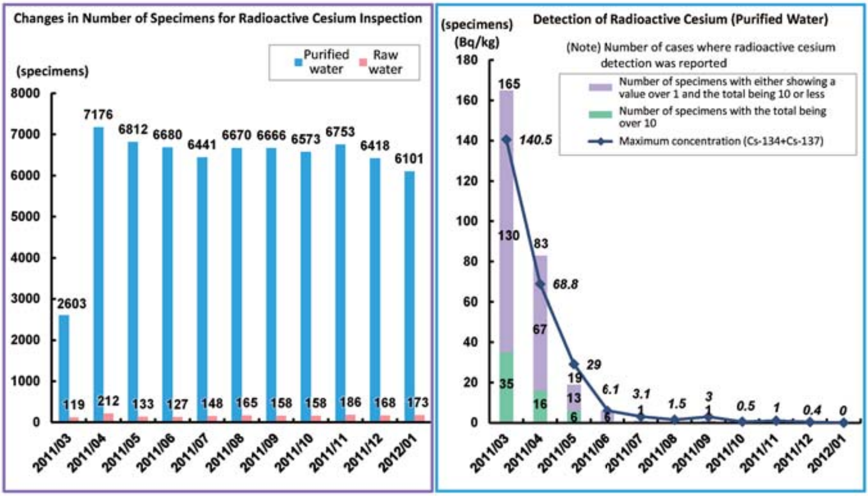
Prepared based on the Committee on Living Environment and Water Supply in March 2012

The tap water monitoring showed that radioactive cesium has seldom been detected since May 2011, not to mention short-half-life radioactive iodine.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Radiation Monitoring of Clean Water

Inspections by Water Suppliers

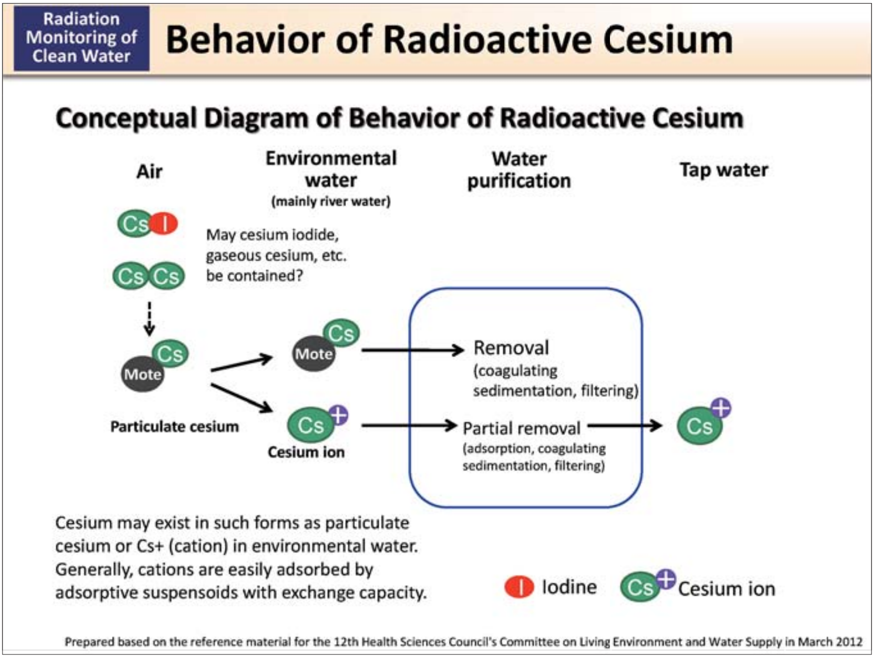


Bq/kg: becquerels per kilogram

Prepared based on 12th Health Sciences Council's Committee on Living Environment and Water Supply in March 2012

Water suppliers conduct inspections of radioactive cesium for approx. 6,000 to 7,000 specimens of purified water and over 100 specimens of raw water per month. The maximum monthly value of radioactive cesium concentration was 140.5 Bq/kg detected in March 2011, but the value declined gradually thereafter and there has been no report of radioactive cesium detection at a level exceeding 10 Bq/kg since June 2011.

Included in this reference material on March 31, 2013



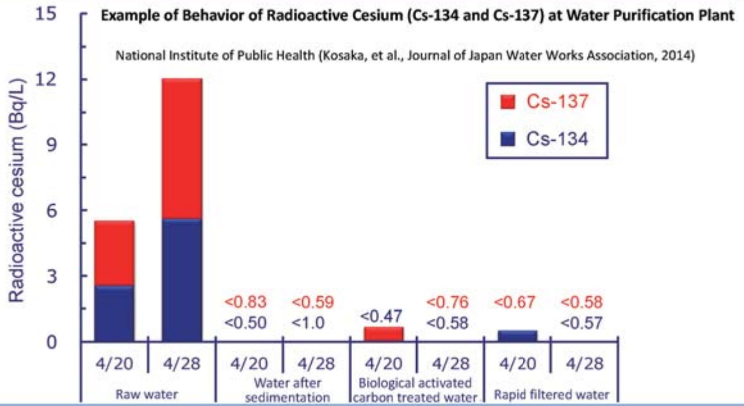
Radioactive cesium discharged due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS consists of Cs-134 and Cs-137 in equal proportion (1:1) and has also been detected at the same rate in the environment. Radioactive cesium was in the form of particles or gas immediately after discharge from the NPS, but it is considered to have fallen down onto the ground surface and to have been adsorbed into soil and dust, etc. In water, radioactive cesium is adsorbed into dust and tends to behave in the same manner as soil or other suspensoids, and therefore, is highly likely to be reduced by removing suspensoids in water.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Radiation Monitoring of Clean Water

Control of Radioactive Cesium

Most of the radioactive cesium that reaches sources of tap water is adsorbed into suspensoids such as soil and flows out. Therefore, radioactive cesium can be controlled through strict turbidity management.



Zeolite, ion exchangers, nanofiltration membranes and reverse osmosis membranes are professionally used for removing radioactive materials, but these cannot be used for ordinary water purification due to high cost, required facilities and inefficiency (in particular, the use of nanofiltration membranes and reverse osmosis membranes is power consuming).

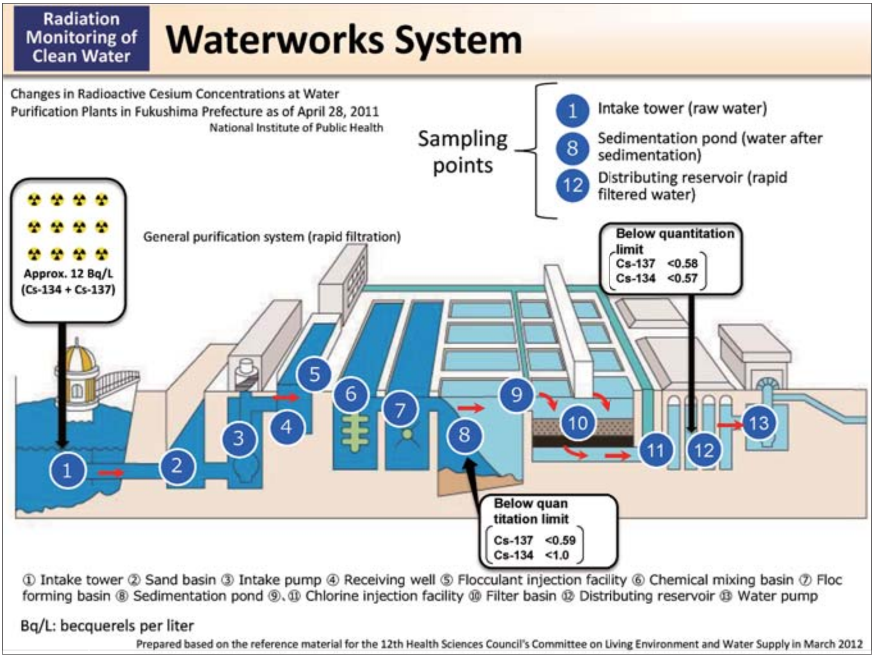
Bq/L: becquerels per liter

Prepared based on the reference material for the 12th Health Sciences Council's Committee on Living Environment and Water Supply in March 2012

As of April 2011, radioactive cesium concentrations in raw water, water after sedimentation, biological activated carbon treated water, and rapid filtered water were measured at water purification plants in Fukushima Prefecture. As a result, it was confirmed that low-concentrated radioactive cesium detected in raw water had decreased through adsorption into soil in the process of sedimentation.

A survey of water purification processes revealed that radioactive cesium had been almost entirely removed together with suspensoids through coagulating sedimentation, sand filtration and the use of powdered activated carbon. At present, radioactive cesium is not detected in almost all purified water. These results showed that radioactive cesium can be controlled through strict turbidity management.

Included in this reference material on March 31, 2013

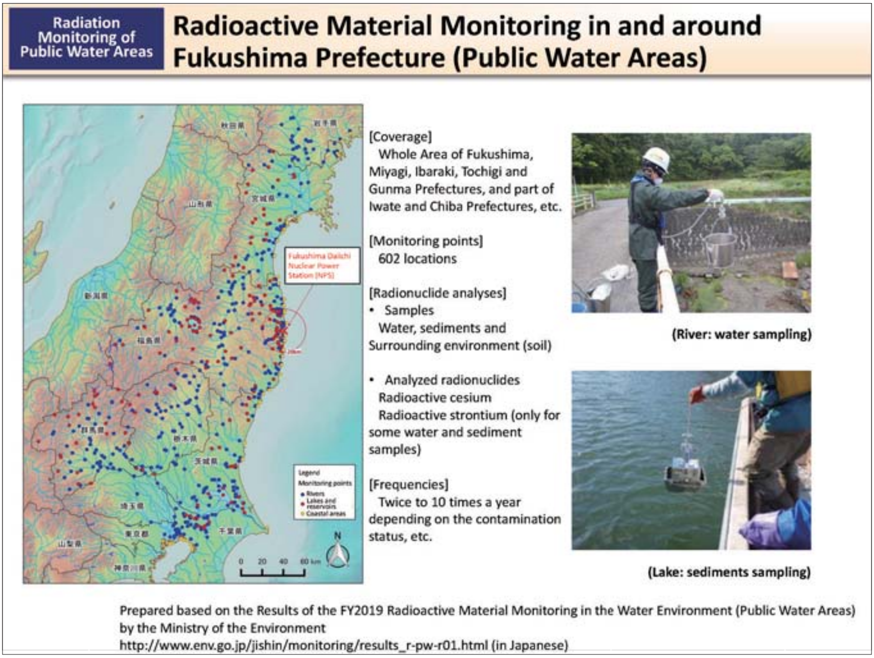


This figure shows the rapid filtration method, which is generally used in Japan. In this method, chemicals are injected into raw water taken from a river or dam to cause sedimentation of mud and small particles and make them into big chunks called "floc." Tap water is created by filtering the clear upper portion of such water.

Cesium has the property to be easily adsorbed into soil and mud (p.36 of Vol. 2, "Behavior of Radioactive Cesium"). Therefore, when water is separated from floc, cesium tends to gather around the floc, which is a chunk of soil and mud. Additionally, tap water is created using the clear upper portion of the water in plant basins. Therefore, this mechanism leaves little chance for cesium to be mixed into tap water.

In the pattern diagram above, radioactive cesium concentrations (Bq/L) actually measured at a water purification plant in Fukushima Prefecture as of April 28, 2011, are indicated at points where measurement was conducted. Radioactive cesium concentration, which was initially approx. 12 Bq/L at the intake tower, decreased to below the quantitation limit in the end when being pumped out from the distribution reservoir. As 1 liter of water weighs approx. 1 kg, it can be found that the concentration was far below 200 Bq/kg, which was the allowable limit for radioactive cesium in tap water publicized by the Ministry of Health, Labour and Welfare (MHLW) in March 2011, and also far below 10 Bq/kg, which is specified in the new standards for radioactive materials in tap water publicized in March 2012 (p.51 of Vol. 2, "Standard Limits Applied from April 2012").

Included in this reference material on March 31, 2015
Updated on March 31, 2019



Radioactive material monitoring was conducted at rivers, lakes and coastal areas in locations centered on Fukushima Prefecture, such as Miyagi and Ibaraki Prefectures, where contamination with radioactive materials was suspected.

In FY2019, monitoring covered 602 locations and analysis was conducted for radioactive cesium and strontium in water, etc.

Monitoring results of radioactive cesium concentrations in water are as follows. Monitoring results for sediments (mud of the bottom of rivers, lakes, etc.) are shown in p.40 of Vol. 2, "Radioactive Material Monitoring in the Water Environment (River Sediments)" through to p.42 of Vol. 2, "Radioactive Material Monitoring in the Water Environment (Coastal Area Sediments)."

[Monitoring results of radioactive cesium concentrations in water]

River water samples (2,004 samples): Radioactive cesium was not detected in any samples.

Lake/reservoir water samples (1,358 samples): Radioactive cesium was not detected in any samples except for 14 collected at 6 locations in the Hamadori District, Fukushima Prefecture.

Coastal samples (534 samples): Radioactive cesium was not detected in any samples.

* At all locations where radioactive cesium or strontium was detected, amounts of suspended solids (SS) and turbidity were relatively large.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Radiation Monitoring of Public Water Areas

Radioactive Material Monitoring in the Water Environment (River Sediments)

Distribution of Radioactive Cesium Concentrations in River Sediments (FY2019)

Number of collected samples

Radioactive cesium concentrations [Bq/kg(dry)]	Iwate Prefecture	Miyagi Prefecture	Fukushima Prefecture, Hamadori District	Fukushima Prefecture, Nakadori District	Fukushima Prefecture, Aizu District	Ibaraki Prefecture	Tochigi Prefecture	Gunma Prefecture	Chiba Prefecture	Saitama Prefecture	Tokyo Metropolis	Total	Percentage
Less than 1,000	79	193	294	323	168	209	278	214	196	8	8	1970	98. 3%
1,000 or more but less than 2,000	0	0	18	0	0	3	0	0	4	0	0	25	1. 2%
2,000 or more but less than 3,000	0	0	4	0	0	0	0	0	0	0	0	4	0. 2%
3,000 or more but less than 4,000	0	0	3	0	0	0	0	0	0	0	0	3	0. 1%
4,000 or more but less than 5,000	0	0	2	0	0	0	0	0	0	0	0	2	0. 1%
5,000 or more but less than 10,000	0	0	0	0	0	0	0	0	0	0	0	0	0. 0%
10,000 or more	0	0	0	0	0	0	0	0	0	0	0	0	0. 0%
Total	79	193	321	323	168	212	278	214	200	8	8	2004	100. 0%

Prepared based on the FY2019 Radioactive Material Monitoring in the Water Environment (Environmental Management Bureau, Ministry of the Environment)

Radioactive cesium concentrations in river sediments were measured in FY2019 as in the previous year.

A total of 2,004 samples, including 812 samples collected in Fukushima Prefecture and others collected in Iwate, Miyagi, Ibaraki, Tochigi, Gunma, Chiba and Saitama Prefectures and the Tokyo Metropolis, were surveyed.

The survey results showed that concentrations of radioactive cesium detected in approx. 98% of these samples were less than 1,000 Bq/kg (dry).

Included in this reference material on March 31, 2013

Updated on March 31, 2021

Radiation Monitoring of Public Water Areas

Radioactive Material Monitoring in the Water Environment (Lake and Reservoir Sediments)

Distribution of Radioactive Cesium Concentrations in Lake and Reservoir Sediments (FY2019)

Number of collected samples

Radioactive cesium concentrations [Bq/kg(dry)]	Miyagi Prefecture	Fukushima Prefecture, Hamadori District	Fukushima Prefecture, Nakadori District	Fukushima Prefecture, Aizu District	Ibaraki Prefecture	Tochigi Prefecture	Gunma Prefecture	Chiba Prefecture	Total	Percentage
Less than 1,000	70	80	43	154	70	30	82	28	557	66.9%
1,000 or more but less than 2,000	3	21	17	19	6	2	11	1	80	9.6%
2,000 or more but less than 3,000	0	22	8	11	0	0	2	3	46	5.5%
3,000 or more but less than 4,000	0	18	7	11	0	0	1	0	37	4.4%
4,000 or more but less than 5,000	0	8	4	3	0	0	0	0	15	1.8%
5,000 or more but less than 10,000	0	30	1	2	0	0	0	0	33	4.0%
10,000 or more	0	64	0	1	0	0	0	0	65	7.8%
Total	73	243	80	201	76	32	96	32	833	100.0%

Prepared based on the FY2019 Radioactive Material Monitoring in the Water Environment (Environmental Management Bureau, Ministry of the Environment)

Radioactive cesium concentrations in lake and reservoir sediments were measured in FY2019 as in the previous year.

A total of 833 samples, including 524 samples collected in Fukushima Prefecture and others collected in Miyagi, Ibaraki, Tochigi, Gunma and Chiba Prefectures, were surveyed.

The survey results showed that concentrations of radioactive cesium detected in approx. 67% of these samples were less than 1,000 Bq/kg (dry).

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Radioactive Material Monitoring in the Water Environment (Coastal Area Sediments)

Distribution of Radioactive Cesium Concentrations in Coastal Area Sediments (FY2019)

Number of collected samples

Radioactive cesium concentrations [Bq/kg(dry)]	Iwate Prefecture	Miyagi Prefecture	Fukushima Prefecture	Ibaraki Prefecture	Chiba Prefecture	Tokyo Metropolis	Total	Percentage
Less than 1,000	4	52	150	20	23	18	267	100. 0%
1,000 or more but less than 2,000	0	0	0	0	0	0	0	0. 0%
2,000 or more but less than 3,000	0	0	0	0	0	0	0	0. 0%
3,000 or more but less than 4,000	0	0	0	0	0	0	0	0. 0%
4,000 or more but less than 5,000	0	0	0	0	0	0	0	0. 0%
5,000 or more but less than 10,000	0	0	0	0	0	0	0	0. 0%
10,000 or more	0	0	0	0	0	0	0	0. 0%
Total	4	52	150	20	23	18	267	100. 0%

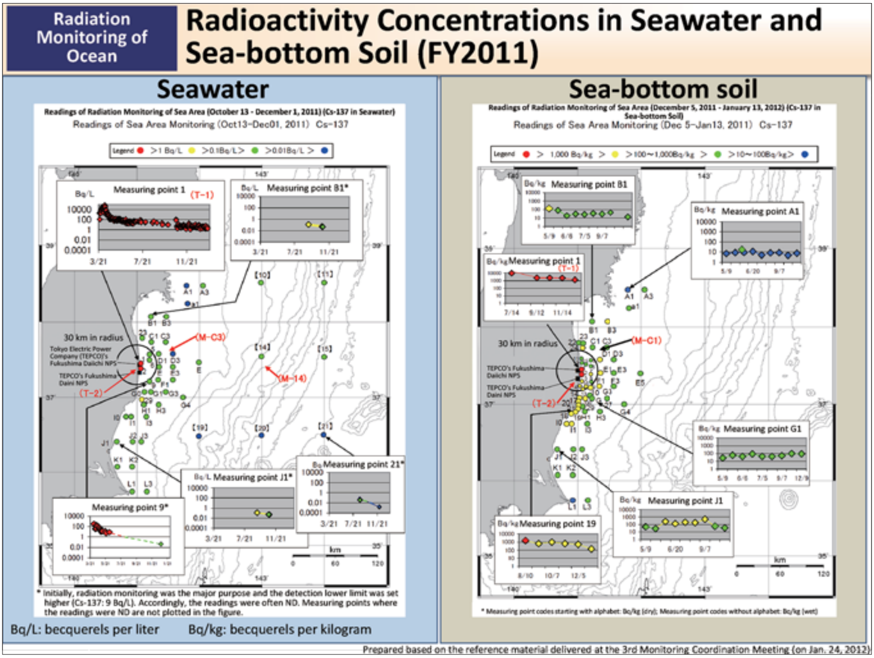
Prepared based on the FY2019 Radioactive Material Monitoring in the Water Environment (Environmental Management Bureau, Ministry of the Environment)

Radioactive cesium concentrations in sediments in coastal areas were measured in FY2019 as in the previous year.

A total of 267 sediment samples collected in coastal areas, including 150 samples collected in Fukushima Prefecture and others collected in Iwate, Miyagi, Ibaraki, Chiba Prefectures and the Tokyo Metropolis, were surveyed.

The survey results showed that concentrations of radioactive cesium detected in all of these samples were less than 1,000 Bq/kg (dry).

Included in this reference material on March 31, 2013
Updated on March 31, 2021



Since October 2011, radiation monitoring of radioactive cesium (Cs-137) in seawater and sea-bottom soil has been conducted jointly by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (until the establishment of the Secretariat of the Nuclear Regulation Authority), Secretariat of the Nuclear Regulation Authority, Fisheries Agency, Japan Coast Guard, Ministry of the Environment (MOE), Fukushima Prefecture and Tokyo Electric Power Company (TEPCO). With regard to samples collected near outlets (at Measuring Points T-1 and T-2), analysis has been conducted not only for radioactive cesium, but also for radioactive iodine (only for seawater samples), radioactive strontium, plutonium, and tritium (only for seawater samples).

The figures show the results of radiation monitoring of the sea area immediately after the accident.

Included in this reference material on March 31, 2013
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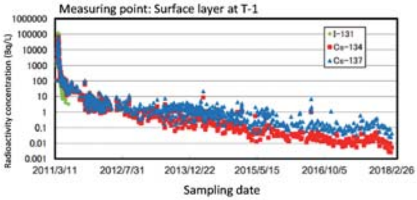
Radiation Monitoring of Ocean

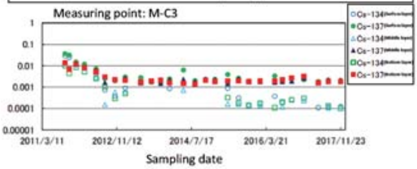
Changes in Radioactivity Concentrations in Seawater

Changes in Radioactivity Concentrations in Seawater in Coastal Areas in Fukushima Prefecture

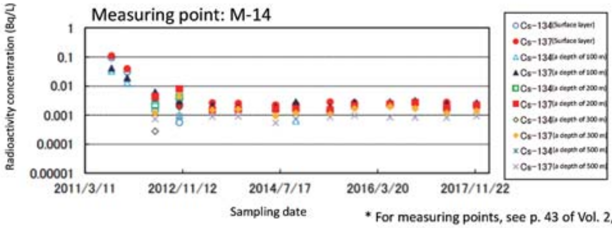


Changes in Radioactivity Concentrations in Seawater Offshore of Fukushima Prefecture

Surface layer: Water surface to a depth of approx. 2 m; Middle layer: Depth of 50 m to 100 m; Bottom layer: Sea bottom to up to approx. 40 m from the bottom



Changes in Radioactivity Concentrations in Seawater in the Open Sea



From the day of earthquake disaster to February 26, 2018

* For measuring points, see p. 43 of Vol. 2, "Radioactivity Concentrations in Seawater and Sea-bottom Soil (FY2011)."

Results of the Sea Area Monitoring by the Nuclear Regulation Authority: https://radioactivity.nsr.go.jp/ja/list/428/list-1.html (in Japanese)

Soil with radioactive cesium is transported to coastal areas via rivers.

Radioactivity concentrations in seawater samples collected near Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS rose to 100,000 Bq/L immediately after the accident, but dropped to one-thousandth (100 Bq/L) in one and a half months as a result of dilution and dispersion. The concentrations further decreased to 10 Bq/L in one and a half years and are 1 Bq/L or less at present.

In six months after the accident, soil containing radioactive cesium was transported from the coastal areas to 30 km offshore, but the concentration detected at Measuring Point M-C3 was 0.05 Bq/L or one-200th of the concentrations detected in the coastal areas. Generally it is considered that radioactivity concentrations become higher at the sea bottom due to settling of part of radioactive cesium, but in 2012, radioactivity concentrations were as low as 0.008 Bq/L in samples collected from bottom layers, and radioactivity concentrations detected in samples collected from surface layers and middle layers also decreased.

At Measuring Point M-14 in the open sea, 180 km away from the land, radioactivity concentrations detected in surface layers were 0.1 Bq/L, the same level of concentrations detected 30 km offshore, in six months after the accident. The concentrations further showed a two-digit decrease to 0.001 Bq/L in two years after the accident.

(Related to p.187 of Vol. 1, "Distribution of Radioactive Cesium in the Ocean")

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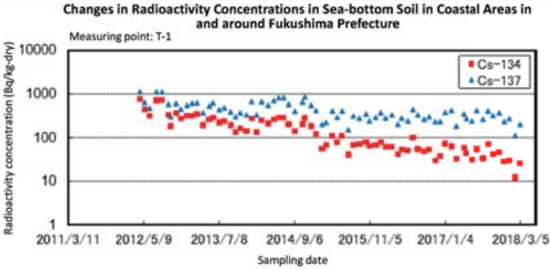
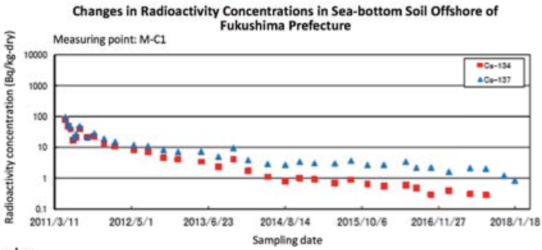
Radiation Monitoring of Ocean

Changes in Radioactivity Concentrations in Sea-bottom Soil





From the day of earthquake disaster to March 5, 2018

* For measuring points, see p.43 of Vol. 2, "Radioactivity Concentrations in Seawater and Sea-bottom Soil (FY2021)."

Results of the Sea Area Monitoring by the Nuclear Regulation Authority: https://radioactivity.nsr.go.jp/ja/list/428/list-1.html (in Japanese)

As a result of measuring dried sea-bottom soil samples collected in the coastal areas near Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, the concentrations of Cs-134 and Cs-137 were initially 1,000 Bq/kg but decreased in two years after the accident to 200 Bq/kg (down by 80%) and 500 Bq/kg (down by 50%), respectively. (Measuring Point T-1)

Radioactivity concentrations detected from sea-bottom soil samples collected 40 km offshore (Measuring Point M-C1) rose to 100 Bq/kg immediately after the accident but decreased to 10 Bq/kg a year later.

(Related to p.187 of Vol. 1, "Distribution of Radioactive Cesium in the Ocean")

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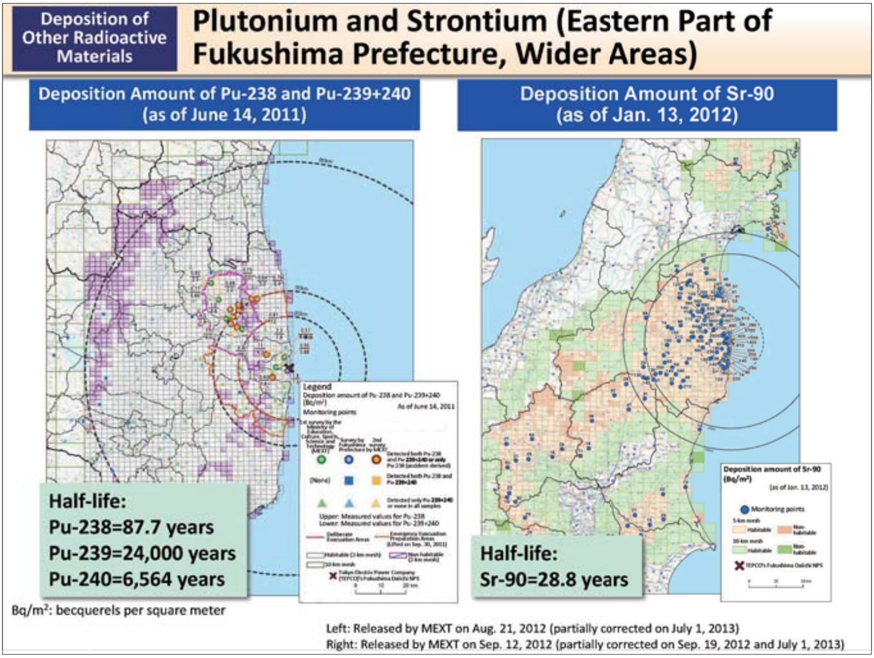

In the soil surveys conducted by the national government in June 2011 and January 2012, soil samples were collected within the 100-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS and in the western part of Fukushima Prefecture outside this zone.

The amounts of deposited Pu-238 and Pu-239+240 detected in the surveys were found to be within their ranges in past measurements conducted from FY1999 to FY2009, before the accident, covering the whole nation. It means that the amounts were within the fluctuations due to past nuclear bomb tests in the atmosphere, except for the amount of Pu-238 detected in a sample collected at one location (p.184 of Vol. 1, "Effects of Nuclear Test Fallout (Japan)").

In the current surveys, the amount of Pu-238 detected in a sample collected at one location exceeded the maximum deposition amount before the accident, and was around 1.4 times the maximum level before the accident. In order to determine whether the detected plutonium has derived from the TEPCO's Fukushima Daiichi NPS Accident, a comparison was made between the ratios between Pu-238 and Pu-239+240 detected in the current surveys and the ratios between deposited Pu-238 and Pu-239+240 measured nationwide for 11 years from FY1999 to FY2009. Locations where the detected Pu-238 and Pu-239+240 are highly likely to be accident-derived are marked with ○ on the map.

Sr-90 was also detected in the current surveys, but measured values for all samples were within the fluctuations due to past nuclear tests in the atmosphere in comparison with the readings of the nationwide measurements conducted from FY1999 to FY2009 before the accident at TEPCO's Fukushima Daiichi NPS. It was also confirmed that the deposition amounts of detected Sr-90 were around one-thousandth of those of Cs-137 at many of the monitoring points in the current surveys. Only occasionally, the deposition amounts of Sr-90 showed some fluctuations, being around one-tenth of those of Cs-137.

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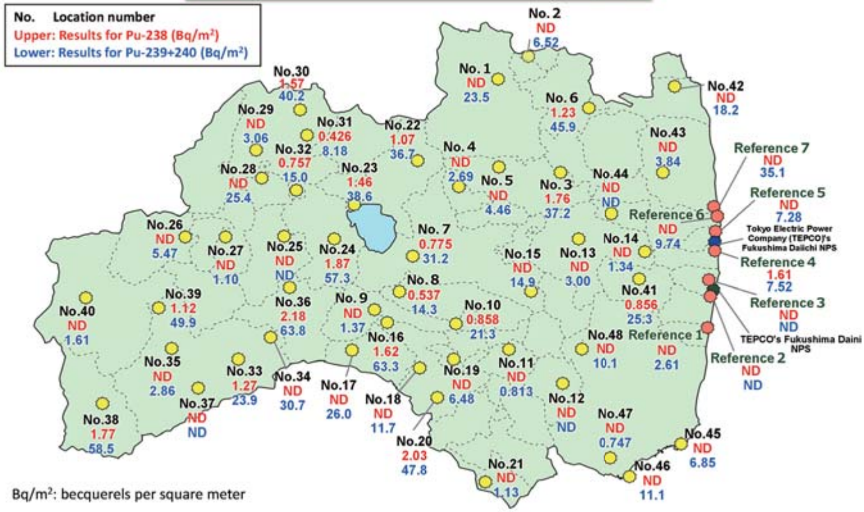
Deposition of Other Radioactive Materials

Plutonium (Fukushima Prefecture)

Analysis Results for Pu-238 and Pu-239+240 (Soil)



Prepared based on the reference material of the Local Nuclear Emergency Response Headquarters (Radioactivity Team) and the Disaster Provision Main Office of Fukushima Prefecture (Nuclear Power Team) of April 6, 2012

Based on the Plan for the Radiation Monitoring of Soil in Fukushima Prefecture, nuclide analysis for Pu-238 and Pu-239+240 was conducted for soil samples collected in Fukushima Prefecture from August 10 to October 13, 2011.

Deposition amounts of plutonium detected within the prefecture in the current monitoring were all within the ranges in past monitoring in the prefecture for ten years before the Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS Accident. At one location (Ottozawa, Okuma Town; Reference 4) out of seven reference monitoring points around TEPCO's Fukushima Daiichi NPS, the result fell outside the range of values before the accident, suggesting the influence of the accident at TEPCO's Fukushima Daiichi NPS.

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Updated on March 31, 2019

Chapter 8

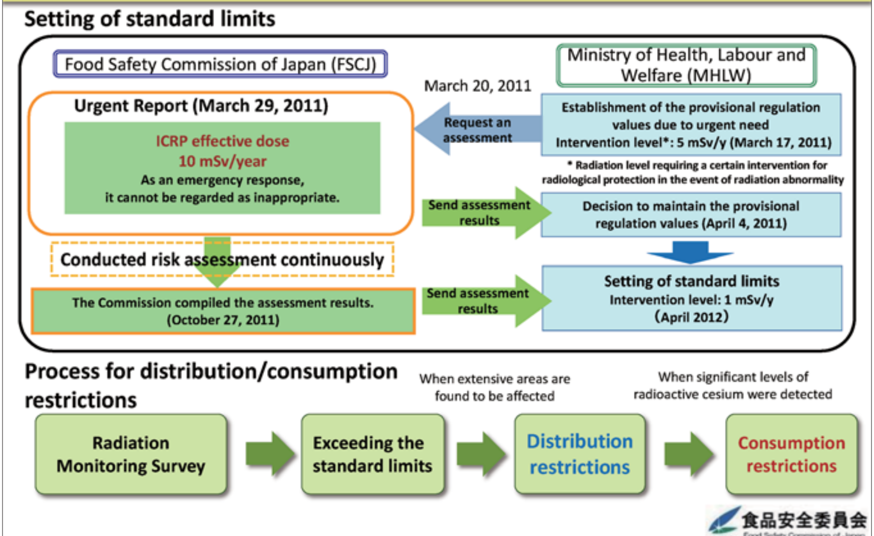
Radioactive Materials in Foods

Chapter 8 explains the standard limits for radioactive materials in foods, results of inspections, and efforts for reducing radioactive concentrations in foods.

You can understand the framework to ensure the safety of foods distributed on the market and concrete measures being taken after the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, and inspection results regarding to what extent there have been foods with radioactive concentrations exceeding the standard limits after the accident up to the present.

Measures for Radioactive Materials in Foods

Setting of Standard Limits for Radioactive Materials in Foods and Distribution/Consumption Restrictions



Prepared based on the FSCJ's briefing material "Health Effects of Radioactive Materials in Foods" and the MHLW's "Measures for and Current Status of Radioactive Materials in Foods"

Generally, health effects caused by consumption of hazardous materials in foods are assessed by the Food Safety Commission of Japan (FSCJ), a risk assessment organization, which implements science-based risk assessments in an objective, neutral and fair manner. Based on the FSCJ's risk assessment, risk management organizations, such as the Ministry of Health, Labour and Welfare (MHLW) and the Ministry of Agriculture, Forestry and Fisheries (MAFF), formulate and implement risk management policies by establishing regulation values for each type of food.

However, under an emergency situation immediately after the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, on March 17, 2011, the MHLW set the provisional regulation values for radioactive materials in foods mainly based on the guideline values given by the Nuclear Safety Commission. Then, the FSCJ held a total of five meetings, compiled the "Urgent Report on Radioactive Materials," and sent it to the MHLW on March 29, 2011. Based on this Urgent Report, the ministry decided to maintain the provisional regulation values as an interim measure.

In October 2011, the FSCJ notified the MHLW of the results of the risk assessment, and the MHLW reviewed the provisional regulation values and set the current standard limits by reducing the intervention level to 1 mSv/year in order to further ensure security and safety and deal with the situation on a long-term basis. The new regulation was adopted on April 1, 2012.

Local governments conduct inspections of radioactive materials in foods based on their respective plans formulated in line with the guideline established by the Nuclear Emergency Response Headquarters. When any item with radioactivity concentration exceeding the standard values is found through an inspection, the relevant item is collected and disposed of. When extensive areas are found to be affected, the Director General of the Nuclear Emergency Response Headquarters (Prime Minister) issues distribution restrictions by designating the regions and the items.

When significant levels of radioactive materials are detected from a food item, consumption restrictions are promptly issued irrespective of the number of inspected samples of that item.

(Related to p.174 of Vol. 1, "Indices Concerning Radioactive Materials in Foods," and p.51 of Vol. 2, "Standard Limits Applied from April 2012")

Source

• Prepared based on the website of the Government's Public Relations Office and the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies" (March 22, 2019), Nuclear Emergency Response Headquarters

Included in this reference material on March 31, 2013
Updated on March 31, 2020

Measures for Radioactive Materials in Foods

Publication of the Inspection Results Concerning Radioactive Materials in Foods

The national government proposes food items to be inspected and inspection frequencies, and respective prefectural governments formulate their inspection plans and carry out inspections accordingly.
Inspection results are publicized by the Ministry of Health, Labour and Welfare and respective local governments.

"Measures for Radioactive Materials in Foods," Ministry of Health, Labour and Welfare
https://www.mhlw.go.jp/shinsai_jouhou/shokuhin.html (in Japanese)

Database of radioactive substances in food
http://www.radioactivity-db.info/ (in Japanese)

In response to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS on March 11, 2011, the provisional regulation values concerning radioactive materials were established on March 17, 2011, based on the Food Sanitation Act (Act No. 233 of 1947). Then, the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies" was compiled on April 4.

The "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies" has been revised in light of the inspection results and accumulated knowledge on countermeasures to reduce radioactive materials (the latest revision was made on March 22, 2019).

Inspection results and information on distribution restrictions and consumption restrictions are positively publicized through websites of the national government and local governments.

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Measures for Radioactive Materials in Foods

Standard Limits Applied from April 2012

○ Immediately after the accident, foods in conformity to the provisional regulation values were generally assessed to have no ill effects and their safety was guaranteed. However, the annual dose limit was reduced to 1 mSv from 5 mSv, which had been permitted under the provisional regulation values, and current standard limits were set based thereon from the perspective of further ensuring security and safety of foods.

○**Provisional regulation values for radioactive cesium**[*1]

Category	Regulation value
Drinking water	200
Milk and dairy products	200
Vegetables	500
Cereals	
Meat, eggs, fish and others	

*1 The regulation values were set also taking into consideration radioactive strontium.

○**Present standard limits concerning radioactive cesium**[*2]

Category	Standard limit
Drinking water	10
Milk	50
General foods	100
Infant foods	50

(Unit: Bq/kg)

*2 The standard limits were set also taking into consideration Sr-90 and radioactive plutonium, etc.

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

Even based on the provisional regulation values applied up to March 2012, safety of foods in conformity thereto was guaranteed in terms of the effects on human health. However, from the perspective of further ensuring the security and safety of foods, the current standard limits were established and have been applied since April 1, 2012.

First of all, the provisional regulation values for radioactive cesium and strontium were based on the premise that the annual radiation dose from foods does not exceed 5 mSv.

The present standard limits are set so that the annual radiation dose from foods should not exceed 1 mSv (p.55 of Vol. 2, "Approach for the Establishment of the Standard Limits ◆ Grounds for the Standard Limits"). Additionally, foods were classified into five categories for the provisional regulation values, but were newly classified into four for the present standard limits (for details, see p.52 of Vol. 2, "Food Categories [Reference]").

(Related to p.174 of Vol. 1, "Indices Concerning Radioactive Materials in Foods," p.57 of Vol. 2, "Approach for the Calculation of the Standard Limits (1/2)," and p.58 of Vol. 2, "Approach for the Calculation of the Standard Limits (2/2)")

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Measures for Radioactive Materials in Foods

Food Categories [Reference]

● **Basic idea**

Drinking water, infant foods and milk, for which special consideration is required, are separately classified into three different categories, while the others are all classified into a single category as general foods. In this manner, all foods and drinks are classified into four categories.

Food category	Reasons to establish the limits	Range of foods
Drinking water	1. Water is essential for human life and there is no substitution for water, and its consumption is large. 2. WHO's guidance level for radioactive cesium in drinking water is 10Bq/kg. 3. Strict management is possible for radioactive materials in tap water.	○ Drinking water, water used for cooking and tea drinks, which is a substitute for water
Infant foods	○ The Food Safety Commission pointed out that "the susceptibility to radiation may be higher in childhood than in adulthood."	○ Foods approved to be labeled as "fit for infants" based on Article 26, paragraph (1) of the Health Promotion Act (Act No. 103 of 2002) ○ Foods and drinks sold as intended for infants
Milk	1. Children consume a lot. 2. The Food Safety Commission pointed out that "the susceptibility to radiation may be higher in childhood than in adulthood."	○ Milk (cow milk, low-fat milk, processed milk, etc.) and milk drinks specified in the Ministerial Order concerning the Ingredient Standards for Milk and Dairy Products (Order of the Ministry of Health and Welfare No. 52 of 1951)
General foods	For the following grounds, foods other than given above are categorized as "general foods." 1. Can minimize the influence of individual differences in eating habits (deviation of the foods to be consumed) 2. Easy to understand for the general public 3. Consistent with international views, such as those of the Codex Alimentarius Commission	○ Foods other than given above

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

Standard limits concerning radioactive materials in foods are established respectively for the four food categories.

For "drinking water," the standard limit was set at 10 Bq/kg due to the following three grounds: (i) Water is essential for human life and there is no substitution for water, and its consumption is large; (ii) WHO's guidance level for radioactive cesium in drinking water is 10Bq/kg; and (iii) Strict management is possible for radioactive materials in tap water (p.38 of Vol. 2, "Waterworks System").

For "milk," the standard limit was set at 50 Bq/kg because (i) children consume a lot and (ii) the Food Safety Commission pointed out that "the susceptibility to radiation may be higher in childhood than in adulthood."

For "infant foods," the standard limit is the same as that for milk at 50 Bq/kg as the Food Safety Commission pointed out that "the susceptibility to radiation may be higher in childhood than in adulthood."

As reasons to set the limit at 100 Bq/kg for "general foods," the following three points are cited: Setting the value in this manner (i) can minimize the influence of individual differences in eating habits (deviation of the foods to be consumed), and is (ii) easy to understand for the general public and (iii) consistent with international views, such as those of the Codex Alimentarius Commission (an intergovernmental body created for the purpose of protecting consumers' health and ensuring fair-trade practices in the food trade, etc. that establishes international standards for foods).

(Related to p.174 of Vol. 1, "Indices Concerning Radioactive Materials in Foods")

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Updated on March 31, 2019

Measures for Radioactive Materials in Foods

Outline of the Results of the Food-related Health Risk Assessment

(Food Safety Commission of Japan (FSCJ), on October 27, 2011)

- **Potential effects of radiation are found when the lifetime additional effective cumulative dose exceeds around 100 mSv. However, radiation dose accumulated in ordinary daily life such as from natural radiation and X-ray exams, etc. is excluded.**

- **In one's lifetime, the susceptibility to radiation may be higher in childhood than in adulthood.(thyroid gland cancer and leukemia)**
  - Risks of leukemia increased in children under the age of five at the time of the accident. (Noshchenko et al. 2010; Data relating to the nuclear accident at Chernobyl)
  - Risks of thyroid gland cancer are higher for children younger at the time of radiation exposure. (Zablotska et al. 2011; Data relating to the nuclear accident at Chernobyl)

  << However, both data contain uncertain points in the estimation of radiation doses, etc. >>

- **It is difficult to identify health effects concerning radiation exposure below 100 mSv.**
  - Inaccuracy in estimation of the amount of exposure
  - Effects of radiation and effects caused by other factors are unlikely to be distinguished.
  - Study population for epidemiological data serving as grounds is not large enough.

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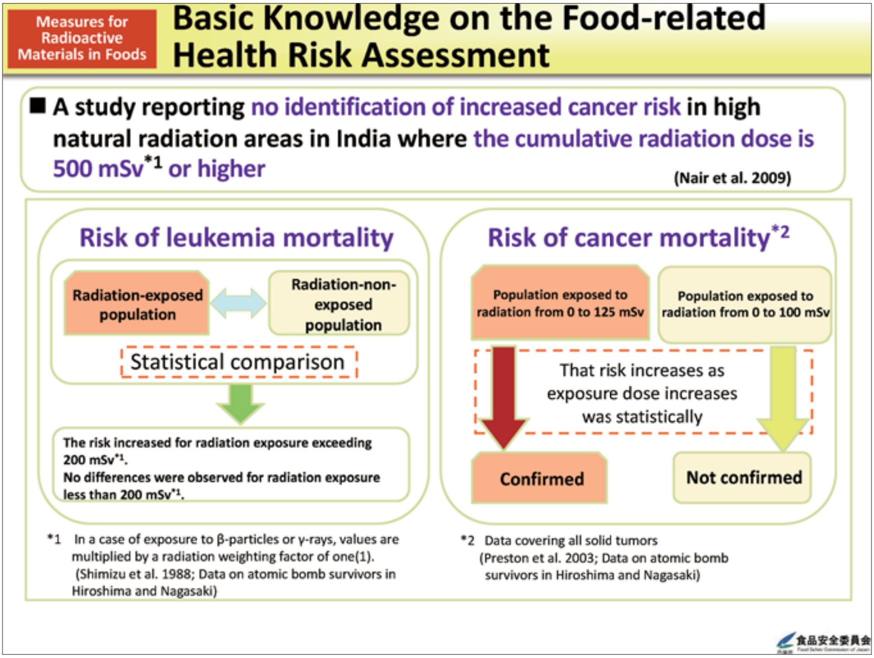
Based on currently available scientific knowledge, the FSCJ discussed additional radiation exposure through contaminated food consumption, and concluded that health effects could be found when the lifetime additional effective dose exceeds around 100 mSv, excluding radiation exposure from everyday life.

Although there are some unclear points in the estimation of radiation doses, etc., on the basis of findings of health effects after the Chernobyl NPS Accident concerning risks of thyroid gland cancer and leukemia, it is likely that the susceptibility to radiation is higher in childhood than in adulthood (p.115 of Vol. 1, "Difference in Radiosensitivity by Age").

On the other hand, if any health effects may occur by exposure to radiation below 100 mSv, it would be very small. As effects of radiation and effects caused by other factors are unlikely to be clearly distinguished and the epidemiological data, due to the small study population, is insufficient to prove the health effects of additional exposure, such as a causal association with cancer, the FSCJ has concluded that it is difficult to identify health effects from the extra cumulative exposure to radiation doses below 100 mSv.

The lifetime additional effective cumulative dose of "around 100 mSv" is not a threshold meaning that radiation exposure below this level causes no health effects nor that radiation exposure above this level surely causes health effects. This is the dose value which risk management organizations should consider for appropriate management of foods.
(Related to p.100 of Vol. 1, "Risks of Cancer Death from Low-Dose Exposure")

Included in this reference material on March 31, 2013



This figure shows epidemiological data on which the Food-related Health Risk Assessment was based.

There was a study report that the increased cancer risk by radiation was not observed among persons exposed to radiation exceeding 500 mSv in total in areas in India where natural radiation doses are high (p.124 of Vol. 1, "Effects of Long-Term Low-Dose Exposure").

The data on atomic bomb survivors in Hiroshima and Nagasaki shows that the risk of leukemia mortality increased for the population exposed to radiation exceeding 200 mSv but that there was no statistically significant difference in the mortality risk between the populations exposed to radiation less than 200 mSv and not exposed to radiation (p.119 of Vol. 1, "Risks of Developing Leukemia").

Another report which analyzed the same data of atomic bomb survivors shows that for the population exposed to radiation from 0 to 125 mSv, it was statistically confirmed that the risk of cancer mortality increases as the exposure dose increases. However, for the population exposed to radiation from 0 to 100 mSv, no statistically significant difference was observed between radiation doses and the mortality risk. Based on these data, the result of the Food-related Health Risk Assessment was derived.

Included in this reference material on March 31, 2013

Measures for Radioactive Materials in Foods

Approach for the Establishment of the Standard Limits ◆ Grounds for the Standard Limits

Q. Why were the standard limits set based on the annual permissible dose of 1 mSv?

A. (i) They are in line with the international indicator based on scientific knowledge.

The Codex Alimentarius Commission, which establishes international specifications for foods, has set indicators so that the annual dose does not exceed 1 mSv.

Note) The International Commission on Radiological Protection (ICRP) considers that stricter requirements below 1 mSv/year would not achieve any significant additional dose reduction. Therefore, based on this, the Codex Alimentarius Commission specifies indicators.

(ii) They are intended to reduce radiation exposure as low as reasonably achievable.

Radiation monitoring surveys have shown considerable decreases over time in radioactivity concentrations measured in foods.

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

The standard limits concerning radioactive materials in foods were set based on the annual permissible dose of 1 mSv, which is adopted as an indicator by the Codex Alimentarius Commission, which establishes international specifications for foods. Originally, the International Commission on Radiological Protection (ICRP) publicized the idea that stricter requirements below 1 mSv/year would not achieve any significant additional dose reduction. Based on this idea, the Codex Alimentarius Commission specifies indicators.

Additionally, the standard limits are based on the principle of ALARA (As Low As Reasonably Achievable) (p.169 of Vol. 1, "Optimization of Radiological Protection"). Radiation monitoring surveys have shown considerable decreases in radioactivity concentrations measured in many of the food samples. Therefore, it was found that the reduction of the standard limit for radioactive cesium concentrations in general foods to 100 Bq/kg would not cause any problem for the dietary patterns of the Japanese people. (Related to p.57 of Vol. 2, "Approach for the Calculation of the Standard Limits (1/2)")

Included in this reference material on March 31, 2013

Updated on March 31, 2019

Measures for Radioactive Materials in Foods

Radionuclides Taken into Consideration

Q. Why are the standard limits set only for radioactive cesium?

○ The standard limits were set in consideration of all radionuclides whose half-life is one year or longer out of the radionuclides that are supposed to have been released due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS based on the assessment by the Nuclear and Industrial Safety Agency.

Regulated radionuclides	(Physical) half-life
Cesium 134	2.1 years
Cesium 137	30 years
Strontium 90	29 years
Plutonium	14 years -
Ruthenium 106	374 days

* The standard limits are not set for radioactive iodine, which has a half-life as short as 8 days and is no longer detected, nor for uranium that exists within the premises of TEPCO's Fukushima Daiichi NPS at the same level as naturally occurring uranium.

○ However, as measurements of radionuclides other than radioactive cesium take time, the standard limits are not set for each of them but are calculated and set so that the total dose from other radionuclides does not exceed 1 mSv if only the standard limits for radioactive cesium are met.

* The maximum doses from radionuclides other than radioactive cesium that people may receive from foods can be calculated by age group based on such data as radioactivity concentrations in soil and easiness of transition of radioactive materials from soil to agricultural products. For example, for people aged 19 years or over, doses from radionuclides other than radioactive cesium account for approx. 12% of the total.

A. While also taking into consideration effects of other radionuclides in calculation, cesium that accounts for the largest percentage and is most easily measured is used as the indicator.

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

This figure shows the grounds why the standard limits are set only for radioactive cesium out of diverse radioactive materials.

All radionuclides whose half-life is one year or longer are taken into consideration, out of the radionuclides that are supposed to have been released due to the accident at TEPCO's Fukushima Daiichi NPS. Radionuclides shown in the table above, such as strontium 90, plutonium, and ruthenium 106, are taken into account in calculation, in addition to radioactive cesium. However, as the standard limits are intended for long-term regulations of radioactive materials in foods, only radionuclides with a relatively long half-life whose long-term influence needs to be taken into account are covered. For example, the standard limits are not set for radioactive iodine. Even if measurements are conducted for these other radionuclides by setting specific standard limits for each of them, it takes time to obtain measurement results. On the other hand, it is easy to measure radioactive cesium. Therefore, the standard limits are calculated and set so that the total dose from other radionuclides does not exceed 1 mSv if only the standard limits for radioactive cesium are met.

Specifically, effects of the radionuclides shown in the table above, such as radioactive cesium, strontium 90 and plutonium, were ascertained through surveys of soil, etc. For example, assuming the entirety of the effects caused by the consumption of foods containing radioactive materials released from TEPCO's Fukushima Daiichi NPS as 100, the effects of radioactive cesium account for around 88 in the case of people aged 19 years or over. On the other hand, the effects of the other radionuclides were found to account for around 12. In this manner, the standard limits were established also taking into consideration the effects of radionuclides other than radioactive cesium.

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Updated on March 31, 2019

Measures for Radioactive Materials in Foods

Approach for the Calculation of the Standard Limits (1/2)

How was the standard limit for radioactive cesium concentration in general foods figured out to be 100 Bq/kg based on the annual permissible dose of 1 mSv?

1. Preconditions for calculation

- **For drinking water, the standard limit is set to be 10 Bq/kg in line with the WHO's guidance level.**
  → The annual permissible dose allocated to general foods is approx. 0.9 mSv (0.88 to 0.92 mSv/y), which is obtained by subtracting that for drinking water (approx. 0.1 mSv/y) from the total annual permissible dose of 1 mSv.
- **Domestically-produced foods are assumed to account for 50% of all distributed foods.**
  * The standard limits are calculated on the assumption that domestically-produced foods contain radioactive materials at levels close to the maximum permissible limit.

2. Conversion from radioactivity concentrations (Bq) to radiation doses (mSv)

Radiation dose (mSv) = Radioactivity concentration (Bq/kg) × Amount of consumption (kg) × Effective dose coefficient (mSv/Bq)

Under the preconditions mentioned in 1. above, the maximum limit for radioactive materials in 1 kg of general foods is calculated so that doses from general foods do not exceed the annual permissible dose for general foods.

(e.g.) < In the case of males aged between 13 and 18 >

0.88 mSv = X (Bq/kg) × 374 kg (50% of the annual consumption of foods) × 0.0000181 (mSv/Bq) (effective dose coefficient in consideration of the effects of all covered radionuclides)

X = 120 (Bq/kg) (rounded off to three digits)

* For adults, the effective dose coefficient for Cs-134 is 0.000019 and that for Cs-137 is 0.000013. The effective dose coefficient thus differs by radionuclide. Therefore, based on respective radionuclides' concentration ratios in foods, the effective dose coefficient in consideration of the effects of all covered radionuclides was used for the calculation of the maximum limits.
* Concentration ratios change over time as each radionuclide has a different half-life. Therefore, the coefficient on the safest side over the coming 100 years was adopted.
* The above explanation is just the outline. For more detailed calculation methods, refer to the reference material of the Pharmaceutical Affairs and Food Sanitation Council.

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

This figure shows the approach for the calculation of the standard limits, explaining the relation between the annual dose limit (1 mSv) and the standard limit for radioactive cesium concentration in general foods (100 Bq/kg).

First, the annual permissible dose of 0.88 to 0.92 mSv is allocated to general foods by subtracting approx. 0.1 mSv permitted for drinking water from the total annual permissible dose of 1 mSv. Next, in consideration of the status of food self-sufficiency in Japan, it is assumed that 50% of all distributed foods (all of the domestically-produced foods) contains radioactive materials. Based on that assumption, in the case of males aged between 13 and 18, 374 kg of foods or 50% of the total annual consumption per person (approx. 748 kg) is supposed to be domestically produced. Additionally, the effective dose coefficient in consideration of the effects of all covered radionuclides (0.0000181 mSv/Bq) is to be used for calculation.

Then, the calculation formula is as follows.

0.88 mSv = (Radioactivity concentration: Bq/kg) × 374 kg × 0.0000181 (mSv/Bq)

(Radioactivity concentration: Bq/kg) = 120 Bq/kg

If concentrations of radioactive materials in general foods do not exceed 120 Bq/kg, the annual dose will remain within 0.88 mSv.

Therefore, the standard limit for general foods (100 Bq/kg), which is lower than 120 Bq/kg, is the value set on the safe side to guarantee safety.

(Related to p.51 of Vol. 2, "Standard Limits Applied from April 2012," and p.58 of Vol. 2, "Approach for the Calculation of the Standard Limits (2/2)")

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Measures for Radioactive Materials in Foods

Approach for the Calculation of the Standard Limits (2/2)

3. Calculation of the upper limits by age group

Intervention level: 1 mSv/y

Age groups are divided more finely than for the provisional regulation values

Subtract permissible dose for drinking water (approx. 0.1 mSv)

Permissible dose to be allocated to general foods (approx. 0.9 mSv) determined

The upper limit is calculated in consideration of the amount of consumption and the conversion factor (effective dose coefficient) by age group.

* Effects of radionuclides other than cesium are also taken into account.

Age group	Gender	Upper limit (Bq/kg)
Under 1 year old	Total average	460
1 to 6 years old	Male	310
	Female	320
7 to 12 years old	Male	190
	Female	210
13 to 18 years old	Male	120
	Female	150
19 years old or older	Male	130
	Female	160
Pregnant women	Female	160
Minimum value		120

Standard limit 100 Bq/kg

The standard limit is set based on the strictest upper limit (the minimum value) out of those for all age groups.
- **The standard limit results in reflecting requirements for all age groups.**
- **The standard limit secures an extra margin of safety from the upper limit especially for infants.**

4. Standard limits for milk and infant foods

These categories are established in consideration of young children. Therefore, the standard limits should be stricter so that consumption of these foods would not cause any harmful effects even if all of them contain radioactive materials up to the upper limits.
→**The standard limits for milk and infant foods are both set to be 50 Bq/kg**, namely half of the 100 Bq/kg for general foods.

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

The basic approach to set the standard limits is to figure out dose limits for each age group.

The annual permissible dose allocated to general foods is approx. 0.9 mSv/year, subtracting that for drinking water from the total.

The table above shows the upper limits for radioactive cesium concentrations (Bq/kg) by age group, which were derived based on the annual consumption and the committed effective dose coefficients for each age group. These limits also take into consideration the influence of radionuclides other than radioactive cesium (p.56 of Vol. 2, "Radionuclides Taken into Consideration").

As a result, the upper limit set for males aged between 13 and 18, 120 Bq/kg, was the strictest of all age groups.

To further ensure safety for all age groups, the standard limit was set at 100 Bq/kg, below the highest upper limit of 120 Bq/kg.

To further ensure the safety of children, the standard limit for milk and infant foods was set to be 50 Bq/kg, which is half of that for general foods. This limit was set so that no negative influence appears, even assuming that milk and all infant foods contain radioactive materials up to the maximum permissible limit.

(Related to p.51 of Vol. 2, "Standard Limits Applied from April 2012," and p.57 of Vol. 2, "Approach for the Calculation of the Standard Limits (1/2)")

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Measures for Radioactive Materials in Foods

Approach for Applying Standard Limits for Drinks and Dried Foods [Reference]

Food category	Standard limits for radioactive materials
Drinks	
Green tea and blend tea partially containing green tea	10 Bq/kg The standard limit for drinking water is applied.
Green tea, etc. with sugar, *matcha* tea, flavoring, vitamin C, etc.	
Barley tea	100 Bq/kg The standard limit for general foods is applied to barley as ingredient.
Tea other than green tea and barley tea, such as black tea, oolong tea, herbal tea, du zhong tea, and houttuynia cordata tea; and coffee.	100 Bq/kg The standard limit for general foods is applied to the products in drinkable form.
Products falling under milk (cow milk, low-fat milk, processed milk, etc.) and milk drinks specified in the Ministerial Order on Milk and Milk Products Concerning Compositional Standards, etc.(Order of the Ministry of Health and Welfare No. 52 of 1951)	50 Bq/kg The standard limit for milk is applied.
Matcha tea and other powdered tea (tea made by grinding tea leaves)	100 Bq/kg The standard limit for general foods is applied to the products in powder form.
Powdered drinks that are served in diluted form	100 Bq/kg The standard limit for general foods is applied to the final products.
Bottled drinks containing *matcha* tea but not containing green tea extract	
Dried foods	
Concentrated foods, including condensed soups, sauces, and dips	100 Bq/kg The standard limit for general foods is applied to the final products.
Dried foods including freeze-dried foods, powdered soups, and instant miso soups	

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" (in Japanese)

厚生労働省

The table shows part of the standard limits for radioactive materials applied to drinks, condensed foods, and dried foods such as powdered soups that are served by dissolving them in cold or hot water. The details of each category are as follows.

• Green tea: Non-fermented tea that is made from leaves of tea plants, including *sencha* (ordinary green tea) and its equivalents—*gyokuro* (refined green tea), roasted green tea, brown rice tea (green tea with roasted brown rice)

• *Matcha* tea and other powdered tea (tea made by grinding tea leaves): This type of tea is ingested in powder form, not as liquid tea obtained by brewing tea leaves and is used as an ingredient for foods like ice cream. Therefore, the standard limit for general foods is applied to this type of tea in powder form.

• Dried foods: For some dried foods, the standard limit for general foods is applied to foods both in dried form and in edible form (reconstituted form). "Dried foods" refers to dried mushrooms, vegetables, and seafood, including sea weeds.

• Dried mushrooms: Dried mushrooms listed in the Japan Standard Commodity Classification (JSCC), including *shiitake* mushrooms (*Lentinula edodes*), and *kikurage* mushrooms (*Auricularia polytricha*).

• Dried vegetables: Dried vegetables listed in the JSCC, including gourd shavings, Japanese radish, fiddleheads (*Osmunda japonica*), brackens (*Pteridium aquilinum*), and taro stems. Products in flake form and in powder form are excluded.

• Dried seaweeds: Processed seaweeds listed in the JSCC, including dried kelp, dried *wakame* (*Undaria pinnatifida*) products, dried *hijiki* (*Sargassum fusiforme*), dried *arame* (*Eisenia bicyclis*), agar.

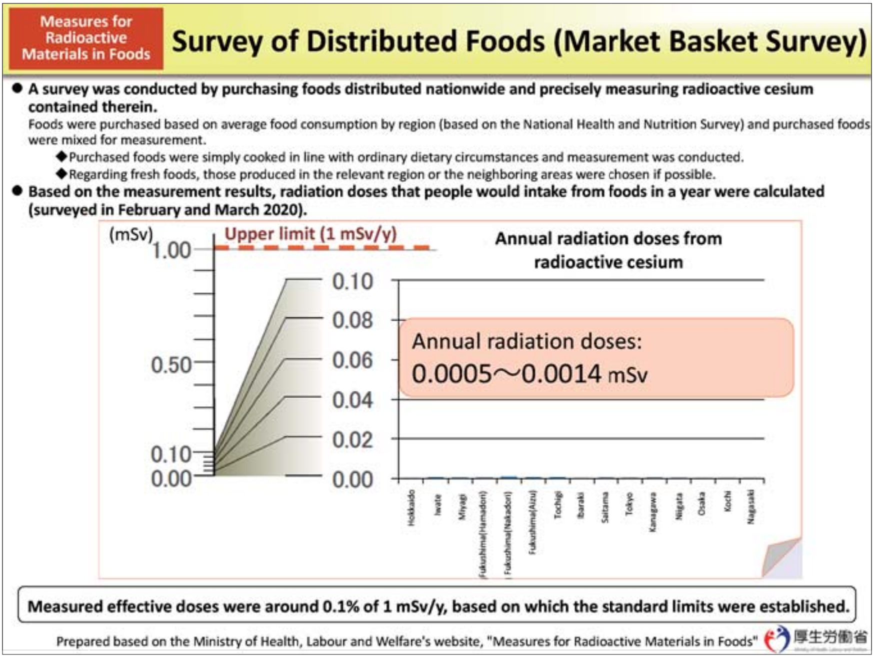
• Dried seafoods: Open-air dried seafoods listed in the JSCC, including fully dried herring fillets, cod fillets, and shark fins; as well as dried boiled-seafoods listed in the JSCC, including abalone and sea cucumbers.

• Dried shiitake mushrooms: Basically, tests are conducted using ground samples to which an adequate amount of water is added. The amount of added water is based on the data (weight change rate)— made public in the Standard Tables of Food Composition in Japan—of the water taken into dried mushrooms as the result of reconstitution. As water used for reconstitution is often used as soup stock in Japan, the amount of radioactive materials migrating from dried mushrooms into the water needs to be determined. This method is equivalent to the testing being conducted by considering the amount of radioactive materials migrating from the samples into the water.

• Concentrated fruit juice: For fruit juice that is distributed in concentrated form for the purpose of transportation and that is surely reprocessed into diluted form at processing facilities before being sold for unspecified persons, the standard limit is basically applied to the products obtained by being diluted to the state of original fruit juice, based on the concentration factor. This is because such concentrated fruit juice is unlikely to be served for human consumption as is.

These standard limits are compiled in the "Q&As on the Setting of Standard Limits for Radioactive Materials in Foods" by the Ministry of Health, Labour and Welfare. (in Japanese)

Included in this reference material on March 31, 2019



Since FY2011, the amount of radioactive materials contained in the average diet has been surveyed using the market basket method.

From February to March 2020, the Ministry of Health, Labour and Welfare conducted a survey by purchasing distributed foods in 15 areas across Japan and measuring radioactive cesium contained therein to estimate annual radiation doses received from radioactive cesium in foods.

Annual radiation doses received from radioactive cesium in foods were estimated to be 0.0005 to 0.0014 mSv, being around 0.1% of the annual permissible dose of 1 mSv/y, based on which the current standard limits were established. Thus, annual radiation doses received from foods were confirmed to be extremely small.

Market basket survey:

One of the survey methods for estimating daily consumption of various chemical substances

Source

• Ministry of Health, Labour and Welfare's website (https://www.mhlw.go.jp/shinsai_jouhou/market_basket.html, in Japanese)

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Measures for Radioactive Materials in Foods

Prefectures and Food Items to be Inspected (Items for which Cultivation/Feeding Management is Difficult and Log-grown Mushrooms)

Food items for which cultivation/feeding management is difficult and relevant prefectures to be inspected

		Aomori	Iwate	Akita	Miyagi	Yamagata	Fukushima	Ibaraki	Tochigi	Gunma	Chiba	Saitama	Tokyo	Kanagawa	Niigata	Yamanashi	Nagano	Shizuoka
Items with radioactivity concentrations exceeding the standard limits	Wild mushrooms and wild plants	□	◎	□	◎	●	◎	◎	●	◎	□	□	□	□	◎	◎	◎	◎
	Wild bird and animal meat	□	◎	□	◎	◎	◎	□	◎	◎	□	□	□	□	●	□	□	□
Items with radioactivity concentrations exceeding half of the standard limits but not exceeding the standard limits	Wild mushrooms and wild plants	□	□	●	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Marine fish		–	–	–	–	–	–	–	×	×	–	×	–	–	–	×	×	–
Inland water fish		–	□	–	□	–	◎	□	◎	◎	◎	–	–	–	–	–	–	–

Log-grown mushrooms to be inspected and relevant prefectures to be inspected

	Aomori	Iwate	Akita	Miyagi	Yamagata	Fukushima	Ibaraki	Tochigi	Gunma	Chiba	Saitama	Tokyo	Kanagawa	Niigata	Yamanashi	Nagano	Shizuoka
Log-grown mushrooms	▲	●	▲	▲	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	●

Classification based on inspection results for the latest one year (from April 1, 2019, to February 29, 2020)

◎: Items wherein radioactivity concentrations exceeding the standard limits were detected (for fishery products, those wherein radioactivity concentrations exceeding half of the standard limits were detected)

●: Items wherein radioactivity concentrations exceeding half of the standard limits were detected (excluding those wherein radioactivity concentrations exceeding the standard limits were detected)

□: Items requiring inspections in consideration of the difficulties in management (wild mushrooms and wild plants), the mobility (wild bird and animal meat), or the status of distribution restrictions (marine fish)

▲: Items requiring cultivation management and monitoring based on the influence of radioactive materials on materials used for production

–: Items that are not classified by relevant prefectures as those requiring inspections based on inspection results for the latest one year

×: Nothing applicable

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

In FY2016, more than five years after the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, radioactivity concentrations had decreased as a whole and food items with radioactivity concentrations exceeding the standard limits had become limited. Therefore, the national government reviewed and made inspection methods more reasonable and efficient, centered on items whose cultivation/feeding is manageable.

Thereafter, as inspection results had been accumulated, the approach for deciding prefectures and items to be inspected and lifting distribution restrictions has been reviewed every year and inspection targets are as shown in the table above as of FY2020.

With regard to items for which cultivation/feeding management is difficult, prefectures where inspections need to be continued are specified for each item in consideration of the difficulties in management therefor.

With regard to log-grown mushrooms, prefectures where inspections need to be continued are also specified considering the influence of radioactive materials on materials used for production.

Included in this reference material on February 28, 2018
Updated on March 31, 2021

Measures for Radioactive Materials in Foods

Prefectures and Food Items to be Inspected (Items whose Cultivation/Feeding is Manageable (excl. Log-grown Mushrooms))

Food items whose cultivation/feeding is manageable (excl. log-grown mushrooms) and relevant prefectures to be inspected

		Fukushima
Items with radioactivity concentrations exceeding half of the standard limits but not exceeding the standard limits	Vegetables	●
	Fruits	●
Rice		■

* Out of items requiring continued monitoring as being significantly affected by feeding management, milk is inspected in Fukushima Prefecture and beef is inspected in Iwate, Miyagi, Fukushima and Tochigi Prefectures.

Classification based on inspection results for the latest one year (from April 1, 2019, to February 29, 2020)
○ : Items wherein radioactivity concentrations exceeding the standard limits (for fishery products, half of the standard limits) were detected
● : Items wherein radioactivity concentrations exceeding half of the standard limits were detected (excluding those wherein radioactivity concentrations exceeding the standard limits were detected)
■ : Food items designated as inspection targets in the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies (March 23, 2020)" (Nuclear Emergency Response Headquarters)
− : Items that are not classified by relevant prefectures as those requiring inspections based on inspection results for the latest one year

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

With regard to items whose cultivation/feeding is manageable (excluding log-grown mushrooms), prefectures where inspections need to be continued are specified for each item based on inspection results for the latest three years, such as prefectures where items with radioactive cesium exceeding half of the standard limits were detected.

In other prefectures, inspections are to be conducted as needed.

Included in this reference material on February 28, 2018
Updated on March 31, 2021

Measures for Radioactive Materials in Foods

Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies

	Local governments marked with ◎ and ● (those marked with ■ and ▲ should conduct inspections correspondingly)	
	Municipalities (exceeding half of the standard limits)	Other municipalities
Exceeding half of the standard limits	3 or more samples	1 or more samples*1
Beef meat	Once every three months for each farm household*2	
Milk	Periodically for each cooler station*3	
Inland water fish Marine fish	Periodically*4	

*1: It is permissible to divide a prefecture into multiple zones across municipalities and conduct inspections for three or more samples in each of those zones.
*2: For farm households whose feeding management has been recognized as appropriate by the relevant local government, it would suffice to conduct inspections once every 12 months or so.
However, inspections may be omitted for cattle (i) being fed by farm households where radioactive cesium has not been detected at levels exceeding half of the standard limits for the last three years, (ii) being fed only with imported feed or feed produced in fields other than those subject to voluntary suspension of distribution and use of feed, and (iii) for which the relevant prefectural government confirms that measures are being taken to prevent use of any feed produced in fields subject to voluntary suspension of distribution and use of feed and finds that inspections are not necessary.
*3: This does not apply to cooler stations, etc. (i) where the relevant local government recognizes appropriate feeding management, (ii) where what is handled is only raw milk produced in areas whose distribution restrictions were lifted more than three years ago, and (iii) where inspection results for the latest three years are all below half of the standard limits.

Classification based on the inspection results for the last one year (from April 1, 2019 to February 29, 2020)
◎ : Local governments whose inspections detected radioactive cesium concentrations exceeding the standard limits (exceeding half of the standard limits for fishery products)
● : Local governments whose inspections detected radioactive cesium concentrations exceeding half of the standard limits (excluding those categorized above)
▲ : Local governments requiring cultivation management and monitoring based on the status of the influence of radioactive materials on materials used for production
■ : Local governments designated as inspection targets in the Attachment to the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies" (March 23, 2020, Nuclear Emergency Response Headquarters)

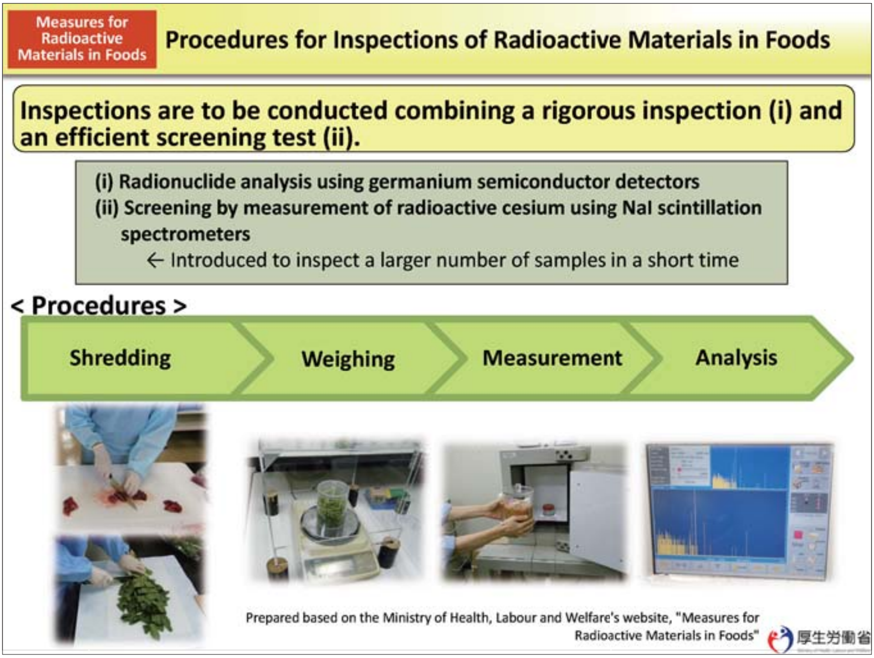
Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods" 厚生労働省

This table shows the required number of samples and frequencies of inspections for local governments whose inspections detected radioactive cesium concentrations exceeding the standard limits (those marked with ◎) and local governments whose inspections detected radioactive cesium concentrations exceeding half of the standard limits (those marked with ●).

The "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies" (March 23, 2020) by the Nuclear Emergency Response Headquarters specifies as follows.

• Regarding local governments that have detected radioactive cesium concentrations exceeding half of the standard limits in any food under this food classification since April 2019, inspections should be conducted for three or more samples for each municipality in the areas where radioactive cesium concentrations exceeding half of the standard limits were detected, and for one or more samples for each municipality in other areas (it is permissible to divide a prefecture into multiple zones across municipalities and conduct inspections for three or more samples in each of those zones) (marked with ◎ and ◯ in the table).

Included in this reference material on March 31, 2013
Updated on March 31, 2021



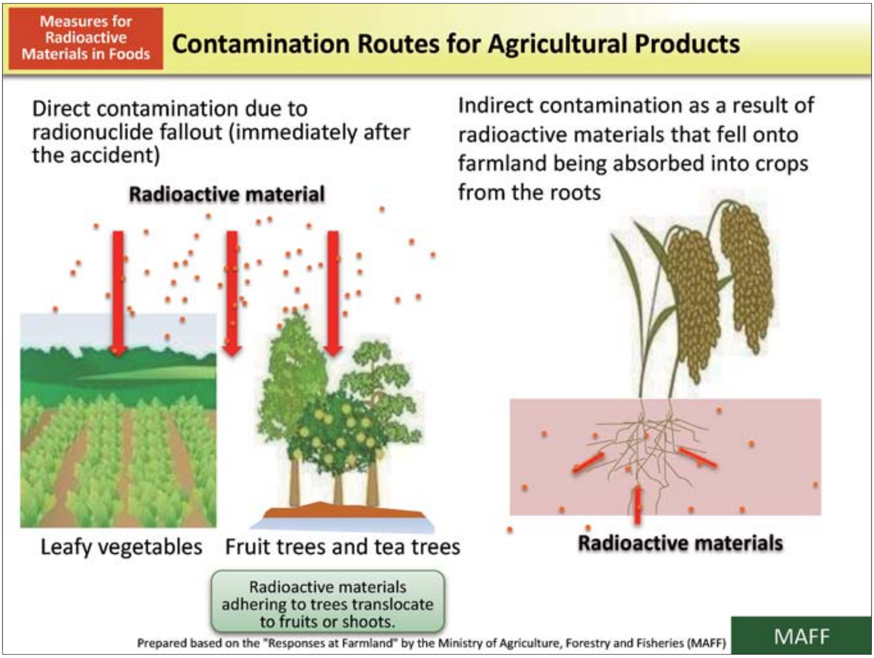
This figure shows procedures for inspections of radioactive materials in foods.

There are two ways to inspect foods, i.e., a rigorous inspection and an efficient screening test.

As a rigorous inspection, radionuclide analysis is conducted using a germanium semiconductor detector. After shredding a food sample, its weight is measured accurately. Then, the shredded sample is put in a prescribed container. The container is set in a detector, which is structured like a box covered with a thick layer of lead, and the amount of radioactive cesium is measured. Lastly, measurement results are analyzed.

For an efficient screening test, a NaI (Tl) scintillation spectrometer is used. A NaI scintillation spectrometer is inferior to a germanium semiconductor detector in terms of measurement accuracy, but can shorten the time required for inspections and is less expensive. If the measurement using a NaI scintillation spectrometer suggests the existence of radioactive cesium exceeding the standard limits, an inspection is conducted again using a germanium semiconductor detector.

Included in this reference material on March 31, 2013
Updated on March 31, 2017



Contamination routes due to radioactive fallout are roughly divided into three.

(i) The figure on the left shows the route of how radioactive fallout directly adheres to crops. High radioactivity concentrations were often detected in leafy vegetables that were grown in the fields at the time of the accident. This is considered to be due to direct contamination.

(ii) The figure in the center shows the route of how radioactive materials that adhered to fruit trees and tea trees immediately after the accident penetrate into trees and translocate*1 to fruits and tea shoots.

(iii) The figure on the right shows the route of how radioactive materials that fell onto soil are absorbed into crops from the roots. Contamination of crops planted after the accident is considered to have followed this route.

(Related to p.179 of Vol. 1, "Transfer to Plants")

*1: Phenomenon wherein nutrients absorbed in a plant or metabolites produced by photosynthesis are transported from one tissue to another tissue

Included in this reference material on March 31, 2013

Updated on March 31, 2019

Measures for Radioactive Materials in Foods

Measures for Reducing Transfer of Radioactive Materials to Crops (1/5) - Decontamination of Farmland -

Stripping of topsoil (Topsoil removal)

Scrape away the topsoil to remove radioactive materials which remain in shallow depth

Inversion tillage

Replace topsoil with subsoil, thereby reducing radioactivity concentrations in the soil layer where plants take root

Prepared based on the "Responses at Farmland" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

MAFF

Radioactive materials that were released into the air and fell onto uncultivated farmland stay on topsoil.

Therefore, at farmland where high radioactivity concentrations are detected, the topsoil is scraped away to remove radioactive materials which remain in shallow depth.

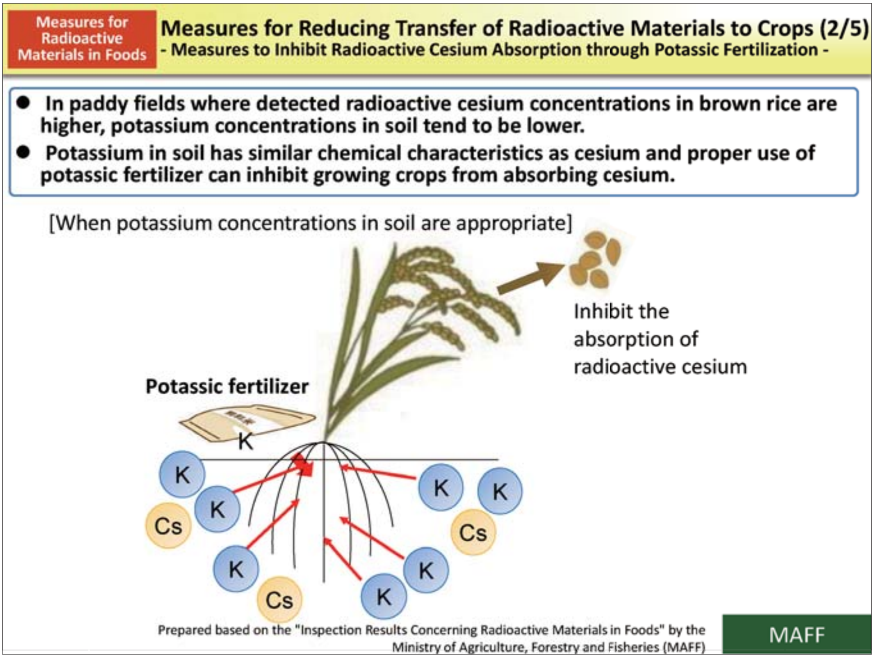
In the meantime, at farmland where detected radioactivity concentrations are relatively low, topsoil is replaced with subsoil (inversion tillage) to reduce radioactivity concentrations in the soil layer where plants take root.

In this manner, efforts have been made to reduce radiation doses released from farmland and inhibit growing crops from absorbing radioactive materials.

(Related to p.180 of Vol. 1, "Distribution of Radioactive Cesium in Soil")

Included in this reference material on March 31, 2013

Updated on March 31, 2017



It is known that crops, such as rice, absorb more radioactive cesium when potassium concentrations in soil are lower.

Potassium and cesium have similar chemical characteristics, and when the soil contains sufficient potassium, less cesium is absorbed into crops. This is because a passage (transporter) on the root surface that lets some potassium through also lets cesium through. Recently, there is also a research report concerning rice plants that do not have such passage (unlikely to absorb cesium).

Therefore, at farmland where potassium concentrations in soil are low, a sufficient amount of potassic fertilizer is applied to increase potassium concentrations above a certain level to inhibit absorption of radioactive cesium into crops.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

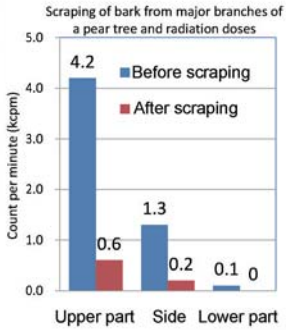
Measures for Radioactive Materials in Foods

Measures for Reducing Transfer of Radioactive Materials to Crops (3/5)
- Washing of Fruit Trees and Removal of Bark -

Wash off radioactive cesium adhering to trees with high-pressure water and scrape away bark to reduce radioactive cesium concentrations

High-pressure washing of a persimmon tree

Scraping of bark from a pear tree



Prepared based on the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

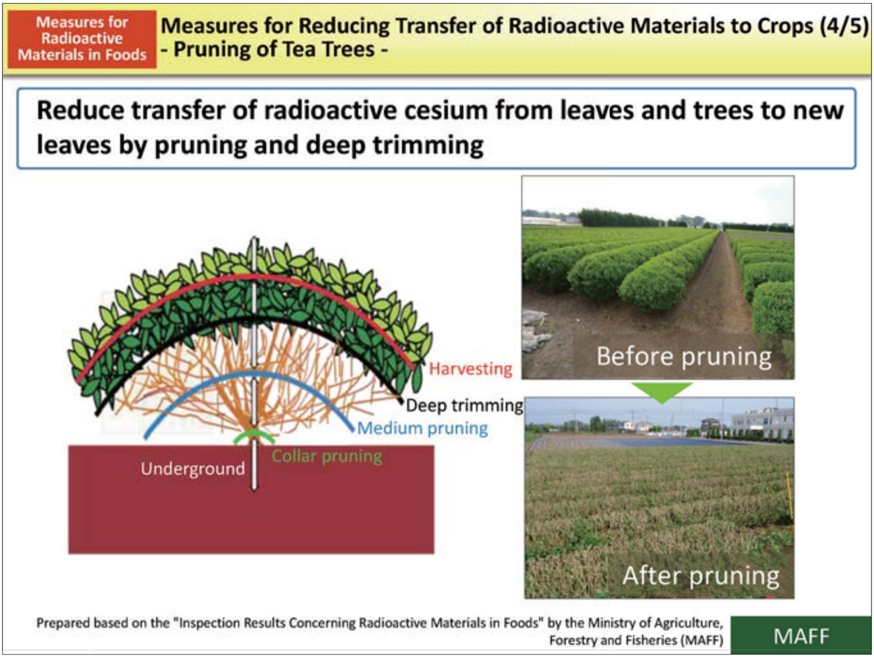
MAFF

In order to prevent translocation of radioactive materials from fruit trees to fruits, trees are washed with high-pressure water and bark is scraped off from trees to remove adhering radioactive materials.

In the case of pear trees, there is data that radiation doses from major branches are reduced by nearly 90% by scraping off the bark.

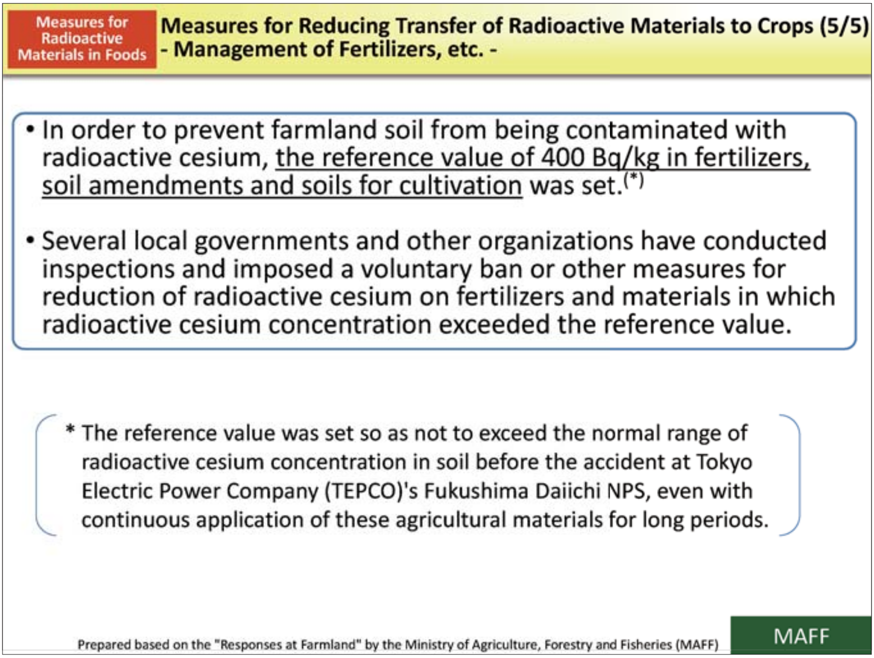
(Related to p.179 of Vol. 1, "Transfer to Plants")

Included in this reference material on March 31, 2013
Updated on March 31, 2017



In the case of tea trees, in order to prevent transfer of radioactive materials from the surface of leaves to new leaves, leaves and branches are trimmed or pruned deeper than usual to remove contaminated parts.
(Related to p.179 of Vol. 1, "Transfer to Plants")

Included in this reference material on March 31, 2013
Updated on March 31, 2017



Regarding materials used for agricultural production, such as fertilizers, soil amendments and soils for cultivation, the reference value for radioactive cesium of 400 Bq/kg was set in order to prevent expansion of contamination of farmland soil by the use of contaminated materials.

Several local governments and other organizations have monitored radioactive cesium concentration in these materials, and provide guidance to ensure that materials containing radioactive cesium exceeding the reference value should not be used at farmland.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Rice

Changes in Inspection Results for Rice (Incl. Inspection of All Rice Bags)

Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
Harvested in 2011	26,464	592	2.2%
Harvested in 2012	Approx.10.37 million	84	0.0008%
Harvested in 2013	Approx.11.04 million	28	0.0003%
Harvested in 2014	Approx.11.02 million	2	0.00002%
Harvested in 2015	Approx.10.50 million	0	0%
Harvested in 2016	Approx.10.27 million	0	0%
Harvested in 2017	Approx.9.98 million	0	0%
Harvested in 2018	Approx.9.25 million	0	0%
Harvested in 2019	Approx.9.49 million	0	0%
Harvested in 2020 (as of the end of December)	Approx.0.3 million	0	0%

* Coverage: 17 prefectures including the Tokyo Metropolis designated as inspection targets in the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies," which compiles basic approaches concerning radioactive materials in foods

Prepared based on the "Inspection Results Concerning Radioactive Cesium Concentrations in Agricultural Products" by the Ministry of Agriculture, Forestry and Fisheries and the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Health, Labour and Welfare

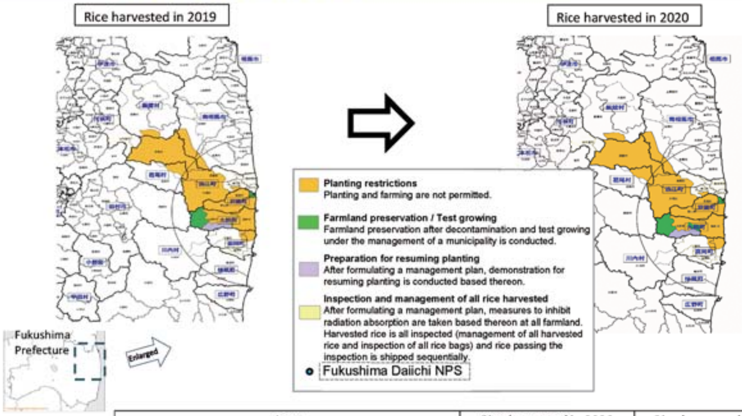
The production and distribution of rice are managed through measures to inhibit radioactive cesium absorption by the use of potassic fertilizer (p.67 of Vol. 2, "Measures for Reducing Transfer of Radioactive Materials to Crops (2/5) - Measures to Inhibit Radioactive Cesium Absorption through Potassic Fertilization -") and inspection of all bags of harvested rice. In Fukushima Prefecture, planting has been restricted and measures to inhibit radioactive cesium absorption have been taken at former Areas under Evacuation Orders and distribution of rice has been strictly controlled through inspection of all rice bags since FY2015 based on the "Policies on Planting of Rice."

Rice containing radioactive cesium at a level exceeding the standard limit decreased year by year, and there has been none since FY2015 (as of the end of December 2020). This standard limit refers to 100 Bq/kg, which has been applied since April 2012 (in FY2011, provisional regulation values were applied, but tabulation is based on the current standard for the purpose of comparison with the results in and after 2012).

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Rice

Areas Subject to Planting Restrictions for Rice to be Harvested in 2020



Area	Rice harvested in 2020	Rice harvested in 2019
Planting restriction	1,950ha	2,150ha
Farmland preservation / Test growing	300ha	100ha
Preparation for resuming planting	200ha	200ha
Inspection and management of all rice harvested	0ha	0ha
Total	2,450ha	2,450ha

Prepared based on the "Areas Subject to Planting Restrictions for Rice to be Harvested in 2020 by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

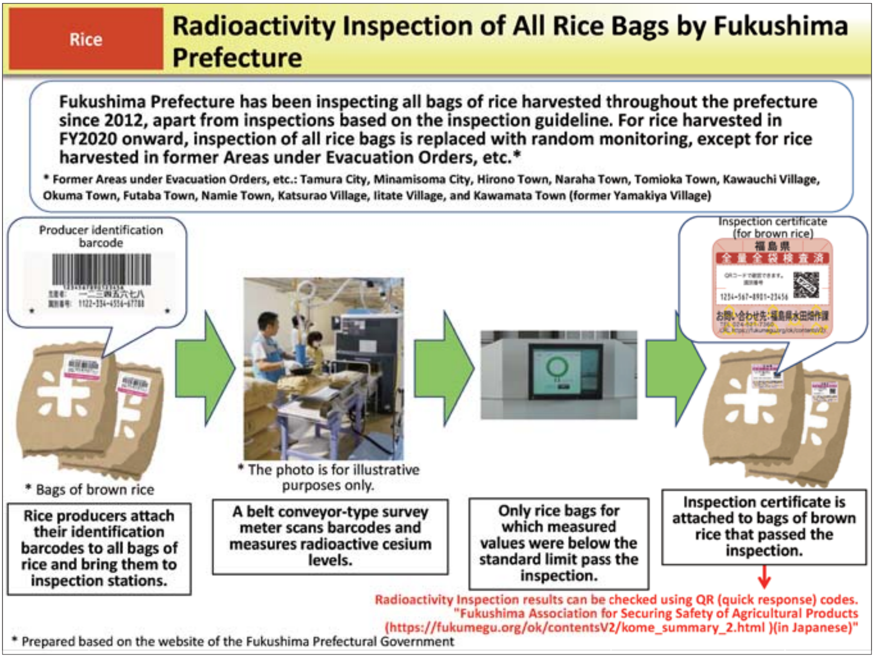
Entry and farming are restricted (planting restrictions) in Areas under Evacuation Orders. In Habitation Restricted Areas, farmland preservation after decontamination and test growing under the management of the relevant municipalities may be conducted (farmland preservation/test growing), and in Preparation Areas for Lift of Evacuation Order, demonstration for resuming planting may be conducted under a management plan formulated by the prefecture and the relevant municipalities (preparation for resuming planting).

In areas not subject to evacuation orders that were under evacuation orders in the previous year or where rice containing radioactive cesium exceeding the standard limit was detected in the previous year, the prefecture and the relevant municipalities formulate a management plan and measures to inhibit radioactive cesium absorption are taken thoroughly and all rice harvested in respective areas is managed and all bags are inspected (inspection and management of all rice harvested).

In areas where inspection and management of all rice harvested were obliged in the previous year and there was none harvested in the previous year wherein radioactive cesium exceeding the standard limit was detected, measures to inhibit radioactive cesium absorption are taken thoroughly by each farm household and all farm households are inspected (inspection and management of all farm households).

In other areas, measures to inhibit radioactive cesium absorption are taken as needed and random inspection is conducted for each area.

Included in this reference material on February 28, 2018
Updated on March 31, 2021



Since 2012, Fukushima Prefecture has been inspecting all bags of rice harvested throughout the prefecture, not limited to the areas instructed by the national government, as an initiative by the prefecture. For radioactivity inspections, belt conveyor-type survey meters are used.

For rice harvested in FY2020 onward, inspection of all rice bags is replaced with random monitoring, except for rice harvested in former Areas under Evacuation Orders*, etc.

Whether the rice has passed the inspection can be checked as follows. In the case of brown rice packed in a 30-kg paper bag that passed the inspection, an inspection certificate is attached to the paper bag.

In the case of polished rice, a polished rice label to prove that it is made from brown rice that passed the inspection is attached. However, as this label is attached on a voluntary basis, some polished rice that passed the inspection may be distributed without the label.

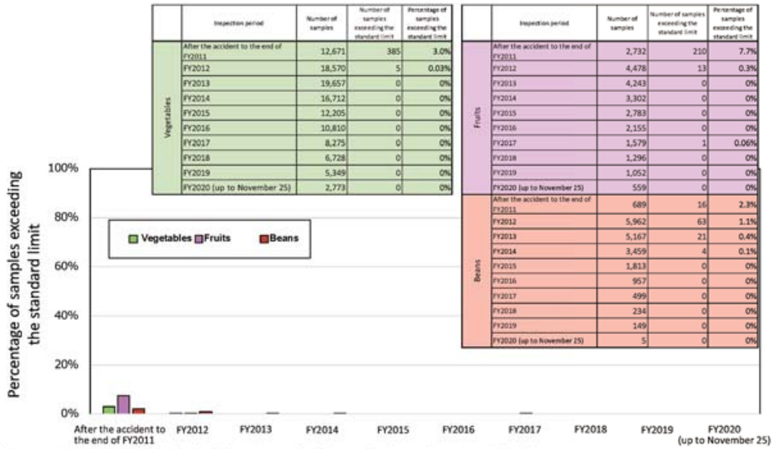
(Partially cited from the website of Fukushima Prefecture "Frequently Asked Questions about Radioactivity Inspection of All Rice Bags": http://www.pref.fukushima.lg.jp/sec/36035b/suiden-zenryozenhukurokensa-faq.html, in Japanese)

* Former Areas under Evacuation Orders, etc.: Tamura City, Minamisoma City, Hirono Town, Naraha Town, Tomioka Town, Kawauchi Village, Okuma Town, Futaba Town, Namie Town, Katsurao Village, Iitate Village, and Kawamata Town (former Yamakiya Village)

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Vegetables, Fruits and Beans

Changes in Inspection Results for Vegetables, Fruits and Beans



	Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
Vegetables	After the accident to the end of FY2011	12,671	385	3.0%
	FY2012	18,570	5	0.03%
	FY2013	19,657	0	0%
	FY2014	16,712	0	0%
	FY2015	12,205	0	0%
	FY2016	10,810	0	0%
	FY2017	8,275	0	0%
	FY2018	6,728	0	0%
	FY2019	5,349	0	0%
	FY2020 (up to November 25)	2,773	0	0%

	Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
Fruits	After the accident to the end of FY2011	2,732	210	7.7%
	FY2012	4,478	13	0.3%
	FY2013	4,243	0	0%
	FY2014	3,302	0	0%
	FY2015	2,783	0	0%
	FY2016	2,155	0	0%
	FY2017	1,579	1	0.06%
	FY2018	1,296	0	0%
	FY2019	1,052	0	0%
	FY2020 (up to November 25)	559	0	0%
Beans	After the accident to the end of FY2011	689	16	2.3%
	FY2012	5,962	63	1.1%
	FY2013	5,167	21	0.4%
	FY2014	3,459	4	0.1%
	FY2015	1,813	0	0%
	FY2016	957	0	0%
	FY2017	499	0	0%
	FY2018	234	0	0%
	FY2019	149	0	0%
	FY2020 (up to November 25)	5	0	0%

* Coverage: 17 prefectures including the Tokyo Metropolis designated as inspection targets in the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies," which compiles basic approaches concerning radioactive materials in foods

• Values for beans are those compiled based on production years.

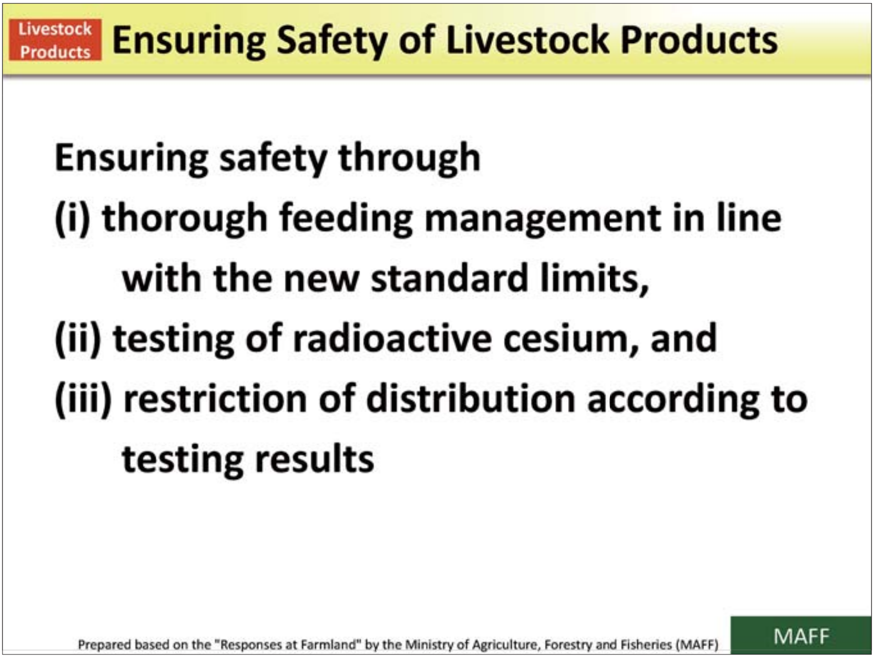
Prepared based on the "Inspection Results Concerning Radioactive Cesium Concentrations in Agricultural Products" by the Ministry of Agriculture, Forestry and Fisheries and the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Health, Labour and Welfare

Upon production and shipment of vegetables, fruits and beans, measures to inhibit radioactive cesium absorption by the use of potassic fertilizer are taken (p.67 of Vol. 2, "Measures for Reducing Transfer of Radioactive Materials to Crops (2/5) - Measures to Inhibit Radioactive Cesium Absorption through Potassic Fertilization -").

No vegetables and beans harvested in FY2015 onward have been found to contain radioactive cesium exceeding the standard limit up to October 2019.

No fruits harvested in FY2013 through to FY2016 were found to contain radioactive cesium exceeding the standard limit. There was one case where radioactive cesium exceeding the standard limit was detected among fruits harvested in FY2017, but there has been no such case for fruits harvested in FY2018 onward. This standard limit refers to 100 Bq/kg, which has been applied since April 2012 (in FY2011, provisional regulation values were applied, but tabulation is based on the current standard for the purpose of comparison with the results in and after 2012).

Included in this reference material on February 28, 2018
Updated on March 31, 2021



Measures for reducing radionuclides in livestock products include (i) thorough feeding management, such as feeding livestock with safe feed, (ii) testing of radioactive cesium before shipment, and (iii) restriction of distribution according to testing results. Through these measures, safety of livestock products has been ensured.

Included in this reference material on March 31, 2013

Livestock Products

Feed Management (1/2)

The reference values for radioactive cesium in feed were established in order to prevent distribution of any livestock products with radioactive cesium concentrations exceeding the standard limits (100 Bq/kg for general foods and 50 Bq/kg for milk).

	Reference value (Bq/kg)
Cattle	100
Pigs	80
Chickens	160
(Cultured fish	40)

Prepared based on the "Responses at Farmland" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

MAFF

The reference values were established for feed by using radioactive cesium concentration as an indicator so that radioactive concentrations of livestock products would not exceed the standard limits.

Also for feed for cultured fish, the reference value was established in the same manner.

Included in this reference material on December 1, 2015

Updated on March 31, 2019

Livestock Products

Feed Management (2/2)

1. Thorough implementation of feeding management, including feeding forage (grass, hay, etc.) whose radiation levels are below the reference values

and

2. Promotion of decontamination measures including inversion tillage in pastures where production of grass whose radiation levels are below the reference values is difficult

Prepared based on the "Responses at Farmland" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

MAFF

On farms, thorough implementation of feeding management, including feeding forage whose radiation levels are below the reference values is ensured.

In pastures, efforts to produce forage crops whose radiation levels are below the reference values by decontamination measures, including inversion tillage, are making progress (p.66 of Vol. 2, "Measures for Reducing Transfer of Radioactive Materials to Crops (1/5) - Decontamination of Farmland -").

Included in this reference material on December 1, 2015
Updated on March 31, 2017

Livestock Products

Inspections for Radioactive Cesium in Livestock Products

(i) Beef

Four prefectures (Iwate, Miyagi, Fukushima, and Tochigi) inspect beef once every three months or so for each farm household. However, for farm households whose proper feeding management was confirmed by relevant local governments, inspections are conducted once every 12 months or so.

However, inspections may be omitted for cattle (i) being fed by farm households where radioactive cesium has not been detected at levels exceeding half of the standard limits for the last three years, (ii) being fed only with imported feed or feed produced in fields other than those subject to voluntary suspension of distribution and use of feed, and (iii) for which the relevant prefectural government confirms that measures are being taken to prevent use of any feed produced in fields subject to voluntary suspension of distribution and use of feed and finds that inspections are not necessary.

(ii) Milk

Inspections are conducted periodically by Fukushima Prefecture.

This does not apply to cooler stations, etc. (i) in areas where feeding management is confirmed to be appropriate, (ii) where what is handled is only raw milk produced in areas whose distribution restrictions were lifted more than three years ago, and (iii) where inspection results for the latest three years are all below half of the standard limits.

Prepared based on the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies" (March 23, 2020) by the Nuclear Emergency Response Headquarters

MAFF

For beef, four prefectures (Iwate, Miyagi, Fukushima, and Tochigi) conduct inspections covering all relevant farm households. However, inspections are not required for farm households for which the relevant local government confirms that measures are being taken to prevent use of any feed produced in fields subject to voluntary suspension of distribution and use of feed or otherwise feeding management is being implemented appropriately.

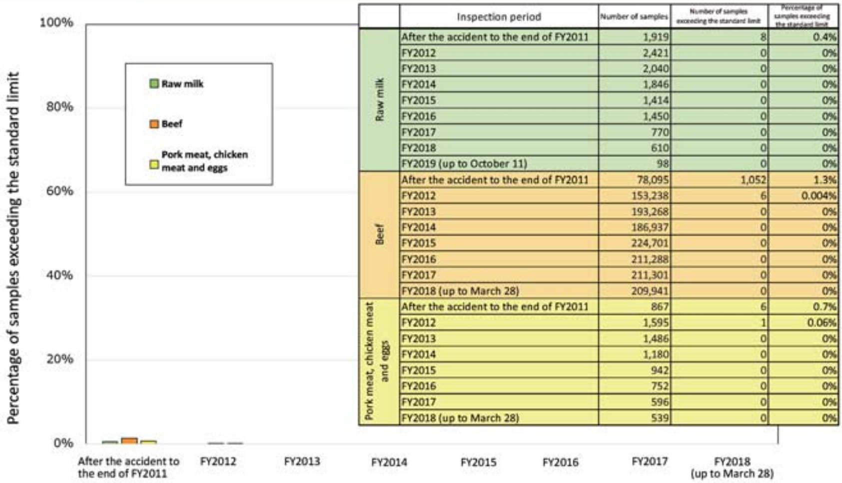
Additionally, milk is also inspected periodically by Fukushima Prefecture.

Included in this reference material on March 31, 2013

Updated on March 31, 2021

Livestock Products

Changes in Inspection Results for Livestock Products



	Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
Raw milk	After the accident to the end of FY2011	1,919	8	0.4%
	FY2012	2,421	0	0%
	FY2013	2,040	0	0%
	FY2014	1,846	0	0%
	FY2015	1,414	0	0%
	FY2016	1,450	0	0%
	FY2017	770	0	0%
	FY2018	610	0	0%
	FY2019 (up to October 11)	98	0	0%
Beef	After the accident to the end of FY2011	78,095	1,052	1.3%
	FY2012	153,238	6	0.004%
	FY2013	193,268	0	0%
	FY2014	186,937	0	0%
	FY2015	224,701	0	0%
	FY2016	211,288	0	0%
	FY2017	211,301	0	0%
	FY2018 (up to March 28)	209,941	0	0%
Pork meat, chicken meat and eggs	After the accident to the end of FY2011	867	6	0.7%
	FY2012	1,595	1	0.06%
	FY2013	1,486	0	0%
	FY2014	1,180	0	0%
	FY2015	942	0	0%
	FY2016	752	0	0%
	FY2017	596	0	0%
	FY2018 (up to March 28)	539	0	0%

* Coverage: 17 prefectures including the Tokyo Metropolis designated as inspection targets in the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies," which compiles basic approaches concerning radioactive materials in foods

Prepared based on the "Inspection Results Concerning Radioactive Cesium Concentrations in Livestock Products" by the Ministry of Agriculture, Forestry and Fisheries and the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Health, Labour and Welfare

Feed for livestock is controlled to reduce radionuclides contained therein as low as possible.

■ Reference values for radioactive cesium concentrations in feed

Feed for cattle and horses: 100 Bq/kg

Feed for pigs: 80 Bq/kg

Feed for chickens: 160 Bq/kg

Feed for cultured fish: 40 Bq/kg

Since April 2011, inspection results for raw milk have all been below the standard limit of 50 Bq/kg. Regarding beef and pork meat, radioactive cesium concentrations exceeding the standard limit of 100 Bq/kg have not been detected since FY2013. Regarding chicken meat and eggs, radioactive cesium concentrations exceeding the standard limit have never been detected. Incidentally, these standard limits are those applied since April 2012 (in FY2011, provisional regulation values were applied, but tabulation is based on the current standard for the purpose of comparison with the results in and after 2012).

Raw milk is inspected for each cooler station, while beef is inspected covering all relevant farm households once every three months or so since FY2018 in Iwate, Miyagi, Fukushima, and Tochigi Prefectures.

Included in this reference material on February 28, 2018

Updated on March 31, 2021

Mushrooms and Wild Plants

Measures to Ensure Safety of Mushrooms and Non-Wood Forest Products

- Introduce safe production materials in order to reduce radioactive contamination
- Provide information on gathering of wild plants and mushrooms

Specific measures

1. Secure safe mushroom logs
   (Support for the purchase of mushroom logs and bed logs, matching of supply and demand of mushroom logs)
2. Decontaminate mushroom logs and bed logs and introduce makeshift greenhouses, etc.
3. Disseminate cultivation management in line with the guideline and give guidance therefor
4. Disseminate cultivation technology to reduce radioactive contamination
5. Provide information using the website and pamphlets and conduct guidance tours

Prepared based on the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

MAFF

Other than wild plants and mushrooms for which cultivation management is impossible, shiitake mushrooms, etc. cultivated using mushroom logs show variation in radioactivity concentrations.

Therefore, measures to reduce contamination are being taken, such as implementing cultivation management in line with the "Guideline on Cultivation Management of Log-cultured Mushrooms to Reduce Radioactive Materials" for the purpose of ensuring that log-cultured mushrooms do not contain radioactive materials exceeding the standard limit for foods, and developing bed log washing machines necessary for cultivating safe mushrooms, etc.

In order to prevent distribution of wild plants and mushrooms with radioactivity concentrations exceeding the standard limit, each local government imposes distribution restrictions on producers and farmers markets and provides them with inspection results or other information.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Mushrooms and Wild Plants

Provisional Safety Standards for Mushroom Logs, etc. [Reference]

- Mushroom logs and beds may be distributed nationwide.
- In order to ensure the safety of supplied mushrooms, provisional safety standards for radioactive cesium concentrations for mushroom logs and beds were established.

Provisional safety standards (from April 2012)	
Mushroom logs and bed logs	50 Bq/kg
Culture media for beds and mushroom beds	200 Bq/kg

Bed logs: Mushroom logs wherein mushroom fungi are planted
Mushroom beds: Culture media mixed with sawdust and nutrients wherein mushroom fungi are planted

Prepared based on the "Responses at Farmlands" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

MAFF

Mushroom logs and beds may be distributed nationwide in the same manner as livestock feeds. Therefore, in order to cultivate safe mushrooms, provisional safety standards for radioactive cesium concentrations were set at 50 Bq/kg for mushroom logs and bed logs and at 200 Bq/kg for mushroom beds, and they are managed properly so that contained radioactive materials do not exceed those standards.

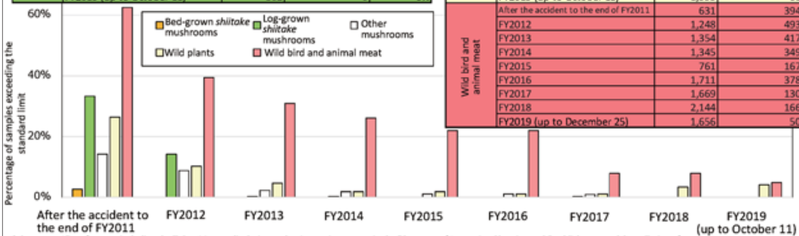
Included in this reference material on March 31, 2013
Updated on March 31, 2021

Mushrooms and Wild Plants

Mushrooms, Wild Plants and Wild Bird and Animal Meat

	Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
Bed-grown Shiitake mushrooms	After the accident to the end of FY2011	358	9	2.5%
	FY2012	868	0	0%
	FY2013	869	0	0%
	FY2014	830	0	0%
	FY2015	754	0	0%
	FY2016	617	0	0%
	FY2017	494	0	0%
	FY2018	434	0	0%
	FY2019 (up to October 11)	49	0	0%
Log-grown shiitake mushrooms	After the accident to the end of FY2011	1,093	364	33.3%
	FY2012	1,513	213	14.1%
	FY2013	1,298	2	0.2%
	FY2014	1,996	3	0.2%
	FY2015	2,139	0	0%
	FY2016	2,362	0	0%
	FY2017	2,264	4	0.2%
	FY2018	1,938	0	0%
	FY2019 (up to October 11)	502	0	0%

	Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
Other mushrooms	After the accident to the end of FY2011	1,881	268	14.2%
	FY2012	2,257	195	8.6%
	FY2013	2,230	50	2.2%
	FY2014	2,169	38	1.8%
	FY2015	2,117	24	1.1%
	FY2016	2,084	23	1.1%
	FY2017	1,890	16	0.8%
	FY2018	2,021	28	1.4%
	FY2019 (up to October 11)	226	1	0.4%
Wild plants	After the accident to the end of FY2011	524	138	26.3%
	FY2012	1,950	197	10.1%
	FY2013	3,184	142	4.5%
	FY2014	3,562	62	1.7%
	FY2015	3,423	63	1.8%
	FY2016	4,178	46	1.1%
	FY2017	3,237	34	1.1%
	FY2018	3,178	105	3.3%
	FY2019 (up to October 11)	1,595	61	3.8%
Wild bird and animal meat	After the accident to the end of FY2011	631	394	62.4%
	FY2012	1,248	493	39.5%
	FY2013	1,354	417	30.8%
	FY2014	1,345	349	25.9%
	FY2015	761	167	21.9%
	FY2016	1,711	378	22.1%
	FY2017	1,669	130	7.8%
	FY2018	2,144	166	7.7%
	FY2019 (up to December 25)	1,656	50	3.0%



* Coverage: 17 prefectures including the Tokyo Metropolis designated as inspection targets in the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies," which compiles basic approaches concerning radioactive materials in foods

* For only wild bird and animal meat, data up to December 25, 2019, is presented.

Prepared based on the "Inspection Results Concerning Radioactive Cesium Concentrations in Agricultural Products" by the Ministry of Agriculture, Forestry and Fisheries and the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Health, Labour and Welfare

Regarding mushrooms, for which cultivation management is possible, thanks to efforts for securing safe logs and the introduction of makeshift greenhouses, etc., radioactive contamination has been reduced through the use of production materials in conformity to the standards. The percentage of mushrooms with radioactive concentrations exceeding the standard limit is decreasing. This standard limit refers to 100 Bq/kg, which has been applied since April 2012 (in FY2011, provisional regulation values were applied, but tabulation is based on the current standard for the purpose of comparison with the results in and after 2012).

■ Provisional safety standards regarding radioactive cesium for mushroom logs, bed logs, culture media for beds and mushroom beds

Mushroom logs and bed logs: 50 Bq/kg
Culture media for beds and mushroom beds: 200 Bq/kg

Radioactive concentrations exceeding the standard limit are still detected in some wild mushrooms and wild plants, for which cultivation management is difficult. Therefore, their shipment is thoroughly controlled continuously.

Wild bird and animal meat, such as boar meat and deer meat, still show radioactive concentrations exceeding the standard limit, although the number of such cases is on a decline. Feeding management like that for livestock animals is difficult for wild birds and animals that move around freely. Therefore, shipment of wild birds and animal meat is restricted by each prefecture in principle, and in some cases, only meat managed based on shipment and inspection policies formulated independently by respective local governments is permitted to be shipped out.

Included in this reference material on February 28, 2018
Updated on March 31, 2020

Fishery Products

Approach for Inspections of Fishery Products

○**Monitoring is conducted once a week or so based on the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies"**

- **The fish species in which radioactive cesium exceeding 50 Bq/kg has been detected and major fishery products are intensively inspected.**
- **Inspection results of neighboring prefectures are taken into account.**

Coastal fish (e.g., Japanese sandlance, seabass, flounders, etc.)	Sea areas off prefectures are divided into zones in consideration of catch landing, fishery management and seasons, etc. and samples are collected at major ports.
Migratory fish (e.g., Skipjack tuna, sardines and mackerels, Pacific saury, etc.)	Fishing grounds are divided into zones off each prefecture from Chiba to Aomori (by lines extending along the prefectural borders to the east) in consideration of migration of fish, etc., and samples are collected at major ports of each zone.
Inland water fish (e.g., YAMAME (land-locked cherry salmon), Japanese smelt, Ayu sweetfish, etc.)	Prefectural areas are divided into zones appropriately in consideration of fishery rights, and samples are collected in major zones.

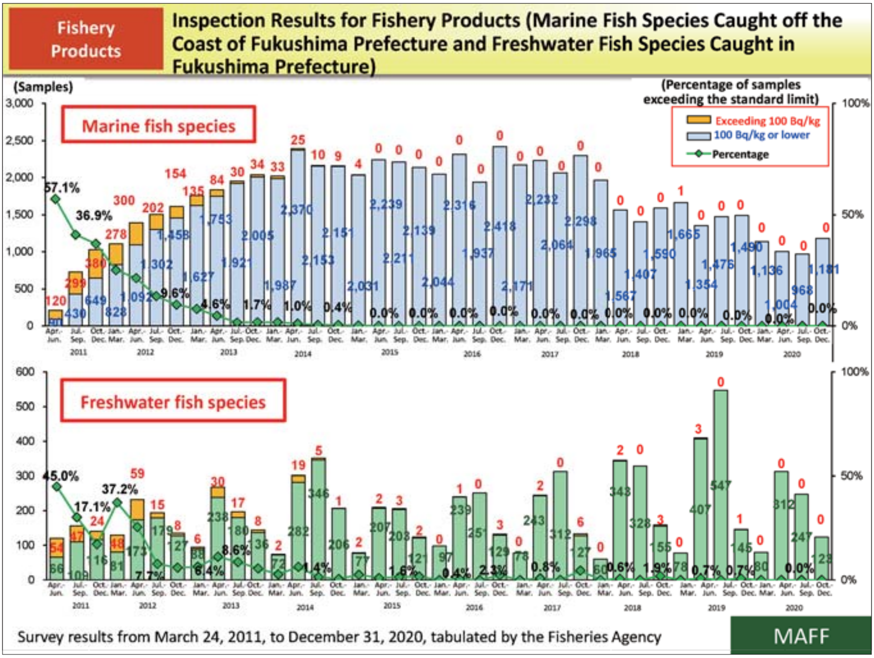
Prepared based on the "Responses at Farmland" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

MAFF

Monitoring of radioactivity in fishery products covers major fish species and fishing grounds, and species in which radioactive cesium concentration exceeding 50 Bq/kg has been detected, based on the "Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies (Guideline)."

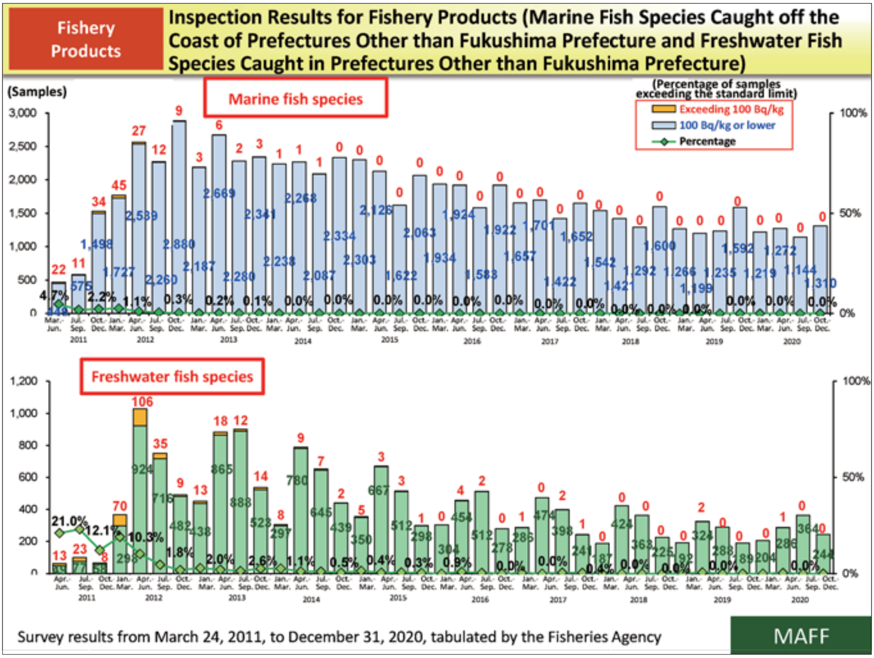
At present, inspections are conducted by classifying the fish species based on their habitats and fishing seasons, while also taking into account inspection results of neighboring prefectures, as shown in the table. Regarding migratory fish, such as bonito and Pacific saury, which migrates over a wide area in the ocean, monitoring is conducted broadly by multiple prefectures based on their migratory routes.

Included in this reference material on March 31, 2013
Updated on March 31, 2021



The percentage of samples exceeding the standard limit for radioactive cesium concentration (100 Bq/kg) was 57% for marine fish and 45% for freshwater fish during the period from April to June 2011, but the percentage decreased by half in one year after the accident. Since April 2012, inspections have been focused on the fish species in which radioactive cesium concentrations exceeding 50 Bq/kg had been detected, and the percentage of samples with radioactive cesium concentrations exceeding the standard limit is continuing to decrease. In particular, regarding marine fish, radioactive cesium concentration exceeding the standard limit was detected in only one sample in January 2019. The number of samples with radioactive cesium concentrations exceeding the standard limit is slightly larger among freshwater fish samples compared with marine fish samples.

Included in this reference material on March 31, 2014
Updated on March 31, 2021



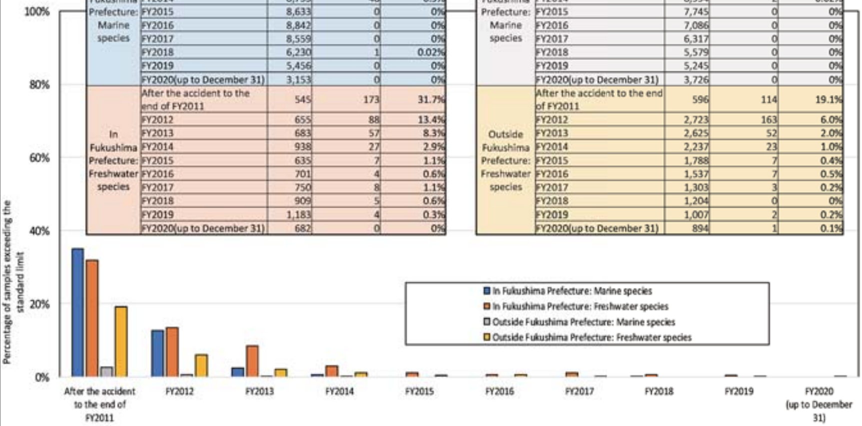
The percentage of samples with radioactive cesium concentrations exceeding the standard limit (100 Bq/kg) has also been decreasing among samples collected off or in prefectures other than Fukushima Prefecture. There have been no such marine fish samples since FY2015, but some freshwater fish samples still show radioactive cesium concentrations exceeding the standard limit.

Included in this reference material on March 31, 2014
Updated on March 31, 2021

Chronological Changes in Inspection Results for Fishery Products

	Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
In Fukushima Prefecture: Marine species	After the accident to the end of FY2011	3,074	1,077	35.0%
	FY2012	6,270	791	12.6%
	FY2013	7,847	181	2.3%
	FY2014	8,753	48	0.5%
	FY2015	8,633	0	0%
	FY2016	8,842	0	0%
	FY2017	8,559	0	0%
	FY2018	6,230	1	0.02%
	FY2019	5,456	0	0%
	FY2020(up to December 31)	3,153	0	0%
In Fukushima Prefecture: Freshwater species	After the accident to the end of FY2011	545	173	31.7%
	FY2012	655	88	13.4%
	FY2013	683	57	8.3%
	FY2014	938	27	2.9%
	FY2015	635	7	1.1%
	FY2016	701	4	0.6%
	FY2017	750	8	1.1%
	FY2018	909	5	0.6%
	FY2019	1,183	4	0.3%
	FY2020(up to December 31)	682	0	0%

	Inspection period	Number of samples	Number of samples exceeding the standard limit	Percentage of samples exceeding the standard limit
Outside Fukushima Prefecture: Marine species	After the accident to the end of FY2011	4,361	112	2.6%
	FY2012	9,917	51	0.5%
	FY2013	9,540	12	0.1%
	FY2014	8,994	2	0.02%
	FY2015	7,745	0	0%
	FY2016	7,086	0	0%
	FY2017	6,317	0	0%
	FY2018	5,579	0	0%
	FY2019	5,245	0	0%
	FY2020(up to December 31)	3,726	0	0%
Outside Fukushima Prefecture: Freshwater species	After the accident to the end of FY2011	596	114	19.1%
	FY2012	2,723	163	6.0%
	FY2013	2,625	52	2.0%
	FY2014	2,237	23	1.0%
	FY2015	1,788	7	0.4%
	FY2016	1,537	7	0.5%
	FY2017	1,303	3	0.2%
	FY2018	1,204	0	0%
	FY2019	1,007	2	0.2%
	FY2020(up to December 31)	894	1	0.1%



* Inspection results are tabulated on a nationwide basis.

Monitoring results from March 24, 2011 to December 31, 2020 tabulated by the Fisheries Agency

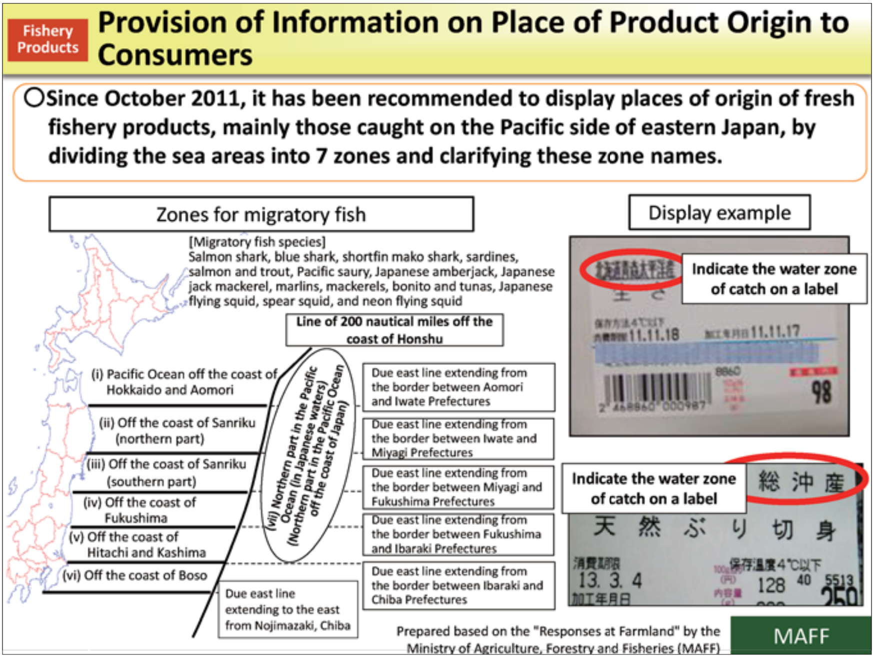
Monitoring of fishery products has been conducted in particular focusing on fish and shellfish which exceeded a radioactive cesium concentration of 50 Bq/kg or are the major products of the relevant prefectures. Monitoring is conducted once a week or so in principle. The number of fishery products exceeding the standard limit has been gradually decreasing.

Shortly after the Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS Accident, approx. 30% of the fishery samples collected in (the sea neighboring) Fukushima Prefecture exceeded the standard limit. Such samples decreased afterwards, and there has been only one sample exceeding the standard limit since April 2015 (as of December 2020). Since September 2014, there have been no samples collected in prefectures other than Fukushima Prefecture that contained radioactive cesium exceeding the standard limit.

Some freshwater fish caught in and outside Fukushima Prefecture still show radioactive cesium concentrations exceeding the standard limit even in FY2019, but the number of such fish is decreasing year by year.

The standard limit refers to 100 Bq/kg, which has been applied since April 2012 (in FY2011, provisional regulation values were applied, but tabulation is based on the current standard for the purpose of comparison with the results in and after 2012).

Included in this reference material on February 28, 2018
Updated on March 31, 2021



Since October 2011, the national government has been encouraging producers to display places of origin of fresh fishery products, mainly those caught on the Pacific side of eastern Japan so that consumers can easily understand where the relevant fishery product was caught.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Import Measures by Other Countries

Outline of Lifting and Easing of Food Import Measures by Other Countries and Regions after the TEPCO's Fukushima Daiichi NPS Accident

In response to the accident at TEPCO's Fukushima Daiichi NPS, countries and regions all over the world imposed various measures on imports from Japan. However, as a result of all-out efforts by the government of Japan, such regulatory measures have been lifted or eased (out of the 55 countries and regions that imposed measures, 41 lifted measures, while 14 continue imposing them).

Details of regulatory measures (Number of countries and regions)		Countries and regions
Completely lifted import measures (41)		Canada, Myanmar, Serbia, Chile, Mexico, Peru, Guinea, New Zealand, Colombia, Malaysia, Ecuador, Viet Nam, Iraq, Australia, Thailand, Bolivia, India, Kuwait, Nepal, Iran, Mauritius, Qatar, Ukraine, Pakistan, Saudi Arabia, Argentina, Turkey, New Caledonia, Brazil, Oman, Bahrain, Congo DR, Brunei, Philippines, Morocco, Egypt, Lebanon, UAE, Israel, Singapore, USA
Continuing import measures (14)	Suspended import of items from some prefectures (5)	Hong Kong, China, Taiwan, South Korea, Macau
	Requests issuance of inspection certificates for items from some or all prefectures (9)	EU , EFTA (Iceland, Norway, Switzerland, Liechtenstein) , UK, French Polynesia, Russia, Indonesia

Note 1) As of October 10, 2021; Classification in accordance with the details of the regulatory measures; Prefectures in Japan and items subject to respective regulatory measures differ by country or region.
Note 2) 27 EU countries and the United Kingdom were counted as one region as they jointly imposed import measures. Number of countries / regions was revised because the UK excluding Northern Ireland adopts measures different from that of EU from 10 Oct 2021.
Note 3) The governments of Thailand and the UAE lifted import measures except for those on some wild animal meat whose export is not allowed due to quarantine or other grounds.

MAFF

In response to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, countries and regions all over the world imposed various measures on imports from Japan. However, as a result of all-out efforts by the government of Japan, such regulatory measures have been eased or lifted. The number of countries or regions imposing measures has decreased from 55 immediately after the accident to 14.

Included in this reference material on February 28, 2018
Updated on March 31, 2022

Chapter 9

Efforts toward Recovery from the Accident

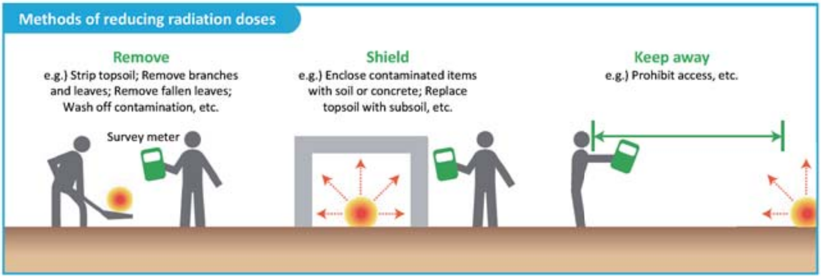
Chapter 9 explains efforts toward recovery from the accident, such as measures against environmental contamination by radioactive materials discharged due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS and transition of Areas under Evacuation Orders.

You can understand how to recover areas contaminated with radioactive materials, how to treat waste, and what measures are being taken at present in Areas under Evacuation Orders and surrounding areas.

Purpose of Decontamination

Reduction of Radiation Doses

Radioactive materials released into the air due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS fell onto the ground with rain, etc. and adhered to soil, vegetation, and buildings in people's living environment. Soil and vegetation, etc. thus contaminated are being removed through decontamination work. Removed soil and vegetation, etc. are shielded to prevent them from affecting the surroundings, thereby reducing radiation doses people receive from the environment.



Prepared based on the website, "Environmental Remediation," of the Ministry of the Environment

Radioactive materials released into the air due to the accident at TEPCO's Fukushima Daiichi NPS fell onto the ground with rain, etc. and adhered to buildings, soil, and vegetation, etc. across a wide area. Therefore, the national government has been striving to reduce additional exposure doses through decontamination such as removing those released radioactive materials.

There are three methods of reducing additional exposure doses to remove, to shield, and to keep away radioactive materials. Combination of these methods can reduce additional exposure doses efficiently.

The first is to remove radioactive materials adhering to soil, vegetation or buildings, etc. from people's living environment by such means as stripping topsoil, removing tree leaves, branches and fallen leaves, and washing and cleaning the surface of buildings.

The second is to cover radioactive materials with soil, etc. thereby shielding radiation and reducing ambient doses and exposure doses accordingly.

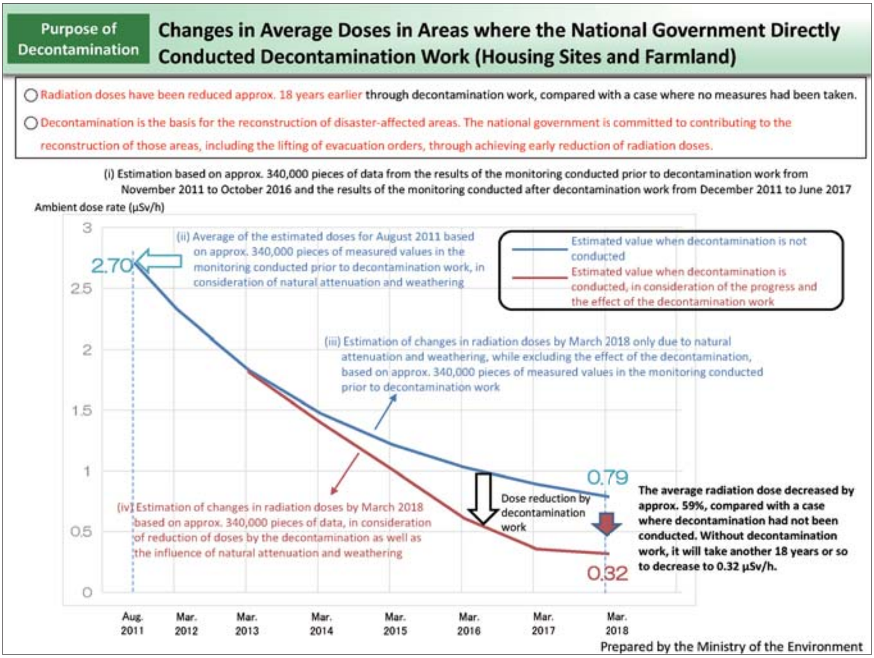
The third is to take advantage of the characteristic of radiation that the radioactivity intensity reduces as the distance increases (in inverse proportion to the square of the distance from the relevant radioactive material) (p.50 of Vol. 1, "Characteristics of External Exposure Doses").

If radioactive materials are kept away from people, exposure doses can be reduced. Therefore, one option is to prohibit access to places where radioactive materials exist.

These methods are combined and employed to reduce people's additional exposure doses.

(Related to p.176 of Vol. 1, "Three Principles of Reduction of External Exposure")

Included in this reference material on March 31, 2013
Updated on February 28, 2018



This figure shows decreases in doses of accident-derived radioactive materials as estimated based on approx. 340,000 pieces of data from the results of the monitoring conducted prior to decontamination work from November 2011 to October 2016 and the results of the monitoring conducted after decontamination work from December 2011 to June 2017.

The blue line in the graph shows ambient dose rates estimated only taking into account the influence of natural attenuation and weathering (natural factors such as wind and rain), by using the values of August 2011 as the basis. The red line in the graph shows ambient dose rates estimated also taking into account the effects of decontamination. When comparing both of these ambient dose rates as of March 2018, it is known that the average ambient dose rate decreased by approx. 59% as a result of decontamination. This means that the reduction of ambient dose rates was accelerated by approx. 18 years through decontamination work.

In this manner, decontamination work has brought about an earlier reduction of radiation doses, while assisting the effects of natural attenuation of radioactive materials.
(Related to p.11 of Vol. 1, "Half-lives and Radioactive Decay")

Included in this reference material on March 31, 2014
Updated on March 31, 2021

Purpose of Decontamination

Decontamination Methods

Decontamination has been conducted in accordance with the circumstances of respective areas.

Specific methods differ by location.

Effective methods differ depending on the status of contamination with radioactive materials. First, ambient dose rates are measured, and an optimal method is selected on a case-by-case basis. Radiation doses are measured before and after decontamination work to confirm the effects.

Measurement → Selection of decontamination methods → Decontamination work → Confirmation of the effects

Case 1 Decontamination methods employed in areas with relatively low radiation doses ● The following are examples.

●Cleaning of eaves and gutters of private houses

●Mowing of vegetation (Provided by Date City)

●Removal of sludge from ditches (Provided by Fukushima City)

Case 2 Decontamination methods employed in areas with relatively high radiation doses (in addition to the above methods)

●Scraping off of topsoil of school yards (Provided by JAEA)

●Washing of building roofs, etc.

●Scraping off of garden soil, etc. (Provided by Date City)

Prepared based on the website, "Environmental Remediation," of the Ministry of the Environment

This figure explains specific decontamination methods.

Even in areas where radiation doses are relatively low, fallen leaves and dirt containing radioactive materials are apt to accumulate under the leaves or in gutters of houses or in ditches on the street, causing higher ambient doses in the surrounding areas. At such locations, fallen leaves and dirt are removed and the relevant places are washed and cleaned.

There are areas where radioactive materials adhere to the shrubbery, underbrush or fallen leaves. Radioactive materials are removed through mowing of vegetation, pruning and removal of fallen leaves.

In areas where radiation doses are relatively high, other decontamination methods, in addition to those employed at areas with relatively low radiation doses, may need to be employed. For example, as radioactive materials mostly exist within a layer a few centimeters below the ground surface, effects of radioactive materials can be mostly diminished by stripping topsoil (for example, to a depth of 5 cm) or replacing topsoil with subsoil.

Areas where radioactive materials adhere to roofs and walls of buildings or on the paved road, relevant parts are washed and cleaned but such method may not be effective in cases where radioactive materials adhere firmly depending on the nature of their raw materials.

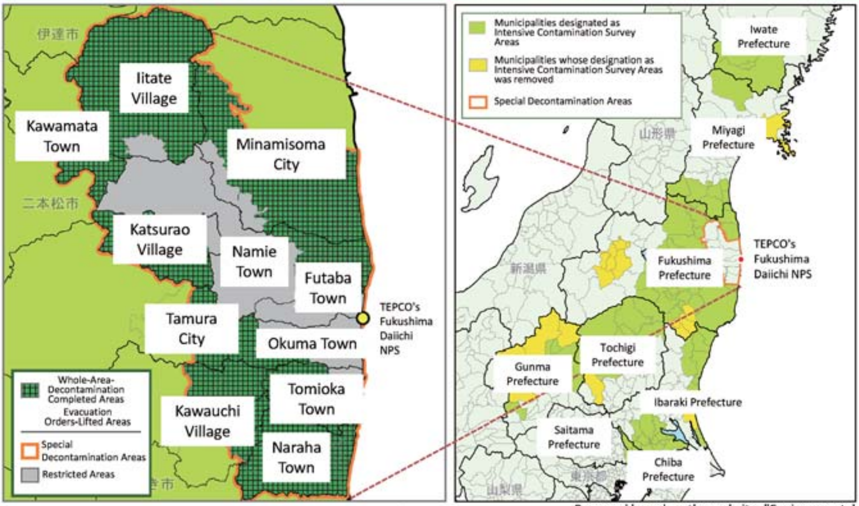
For farmland, proper methods need to be selected in consideration of the effects on agricultural products, as well as the effects on people due to exposure. In farmland plowed after the accident, radioactive materials exist little deeper from the ground surface. However, if all contaminated soil is removed, the farmland becomes unsuitable for farming. Therefore, at such farmland, various methods such as deep tillage (plowing soil as deep as 30 cm in principle) or inversion tillage (replacing topsoil with subsoil) (p.66 of Vol. 2, "Measures for Reducing Transfer of Radioactive Materials to Crops (1/5) - Decontamination of Farmland -") are being employed.

Included in this reference material on March 31, 2013
Updated on February 28, 2018

Decontamination

Special Decontamination Areas and Intensive Contamination Survey Areas

Special Decontamination Areas | Intensive Contamination Survey Areas



As of March 31, 2020

Prepared based on the website, "Environmental Remediation," of the Ministry of the Environment

After the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, the Diet enacted the Act on Special Measures Concerning the Handling of Environment Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District - Off the Pacific Ocean Earthquake that Occurred on March 11, 2011 (Act on Special Measures Concerning the Handling of Environment Pollution by Radioactive Materials) in August 2011.

Special Decontamination Areas and Intensive Contamination Survey Areas were designated as areas where decontamination is to be conducted under this Act on Special Measures. The decontamination has been conducted in these areas in line with the Act. The soil and waste removed through decontamination work are collected, transported, stored, and finally disposed of safely based on the same Act.

Special Decontamination Areas are areas where the national government directly conducts decontamination work. 11 municipalities in Fukushima Prefecture which were once designated as a Restricted Area or a Deliberate Evacuation Area are designated as Special Decontamination Areas.

Intensive Contamination Survey Areas are areas where municipalities take the initiative in decontamination work, and the national government takes financial measures and technical measures to assist these municipalities.

Whole area decontamination work was completed in all municipalities designated as Special Decontamination Areas by the end of March 2017. Thereafter, by the end of March 2018, whole area decontamination work was completed in all 100 municipalities in eight prefectures including Intensive Contamination Survey Areas, except for Restricted Areas.

In cases that there are any points where the effects of decontamination are not maintained after the completion of whole area decontamination work, causes are to be ascertained to the extent possible depending on the circumstances of individual points, and follow-up decontamination is to be conducted when it is found necessary by comprehensively taking into consideration the spread of the contamination and the effects and feasibility of decontamination work, in addition to additional exposure doses.

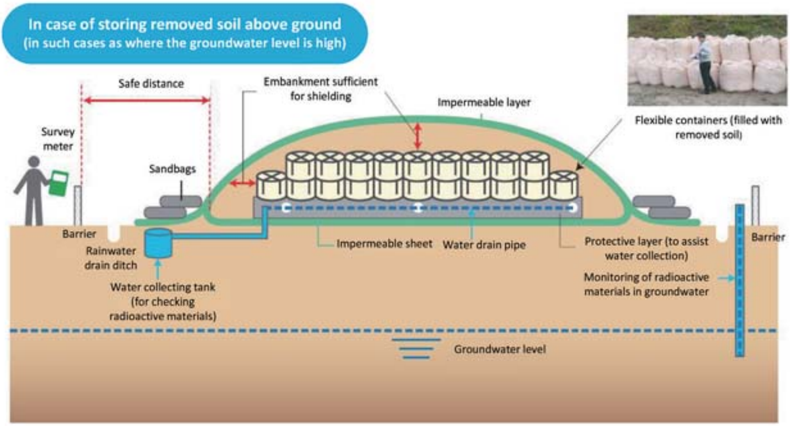
In Special Decontamination Areas, evacuation orders were all lifted by March 4, 2020, for all Habitation Restricted Areas and Preparation Areas for Lifting of Evacuation Orders. Additionally, in Intensive Contamination Survey Areas, it was confirmed that radiation doses decreased to below 0.23 μSv/h in 16 municipalities by the end of March 2020, and the designation as Intensive Contamination Survey Areas was removed for these 16 municipalities.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Storage of Removed Soil and Waste

Storage in Temporary Storage Sites (When Storing Removed Soil above Ground)

Soil removed through decontamination work is stored safely on site or at Temporary Storage Sites for a certain period of time.



Prepared based on the website, "Environmental Remediation," of the Ministry of the Environment

The soil and waste removed through decontamination work are stored and managed temporarily on site or at Temporary Storage Sites.

Specifically, removed soil is put in a container (flexible container, etc.) and placed on an impermeable layer (impermeable sheet, etc.), and is shielded sufficiently by such methods as placing sandbags filled with uncontaminated soil around the site to reduce ambient dose rates at the boundary to the same level as that in the surrounding areas.

Additionally, the site is covered with an impermeable sheet, etc., thereby preventing scattering and leakage of removed soil and further preventing infiltration of rainwater and resulting contamination of groundwater, etc.

Radiation doses at the site and radioactivity concentrations in groundwater are measured regularly.

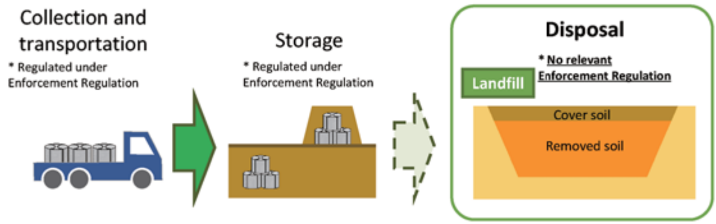
Furthermore, from the perspective of keeping the site away from the public (securing distance), public access to the site is prohibited, and shortening of working hours and other measures are also considered from the perspective of reducing workers' exposure to radiation (p.176 of Vol. 1, "Three Principles of Reduction of External Exposure").

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Management of Removed Soil and Waste

Status of Removed Soil Outside Fukushima Prefecture

◯ Removed soil outside Fukushima Prefecture has been stored safely by respective municipalities based on the storage methods regulated by the national government.
◯ Municipalities are to follow the disposal methods regulated by the national government, if they collect removed soil and dispose of it by means of landfill in the future.
◯ However, specific disposal methods have yet to be determined, and the national government is required to specify disposal methods by Enforcement Regulation.
→ At present, the Study Team on Disposal of Removed Soil, which consists of intellectuals, is deliberating on disposal methods from professional standpoints. Furthermore, demonstration projects on landfill disposal have been implemented in Tokai Village in Ibaraki Prefecture and Nasu Town in Tochigi Prefecture.



Prepared by the Ministry of the Environment

Removed soil outside Fukushima Prefecture has been stored safely by respective municipalities (decontamination entities) based on the storage methods regulated by the national government.

Municipalities are to follow the disposal methods regulated by the national government, in case of disposing of removed soil by means of landfill.

However, specific disposal methods have yet to be determined, and the national government is required to specify disposal methods by Enforcement Regulation.

Accordingly, the Ministry of the Environment (MOE) established the Study Team about Disposal of Removed Soil, which consists of intellectuals, in December 2016, and the Study Team has been continuing deliberations from professional standpoints. Furthermore, MOE has been implementing demonstration projects on landfill disposal at two locations, Tokai Village in Ibaraki Prefecture and Nasu Town in Tochigi Prefecture, with the aim of confirming influence on the workers and surrounding environments in case of disposing of removed soil by means of landfill.

Based on the results of the demonstration projects and deliberations by the Study Team, the national government will establish a necessary Enforcement Regulation and Guidelines.

Included in this reference material on March 31, 2019
Updated on March 31, 2020

Others

Comprehensive Efforts toward Regeneration of Forests and Forestry in Fukushima

○ In order to ensure safe and secure lives of the residents and regenerate forests and forestry in Fukushima, relevant ministries and agencies carry out the following measures comprehensively in collaboration with the prefecture and municipalities, while obtaining the understanding of the people in Fukushima.

I. Efforts toward regeneration of forests and forestry

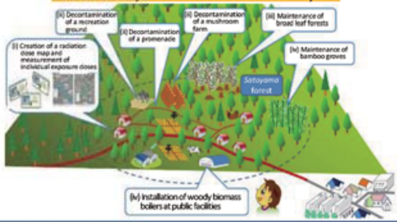
1. Efforts for ensuring safe and secure living environment

- Steadily continue decontamination work for forests near people's houses, etc.
- For residential areas surrounded by forests on three sides, taking measures as necessary, such as decontaminating forests 20m or further from the border or installing barriers to prevent soil runoff

2. Efforts for restoring *Satoyama* forests close to residential houses

- Based on needs of local people, decontamination was conducted properly at places in the forest where residents enter for recreation or daily use; Make efforts for regenerating forestry in broad leaf forests and bamboo groves, etc.
- Select model districts in and around Areas under Evacuation Orders (including areas where evacuation orders have been lifted), comprehensively promote efforts for restoring *Satoyama* forests in those model districts, and reflect the outcomes of such efforts in carrying out further appropriate measures.

Picture of *Satoyama* Forest Restoration Model Project



3. Efforts for regenerating forestry in mountainous areas, etc.

- Promote a project to conduct tree thinning or other forest maintenance work together with measures concerning radioactive materials, and a demonstration project aiming for regeneration of forestry
- Newly prepare a guidebook on radiation safety that is easy to understand for workers

II. Future-oriented efforts for research and studies

- Continuously engage in research and studies for monitoring radiation doses in the forest, understanding behavior of radioactive materials and reducing radiation doses; Continue efforts for regeneration of forests and forestry into the future while utilizing the outcomes of such research and studies in formulating further measure

III. Information provision and communication

- Meticulously provide the latest information regarding knowledge on radioactive materials in forests and the national government's efforts toward regeneration of forests and forestry, using such media as relevant ministries' websites and PR magazines
- Continue efforts for ensuring safe and secure lives of the people in Fukushima through maintaining good communication, including dispatching experts

Prepared by the Ministry of the Environment

In addition to decontamination, comprehensive efforts for regenerating the forestry industry and ensuring safe and secure lives of the residents are indispensable for the regeneration of forests and forestry in Fukushima Prefecture. Based on the guideline, "Comprehensive Efforts toward Regeneration of Forests and Forestry in Fukushima," which was compiled by the Reconstruction Agency, the Ministry of Agriculture, Forestry and Fisheries, and the Ministry of the Environment in March 2016, relevant ministries and agencies have been carrying out measures comprehensively for those purpose, while obtaining the understanding of the people in Fukushima. In November 2020, the outcome of the *Satoyama* Forest Restoration Model Project, which had been conducted in 14 districts based on the guideline, was compiled and published. In FY2020 onward, efforts for restoring *Satoyama* forests will be continued by expanding the coverage as the *Satoyama* Forest Restoration Project.

According to the knowledge obtained at the Environment Restoration Panel established in the Ministry of the Environment, it is found that removal of sedimentary organic materials at locations 20m or further from the border of the forest adjacent to houses and farmland, etc. has little effect in reducing ambient dose rates at the forest border. Also, broad removal of sedimentary organic materials in forests may even make things worse, in ways such as increasing bad effects on trees due to causing erosion of dirt, etc. containing radioactive cesium or impoverishing the soil. Accordingly, under the basic policy to prioritize areas especially necessary from the perspective of protecting human health, decontamination of forests has been conducted within approx. 20m from the borders of the forests adjacent to houses or farmland, etc., in principle.

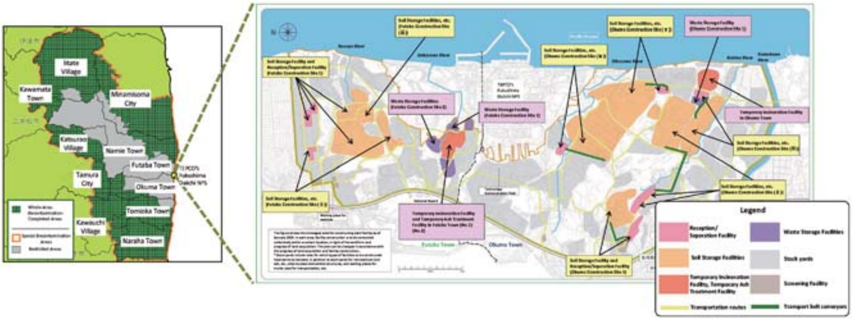
Included in this reference material on March 31, 2017
Updated on March 31, 2021

Interim Storage Facility

Interim Storage Facility for Removed Soil and Waste

Outline of the Interim Storage Facility

○ In Fukushima Prefecture, large quantities of contaminated soil and waste have been generated from decontamination works.
○ Currently, it is difficult to clarify methods of final disposal of the soil and waste.
○ **It is necessary to establish an Interim Storage Facility (ISF) in order to manage and store the soil and waste safely and intensively until final disposal.**
(Site Area: approx. 16 km²)
- Removed soil and waste generated from decontamination works in Fukushima Prefecture and incineration ash with radioactivity concentrations exceeding 100,000 Bq/kg are stored.
- The national government has legally specified its intention to take measures necessary for completing final disposal outside Fukushima Prefecture within 30 years after the commencement of interim storage (the Amended JESCO (Japan Environmental Storage & Safety Corporation) Act was promulgated in November 2014).



Prepared by the Ministry of the Environment

In Fukushima Prefecture, large quantities of contaminated soil and waste have been generated from decontamination work. The whole amount of material to be transported to the Interim Storage Facility (ISF) is estimated to be approx. 14 million m^3, which is equivalent to approx. 11 times the volume of the Tokyo Dome.

Currently, it is difficult to clarify methods of final disposal of the soil and waste, and it is indispensable to establish an ISF as a facility to manage and store the soil and waste safely and intensively until final disposal.

At the ISF, the following are to be stored:

(i) Removed soil and waste (e.g. fallen leaves and branches, etc.) generated from decontamination work which is currently stored in Temporary Storage Sites;

(ii) Incineration ash with radioactivity concentrations exceeding 100,000 Bq/kg.

Consent to accept the construction of the ISF was obtained from Fukushima Prefecture in September 2014 and from Okuma Town and Futaba Town in January 2015. The total area of the planned site is approx. 16 km^2, almost the same area as Shibuya Ward in Tokyo.

• Breakdown of the whole amount of material to be transported to the ISF (approx. 14 million m^3)
(i) Volume of the soil and waste that have already been transported to the ISF
(ii) Volume to be transported (volume of the soil and waste stored at Temporary Storage Sites, etc., including combustibles before incineration)
(iii) Volume of waste reduced and stored at Temporary Incineration Facilities

Included in this reference material on January 18, 2016
Updated on March 31, 2021

Interim Storage Facility

Construction of Interim Storage Facility

- As a site for constructing the Interim Storage Facility (ISF), the national government plans to secure approx. 1,600 ha. As of the end of December 2020, the national government concluded contracts for approx. 1,205 ha (approx. 75.3% of the envisaged construction site; with regard to privately-owned land, 91.1% of the total area was acquired) with 1,787 registered land owners (approx. 75.7% of the total). The acquisition of required land has thus been progressing steadily.
- The development of the facilities also progressed steadily, and in March 2020, the ISF commenced operations for all processes from the treatment and to the storage of removed soil and waste.

Prepared by the Ministry of the Environment

The site necessary for the construction of the Interim Storage Facility (ISF) is estimated to be approx. 1,600 ha and the number of relevant registered land owners is 2,360. By the end of December 2020, the contracts have been steadily concluded for approx. 1,205 ha (approx. 75.3% of the envisaged construction site; with regard to privately-owned land, 91.1% of the total area was acquired) with 1,787 registered land owners (approx. 75.7% of the total). The national government considers it most important to obtain understanding on the construction of the ISF, not to mention building a relationship of trust with land owners, and is committed to continuing efforts of providing sufficient explanations to land owners.

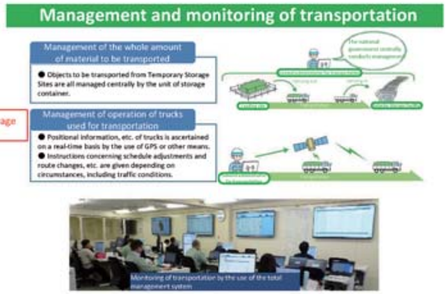
Construction of the Reception/Separation Facilities and Soil Storage Facilities started in November 2016. The Reception/Separation Facilities receive the removed soil and waste which is transported from the Temporary Storage Sites in Fukushima Prefecture to the ISF. The soil and waste are unloaded from trucks, taken out from container bags and separated into combustibles and incombustibles. The Soil Storage Facilities store the soil treated at the Reception/Separation Facilities safely in accordance with their radioactivity concentrations and other properties. Reception and separation of the removed soil and waste started in June 2017 and storage of the treated soil at the Soil Storage Facilities started in October 2017. In March 2020, the ISF commenced operations for all processes of the treatment and storage of removed soil and waste.

At the ISF, safety measures to prevent scattering and leakage of radioactive materials are taken. At the Reception/Separation Facilities, scattering of radioactive materials to outside of the facilities is being prevented by roofs, walls, and double doors and through negative pressure control. Floors are structured not to allow permeation of a liquid for the purpose of preventing contaminated water, etc. from permeating into groundwater. At Soil Storage Facilities, scattering of radioactive materials is prevented by watering, and covering with soil, and permeation into groundwater is prevented by seepage control. Leachate, etc. generated at these facilities is treated properly at a leachate treatment facility and is discharged after water quality management.

Included in this reference material on February 28, 2018
Updated on March 31, 2021

Interim Storage Facility — Transportation of Removed Soil and Waste

- ◯ Transportation of the soil and waste from Temporary Storage Sites (TSS) to the Interim Storage Facility (ISF) has been implemented mostly using 10-ton dump trucks.
- ◯ Transportation was commenced at the end of FY2014. In FY2020, removed soil and waste were transported from 25 municipalities.
- ◯ Safe and secure transportation is being conducted through managing the whole amount of material to be transported and operation of trucks used for transportation, and conducting environmental monitoring, etc.



* Even in municipalities where transportation has been completed, if any object that needs to be transported is generated, such object is to be transported to the ISF.

Prepared by the Ministry of the Environment

By the end of December 2020, an accumulative total volume of approx. 10,110,000 m^3 of the removed soil and waste had been transported to the Interim Storage Facility (ISF).

Transportation to the ISF is being conducted on a safety-first policy. Major traffic safety measures are as follows.

1. Training for new and existing workers

Training on transportation of removed soil and waste to the ISF is provided to truck drivers and other workers newly employed. Workers already engaging in transportation also receive training again every fiscal year.

2. Pre-driving of transportation routes

All drivers drive the transportation routes in advance to mutually check high-risk spots and things to note, etc.

3. On-site checking of driving status

At spots where attention should be paid for speeding or heavily trafficked spots, etc. driving status of trucks transporting removed soil and waste is checked (including on their way back).

4. Commendation of superior drivers

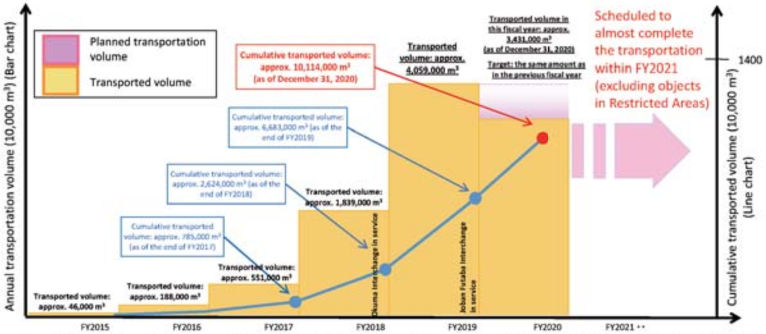
With the aim of improving and maintaining drivers' motivation and safety awareness, superior driver certificates (to be put on helmets and dashboards) are given to drivers who conducted transportation safely for 100 days or longer via contractors.

Included in this reference material on February 28, 2018
Updated on March 31, 2021

Interim Storage Facility

Current Status of Transportation to the Interim Storage Facility

- ○ In order to transport the whole amount of material to be transported to the Interim Storage Facility (ISF) (approx. 14,000,000 m³), transportation is being conducted **on a safety-first policy**, in light of the status of acquisition of the required site and development of facilities, while **making efforts to obtain understanding of local residents**.
- ○ It is expected to **almost complete transportation of removed soil and waste that have been temporarily stored in Fukushima Prefecture (excluding those in Restricted Areas) to the ISF by the end of FY2021**.
- ○ In FY2020, **the same amount of removed soil and waste as in the previous fiscal year is to be transported** on a safety-first policy. So far, **a total of approx. 10,110,000 m³, which accounts for over 70% of the whole amount of material to be transported, has been transported to the ISF** (as of December 31, 2020).



(Source) Volumes of transported objects from FY2015 to FY2019, with (planned) transportation volume for FY2020 as indicated in Policy on Interim Storage Facility Project in FY2020

Prepared by the Ministry of the Environment

In accordance with the "Policy on the Interim Storage Facility Project in FY2021" announced on December 11, 2020, the transportation of removed soil and waste temporarily stored in Fukushima Prefecture (except the Restricted Areas) is expected to be mostly completed by the end of FY2021. At the same time, the transportation of the removed soil and waste from Specified Reconstruction and Revitalization Base Areas has been carried out.

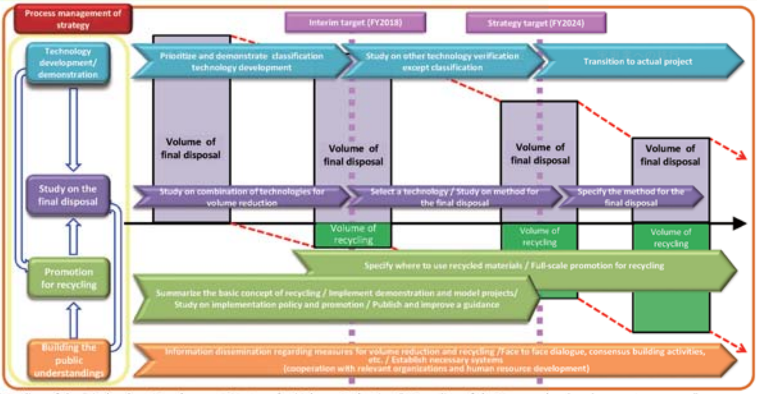
The figure shows transported volumes from FY2015 to FY2020, etc.

Included in this reference material on March 31, 2017

Updated on March 31, 2021

Interim Storage Facility | **Final Disposal Outside Fukushima Prefecture and Technology Development Strategy for Volume Reduction & Recycling of the Removed Soil**

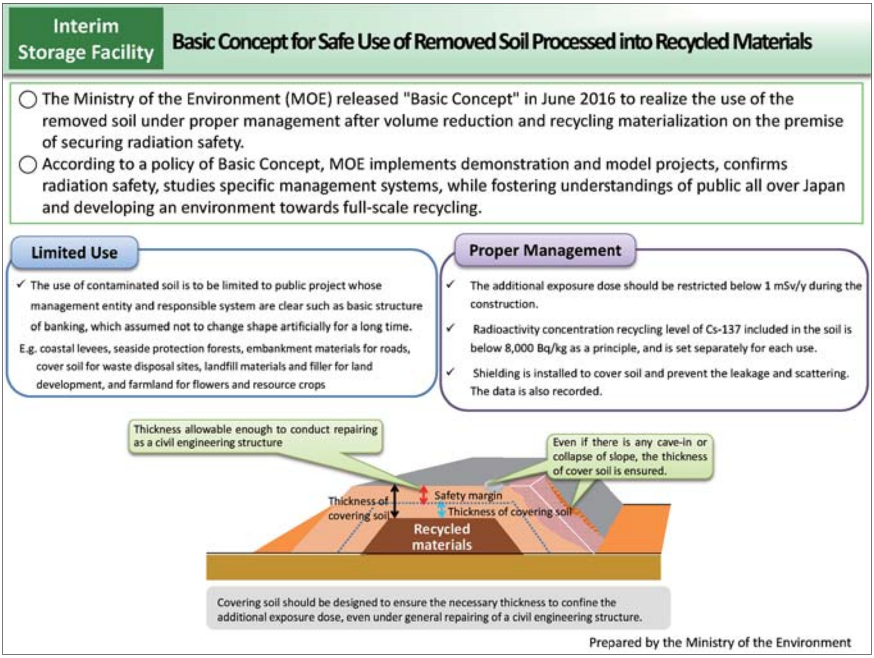
- ◯ Regarding the soil and waste removed in off-site decontamination work in Fukushima Prefecture, the national government is to **take necessary measures to complete final disposal outside the prefecture within 30 years from the start of transfer to the Interim Storage Facility**. In order to reduce the final disposal volume, **the government has been making all-out efforts for volume reduction and recycling** of removed soil and waste.
- ◯ Specific efforts for volume reduction and recycling have been made in line with the "**Technology Development Strategy for Volume Reduction & Recycling of the Removed Soil under Interim Storage**" and the "Process Chart," which the Ministry of the Environment formulated in 2016 and revised in 2019.



(Figure) Outline of the "Technology Development Strategy for Volume Reduction & Recycling of the Removed Soil under Interim Storage"
Prepared by the Ministry of the Environment

For achieving final disposal of the soil and waste removed through off-site decontamination work outside Fukushima Prefecture within 30 years from the start of transfer to the Interim Storage Facility, it is important to increase the amount of removed soil and waste that can be recycled to the extent possible through processing them while fully utilizing volume reduction technology, etc., thereby reducing the total amount for final disposal. Regarding volume reduction and recycling of removed soil and waste, efforts have been made steadily to develop technologies, promote recycling, and study the direction for final disposal in line with the "Technology Development Strategy for Volume Reduction & Recycling of the Removed Soil under Interim Storage," which the Ministry of the Environment (MOE) published in April 2016. In the mid fiscal year of the Strategy (FY2018), MOE comprehensively reviewed the achievement of the interim target and the forecast of technology development and recycling in the future, etc. and revised the Strategy in March 2019. Additionally, MOE published a guide (draft), which compiled technological matters to note in handling recycled materials safely in public works, etc., in March 2019 and updated it in December 2019.

Included in this reference material on March 31, 2019
Updated on March 31, 2021



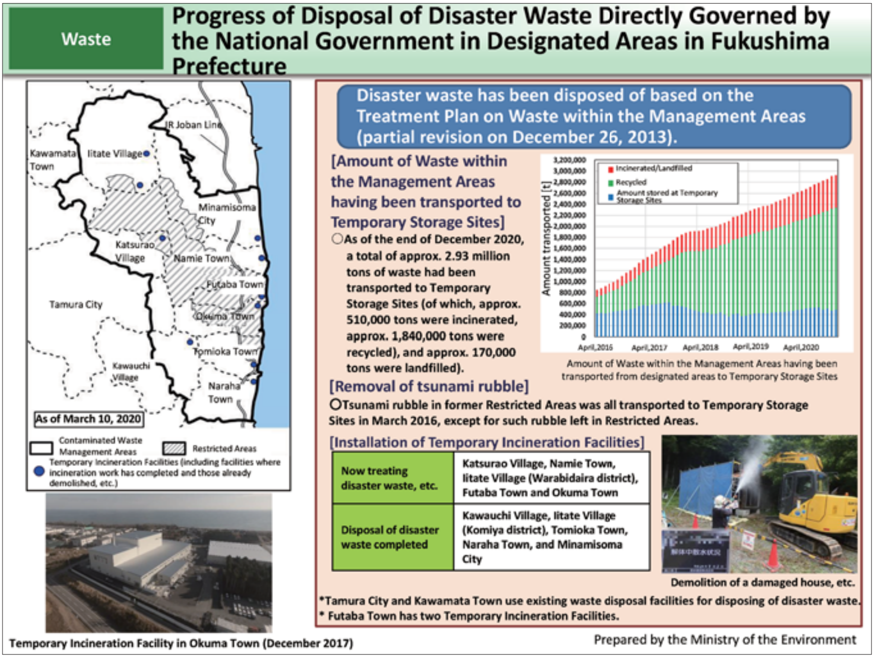
With the aim of obtaining public understanding and trust for recycling of the soil removed through off-site decontamination work in Fukushima Prefecture, and at the same time promoting safe use of removed soil processed into recycled materials by stage, the Ministry of the Environment (MOE) compiled the Basic Concept for Safe Use of Removed Soil Processed into Recycled Materials in June 2016. This Basic Concept imposes a limitation that processed removed soil be only used in public works, etc. where management entities and responsibility-related systems are clarified. It also sets the upper limit for radioactivity concentrations of recycled materials to limit additional exposure doses, while supposing that they are used under proper management, such as with shielding by cover soil.

At present, based on this Basic Concept, MOE is implementing demonstration projects in Minamisoma City and Iitate Village to confirm the safety of processed removed soil. The results obtained so far through the demonstration projects have shown no significant changes in ambient dose rates or other values since commencing the projects, and measured values of radioactive cesium in seepage water through cover soil were all below the detection limit.

In the demonstration project in Iitate Village, the development of farmland was commenced in FY2020 and an experiment to grow edible crops has been conducted to confirm growth and safety. As of December 2020, concentrations of radioactive cesium in those edible crops measured by the method specified by the Ministry of Health, Labour and Welfare can be all assessed as below the detection limit (less than 20 Bq/kg) (as a result of continuing measurements until Cs was detected, all values were 0.1 to 2.3 Bq/kg, far below the standard limit for general foods (100 Bq/kg)).

MOE's website, "Interim Storage Facility": Demonstration Project for Recycling in Minamisoma City
http://josen.env.go.jp/chukanchozou/facility/effort/recycling/minamisoma.html (in Japanese)
MOE's website, "Interim Storage Facility": Demonstration Project for Recycling in Iitate Village
http://josen.env.go.jp/chukanchozou/facility/effort/recycling/iitate.html (in Japanese)

Included in this reference material on March 31, 2019
Updated on March 31, 2021



Waste within the Management Areas in Fukushima Prefecture has been disposed of based on the Plan on Waste within the Management Areas, which was revised in December 2013.

Such waste, which includes tsunami rubble, debris of damaged houses, and waste from houses after cleaning-up, has been transported sequentially to Temporary Storage Sites. As of the end of December 2020, a total of approx. 2.93 million tons had already been transported. Transported waste is recycled as much as possible.

It was decided to incinerate inflammable waste to reduce volume at Temporary Incineration Facilities constructed at 11 locations in nine municipalities. As of the end of December 2020, six such facilities were in operation and waste is being steadily incinerated.

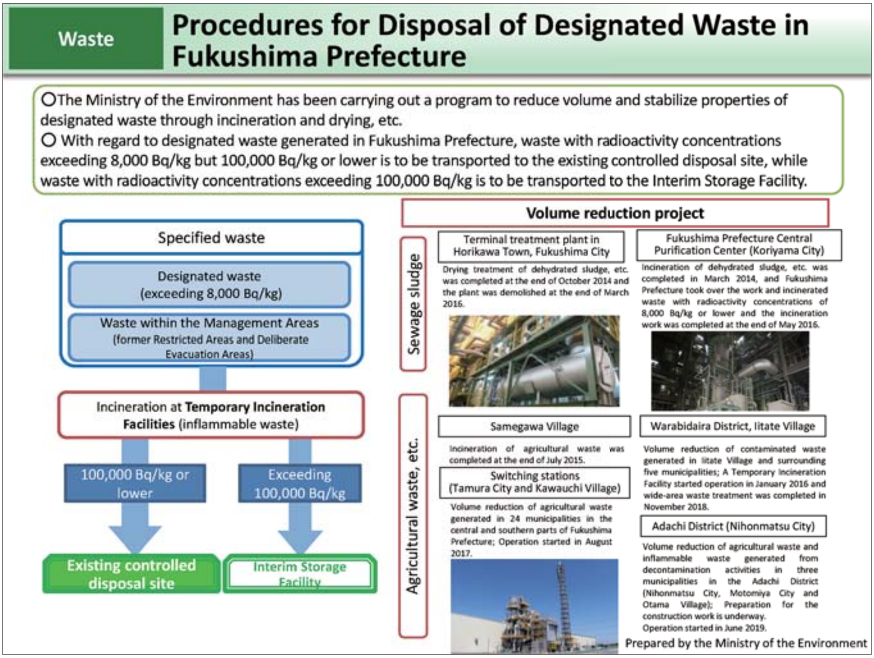
Included in this reference material on February 28, 2018
Updated on March 31, 2021

Designated waste includes ash left after incinerating waste contaminated with radioactive materials, sludge generated through sewage treatment, soil that remains at purification plants to supply tap water (p.38 of Vol. 2, "Waterworks System"), agricultural by-products such as rice straw and pasture grass, etc.

As of the end of September 2020, there was a total of over 320,000 tons of designated waste in 10 prefectures, including Tokyo Metropolis. Such waste is temporarily being stored at incineration facilities, purification plants, sewage treatment facilities, farmland, etc., where it was generated, until the national government establishes a proper disposal system.

The waste is to be covered with impermeable sheets, etc. to prevent infiltration of rainwater and measures to prevent scattering and runoff of the waste are being taken in line with the guidelines and the Act on Special Measures Concerning the Handling of Environment Pollution by Radioactive Materials. Officials of the Ministry of the Environment visit various locations and check the status of temporary storage periodically to ensure safe and proper storage of designated waste.

Included in this reference material on January 18, 2016
Updated on March 31, 2021



In Fukushima Prefecture, designated waste with radioactivity concentrations exceeding 8,000 Bq/kg but 100,000 Bq/kg or lower is to be transported to the existing controlled disposal site, while designated waste with radioactivity concentrations exceeding 100,000 Bq/kg is to be transported to the Interim Storage Facility.

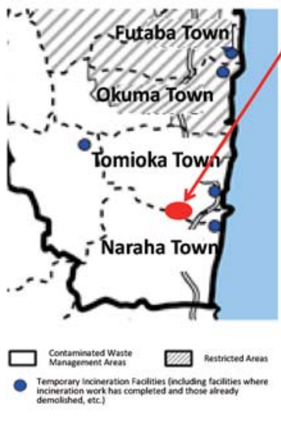
Additionally, designated waste is incinerated, dried or otherwise handled to reduce volume and stabilize their properties in Fukushima Prefecture.

Included in this reference material on January 18, 2016
Updated on March 31, 2021

Waste

Landfill Disposal Plan of Specified Waste Utilizing the Controlled Disposal Site

In order for reconstruction of eight municipalities in Futaba County and ultimately the entirety of Fukushima Prefecture, the issue of waste contaminated with radioactive materials needs to be solved as early as possible. It is planned to safely and promptly bury waste with radioactivity concentrations not exceeding 100,000 Bq/kg at the existing controlled disposal site, former Fukushima Ecotec Clean Center. Transport of specified waste was commenced in November 2017.



Prepared by the Ministry of the Environment

Specified Waste Landfill Disposal Facility (Former Fukushima Ecotec Clean Center)

[Outline of the facility]

- Location: in Tomioka Town (transport via Naraha Town)
- Area: approx. 9.4 ha
- Capacity: approx. 960,000 m³ (Possible landfill capacity: approx. 650,000 m³)

Outline of the landfill disposal program

○ **Waste to be buried**

•Household refuse of returned residents in eight municipalities in Futaba County < approx. 27,000 m³ >

•Waste within the Management Areas < approx. 445,000 m³ >

•Designated waste in Fukushima Prefecture < approx. 182,000 m³ >

○ **Period**

•Household refuse from eight municipalities in Futaba County: for approx. 10 years

• Waste within the Management Areas and designated waste: for approx. 6 years

○ **Landfill disposal, radiation monitoring, etc.**

•Multiple safety measures should be taken to prevent leakage of radioactive materials such as curbing elution of radioactive cesium or infiltration of rainwater.

•The status of seepage control and leachate treatment facility, etc. is to be periodically checked and ambient dose rates and radioactivity concentrations of groundwater, etc. should be monitored.

○ **Responsibility of the Ministry of the Environment and its management system**

•Based on the Act on Special Measures, the Ministry of the Environment will serve as the responsible entity and initially nationalize the disposal site and responsibly conduct landfill disposal of specified waste.

•The Ministry of the Environment constantly stations a supervisor at a newly established local office, thereby ensuring a system to properly manage landfill disposal and related facilities.

Waste with radioactivity concentrations not exceeding 100,000 Bq/kg generated in Fukushima Prefecture is to be buried promptly at the existing controlled disposal site.

In order to implement this program, the national government first asked Fukushima Prefecture for consent to accept the construction of an Interim Storage Facility in December 2013, and then provided explanations to Tomioka Town and Naraha Town, and their assemblies and residents.

In December 2015, consent was obtained from Fukushima Prefecture, Tomioka Town and Naraha Town for the implementation of this program. The national government nationalized the existing controlled disposal site in April 2016 and concluded a safety agreement with Fukushima Prefecture and the two municipalities in June 2016. Preparatory work was conducted thereafter and the transport of waste to the facility was commenced in November 2017. Additionally, the Ministry of the Environment (MOE) has endeavored to provide related information positively through the Reprun Fukushima, a specified waste landfill information facility, which commenced operation in August 2018.

In order to steadily facilitate disposal of waste contaminated with radioactive materials, utmost efforts will be continued to properly carry out this program with safety as the top priority and to build a stronger relationship of trust with local residents.

Included in this reference material on January 18, 2016
Updated on March 31, 2021

Waste: Status of the Five Prefectures concerning Designated Waste

Miyagi Prefecture

[Municipal mayors' conference]

1st to 4th: Oct. 2012 to Nov. 2013

5th: Jan. 20, 2014

→ Three candidate sites for detailed survey were presented (Fukayamadake, Kurihara City; Shimohara, Taiwa-cho; Tashirodake, Kami Town).

7th (held by the prefecture): Aug. 4, 2014

→ The prefectural governor announced the acceptance of a detailed survey as a consensus of all municipal mayors.

Detailed surveys were commenced at the three candidate sites in August 2014. However, an on-site survey was not possible due to protests by Kami Town (also suspended in 2015).

(Apr. 5, May 29, and Oct 13, 2015: Forum targeting prefectural residents

Oct. to Nov. 2015 (twice): Opinion exchange with Kami Town with the participation of experts)

9th: Mar. 19, 2016

→ Results of the remeasurement for designated waste and approaches of the Ministry of the Environment were explained.

Apr. 15, 2016: The prefecture requested the suspension of an on-site survey until certain prefectural policy is decided.

11th (held by the prefecture): Nov. 3, 2016

→ Results of the measurement for waste other than designated waste were released. The prefecture presented its draft policy on disposal of waste with radioactivity concentrations not exceeding 8,000 Bq/kg (excluding designated waste).

12th (held by the prefecture): Dec. 27, 2016

→ Agreement on the prefectural disposal policy was not obtained from Kurihara City and Tome City, and it was decided to have discussions again.

13th (held by the prefecture): Jun. 18, 2017

→ The prefecture presented its new draft disposal policies such as to require each district to independently treat contaminated waste generated therein.

14th (held by the prefecture): Jul. 15, 2017

→ Agreement was reached on the draft disposal policy presented at the previous meeting.

Test incineration was completed in four districts, Ishinomaki, Sennan, Kurokawa and Osaki. → Ishinomaki: Full-fledged incineration was completed.; Kurokawa: Application to farmland is planned; Sennan and Osaki: Full-fledged incineration is underway.

Tochigi Prefecture

[Municipal mayors' conference]

1st to 3rd: Apr. 2013 to Aug. 2013

4th: Dec. 24, 2013

→ Selection method was determined.

Jul. 30, 2014

→ One candidate site for detailed survey was presented (Terashimairi, Shioya Town).

5th and 6th: Jul. 2014 to Nov. 2014

May 14, Jun. 22, and Sep. 13, 2015: Forum targeting prefectural residents

Oct. 14, 2015: Survey of the effects of the heavy rain in Terashimairi, Shioya Town

Dec. 7, 2015: The mayor of Shioya Town declared the surrender of the designation as a candidate site for detailed survey.

7th: May 23, 2016

→ Remeasurement for designated waste was decided.

8th: Oct. 17, 2016

→ Results of the remeasurement were released and future directions were presented.

Mar. 30, 2017: Results of the confirmation of intentions of people temporarily storing waste by themselves were released.

Jul. 10, 2017: Meeting of mayors of municipalities concerning measures to ease burdens of farm households storing waste by themselves (i)

→ Draft of policy for measures to ease burdens of farm households storing waste by themselves were presented.

Nov. 26, 2018: Meeting of mayors of municipalities (ii)

→ Agreement was reached on efforts to muster opinions of municipalities, including those on remeasurement.

Mar. 19, 2019: Results of the remeasurement was released.

Jun. 26, 2020: Meeting of mayors of municipalities (iii)

→ Participants confirmed future directions.

Efforts are to be made continuously to seek agreement on detailed surveys and make adjustments with the prefecture and municipalities storing waste regarding measures to ease the burden on farm households storing waste by themselves.

Chiba Prefecture

[Municipal mayors' conference]

1st to 3rd: Apr. 2013 to Jan. 2014

4th: Apr. 17, 2014

→ Selection method was determined.

Apr. 24, 2015

→ One candidate site for detailed survey was presented.

(Part of the premises of TEPCO's Chiba Thermal Power Station (Chuo Ward, Chiba City))

May 20 and Jun. 2, 2015: Chiba City Assembly Plenary Meeting

Jun. 8 and Jun. 10, 2015: Chiba City Assembly and the city mayor requested fresh discussions.

Jun. 29, Jul. 7, 13 and 20, and Aug. 7, 2015: Explanations were given to community organization leaders and residents of Chiba City.

Dec. 14, 2015: Response to the request for fresh discussions was made.

Jun. 28, 2016: Chiba City requested for removal of the designation.

Jul. 22, 2016: Designation was removed for designated waste in Chiba City.

Efforts are to be made continuously to seek agreement on detailed surveys.

Ibaraki Prefecture

[Municipal mayors' conference]

1st: Apr. 12, 2013

2nd: Jun. 27, 2013

3rd: Dec. 25, 2013

4th: Jan. 28, 2015

[Meeting of mayors of municipalities where waste is temporarily stored]

1st: Apr. 6, 2015

2nd: Feb. 4, 2016

→ The policy to continue on-site storage and promote staged disposal was determined.

Mar. 31, 2017: Remeasurement for designated waste, etc. in the prefecture was conducted and the results were released.

Gunma Prefecture

[Municipal mayors' conference]

1st: Apr. 19, 2013

2nd: Jul. 1, 2013

3rd: Dec. 26, 2016

→ The policy to continue on-site storage and promote staged disposal was determined.

Prepared by the Ministry of the Environment

Prefectures other than Fukushima Prefecture which are in urgent need to secure Temporary Storage Sites for designated waste (Miyagi Prefecture, Tochigi Prefecture, Chiba Prefecture, Ibaraki Prefecture and Gunma Prefecture) are taking measures in accordance with the circumstances of respective prefectures. They ascertain the current status through the measurement of radioactivity concentrations, based on discussions at municipal mayors' conferences.

Regarding candidate sites for detailed surveys, Miyagi, Tochigi and Chiba Prefectures followed selection methods determined through discussions at expert meetings and municipal mayors' conferences, and presented selected candidate sites in January 2014, July 2014 and April 2015, respectively. However, detailed surveys have not been conducted due to a failure to obtain understanding of relevant regions.

In the meantime, Miyagi Prefecture determined its policy that each municipality is to make efforts to dispose of contaminated waste with radioactivity concentrations not exceeding 8,000 Bq/kg under the initiative of the prefectural government, and the Ministry of the Environment is offering financial and technical support. As part of such efforts, test incineration was commenced sequentially in four districts (Ishinomaki, Kurokawa, Sennan and Osaki) from March 2018 and was completed by July 2019. As of the end of December 2020, full-fledged incineration was completed in the Ishinomaki district and was underway in the Sennan and Osaki districts. In the Sennan district, full-fledged incineration is suspended to prioritize disposal of waste generated by the 2019 East Japan Typhoon.

In November 2018, the national government presented a provisional policy for volume reduction and centralized collection of designated waste by the unit of municipality, targeting Tochigi Prefecture and municipalities storing designated waste, with the aim of easing burdens of farm households that have been storing designated waste by themselves, while maintaining the basic policy to ultimately develop long-term management facilities. Agreement was reached on the provisional policy. Additionally, it was confirmed that the national government will compile its approach for the selection of provisional storage sites and make efforts to select relevant sites as promptly as possible in collaboration with Tochigi Prefecture and municipalities.

As for Chiba Prefecture, it is also making efforts to obtain understanding of local residents for the implementation of a detailed survey concerning long-term management facilities.

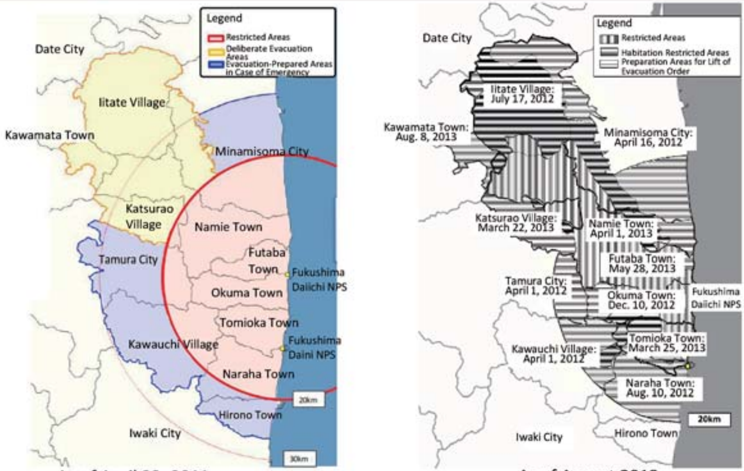
Ibaraki and Gunma Prefectures determined the policies to continue on-site storage and promote staged disposal respectively in February 2016 and December 2016. Based on the determined policies, both prefectures will repair or reinforce storage sites as necessary and will dispose of designated waste whose radioactivity concentrations have reduced to 8,000 Bq/kg or lower at existing disposal facilities in a staged manner.

Included in this reference material on March 31, 2016

Updated on March 31, 2021

Activities in Areas under Evacuation Orders

Designation of Areas under Evacuation Orders



As of April 22, 2011 (when the designation of areas immediately after the accident was completed)

As of August 2013 (when the review of areas was completed)

* Dates in the parentheses are the dates on which the designation after the review was put into effect, respectively.

Prepared based on the 15th meeting of the Nuclear Emergency Response Headquarters (May 17, 2011) and the 31st meeting of the Nuclear Emergency Response Headquarters (August 7, 2013), etc.

Based on Article 15, paragraph (2) of the Act on Special Measures Concerning Nuclear Emergency Preparedness, a Declaration of a Nuclear Emergency Situation was issued at 19:03 on March 11, 2011. At 18:25 on the following day, evacuation orders were issued for the 20-km zone of TEPCO's Fukushima Daiichi NPS.

On April 11, 2011, areas around the 20-km zone where annual cumulative doses would be highly likely to exceed 20 mSv after the accident were designated as Deliberate Evacuation Areas, taking into account the standard limits for radiological protection in emergency exposure situations, and areas within 20 km to 30 km were designated as Evacuation-Prepared Areas in Case of Emergency. Additionally on April 21, 2011, considering future risks due to the accident, areas within 20 km from the NPS were designated as Restricted Areas and access was prohibited in principle.

In June 2011 onward, spots where decontamination work would not be easy and annual cumulative doses would be highly likely to exceed 20 mSv were designated as specific spots recommended for evacuation, based on the results of the environmental monitoring by the national government and Fukushima Prefecture.

On December 16, 2011, the reactors reached a state of cold shutdown and it was confirmed that the discharge of radioactive materials was under control. Accordingly, on December 26, the designation of Restricted Areas was removed and it was proposed to review Areas under Evacuation Orders and to newly designate Restricted Areas, Habitation Restricted Areas and Preparation Areas for Lifting of Evacuation Orders. Upon reviewing Areas under Evacuation Orders, four problems common to all subjected areas were cited as problems to be addressed: (i) need to ensure safety and security of residents; (ii) need for decontamination and due consideration of children's radiation exposure; (iii) reconstruction of infrastructure and job creation; and (iv) compensation.

As requirements for lifting evaluation orders, the following were set: (i) it is certain that annual cumulative doses estimated based on ambient dose rates will become 20 mSv or lower; (ii) infrastructure (such as electricity, gas, water and sewer services, major transportation systems, and communication networks) and living-related services (such as medical services, nursing care, and postal services) indispensable for daily lives have been almost restored and decontamination work has progressed sufficiently centered on children's living environments; and (iii) consultations have been held sufficiently among the prefecture, municipalities and residents.

(Related to p.173 of Vol. 1, "ICRP Recommendations and Responses of the Japanese Government")

Included in this reference material on February 28, 2018
Updated on March 31, 2020

Activities in Areas under Evacuation Orders

Designation of Restricted Areas and Areas under Evacuation Orders and Removal Thereof

April 22, 2011, onward Area designation immediately after accident	April 2012, onward After confirming cold shutdown of the reactors
Restricted Areas(*1) Areas within 20 km in radius from the Nuclear Power Station (NPS); The relevant areas were designated as Areas under Evacuation Orders on March 12, 2011.	**Preparation Areas for Lift of Evacuation Order** Areas where it is confirmed that annual cumulative doses will surely become 20 mSv or lower(*2)
Deliberate Evacuation Areas Areas 20 km or farther from the NPS where cumulative doses would be highly likely to exceed 20 mSv within one year after the accident	**Habitation Restricted Areas** Areas where annual cumulative doses would be highly likely to exceed 20 mSv(*2)
Evacuation-Prepared Areas in Case of Emergency Areas within 20 km to 30 km in radius from the NPS other than Deliberate Evacuation Areas; The relevant areas were designated as In-house Evacuation Areas on March 12, 2011.	**Restricted Areas(*3)** Areas where annual cumulative doses exceed 50 mSv(*2) at present and would be highly likely to remain above 20 mSv(*2) even after 6 years from the accident

Areas under Evacuation Orders:
Areas for which evacuation orders were issued based on Article 15, paragraph (3) of the Act on Special Measures Concerning Nuclear Emergency Preparedness; Areas under Evacuation Orders and the 20-km zone of the Nuclear Power Station were rearranged and were newly designated as Preparation Areas for Lift of Evacuation Order, Habitation Restricted Areas or Restricted Areas.

(*1) Areas where access is restricted pursuant to the provisions of Article 63, paragraph (1) of the Disaster Countermeasures Basic Act as applied pursuant to Article 28, paragraph (2) of the Act on Special Measures Concerning Nuclear Emergency Preparedness, following the deemed replacement of terms
(*2) Based on the dose data obtained through the 4th airborne monitoring survey after correction as of March 31, 2012
(*3) The term "Areas where returning is difficult" was formerly used instead of "Restricted Areas" as a literal translation from Japanese.

Prepared based on the "Basic Idea on Review of the Restricted Areas and Areas under Evacuation Orders in Response to the Completion of Step 2 and Matters to be Discussed" (December 26, 2011; Nuclear Emergency Response Headquarters)

Immediately after the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS on March 11, 2011, the Nuclear Emergency Response Headquarters issued evacuation orders in order to avoid risks to residents' lives and designated the areas within 20 km from the NPS as Areas under Evacuation Orders on March 12.

On April 22, for fear of any risks that residents might be exposed to a large amount of radiation at one time as a result of worsening of the situation, the Headquarters designated the relevant areas as Restricted Areas to prohibit access in principle, and also designated areas 20 km or farther from the NPS where cumulative doses would be highly likely to exceed 20 mSv within one year after the accident as Deliberate Evacuation Areas.

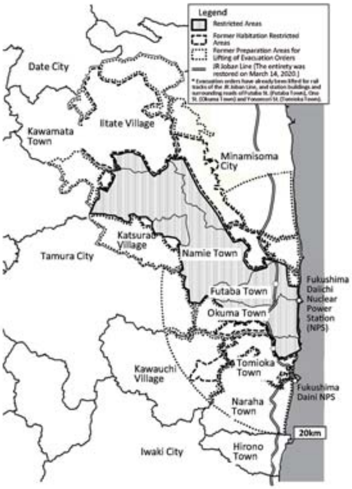
On December 16, the reactors reached a state of cold shutdown and the Nuclear Emergency Response Headquarters confirmed that the chaotic situation after the accident ended. Accordingly, on December 26, the basic idea on review of Restricted Areas and Areas under Evacuation Orders was presented. The Headquarters made preparations for the review while closely consulting with the prefecture, municipalities and residents and making adjustments, and at the same time endeavored to address problems common to all subjected areas.

On March 30, 2012, the Nuclear Emergency Response Headquarters reviewed Restricted Areas and Areas under Evacuation Orders in accordance with radiation doses and problems unique to respective areas. By August 2013, the designation of Restricted Areas and Specific Spots Recommended for Evacuation was completely removed, and Areas under Evacuation Orders were newly designated as Preparation Areas for Lifting of Evacuation Orders, Habitation Restricted Areas, or Restricted Areas.
(Related to p.173 of Vol. 1, "ICRP Recommendations and Responses of the Japanese Government")

Included in this reference material on February 28, 2018
Updated on March 31, 2020

Reconstruction and Revitalization from the Accident

Removal of the Designation of Areas under Evacuation Orders



○ Removal of the designation as Areas under Evacuation Orders for respective municipalities

April 1, 2014	Tamura City	Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
October 1	Kawauchi Village	Removal of the designation of Preparation Areas for Lifting of Evacuation Orders Shift from Habitation Restricted Areas to Preparation Areas for Lift of Evacuation Order
September 5,2015	Naraha Town	Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
June 12, 2016	Katsurao Village	Removal of the designation of Habitation Restricted Areas Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
June 14	Kawauchi Village	Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
July 12	Minamisoma City	Removal of the designation of Habitation Restricted Areas Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
March 31, 2017	Iitate Village, Kawamata Town, Namie Town	Removal of the designation of Habitation Restricted Areas Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
April 1	Tomioka Town	Removal of the designation of Habitation Restricted Areas Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
April 10, 2019	Okuma Town	Removal of the designation of Habitation Restricted Areas Removal of the designation of Preparation Areas for Lifting of Evacuation Orders
March 4, 2020	Futaba Town	Removal of the designation of Preparation Areas for Lifting of Evacuation Orders Removal at some areas near Futaba St.
March 5	Okuma Town	Removal at some areas near Ono St.
March 10	Tomioka Town	Removal at some areas near Yonomori St.

Prepared based on the 50th meeting of the Nuclear Emergency Response Headquarters (January 17, 2020), etc.

At the joint meeting of the Reconstruction Promotion Council and the Nuclear Emergency Response Headquarters held on March 7, 2013, it was pointed out that "a certain view should be indicated within the year" regarding the lift of evacuation orders. Accordingly, procedures to be followed for lifting evacuation orders were presented based on the discussions over the Cabinet decision on December 20, 2013, titled "For Accelerating the Reconstruction of Fukushima from the Nuclear Disaster." In order to ease returning residents' anxiety over health effects of radiation, measures are being taken to reduce radiation exposure and eliminate health concerns (risk communication program). These measures include deployment of counselors, development of counselor support centers, ascertaining and management of personal doses, and radiation monitoring.

In the meantime, evacuation orders were lifted by March 2020 for all areas designated as Preparation Areas for Lifting of Evacuation Orders or Habitation Restricted Areas, except for Restricted Areas.

Regarding Restricted Areas, evacuation orders were lifted for the first time for some areas in Futaba Town, Okuma Town and Tomioka Town within the Specified Reconstruction and Revitalization Base Areas designated as Restricted Areas, upon the reopening of the entirety of the JR Joban Line. Kawauchi Village and Hirono Town had recommended evacuation for areas other than Areas under Evacuation Orders designated by the national government, based on their independent determinations, but lifted the evacuation recommendation on January 31, 2012, and on March 31, 2012, respectively.

The latest information, the current status of evacuees and the details of the areas under evacuation orders in 12 municipalities are posted on the portal site, "Fukushima Revitalization Station".

"Fukushima Revitalization Station"
https://www.pref.fukushima.lg.jp/site/portal-english/

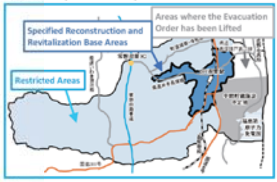
Included in this reference material on February 28, 2018
Updated on March 31, 2020

Development of Specified Reconstruction and Revitalization Base Areas and Radiological Protection Measures Therefor

[Approval of Plans for Specified Reconstruction and Revitalization Base Areas and Targeted Timing for Lifting Evacuation Orders]

Municipality name	Approval date	Targeted timing for lifting evaluation orders
Futaba Town	Sep. 15, 2017	Around spring of 2022
Okuma Town	Nov. 10, 2017	By around spring of 2022
Namie Town	Dec. 22, 2017	March 2023
Tomioka Town	Mar. 9, 2018	Around spring of 2023
Iitate Village	Apr. 20, 2018	Around spring of 2023
Katsurao Village	May 11, 2018	By around spring of 2022

Example of a Specified Reconstruction and Revitalization Base Areas (Futaba Town)



"Specified Reconstruction and Revitalization Base Area Reconstruction and Revitalization Plan" by the Reconstruction Agency

https://www.reconstruction.go.jp/topics/main-cat1/sub-cat1-4/saiseikyoten/20170913162153.html (in Japanese)

"Radiological Protection Measures at Specified Reconstruction and Revitalization Base Areas"
(Dec. 12, 2018, by the Cabinet Office's Support Team for Residents Affected by Nuclear Incidents, the Reconstruction Agency, the Ministry of the Environment, and the Secretariat of the Nuclear Regulation Authority)

As Specified Reconstruction and Revitalization Base Areas are areas where entries have been strictly restricted as Restricted Areas, required measures are to reduce residents' exposure doses and meticulously respond to their worries over radiation.

Under this concept, radiological protection measures should be taken in two stages, the first stage to make preparations for returning and rebuild communities ahead of the lifting of the evacuation order and the second stage to achieve the lifting of the evacuation order for further accelerating related initiatives.

Prepared based on the "Radiological Protection Measures at Specified Reconstruction and Revitalization Base Areas" (2018) by the Cabinet Office's Support Team for Residents Affected by Nuclear Incidents, the Reconstruction Agency, the Ministry of the Environment, and the Secretariat of the Nuclear Regulation Authority and the "Toward the Lifting of Evacuation Orders and Returning and Inhabitation of Residents for Specified Reconstruction and Revitalization Base Areas" (2018) by the Nuclear Emergency Response Headquarters

As radiation doses have decreased in some Restricted Areas, the national government published its policy in August 2016 to develop "reconstruction bases with the aim of lifting evacuation orders and permitting inhabitation in such areas within around five years in light of the status of decreases in radiation doses". In response, the Act on Special Measures for the Reconstruction and Revitalization of Fukushima was amended in May 2017 and the system for Specified Reconstruction and Revitalization Base Areas was established thereby. Plans for reconstruction and revitalization that all municipalities (Futaba Town, Okuma Town, Namie Town, Tomioka Town, Iitate Village, and Katsurao Village) had formulated for Specified Reconstruction and Revitalization Base Areas were approved by May 2018 and their development has been promoted.

In December 2018, as moves toward the lifting of evacuation orders for these municipalities had become active, the national government presented its policy to take radiological protection measures for Specified Reconstruction and Revitalization Base Areas in two stages, a stage to prepare for returning and a stage to achieve the lifting of evacuation orders, with the aim of further accelerating efforts for lifting evacuation orders.

In a stage to prepare for returning, the national government will not only ensure steady management of individuals' doses and secure a consultation system, but also minutely obtain doses and other information and provide estimated exposure doses based on detailed dose maps and representative behavior patterns or otherwise take multi-layered measures in cooperation with local governments.

In a stage to achieve the lifting of evacuation orders, as residents spend more time and move around more widely than in the preparatory stage, the national government will take measures to reduce residents' exposure doses based on dose data and individuals' living conditions and risk communication measures to meticulously respond to residents' worries and anxieties, comprehensively and in a multi-layered manner in line with each local government's wishes, in addition to steadily managing individuals' doses and securing a consultation system.

Included in this reference material on March 31, 2020

Reconstruction and Revitalization from the Accident

Demolition of Houses and other Buildings and Decontamination in Specified Reconstruction and Revitalization Base Areas

- ○ Works to demolish houses and other buildings and decontamination work have commenced in all of the six towns and villages (Futaba Town, Okuma Town, Namie Town, Tomioka Town, Iitate Village and Katsurao Village). Works have been completed for station squares, kindergartens, gymnasiums and other public facilities. Efforts to restore the environment are thus steadily progressing.
- ○ Ahead of the full reopening of the Japan Railway (JR) Joban Line on March 14, 2020, evacuation orders were lifted partially for some of the Specified Reconstruction and Revitalization Base Areas (on March 4 for Futaba Town, on March 5 for Okuma Town, and on March 10 for Tomioka Town) in advance of other areas.
- ○ In Specified Reconstruction and Revitalization Base Areas, **decontamination has been completed for over 70%, and the demolition of houses and other buildings has been completed for approximately 79% out of the total number of applications** (as of the end of December 2020).

Prepared by the Ministry of the Environment

When the Prime Minister approves Reconstruction and Revitalization Plans of Specified Reconstruction and Revitalization Base Areas in Restricted Areas made by the relevant municipalities, the demolition of houses and other buildings, decontamination work, development of infrastructure, etc. are conducted in an integrated manner in those areas.

The Ministry of the Environment (MOE) is now carrying out the demolition of houses and other buildings and decontamination work in all Specified Reconstruction and Revitalization Base Areas of Futaba Town, Okuma Town, Namie Town, Tomioka Town, Iitate Village and Katsurao Village based on their plans. Ahead of the full reopening of the JR Joban Line in March 2020, evacuation orders were lifted for some parts around Yonomori Station, Ono Station and Futaba Station among Specified Reconstruction and Revitalization Base Areas in advance of other areas.

At present, toward the lifting of evacuation orders for the entirety of respective areas, the demolition of houses and other buildings and decontamination work are being intensively promoted. As of the end of December 2020, decontamination has been completed for over 70% and the demolition of houses and other buildings has been completed for approximately 79% out of the total number of applications. Specified waste from demolished houses and other buildings is to be buried after volume reduction for disposal at the controlled disposal site managed by the Futaba Regional Municipal Association (Clean Center Futaba), and MOE, the Association and Fukushima Prefectural Government concluded the basic agreement thereon in August 2019.

Included in this reference material on March 31, 2021

Regarding the Fukushima Innovation Coast Framework, deliberations were commenced with the aim of having people around the world witness the spectacular recovery of the Hamadori District at the time of the Tokyo Olympic and Paralympic Games in 2020. The Fukushima Innovation Coast Framework Workshop compiled the Framework in June 2014, aiming to build a new industrial base in the Hamadori District in order to recover the industry and employment in the district that was severely affected by the earthquake and the nuclear disaster.

For achieving the framework, efforts have been made to develop bases for R&D on decommissioning, research and demonstration on robot technology, and information provision (archives base), to materialize projects in such fields as environment and recycling, energy including hydrogen and renewable energy, the agriculture, forestry and fisheries industry, medical services, and aerospace, and to form industrial clusters, foster human resources and develop living environment, etc.

In December 2019, the Reconstruction Agency, the Ministry of Economy, Trade and Industry and Fukushima Prefecture jointly compiled the "Blueprint of Industrial Development Placing the Fukushima Innovation Coast Framework at the Core," which shows envisaged independent and sustainable industrial development in the Hamadori District and concrete measures therefor also in consideration of the future after the reconstruction and revitalization period. Based on the Blueprint, Fukushima Prefecture formulated a draft revision of the Intensive Promotion Plan based on the Act on Special Measures for the Reconstruction and Revitalization of Fukushima in March 2020, and the revised plan was approved by the Prime Minister on May 1, 2020.

Additionally, Fukushima Prefecture established a general incorporated foundation, "Fukushima Innovation Coast Promotion Organization," in July 2017 as the central organization in promoting the Fukushima Innovation Coast Framework towards its realization. The Organization has strengthened its system sequentially since April 2018 and became a public interest incorporated foundation on January 1, 2019. In June 2020, the Act on Special Measures for the Reconstruction and Revitalization of Fukushima was amended, and a system was newly introduced to make it possible to dispatch national public employees to the Organization while maintaining their status as national public employees.

Included in this reference material on February 28, 2018
Updated on March 31, 2021

Reconstruction and Revitalization from the Accident

Traffic on Major Roads in Restricted Areas

- **Joban Expressway:** The entirety was restored in March 2015.
  Source: https://www.e-nexco.co.jp/en/pressroom/head_office/2014/1225/00006647.html
- **JR Joban Line:** The entirety was restored in March 2020.
  Source: https://www.jreast.co.jp/press/2019/20200117_ho01.pdf (in Japanese)
- **National roads and prefectural roads:** Transit without carrying and presenting a pass came to be permitted for National Road 6 from September 2014, for National Road 114 from September 2017, and for Prefectural Road 35 from September 2019.

Exposure doses of drivers passing through

Dose survey period		November 2018 to January 2019	August 2017	November to December 2019	
Section		Japan Expressway: between Hirono IC and Minamisoma IC	National Road 114: between the border of Kawamata Town and Namie IC	National Road 6: in Restricted Areas	Prefectural Road 35: in Restricted Areas
Exposure dose while passing through (μSv)	Automobiles	0.28	1.01	0.39	0.51
	Motorcycles	0.34	-	0.49	0.63

Reference) Exposure dose during a round flight between Tokyo and New York: approx. 80 to 110 μSv

Source: Prepared by the Support Team for Residents Affected by Nuclear Incidents based on the "Results of Radiation Dose Surveys in Restricted Areas along National Roads 114, 399 and 459 and Prefectural Roads 49 and 34" (September 15, 2017), the "Results of Radiation Dose Surveys in Restricted Areas along National Roads 6 and 114 and Prefectural Roads 34, 35, 36, 253 and 256" (January 30, 2020), and NEXCO East's website (https://jobando.jp/hibakusenryo/hibakuryo.html (in Japanese))

In Restricted Areas, transit had been restricted except for temporary entry of residents and transit based on the Special Transit Permission System.

As National Road 6 is a key major road for reconstruction and recovery of Fukushima Prefecture, after completion of decontamination and road repair work, special transit without carrying and presenting a pass came to be permitted for National Road 6 and Prefectural Road 36 on September 15, 2014, as a result of consultations with the relevant municipalities.

The Special Transit Permission System has also been applied to National Road 114 and Prefectural Road 35 based on consultations with the relevant local governments and organizations. From March 2020, motorcycles are also permitted to use some routes, such as National Road 6 and Prefectural Road 35. The most recent status of the application of the Special Transit Permission System and the results of dose surveys under the application of the system are published in the form of a notice of the Support Team for Residents Affected by Nuclear Incidents, Cabinet Office (https://www.meti.go.jp/earthquake/nuclear/kinkyu.html, in Japanese).

Included in this reference material on February 28, 2018
Updated on March 31, 2020

Chapter 10

Health Management

Chapter 10 outlines the Fukushima Health Management Survey and other surveys and examinations that are conducted for the purpose of promoting the health of the residents of Fukushima Prefecture and ensuring their safety in light of the effects of radiation due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS.

You can understand Fukushima Prefecture's efforts for health management in order to promote and maintain residents' good health toward the future.

Outline of the Fukushima Health Management Survey

What is Fukushima Prefecture's Fukushima Health Management Survey?

Considering the effects of radiation due to the nuclear disaster, Fukushima Prefecture has been conducting the "Fukushima Health Management Survey" since June 2011 in order to monitor and improve the health of residents for the long term into the future.

The Fukushima Health Management Survey consists of the following five components.

(i) Basic Survey (estimation of external doses) (all residents)

(ii) Detailed Surveys

- **Thyroid Ultrasound Examination** (residents aged around 18 or younger as of March 11, 2011)
- **Comprehensive Health Checkup** (residents in Evacuation Areas)
- **Mental Health and Lifestyle Survey** (residents in Evacuation Areas)
- **Pregnancy and Birth** Survey (pregnant women who have obtained a maternity handbook for each fiscal year)

Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University (information on the Fukushima Prefecture's Fukushima Health Management Survey)

In the aftermath of the diffusion of radioactive materials from the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, subsequent evacuations and such, the "Fukushima Health Management Survey" was commenced in Fukushima Prefecture, aiming to improve and maintain the health of the residents of the prefecture into the future by means of understanding their health conditions and linking such data to the prevention and early detection and treatment of diseases, while assessing their radiation doses.

Within the Fukushima Health Management Survey, the Basic Survey was offered to all residents of Fukushima Prefecture to ascertain their external doses during the four months following the accident at the NPS, and the Thyroid Ultrasound Examination has been conducted for all residents who were around 18 years old or younger at the time of the accident. The Comprehensive Health Checkup to ascertain physical health conditions and the Mental Health and Lifestyle Survey to ascertain mental health conditions have also been conducted for approximately 210,000 people who were residing in areas designated for evacuation after the accident. Furthermore, the Pregnancy and Birth Survey has been conducted for pregnant women who obtained a maternity handbook within Fukushima Prefecture and those who obtained a maternity handbook somewhere else but gave birth in the prefecture.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Outline of the Fukushima Health Management Survey

Fukushima Health Management Survey (Survey Promotion System)

[Purpose of the Survey]

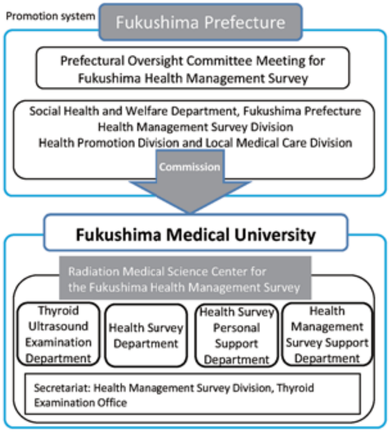
Considering the effects of radiation due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, Fukushima Prefecture has commissioned Fukushima Medical University to conduct the "Fukushima Health Management Survey" for all residents of the prefecture in order to monitor and improve their health for the long term and ensure their safety and peace of mind.

By continuously conducting surveys and health checkups, the Survey aims to achieve the prevention and early detection and treatment of diseases and improve the health of residents into the future, while developing better systems for research, education and medical services.

[Promotion system]

Under guidance and advice from qualified individuals comprising the Prefectural Oversight Committee Meeting for Fukushima Health Management Survey, Fukushima Prefecture and Fukushima Medical University have been jointly conducting the Survey.

Fukushima Medical University established the Radiation Medical Science Center for the Fukushima Health Management Survey in September 2011.



Prepared based on the outline of the "Fukushima Health Management Survey," Fukushima Prefecture

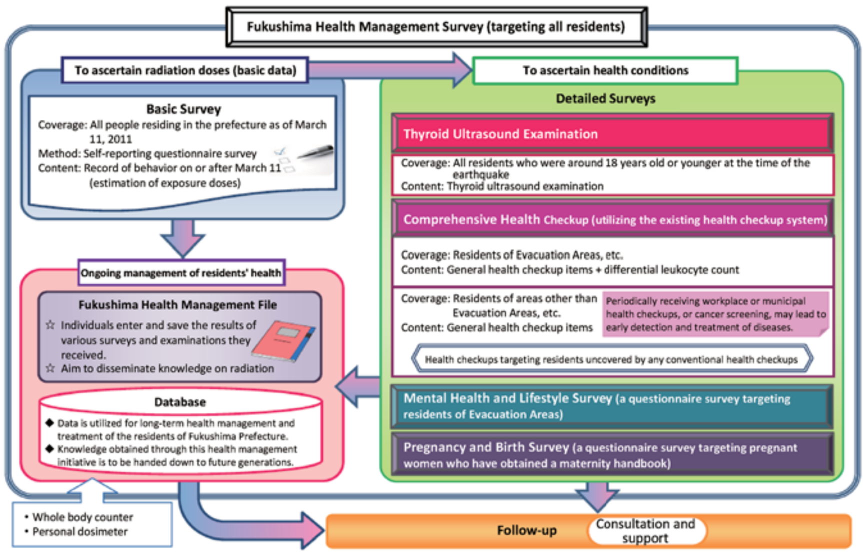
The Fukushima Health Management Survey is being carried out by Fukushima Medical University under commission from Fukushima Prefecture, which serves as the responsible entity. Fukushima Medical University established the Radiation Medical Science Center for the Fukushima Health Management Survey to carry out the Survey.

Fukushima Prefecture set up the Prefectural Oversight Committee Meeting for Fukushima Health Management Survey with the aim of obtaining advice on the Fukushima Health Management Survey from a broad panel of experts.

Included in this reference material on March 31, 2015
Updated on March 31, 2020

Outline of the Fukushima Health Management Survey

Fukushima Health Management Survey (Overview)



Prepared based on the outline of the "Fukushima Health Management Survey," Fukushima Prefecture

The Fukushima Health Management Survey is broadly divided into the Basic Survey and Detailed Surveys.

The Basic Survey was conducted for the purpose of estimating residents' external doses for the four months after the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS based on their behavioral records and obtaining data that is to serve as the basis for monitoring and protecting their health into the future.

The Detailed Surveys are to ascertain residents' present health conditions, as follows:

The first is the Thyroid Ultrasound Examination for all residents who were around 18 years old or younger as of March 11, 2011. As cases of thyroid cancer increased among children after the Chernobyl NPS Accident, this examination aims to ascertain children's thyroid status and promote their health for the long term.

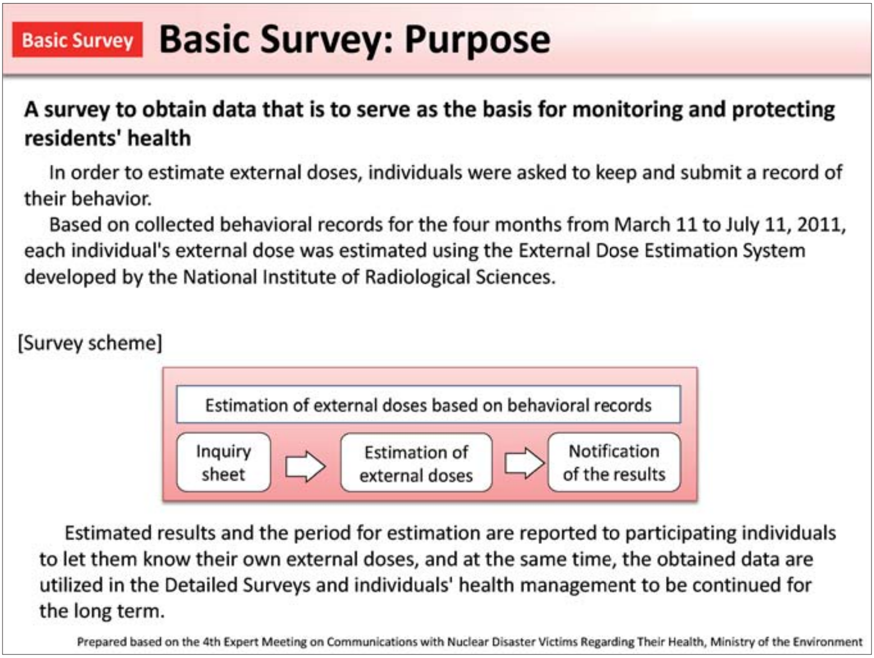
The second is the Comprehensive Health Checkup for people who used to reside in Evacuation Areas, being conducted with the aim of achieving the prevention, early detection, and treatment of lifestyle-related diseases that may be caused by changes in their living circumstances.

The third is the Mental Health and Lifestyle Survey, which is also conducted for people from Evacuation Areas. This is for offering support to the disaster victims to ease anxiety caused by the Great East Japan Earthquake and the accident at the NPS.

The fourth is the Pregnancy and Birth Survey targeting pregnant women who have worries over various things including radiation fears in relation to childbirth and child rearing.

Fukushima Prefecture compiles all data into a centralized database for the long-term utilization of accumulated knowledge.

Included in this reference material on March 31, 2013
Updated on March 31, 2020



The Basic Survey was commenced for the purpose of estimating the level of external doses of the residents of Fukushima Prefecture based on the records of their behavior, informing them of the estimation results individually, and thereby promoting and maintaining the health of the prefectural residents, in light of the effect of radiation due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, which occurred following the Great East Japan Earthquake.

Specifically, inquiry sheets were delivered to the applicable residents to ask them to record their behavior during the four months after the accident. Based on the behavioral records entered in the inquiry sheets, individuals' external doses were estimated using a program developed by the National Institute of Radiological Sciences. The four months after the accident, which is the targeted period of the Basic Survey, is the period during which ambient dose rates were the highest, and it is most important to determine people's external doses during this period.

Individuals' estimated external doses were compiled and statistically processed, and have been utilized for analyzing radiation exposure and its health effects in Fukushima Prefecture.

Included in this reference material on March 31, 2013
Updated on March 31, 2020

Basic Survey

Basic Survey: Outline

[Period for estimation]

Behavior during the four months from March 11 to July 11, 2011

[Coverage]

Approx. 2.06 million people

- Residents of the prefecture:

  People with residence registration in the prefecture from March 11 to July 1, 2011

- People residing outside the prefecture:

  (1) People who were registered as residents in other prefectures but were residing in the prefecture from March 11 to July 1, 2011

  (2) People residing outside the prefecture who commuted to work or school in the prefecture from March 11 to July 1, 2011

  (3) People residing outside the prefecture who temporarily stayed in the prefecture from Mar. 11 to Mar. 25, 2011

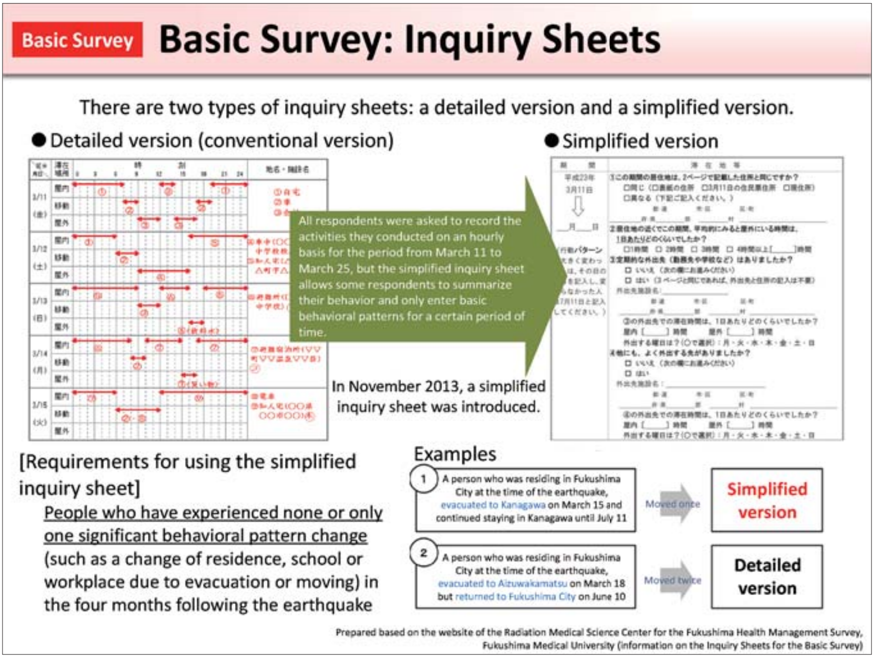
(For people residing outside the prefecture, inquiry sheets were sent upon their request.)

The 4th Expert Meeting on Communications with Nuclear Disaster Victims Regarding Their Health, Ministry of the Environment

The period for surveying behavioral records was the four months from March 11 to July 11, 2011.

The Basic Survey covered approx. 2.06 million people who were registered as residents of the prefecture at the time of the earthquake. People registered as residents in other prefectures were also covered if they resided, commuted to work or school, or temporarily stayed in the prefecture during this period.

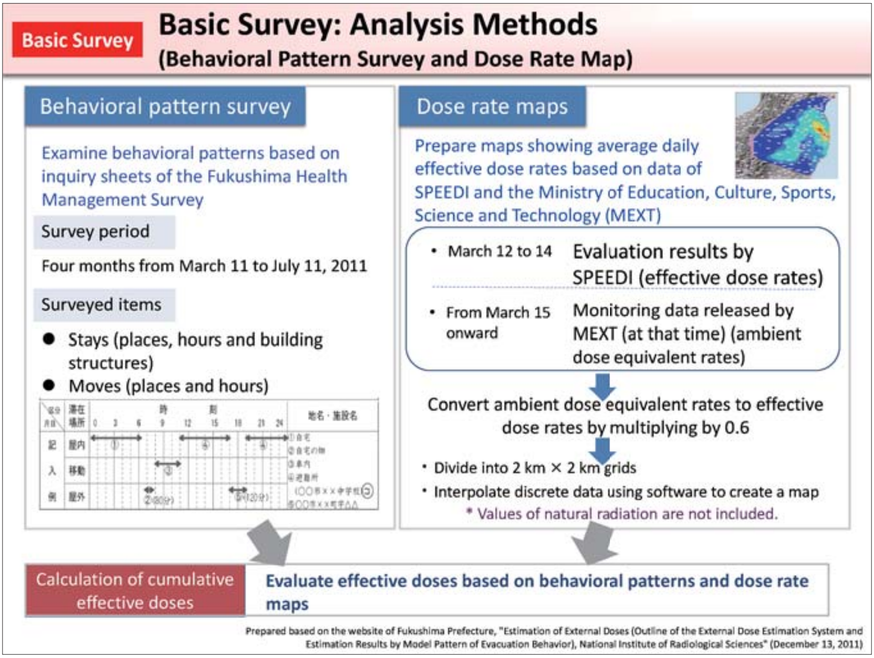
Included in this reference material on March 31, 2013
Updated on March 31, 2019



The inquiry sheet for the Basic Survey requires respondents to record the activities they conducted on an hourly basis for the period from March 11 to March 25. In response to complaints concerning the difficulty in filling in the sheet, a simplified version was introduced in November 2013.

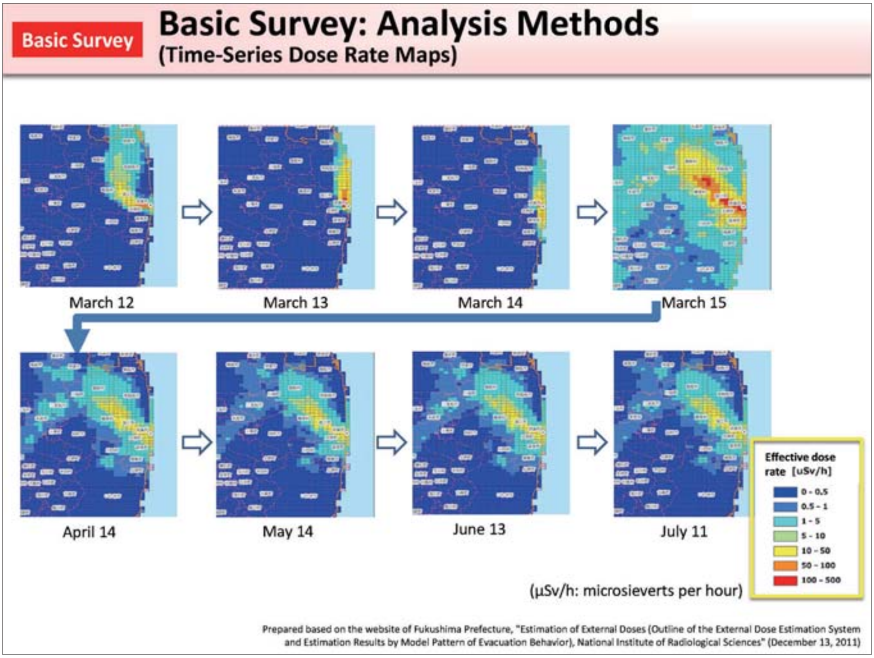
However, in order to maintain the accuracy of the survey, the simplified inquiry sheet may be used only by those who have experienced none or only one significant change in their living place due to evacuation or moving, etc. in the four months following the earthquake.

Included in this reference material on March 31, 2013
Updated on March 31, 2019



In the Basic Survey, external doses were evaluated combining the results of the behavioral pattern survey and the created dose rate maps. The evaluation was conducted based on dose rate maps and behavioral records entered by respondents, such as where and how long they stayed in buildings, and the type of buildings where they stayed, during the survey period.

Included in this reference material on March 31, 2013
Updated on March 31, 2019



Dose rate maps used here are the monitoring data released by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (at that time).*1

*1: For the three days from March 12 to March 14, which are included in the period (March 12 to March 15, 2011) during which the monitoring data released by MEXT (at that time) is not available, calculation results by SPEEDI (System for Prediction of Environmental Emergency Dose Information) using the data on radioactive material discharge released by the Nuclear and Industrial Safety Agency (at that time) in June 2011 were applied. Data for March 15 was assumed to be the same as that for March 16, and from March 16 onward, the monitoring data released by MEXT (at that time) was used.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Basic Survey

Basic Survey: Obtained Responses and Their Representativeness

The response rate was 27.7% for the entire Fukushima Prefecture.
However, as a result of the examination on the representativeness, the dose distribution based on the responses obtained so far in the seven districts in the prefecture was found to be unbiased and to properly represent that of respective districts.

Table 1 Responses to the Basic Survey

As of March 31, 2020

Coverage		2, 055, 251	
Number of responses	Detailed version	493, 859	24. 0%
	Simplified version	74, 773	3. 6%
	Total	568, 632	27. 7%

* Response rates are rounded off for each category.

Table 2 Response rate by age group

As of March. 31, 2020

Age group	0~9	10~19	20~29	30~39	40~49	50~59	60~	Total
Response rate	46.6%	36.2%	18.2%	24.8%	22.5%	23.0%	27.9%	27.7%

* Rates (%) are rounded off.

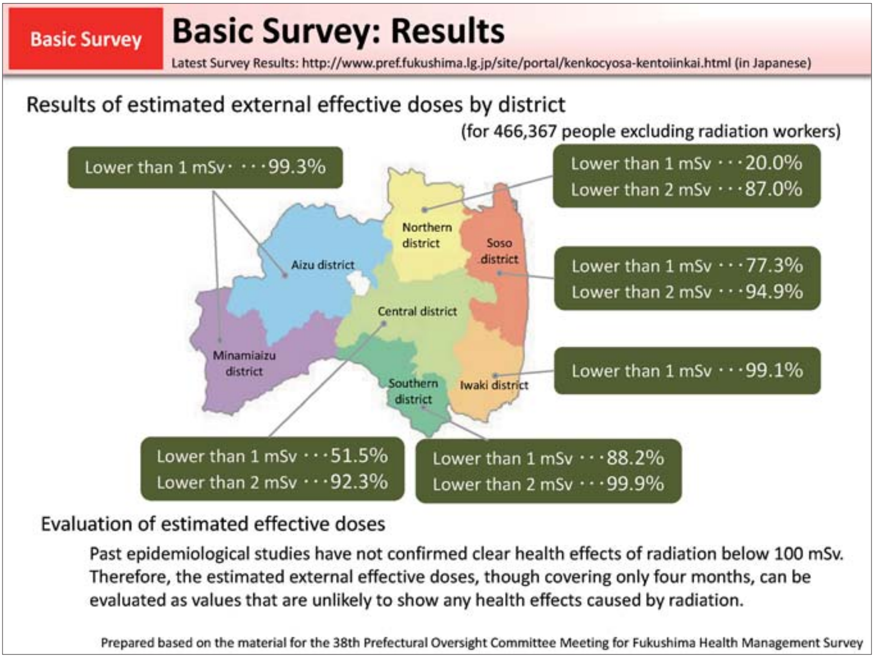
Prepared based on the material for the 38th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

Approx. 568,632 people have responded so far (response rate: 27.7%).

In light of the fact that the response rate of the Basic Survey had remained unchanged at around 27%, an examination on the representativeness of the dose distribution was conducted in FY2015. As a result of the examination, the dose distribution based on the responses obtained so far in the seven districts in the prefecture was found to be unbiased and to properly represent that of respective districts.

See the following website for details:
http://www.pref.fukushima.lg.jp/uploaded/attachment/151271.pdf (in Japanese)

Included in this reference material on March 31, 2013
Updated on March 31, 2021



Out of a total of 554,320 people for whom external effective doses have been estimated by March 31, 2020, a total of 475,579 people submitted records of their behavior for the entirety of the four-month period for estimation. The figure above shows the estimation results of 466,367 people, excluding those who had engaged in radiation work, by district. As shown in the figure, people for whom estimated external effective doses were lower than 1 mSv accounted for 88.2% in the southern district, 99.3% in the Aizu and Minamiaizu districts, 77.3% in the Soso district, and 99.1% in the Iwaki district. The maximum value was 25 mSv estimated for a person residing in the Soso district.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Purpose and Coverage

"We will promote the health of the children in Fukushima for the long term."

[Purpose]

It has been reported that cases of thyroid cancer increased among children after the Chernobyl NPS Accident due to internal exposure to radioactive iodine. Although radioactive iodine doses are considered to be lower in Fukushima than in Chernobyl, the Thyroid Ultrasound Examination was commenced with the aim of ascertaining children's thyroid status and promoting their health for the long term.

[Coverage]

All people of Fukushima Prefecture who were aged zero to 18 as of March 11, 2011 (those born from April 2, 1992, to April 1, 2011) (approx. 368,000 people)
* For the Full-scale Survey in FY2014 onward, the coverage was expanded to include those born from April 2, 2011, to April 1, 2012 (approx. 381,000 people in total).

Prepared based on the Report on the Fukushima Prefecture's Fukushima Health Management Survey (FY2019)

It has been reported that cases of thyroid cancer increased among children after the Chernobyl NPS Accident due to internal exposure to radioactive iodine. Compared with the Chernobyl NPS Accident, the amount of radioactive materials discharged into the environment after the accident in Fukushima was much smaller, and estimated internal and external doses of the residents were even smaller. Therefore, it is predicted that there would be no epidemiologically detectable thyroid health risks (p.141 of Vol. 1, "Evaluation of the Interim Report on Thyroid Cancer Compiled by the Expert Meeting on Health Management After the TEPCO's Fukushima Daiichi NPS Accident"). However, as concerns remain about effects of radiation due to the accident on children's thyroid glands, the Thyroid Ultrasound Examination has been continued under the framework of the Fukushima Health Management Survey with the aim of ascertaining children's thyroid status and promoting their health into the future.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Outline (1/3)

● Examination schedule

	Category	Period	Eligible subjects
First examination < Finished >	**Preliminary Baseline Survey** In order to ascertain children's thyroid status	Oct. 2011 - March 2014	Residents who were residing in Fukushima Prefecture at the time of the earthquake and were approximately 18 years old or younger (those born from April 2, 1992, to April 1, 2011)
Second examination Third examination Fourth examination < Finished >	**Full-scale Survey** In order to make comparison with the results of the Initial Screening	April 2014 - March 2020	Those born from April 2, 2011, to April 1, 2012 *Once every two years until becoming 20 years old, then once every five years after becoming 25 years old, for example, at the ages of 30, 35 and so on
Fifth examination*1		April 2020 -	

*1 Depending on the age of residents, the examination is the fourth one. For details, access the following to check the year to receive the examination (https://fukushima-mimamori.jp/thyroid-examination/yearsearch.html) (in Japanese).

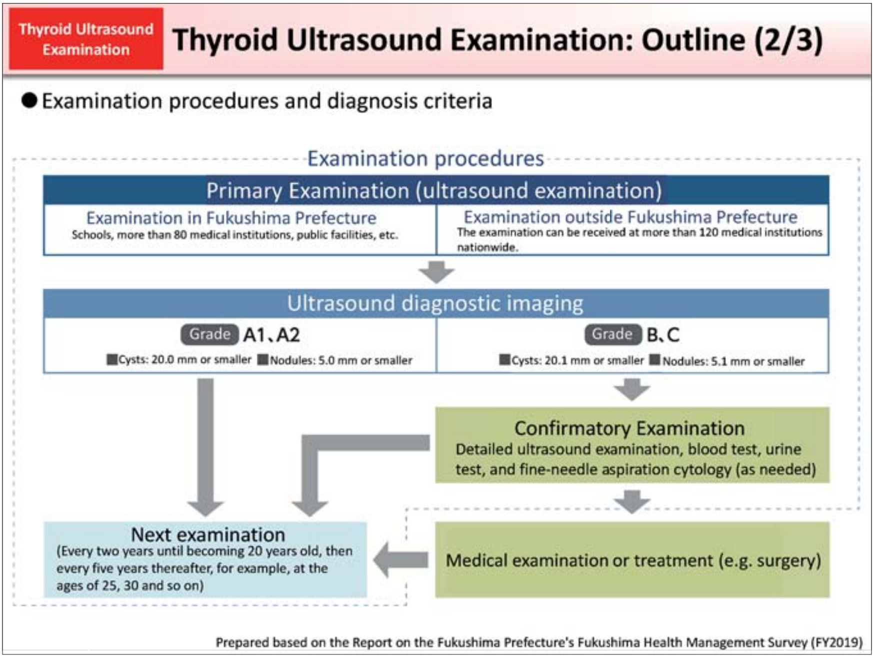
Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University (information on the Thyroid Ultrasound Examination)

Ascertaining the current thyroid status of the relevant group of people even though radiation effects are unlikely to be detected is very important for promoting their health for the long term. Therefore, the Thyroid Ultrasound Examination was conducted for all children in Fukushima Prefecture after the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS over a period of approximately two and a half years from October 2011 (Preliminary Baseline Survey).

Then, in FY2014, the coverage was expanded to include those born from April 2, 2011, to April 1, 2012, and the Full-scale Survey was conducted as the second examination.

From the third examination onward, the targeted people receive examinations once every two years until they become 20 years old and once every five years thereafter.

Included in this reference material on March 31, 2013
Updated on March 31, 2021



The Primary Examination checks whether there are any nodules or cysts and measures the sizes thereof, if any. The Confirmatory Examination is recommended to those who are considered to require a more detailed examination.

In the Confirmatory Examination, a more accurate ultrasound examination, plus blood and urine tests are conducted, and fine-needle aspiration cytology is also conducted when a doctor considers it necessary.

The Thyroid Ultrasound Examination is completed at this point.

Then, individuals who are found to require treatment receive it from their regular healthcare provider, under the relevant medical insurance system.

Included in this reference material on March 31, 2016
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Outline (3/3)

● Content of the examination

[Primary Examination]

An ultrasound examination assesses whether there are any nodules or cysts. The examination ordinarily finishes in three to five minutes with no pain involved.

The diagnosis panel, consisting of medical specialists, reviews the ultrasound images and makes diagnoses. The examination results are sent by post, but explanations are given at the examination venues or by phone upon examinees' requests.

[Confirmatory Examination]

When a more detailed examination is found to be necessary as a result of the Primary Examination, the Confirmatory Examination is conducted for the relevant person.
In the Confirmatory Examination, another ultrasound examination, plus blood and urine tests are conducted.

If a doctor considers it necessary as a result of these tests, fine-needle aspiration cytology of the thyroid may also be performed and interpreted.

Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University (information on the Thyroid Ultrasound Examination, FAQs)

An ultrasound examination is conducted with an examinee lying on his/her back. A doctor places an ultrasonic probe with jelly on its tip over the examinee's thyroid (located around the base of the neck) and examines whether there are any cysts or nodules while moving the probe over the examinee's skin.

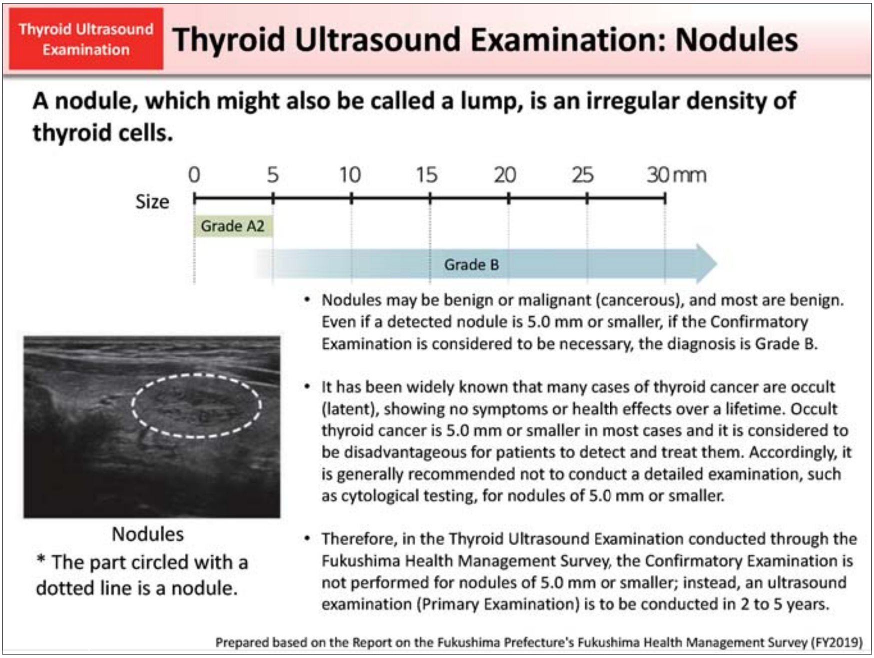
The examination ordinarily finishes in three to five minutes with no pain involved.

Definitive diagnoses from the Primary Examination are not made at the venues. In order to make comprehensive and objective judgments, ultrasound images are later reviewed by a panel of medical specialists. This is to ensure a consistently high level of diagnostic accuracy throughout the Fukushima Health Management Survey.

The sizes of nodules and cysts mentioned above are reference values for making diagnoses. If any nodules or cysts found in ultrasound images are suspected to be malignant, the case is designated as Grade B irrespective of the sizes of the nodules or cysts and the Confirmatory Examination is recommended.

In the Confirmatory Examination, a more accurate ultrasound examination, plus blood and urine tests, are conducted. If, as a result of these tests, a doctor considers it necessary, fine-needle aspiration cytology, an examination of a sample tissue taken from the person's thyroid, may also be conducted.

Included in this reference material on March 31, 2016
Updated on March 31, 2019

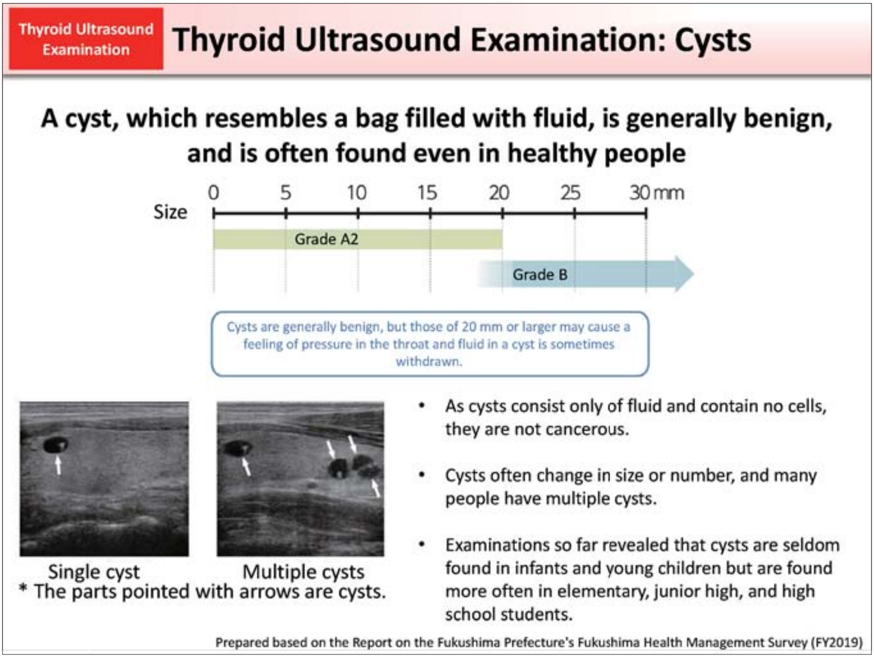


A nodule, which might also be called a lump, is a thyroid cell with irregular density. Some nodules are malignant, but most are benign.

It has been known that thyroid cancer is often latent, presenting no symptoms or health effects over a lifetime. Thus, detecting all cancers and forcing patients to receive treatment may be sometimes rather disadvantageous, so a detailed examination, such as cytological testing, is not generally conducted for small nodules. In the Thyroid Ultrasound Examination conducted through the Fukushima Health Management Survey, the Confirmatory Examination is not performed for nodules of 5 mm or smaller; instead, the next regularly scheduled ultrasound examination (Primary Examination) is to be conducted.

In some cases, a person once diagnosed as Grade A1 is diagnosed as Grade A2 or Grade B in the next examination, or conversely, a person once diagnosed as Grade A2 is subsequently diagnosed as Grade A1.

Included in this reference material on March 31, 2013
Updated on March 31, 2021



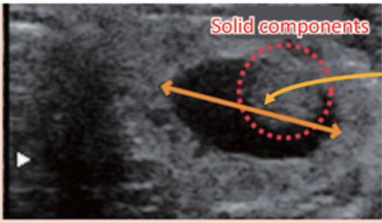
Cysts identified in the Thyroid Ultrasound Examination being conducted in Fukushima Prefecture are considered benign, consisting only of fluid and containing no cells. They are often found even in healthy people, especially among primary and secondary school students. Therefore, repeated examinations often find cysts as children grow up.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Handling of Cysts with Solid Components

Cysts with solid components are all judged as nodules.



Measure the entirety of a cyst

When the maximum size of a cyst with solid components (the length of the orange arrow) is 5.1 mm or larger, the examinee is diagnosed as Grade B.

- "Cysts with solid components," which are cysts containing nodules inside, are all evaluated as nodules in this examination.
- In such case, not the size of a nodule inside but the maximum size of a cyst with the nodule is recorded. For example, when a 3 mm-nodule is found in a 30 mm-cyst, the relevant examinee is judged to have a 30 mm-nodule and is diagnosed as Grade B (as the size exceeds 5.1 mm).

Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University (information on the Thyroid Ultrasound Examination, FAQs)

Some cysts contain nodules. In the Thyroid Ultrasound Examination conducted in the Fukushima Health Management Survey, those cysts with solid components (nodules) are all judged as nodules and diagnosis criteria for nodules are applied.

For example, a 30 mm-cyst with a 3 mm-nodule is judged as a nodule and diagnosis criteria for nodules are applied. As the size is larger than 5.1 mm, the examinee is diagnosed as Grade B and is advised to receive the Confirmatory Examination.

Items judged as fluid-only cysts are considered to be benign.

(Related to p.130 of Vol. 2, "Thyroid Ultrasound Examination: Cysts")

Included in this reference material on March 31, 2016
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: System for Examinations in and outside Fukushima

Expansion of available institutions and system for implementing examinations in Fukushima Prefecture

Efforts have been continued to increase the number of institutions in Fukushima Prefecture and to enhance system for implementing examinations in order to reduce the number of people who cannot receive the examination due to various reasons.

Expansion of institutions for implementing examinations outside Fukushima Prefecture

Efforts have been continued to increase institutions so that people can receive the examination even outside the prefecture.

The examination can be received at more than 120 medical institutions nationwide.
In order to receive the Thyroid Ultrasound Examination, you need to make a reservation in advance with the Radiation Medical Science Center for the Fukushima Health Management Survey.

Provision of explanation booths

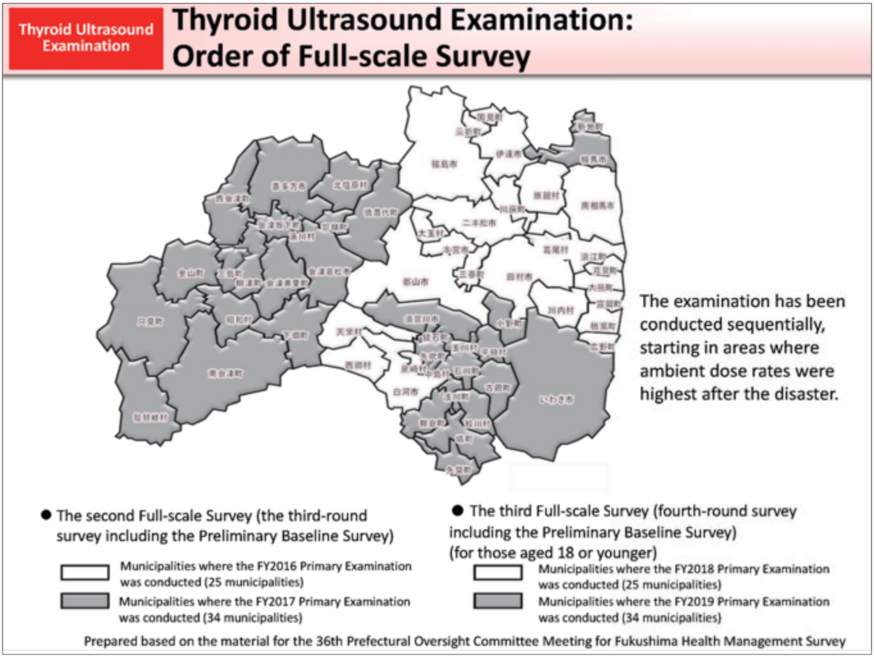
Since July 2015, booths have been set up at examination venues in public facilities, etc. for providing examinees with explanations on examination results. Physicians explain provisional examination results available on the day using ultrasound images.

When explanation booths cannot be set up at the examination venue or for examination performed in some venues such as schools, telephone consultation services are provided instead.

Prepared based on the Fukushima Health Management Survey Reports (2018 and 2019)

The Thyroid Ultrasound Examination is conducted in collaboration between Fukushima Medical University and medical institutions in and outside Fukushima Prefecture. For more convenience to residents of the prefecture, efforts have been made to increase venues and opportunities with the aim of promoting the health of the residents in Fukushima Prefecture for the long term.

Included in this reference material on March 31, 2015
Updated on March 31, 2021



The Thyroid Ultrasound Examination has been conducted sequentially, starting in areas where ambient dose rates were higher at the time of the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS.

For Full-scale Surveys following the Preliminary Baseline Survey, notices of the examination have been sent mostly in the same order.

Since the third Full-scale Survey (fourth-round survey overall), the examination has been conducted mostly in the same order for those aged 18 or younger. However, for those aged 19 or older, the examination has been conducted not by region but by age (school year). In FY2018, those born in FY1996 (aged 22) and born in FY1998 (aged 20) were examined, and in FY2019, those born in FY1997 (aged 22) and born in FY1999 (aged 20) were examined.

Since FY2017, the examination has been conducted for those who become 25 years old in the relevant year, and then once every five years thereafter.

Included in this reference material on March 31, 2015
Updated on March 31, 2019

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Results of the Preliminary Baseline Survey

Latest Examination Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

● Results of the Primary Examination

	Number of eligible subjects (people)	Number of examinees (people)			Number of those diagnosed (people)				
		Examination rate (%)	Examinees from outside of the prefecture	Diagnosis rate (%)	Breakdown by grade (%)				
					A		Those recommended to take the Confirmatory Examination	
					A 1	A 2	B	C
Total	367,649	300,473 (81.7)	9,511	300,473 (100.0)	154,605(51.5)	143,574 (47.8)	2,293(0.8)	1 (0.0)

Grade A : 99.2%

● Results of the Confirmatory Examination

	Number of eligible subjects (people)	Number of examinees (people)	Rate of definitive diagnosis (%)	Number of those who received a definitive diagnosis (people)			
				For next examination		For regular healthcare program, etc.	
		Examination rate (%)		A 1	A 2		Those who received fine-needle aspiration cytology
Total	2,293	2,130 (92.9)	2,090 (98.1)	132 (6.3)	579 (27.7)	1,379 (66.0)	547 (39.7)

● Results of the fine-needle aspiration cytology

Malignant or suspicious for malignancy: 116 people; 39 males and 77 females

Average age: 17.3 ± 2.7 years old (8 to 22 years old); At the time of the earthquake: 14.9 ± 2.6 years old (6 to 18 years old)

Average tumor size: 13.9 ± 7.8 mm (5.1 to 45.0 mm)

● Out of 116 people whose tumors were diagnosed as malignant or suspicious for malignancy, 102 received surgery (benign nodule: 1; papillary cancer: 100; poorly differentiated cancer: 1).

Prepared based on the material for the 27th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

These are the results of the Preliminary Baseline Survey, which was the very first Thyroid Ultrasound Examination (FY2011 to FY2013).

Examinees diagnosed as Grade A in the Primary Examination accounted for 99.2% of the total, while those diagnosed as Grade B accounted for 0.8%. It became clear that most of those diagnosed as Grade A2 had cysts of 20 mm or smaller and that those diagnosed as Grade B had nodules of 5.1 mm or larger.

In the Confirmatory Examination, as a result of a more accurate ultrasound examination and other tests, 34%, or approximately one out of three who received the Confirmatory Examination, were diagnosed as being equivalent to Grade A and were recommended to receive the next periodic examination (Full-scale Survey) in the same manner as those diagnosed as Grade A in the Primary Examination. This is because those who were suspected to have any abnormalities were diagnosed as Grade B just to be safe in the Primary Examination, and such people include those eventually diagnosed as Grade A in the Confirmatory Examination as a result of comprehensive and objective judgments through a more detailed examination, etc.

Among the examinees whose results of the Confirmatory Examination were finalized, 66% were shifted to ordinary medical care covered by health insurance, and appropriate measures are determined by the responsible doctor, based on individual findings and circumstances.

Furthermore, 39.7% went through fine-needle aspiration cytology, and 116 examinees were diagnosed as malignant or suspicious for malignancy. Out of these examinees, it is known that 102 had surgery. However, not all the patients who are diagnosed as malignant or suspicious for malignancy are indicated for immediate surgery, and the decisions are made depending on the individuals' situations after the consultation among physicians, examinees, and their families.

Included in this reference material on March 31, 2016
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Results of the First Full-scale Survey (Second-round Survey)

Latest Examination Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

● Results of the Primary Examination

	Number of eligible subjects (people)	Number of examinees (people)		Diagnosis rate (%)	Number of those diagnosed (people) Breakdown by grade (%)			
		Examination rate (%)	Examinees from outside of the prefecture		A		Those recommended to take the Confirmatory Examination	
					A 1	A 2	B	C
Total	381,244	270,540(71.0)	15,658	270,529 (100.0)	108,718(40.2)	159,584(59.0)	2,227(0.8)	0 (0.0)

Grade A : 99.2%

● Results of the Confirmatory Examination

	Number of eligible subjects (people)	Number of examinees (people)	Rate of definitive diagnosis (%)	Number of those who received a definitive diagnosis (people)			
		Examination rate (%)		For next examination		For regular healthcare program, etc.	
				A 1	A 2		Those who received fine-needle aspiration cytology
Total	2,227	1,874(84.1)	1,826(97.4)	63(3.5)	365(20.0)	1,398(76.6)	207(14.8)

* The total of percentages with one decimal place may not be 100% due to rounding.

● Results of the fine-needle aspiration cytology

Malignant or suspicious for malignancy: 71people; 32 males and 39 females
Average age: 16.9 ± 3.2 years old (9 to 23 years old); At the time of the earthquake: 12.6 ± 3.2 years old (5 to 18 years old)
Average tumor size: 11.1 ± 5.6 mm (5.3 to 35.6 mm)

● Out of 71 people whose tumors were diagnosed as malignant or suspicious for malignancy, 54 received surgery (papillary cancer: 53; other types of thyroid cancer: 1).

Prepared based on the material for the 31st and 39th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

These are the results of the first Full-scale Survey, which was the second round of the Thyroid Ultrasound Examination.

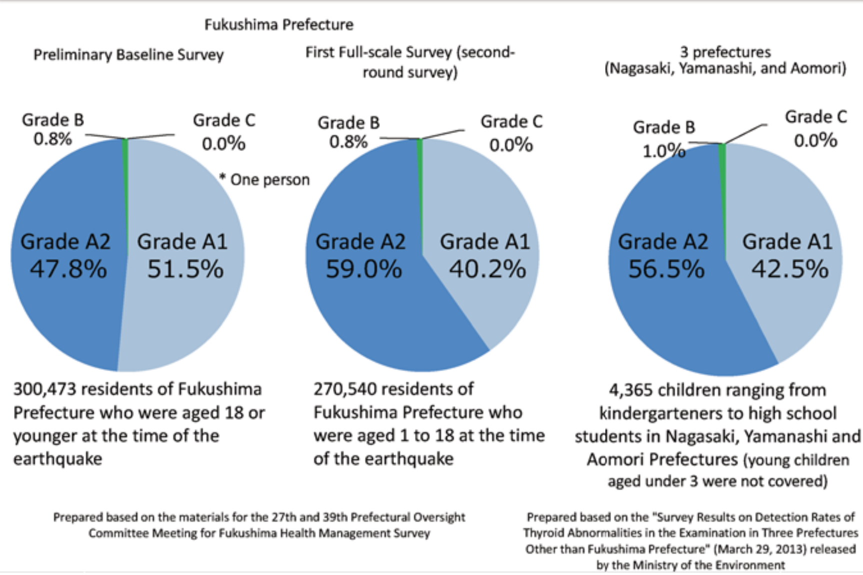
Examinees diagnosed as Grade A in the Primary Examination accounted for 99.2% of the total, while those diagnosed as Grade B accounted for 0.8%. Most of those diagnosed as Grade A2 had cysts of 20 mm or smaller and those diagnosed as Grade B had nodules of 5.1 mm or larger. This tendency was the same as that observed in the Preliminary Baseline Survey.

In the Confirmatory Examination, as a result of fine-needle aspiration cytology, 71 examinees were diagnosed that their tumors were malignant or suspicious for malignancy.

Included in this reference material on March 31, 2016
Updated on March 31, 2021

Thyroid Ultrasound Examination

Comparison between the Thyroid Ultrasound Examination and the Examination in Other Prefectures



When the Thyroid Ultrasound Examination commenced, many concerns were raised about a relatively high percentage of examinees diagnosed as Grade A2. Therefore, in FY2012, the Ministry of the Environment (MOE) conducted the thyroid examination targeting approx. 4,300 children in Nagasaki, Yamanashi and Aomori Prefectures (3-prefecture examination) in the same manner as the examination conducted in Fukushima Prefecture.

The Preliminary Baseline Survey in Fukushima Prefecture covered those aged zero to 18 at the time of the earthquake, and the first Full-scale Survey covered those aged two to 23 at the time of the examination, respectively, while the 3-prefecture examination excluded children aged under 3 and covered only those aged 3 to 18. As the sample size of the cohort was much smaller in the 3-prefecture examination, a simple comparison cannot be made, but the results show that those diagnosed as Grade A2 were not exceedingly greater in number among the children of Fukushima Prefecture. The results of the 3-prefecture examination after age adjustment based on the demographics of Japan as of 2010 show that the detection rate of cysts was reported as 52.35% and that of nodules as 1.54%,[*1] which were similar to the results of the Preliminary Baseline Survey and the first Full-scale Survey in Fukushima Prefecture. The report of the 3-prefecture examination also made the following observations: "It is generally known that the detection rate of nodular lesions is lower in the group of examinees aged 3 to 5 than in the group of examinees aged 6 or older, and that females show higher detection rate than males. Therefore, there is the possibility that a detection rate tabulated based on simple descriptive statistical methods as in this case may be higher than the actual rate."[*2] In fact, the percentage of those diagnosed as Grade A2 in the first Full-scale Survey (second-round survey) excluding examinees aged 2 or younger was extremely close to the results of the 3-prefecture examination.

*1: Hayashida N, et al. Thyroid Ultrasound Findings in Children from Three Japanese Prefectures: Aomori, Yamanashi and Nagasaki. PLoS One. 8(12): e83220, 2013.
*2: "Report on the Outcome of the FY2012 Survey on Detection Rates of Thyroid Abnormalities" (commissioned by MOE), The Japan Association of Breast and Thyroid Sonology (March 2013)

Included in this reference material on March 31, 2014
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Results of the Second Full-scale Survey (Third-round Survey)

Latest Examination Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

● Results of the Primary Examination

	Number of eligible subjects (people)	Number of examinees (people)		Diagnosis rate (%)	Number of those diagnosed (people)			
					Breakdown by grade (%)			
					A		Those recommended to take the Confirmatory Examination	
		Examination rate (%)	Examinees from outside the prefecture		A 1	A 2	B	C
Total	336,670	217,921(64.7)	12,509	217,920 (100.0)	76,433(35.1)	139,986(64.2)	1,501(0.7)	0 (0.0)

Grade A: 99.3%

● Results of the Confirmatory Examination

	Number of eligible subjects (people)	Number of examinees (people)	Rate of definitive diagnosis (%)	Number of those who received a definitive diagnosis (people)			
				For next examination		For regular healthcare program, etc.	
		Examination rate (%)		A 1	A 2		Those who received fine-needle aspiration cytology
Total	1,501	1,101(73.4)	1,060(96.3)	9(0.8)	100(9.4)	951(89.7)	78(8.2)

* The total of percentages with one decimal place may not be 100% due to rounding.

● Results of the fine-needle aspiration cytology

Malignant or suspicious for malignancy: 31 people; 13 males and 18 females
Average age: 16.3 ± 2.9 years old (12 to 23 years old); At the time of the earthquake: 9.6 ± 2.9 years old (5 to 16 years old)
Average tumor size: 12.9 ± 6.4 mm (5.6 to 33.0 mm)

● Out of 31 people whose tumors were diagnosed as malignant or suspicious for malignancy, 27 received surgery (papillary cancer: 27).

Prepared based on the material for the 39th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

These are the results of the second Full-scale Survey, which was the third round of the Thyroid Ultrasound Examination. Examinees diagnosed as Grade A in the Primary Examination accounted for 99.3% of the total, while those diagnosed as Grade B accounted for 0.7%. Most of those diagnosed as Grade A2 had cysts of 20 mm or smaller and those diagnosed as Grade B had nodules of 5.1 mm or larger. This tendency was the same as that observed in the Preliminary Baseline Survey and the first Full-scale Survey (second-round survey). In the Confirmatory Examination, as a result of fine-needle aspiration cytology, 31 examinees were diagnosed that their tumors were malignant or suspicious for malignancy.

Included in this reference material on March 31, 2019
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Results of the Third Full-scale Survey (Fourth-round Survey)

Latest Examination Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

● Results of the Primary Examination

	Number of eligible subjects (people)	Number of examinees (people)		Diagnosis rate (%)	Number of those diagnosed (people) Breakdown by grade (%)			
		Examination rate (%)	Examinees from outside of the prefecture		A		Those recommended to take the Confirmatory Examination	
					A 1	A 2	B	C
Total	294,240	180,570(61.4)	9,799	177,424 (98.3)	59,808(33.7)	116,289(65.5)	1,327(0.7)	0 (0.0)

Grade A: 99.3%

● Results of the Confirmatory Examination

	Number of eligible subjects (people)	Number of examinees (people) Examination rate (%)	Rate of definitive diagnosis (%)	Number of those who received a definitive diagnosis (people)			
				For next examination		For regular healthcare program, etc.	
				A 1	A 2		Those who received fine-needle aspiration cytology
Total	1,327	741(55.8)	647(87.3)	2(0.3)	57(8.8)	588(90.9)	49(8.3)

* The total of percentages with one decimal place may not be 100% due to rounding.

● Results of the fine-needle aspiration cytology

Malignant or suspicious for malignancy: 21 people; 11 males and 10 females
Average age: 16.6 ± 2.5 years old (11 to 20 years old); At the time of the earthquake: 8.6 ± 2.4 years old (4 to 12 years old)
Average tumor size: 11.6 ± 5.3 mm (6.1 to 29.4 mm)

● Out of 21 people whose tumors were diagnosed as malignant or suspicious for malignancy, 13 received surgery (papillary cancer: 13).

Prepared based on the material for the 39th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

These are the results of the third Full-scale Survey which was the fourth round of the Thyroid Ultrasound Examination.

Examinees diagnosed as Grade A in the Primary Examination accounted for 99.3% of the total, while those diagnosed as Grade B accounted for 0.7%. Most of those diagnosed as Grade A2 had cysts of 20 mm or smaller and those diagnosed as Grade B had nodules of 5.1 mm or larger. This tendency was the same as that observed in the Preliminary Baseline Survey and the first and second Full-scale Surveys (second- and third-round surveys).

In the Confirmatory Examination, as a result of fine-needle aspiration cytology, 21 examinees were diagnosed that their tumors were malignant or suspicious for malignancy.

Included in this reference material on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Results of Full-Scale Survey (Examination at the Age of 25)

Latest Examination Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

● Results of the Primary Examination

	Number of eligible subjects (people)	Number of examinees (people)		Diagnosis rate (%)	Number of those diagnosed (people)			
					Breakdown by grade (%)			
					A		Those recommended to take the Confirmatory Examination	
		Examination rate (%)	Examinees from outside the prefecture		A 1	A 2	B	C
Total	66,637	5,578(8.4)	1,793	5,234 (93.8)	2,228(42.6)	2,762(52.8)	244(4.7)	0 (0.0)

Grade A: 95.3%

● Results of the Confirmatory Examination

	Number of eligible subjects (people)	Number of examinees (people) Examination rate (%)	Rate of definitive diagnosis (%)	Number of those who received a definitive diagnosis (people)			
				For next examination		For regular healthcare program, etc.	
				A 1	A 2		Those who received fine-needle aspiration cytology
Total	244	168(68.9)	160(95.2)	1(0.6)	10(6.3)	149(93.1)	13(8.7)

* The total of percentages with one decimal place may not be 100% due to rounding.

● Results of the fine-needle aspiration cytology

Malignant or suspicious for malignancy: 7 people; 2 males and 5 females
Average age: 25.3 ± 1.0 years old (24 to 27 years old); At the time of the earthquake: 17.1 ± 0.7 years old (16 to 18 years old)
Average tumor size: 22.6 ± 15.6 mm (10.8 to 49.9 mm)

● Out of 7 people whose tumors were diagnosed as malignant or suspicious for malignancy, 4 received surgery (papillary cancer: 3; follicular cancer: 1).

Prepared based on the material for the 39th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

In the implementation period of the second Full-scale Survey (FY2017), a survey targeting people who become 25 years old during the relevant fiscal year was commenced as part of the Full-scale Survey. These are the results of such surveys targeting people born in FY1992 through FY1994.

Examinees diagnosed as Grade A in the Primary Examination accounted for 95.3% of the total, while those diagnosed as Grade B accounted for 4.7%. Most of those diagnosed as Grade A2 had cysts of 20 mm or smaller and those diagnosed as Grade B had nodules of 5.1 mm or larger. This tendency was the same as that observed so far, but targeted examinees were older than in prior examinations, and therefore, the percentages of those diagnosed as Grade B and those diagnosed to have nodules were higher compared with the Preliminary Baseline Survey and the first to third Full-scale Surveys (second- to fourth-round surveys).

In the Confirmatory Examination, as a result of fine-needle aspiration cytology, 7 examinees were diagnosed that their tumors were malignant or suspicious for malignancy.

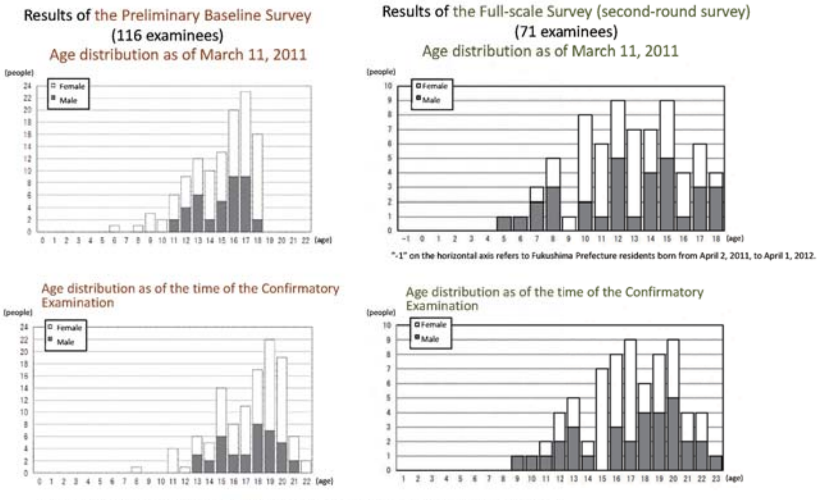
Included in this reference material on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Results of the Preliminary Baseline Survey and the Full-scale Survey (Details of Fine-needle Aspiration Cytology 1)

Latest Examination Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

- Age distribution of examinees whose tumors were diagnosed as malignant or suspicious for malignancy as a result of fine-needle aspiration cytology



Prepared based on the Materials for the 27th and 31st Prefectural Oversight Committee Meetings for Fukushima Health Management Survey

These graphs show the age distributions of examinees whose thyroid lesions were diagnosed as malignant or suspicious for malignancy by fine-needle aspiration cytology in the Preliminary Baseline Survey and the Full-scale Survey (second-round survey): they are shown by the age as of March 11, 2011 (top) and at the time of the Confirmatory Examination (bottom). The results of the Preliminary Baseline Survey and the Full-scale Survey (second-round survey) do not show the situation where thyroid cancer is found more frequently among young children (aged zero to 5), who are considered to have higher sensitivity to radiation, than among people in the other age groups.

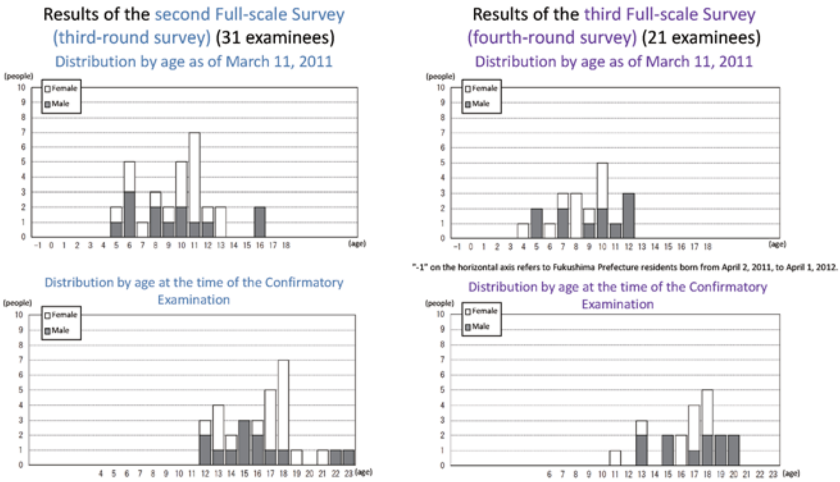
Included in this reference material on March 31, 2014
Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Results of the Preliminary Baseline Survey and the Full-scale Survey (Details of Fine-Needle Aspiration Cytology 2)

Latest Examination Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

● Age distribution of examinees whose tumors were diagnosed as malignant or suspicious for malignancy as a result of fine-needle aspiration cytology



Prepared based on the material for the 39th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

These graphs show the age distribution, as of March 11, 2011, of examinees who subsequently had thyroid lesions diagnosed as malignant or suspicious for malignancy by fine-needle aspiration cytology in the second and third Full-scale Surveys (third- and fourth-round surveys), and their ages at the time of the Confirmatory Examination. The distribution by age at the time of the disaster tends to be shifted towards younger ages compared with the results of the Preliminary Baseline Survey and the first Full-scale Survey (second-round survey), but the distribution by age at the time of the Confirmatory Examination was the same as in the case of the Preliminary Baseline Survey and the first Full-scale Survey (second-round survey).

Included in this reference material on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Remarks on the Results of the Preliminary Baseline Survey

● The Thyroid Ultrasound Examination, which had no precedent for childhood screening, revealed thyroid cancers that might have otherwise gone unnoticed.

Percentage of examinees whose tumors were diagnosed as malignant or suspicious for malignancy as a result of fine-needle aspiration cytology (against the total examinees of the Primary Examination)

FY2011	FY2012	FY2013
0.03%	0.04%	0.04%

Material for the 20th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

● Evaluation of thyroid cancers found in the Preliminary Baseline Survey, the Interim Report by the Prefectural Oversight Committee Meeting for Fukushima Health Management Survey (March 2016)

"Comprehensively considering that: exposure doses due to the accident at the Fukushima Daiichi NPS were generally lower than those caused by the Chernobyl NPS Accident; the period of time from the exposure to the detection of cancers is short (mostly from one to four years); cancers have not been detected in those aged 5 or younger at the time of the accident; and there is no significant regional difference in detection rates, it can be concluded that thyroid cancers found so far through the Thyroid Examination cannot be attributed to radiation discharged due to the accident.

However, the possibility of radiation effects may be small but cannot be completely denied at this point in time. Additionally, it is necessary to accumulate information in the long term for accurate evaluation of the effects. Therefore, the Thyroid Ultrasound Examination should be continued, while meticulously explaining the disadvantages of receiving the examination and obtaining the understanding of examinees."

○ The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) reiterated in its 2017 White paper* that excessive thyroid cancer risks due to radiation exposure do not need to be taken into consideration.

* Developments since the 2013 UNSCEAR Report on the levels and effects of radiation exposure due to the nuclear accident following the great east-Japan earthquake and tsunami (A 2017 White Paper to guide the Scientific Committee's future programme of work)

In order to ascertain radiation effects, it is necessary to monitor developments over a long term.

Thyroid cancers found so far through the Thyroid Ultrasound Examination being conducted in Fukushima Prefecture are considered to be unrelated to the radiation discharged due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS.

This evaluation is based on a comprehensive judgment of the following facts:

(i) Exposure doses due to the accident at the Fukushima Daiichi NPS were generally lower compared with those caused by the Chernobyl NPS Accident.

(ii) The period of time from the exposure to the detection of cancers is short, mostly from one to four years.

(iii) Cancers have not been detected in those who were 5 years old or younger at the time of the accident.

(iv) Age distribution of patients significantly differs in Fukushima Prefecture and Chernobyl (p.140 of Vol. 1, "Comparison between the Chernobyl NPS Accident and the TEPCO's Fukushima Daiichi NPS Accident (Ages at the Time of Radiation Exposure)").

(v) There are no significant differences in detection rates among different regions.

However, it is necessary to monitor developments over a long term to ascertain radiation effects.

(Related to p.141 of Vol. 1, "Evaluation of the Interim Report on Thyroid Cancer Compiled by the Expert Meeting on Health Management After the TEPCO's Fukushima Daiichi NPS Accident")

Included in this reference material on March 31, 2015

Updated on March 31, 2021

Thyroid Ultrasound Examination

Thyroid Ultrasound Examination: Outline of the Evaluations of the First Full-Scale Survey (Second-round Survey) Results

In June 2019, the Thyroid Ultrasound Examination Evaluation Subcommittee, which was established under the Prefectural Oversight Committee for the Fukushima Health Management Survey, concluded that "at present, there are no indication of radiation effect on thyroid cancers found in the first Full-scale Survey," in consideration of the points described below. The Subcommittee reported this conclusion at the Prefectural Oversight Committee Meeting held in July 2019, and the Committee approved this report.

- As a result of the analysis of association between estimated absorbed thyroid doses and thyroid cancer detection rates published by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), no constant correlation (doses and effects), such as an increase in detection rates associated with an increase in doses, was found.
- The detection rates of suspected thyroid cancer through ultrasound examinations, etc. are higher among people who were older at the time of the accident, and the age group in which thyroid cancer was detected more frequently is different from that after the Chernobyl NPS Accident (mainly young children).

Prepared based on material for the 35th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

In June 2019, the Thyroid Ultrasound Examination Evaluation Subcommittee, which was established under the Prefectural Oversight Committee for the Fukushima Health Management Survey, published the "Report on the Results of the first Full-scale Survey of the Fukushima Thyroid Ultrasound Examination." In the Report, the Subcommittee states that no correlation is found between thyroid cancer cases detected through the first Full-scale Survey (second-round survey) and radiation exposure due to Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS Accident. Additionally, the Subcommittee points out the necessity to review evaluations of the Thyroid Ultrasound Examination and examination results from the following perspectives:

• It is necessary to analyze accumulated results of the second and third Full-scale Surveys.

• It is necessary to conduct analyses by properly ascertaining the status of developing cancer among the subjects of Thyroid Ultrasound Examination using regional and national cancer registries.

• It is necessary to study correlation between doses and incidence rates of thyroid cancer in the future by using more detailed data on estimated thyroid exposure doses as a case-control study with adjusted confounding factors or as a prospective study.

Included in this reference material on March 31, 2020

Comprehensive Health Checkup

Comprehensive Health Checkup: Purpose

Due to the Great East Japan Earthquake and the subsequent accident at TEPCO's Fukushima Daiichi NPS, many people were forced to live under evacuation and experienced significant changes in their diet, fitness or other daily habits. Some have worries over their health due to their inability to receive health checkups. Therefore, Fukushima Prefecture commenced the Comprehensive Health Checkup for people residing in Evacuation Areas with the aim of ascertaining the overall health conditions of the residents and utilizing the obtained data for the prevention of lifestyle-related diseases and early detection and treatment of diseases.

Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University (information on the Comprehensive Health Checkup)

Due to the Great East Japan Earthquake and the subsequent accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, many residents were forced to live as evacuees. Fukushima Prefecture has been conducting the Comprehensive Health Checkup for the purpose of monitoring whether they have any physical problems and guiding them to early treatment as necessary.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Comprehensive Health Checkup

Comprehensive Health Checkup: Outline (1/2)

[Check items]

Age group	Check items
Aged zero to 6 (babies and preschoolers)	Body height and weight [Only when requested] Blood counts (red blood cell count, hematocrit, hemoglobin, platelet count, white blood cell count, and differential white blood cell count)
Aged 7 to 15 (first to ninth grade students)	Body height, weight, blood pressure, and blood counts (red blood cell count, hematocrit, hemoglobin, platelet count, white blood cell count, and differential white blood cell count) [Only when requested] Blood biochemistry (AST, ALT, γ-GT, TG, HDL-C, LDL-C, HbA1c, blood sugar, serum creatinine, and uric acid)
Aged 16 or older	Body height, weight, abdominal girth (or BMI), blood pressure, and blood counts (red blood cell count, hematocrit, hemoglobin, platelet count, white blood cell count, and differential white blood cell count) Urinalysis (protein, glucose and blood) Blood biochemistry (AST, ALT, γ-GT, TG, HDL-C, LDL-C, HbA1c, blood sugar, serum creatinine, eGFR, and uric acid) * Items in red letters are additional items that are not ordinarily checked in the specified health checkups.

[Eligible subjects]

Residents who were registered at any of the municipalities designated as Restricted Areas, Deliberate Evacuation Areas or Evacuation-Prepared Areas in Case of Emergency or at any of the areas containing Specific Spots Recommended for Evacuation as of 2011 (approx. 210,000 people) and residents who were found to require the Comprehensive Health Checkup as a result of the Basic Survey

(= The entire areas of Tamura City, Minamisoma City, Kawamata Town, Hirono Town, Naraha Town, Tomioka Town, Kawauchi Village, Okuma Town, Futaba Town, Namie Town, Katsurao Village and Iitate Village, and parts of Date City)

Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University (information on the Comprehensive Health Checkup)

Check items for all age groups are decided so that each of the residents residing in covered areas can ascertain their own health conditions and obtained data can be utilized for the prevention and early detection and treatment of lifestyle-related and other diseases.

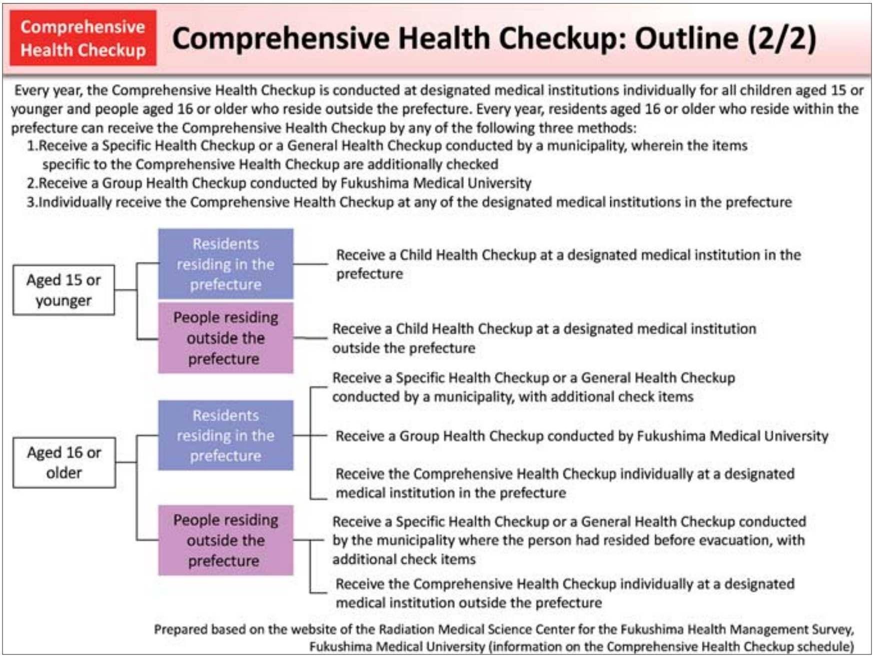
Based on the check items for the Specific Health Checkup targeting people aged 16 or older, ordinary health checkups are conducted by adding other necessary items, such as blood counts (those in red letters).

The Comprehensive Health Checkup covers people who were residing in any of the municipalities designated as Restricted Areas, Deliberate Evacuation Areas or Evacuation-Prepared Areas in Case of Emergency or in any of the areas containing Specific Spots Recommended for Evacuation*1 at the time of the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS.

*1: The entire areas of Tamura City, Minamisoma City, Kawamata Town, Hirono Town, Naraha Town, Tomioka Town, Kawauchi Village, Okuma Town, Futaba Town, Namie Town, Katsurao Village and Iitate Village, and parts of Date City

Included in this reference material on March 31, 2013

Updated on March 31, 2021



Children aged 15 or younger, whether residing in or outside Fukushima Prefecture, can receive pediatric health checkups at any of the designated medical institutions with cooperating pediatricians.

Residents aged 16 or older who reside in Fukushima Prefecture can select any of the following methods to receive a checkup: receive a Specific Health Checkup or a General Health Checkup conducted by a municipality, with additional check items specific to the Comprehensive Health Checkup; receive a Group Health Checkup conducted by Fukushima Medical University; or receive the Comprehensive Health Checkup individually at a designated medical institution in the prefecture.

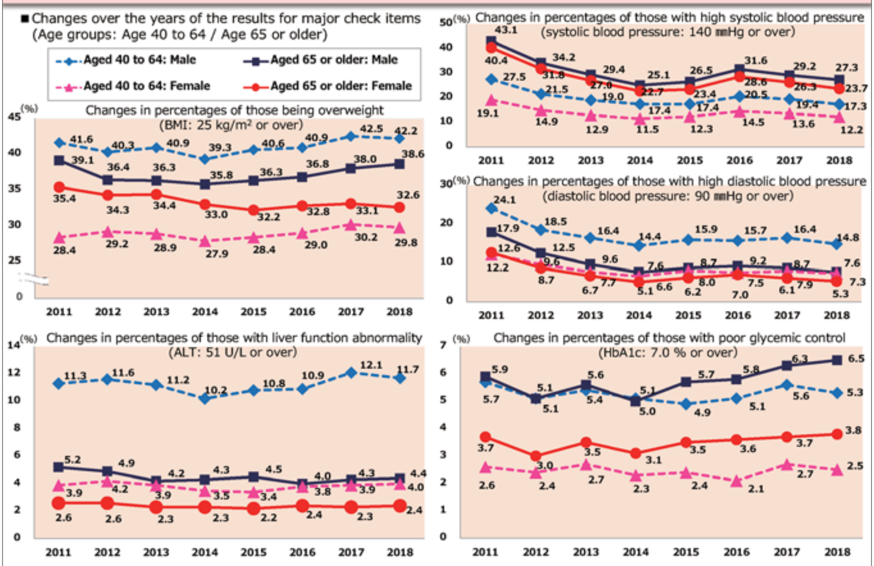
Included in this reference material on March 31, 2013
Updated on March 31, 2020

Comprehensive Health Checkup

Comprehensive Health Checkup: What Has Become Clear

(Overweight, High Blood Pressure, Liver Function Abnormality, and Hyperglycemia)

Latest Survey Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)



Prepared based on the materials for the 21st,26th,30th,34th and 37th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

From the results of the Comprehensive Health Checkup conducted from FY2011 to FY2018, changes in the results for major check items over the years were examined.

● Examinees being overweight

The condition of being overweight (BMI: 25 kg/m^2 or over) was found more among males than among females for all these fiscal years. Looking at the changes in each fiscal year, the percentage of overweight female examinees aged 65 or older showed a declining trend from FY2011 to FY2015 but did not show a large change from FY2016 to FY2018.

● Examinees with high blood pressure

The percentage of examinees with high systolic blood pressure (systolic blood pressure: 140 mmHg or over) showed a declining trend from FY2011 to FY2014 for both males and females aged 40 or older. The percentage increased from FY2015 to FY2016 but decreased toward FY2018.

The percentage of examinees with high diastolic blood pressure (diastolic blood pressure: 90 mmHg or over) showed a declining trend from FY2011 to FY2014 for both males and females aged 40 or older but did not show a large change from FY2015.

● Examinees with liver function abnormality

The percentage of examinees with liver function abnormality (ALT: 51 (U/L) or over), which is generally higher among males aged 40 to 64, has been almost flat overall.

● Examinees with poor glycemic control

The percentage of examinees with poor glycemic control (HbA1c: 7.0% or over) has been higher among males than among females for all these fiscal years. When compared with the percentage in FY2011, the percentage in FY2018 was higher for males aged 65 or older.

Included in this reference material on March 31, 2016
Updated on March 31, 2021

Mental Health and Lifestyle

Mental Health and Lifestyle Survey: Purpose

"We will promote the mental and physical health of residents of the Evacuation Areas, etc."

Due to harsh experiences of the Great East Japan Earthquake and the accident at TEPCO's Fukushima Daiichi NPS and subsequent life as evacuees, many people are experiencing anxiety and stress. Accordingly, Fukushima Prefecture commenced the Mental Health and Lifestyle Survey with the aim of accurately understanding the mental and physical problems of residents and meticulously providing each of them with proper health, medical and welfare services.

Prepared based on the material for the 38th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

Many of the residents whose houses are located in municipalities designated as Evacuation Areas were forced to evacuate and live as evacuees for a prolonged period of time. They have experienced drastic changes in their living environment and have been forced to change their individual lifestyles as well. In order to carefully watch not only the physical disorders but also mental problems of these residents and offer them appropriate support and build a better system therefor, Fukushima Prefecture has been conducting the Mental Health and Lifestyle Survey.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Mental Health and Lifestyle

Mental Health and Lifestyle Survey: Outline (1/2)

[Eligible subjects]
- Residents who were registered at any of the covered areas from March 11, 2011, to April 1, 2012 (also after moving out of the covered areas)
- Residents registered at any of the Evacuation Areas, etc. as of April 1 of the fiscal year during which the survey is conducted

[Covered areas]

Hirono Town, Naraha Town, Tomioka Town, Kawauchi Village, Okuma Town, Futaba Town, Namie Town, Katsurao Village and Iitate Village, Minamisoma City, Tamura City, Kawamata Town, and parts of Date City (areas containing Specific Spots Recommended for Evacuation)

[Method]

Inquiry sheets: Self-reporting questionnaires or those to be filled in by guardians

[Major survey items]
- Present physical and mental status
- Lifestyle (diet, sleep, smoking, and exercise habits)
- Present living conditions (adults)

[Measures for support]

Collected responses are evaluated and analyzed by the staff which include physicians of Fukushima Medical University. If respondents are considered to require counseling and support regarding their mental health and lifestyle, support by phone is provided by the "Mental Health Support Team," which consists of staff including clinical psychotherapists, public health nurses, and clinical nurses. When professional medical care is considered to be required through the support by phone, registered physicians of medical institutions in Fukushima Prefecture (*see p.150 of Vol. 2, "Mental Health and Lifestyle Survey: Outline (2/2)") are introduced.

When continued support is necessary, required support will be discussed and offered in collaboration with the municipality where the person had originally resided before evacuation.

Prepared based on the material for the 38th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

As in the case of the Comprehensive Health Checkup, the Mental Health and Lifestyle Survey also covers residents who were registered, as of March 11, 2011, and as of April 1 of the relevant survey year, at any of the municipalities that were designated as Restricted Areas, Deliberate Evacuation Areas or Evacuation-Prepared Areas in Case of Emergency or at any of the areas containing Specific Spots Recommended for Evacuation at the time of the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. Different inquiry sheets are used depending on the age groups, with the aim of taking required measures more appropriately. Children are divided into four age groups: those aged zero to 3; those aged 4 to 6; elementary school students; and junior high school students. People aged 16 or older are categorized as adults.

In addition to questions concerning mental problems, such as depression and traumatic stress, the survey items include questions about changes in lifestyles, such as diet, sleep, drinking, smoking, and exercise habits.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Mental Health and Lifestyle

Mental Health and Lifestyle Survey: Outline (2/2)

- Procedures from submission of an inquiry sheet to receipt of support -
Relevant organizations and doctors are collaboratively offering care.

* For people who are considered to require continued support, care is provided in collaboration with regional registered doctors and municipalities, etc.

* Survey results are sent individually from FY2014.

* Registered doctors: Psychiatrists and pediatricians, etc., who have received lectures concerning disaster mental health and radiation medical science: As of July 1, 2020, there are 125 registered doctors in 81 medical institutions.

Number of people who received support by phone

	Children	Adults
FY2011	1,180	6,310
FY2012	623	5,991
FY2013	473	3,913
FY2014	327	3,053
FY2015	250	2,567
FY2016	181	2,382
FY2017	210	2,410
FY2018	167	2,404

Number of people who received support in writing

	Children	Adults
FY2011	1,066	10,898
FY2012	800	10,168
FY2013	752	7,664
FY2014	517	6,244
FY2015	435	6,075
FY2016	336	6,098
FY2017	375	5,545
FY2018	297	4,994

Prepared based on the materials for the 11th, 15th, 19th, 22nd, 26th, 27th, 31st, 32nd, 35th, 38th, and 39th Prefectural Oversight Committee Meetings for Fukushima Health Management Survey

Analysis results and advice based thereon are individually sent to people who have submitted inquiry sheets. For respondents who are considered to require professional support as a result of analyzing their responses, clinical psychotherapists, public health nurses, or clinical nurses, etc. make a phone call to offer support concerning problems with their mental health and lifestyles. If necessary, brochures containing health-related information and contacts for consultation services are provided by mail.

Remarks by people who have received support by phone include, "I am glad that I can confess what I cannot say to my family," or, "I am relieved to know that I can call this number to make consultations whenever I feel depressed."

Regarding those in need of continued support or professional medical care, support is offered in collaboration with municipalities, the Fukushima Center for Disaster Mental Health and registered doctors who can provide professional advice.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

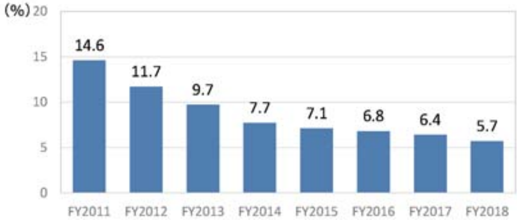
Mental Health and Lifestyle

Mental Health and Lifestyle Survey: What Has Become Clear (1/5)

Latest Survey Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

[Mental health of adults (aged 16 or older)]

● Percentage of people who are considered to require support for their depressions and anxieties

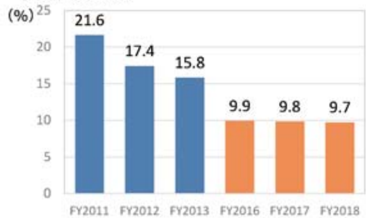


Measurement scale: K6*

* Respondents reply to each question of a six-item questionnaire concerning their depression and anxieties with a score from zero to four points. When the total is 13 points or over, a mood disorder or anxiety disorder is suspected.

● Percentage of people who are considered to require support for their traumatic stresses due to the disaster

Measurement scale: PCL* (FY2011 to FY2013)
PCL-4** (FY2016 to FY2018)



* Respondents reply to each question of a 17-item questionnaire concerning their frequently arising problems and need arising from their disaster experience (traumatic stress) with a score from one to five. When the total is 44 points or over, PTSD is suspected.

** Respondents reply to each question of a 4-item questionnaire with a score from one to five points. When the total is 12 points or over, PTSD is suspected.

In order to ease psychological burdens associated with replying to the questionnaire, the FY2014 and FY2015 surveys did not include PCL-related questions.

Prepared based on the materials for the 38th Prefectural Oversight Committee Meetings for Fukushima Health Management Survey

K6[*1] is used as a scale to evaluate the levels of mental health of adults (aged 16 or older). K6 still remains at a high level (bad), compared with the value (3.0%) in a prior study in Japan (Kawakami, 2007), although the values have been declining (improving) compared with the FY2011 survey and the FY2012 survey.

Females show higher values than males. By age group, values for younger people tend to be higher.

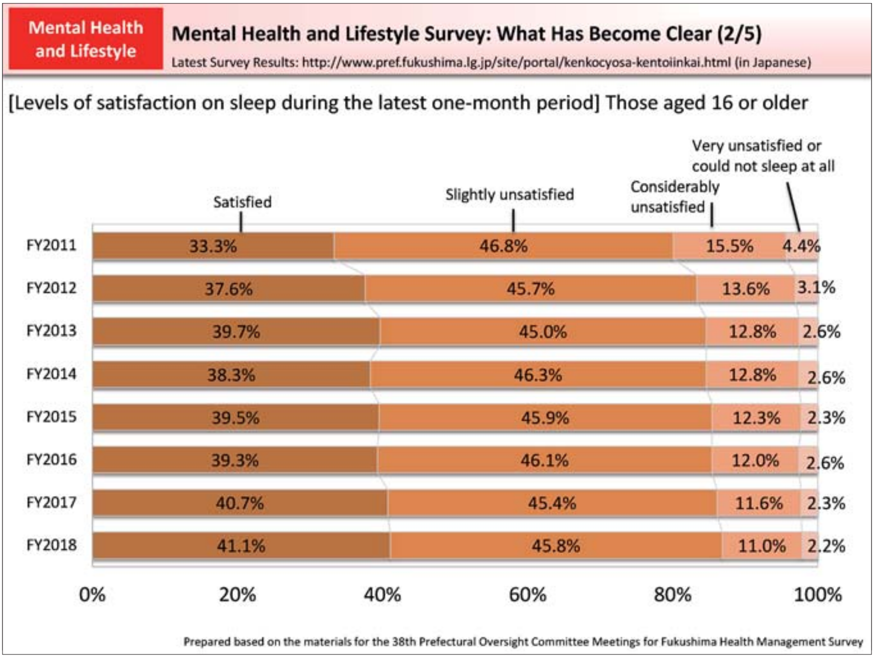
As a scale to evaluate traumatic stress of adults (aged 16 or older), PCL[*2] is used. PCL declined (improved) significantly in the surveys in FY2016 to FY2018, compared with the results of the surveys in FY2011 to FY2013. However, it was found that nearly 10% of the examinees still have strong traumatic stress.

By gender, females generally show higher values than males, and values tend to become higher for older examinees.

*1: K6: Respondents reply to each question of a six-item questionnaire concerning the frequencies with which they felt depressed or anxious during the past 30 days (such as "Have you felt extremely nervous?" or "Have you felt desperate and helpless?"). This survey targets people aged 16 or older to evaluate risks of any mood or anxiety disorder.

*2: PCL (Post-Traumatic Stress Disorder Checklist): Respondents reply to each question concerning their mental and physical reactions (traumatic stress) during the past 30 days in relation to their disaster experience. This survey also targets people aged 16 or older to evaluate individuals' levels of traumatic stress. The survey was suspended for two years after being conducted in FY2011 to FY2013 and was resumed in FY2016 by significantly reducing questionnaire items (it has been confirmed that the reliability of this scale is unchanged even with fewer questionnaire items).

Included in this reference material on March 31, 2015
Updated on March 31, 2021



Sleep is a significant factor that exerts influence on various chronic diseases such as high blood pressure or diabetes, as well as affecting people's mental health.

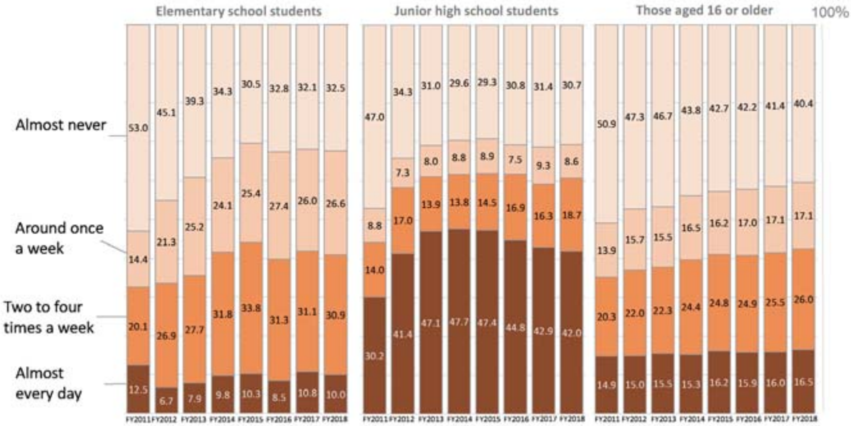
The figure shows that approximately 60% of the respondents are still somewhat unsatisfied with their sleep, while the number of those satisfied with their sleep is gradually increasing.

Included in this reference material on March 31, 2016
Updated on March 31, 2021

Mental Health and Lifestyle Survey: What Has Become Clear (3/5)

Latest Survey Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

[Percentages concerning daily exercises]

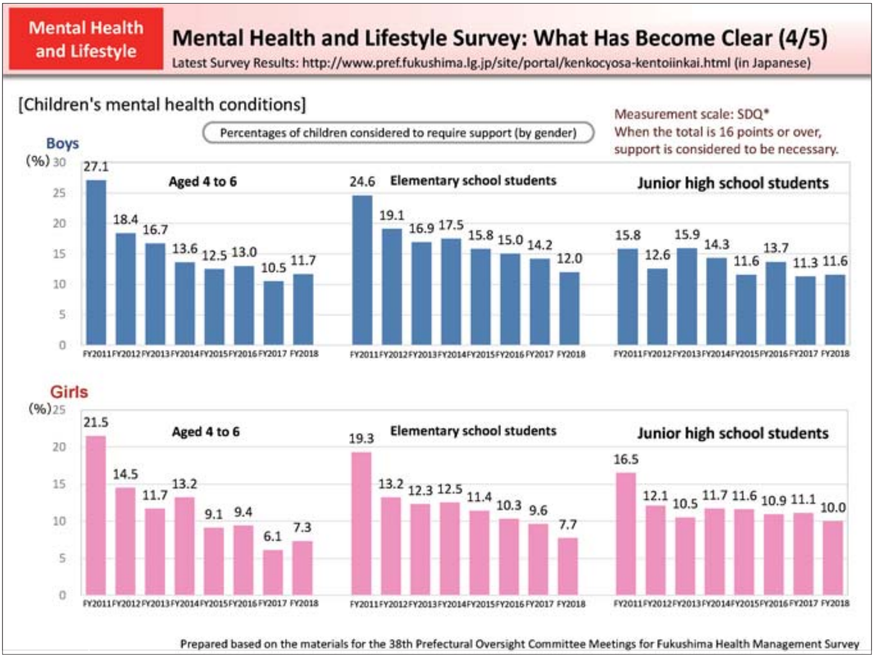


Prepared based on the material for the 38th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

Not only adults (aged 16 or older), but also elementary school students and junior high school students have come to have more chances for exercises, showing an improving trend. However, no significant change was observed in FY2018, compared with the level in FY2017.

In particular, exercises are considered to exert a significant influence on the growth of elementary school students and junior high school students, and exercise habits are also very important for adults for improving their mental health and preventing lifestyle-related diseases.

Included in this reference material on March 31, 2016
Updated on March 31, 2021



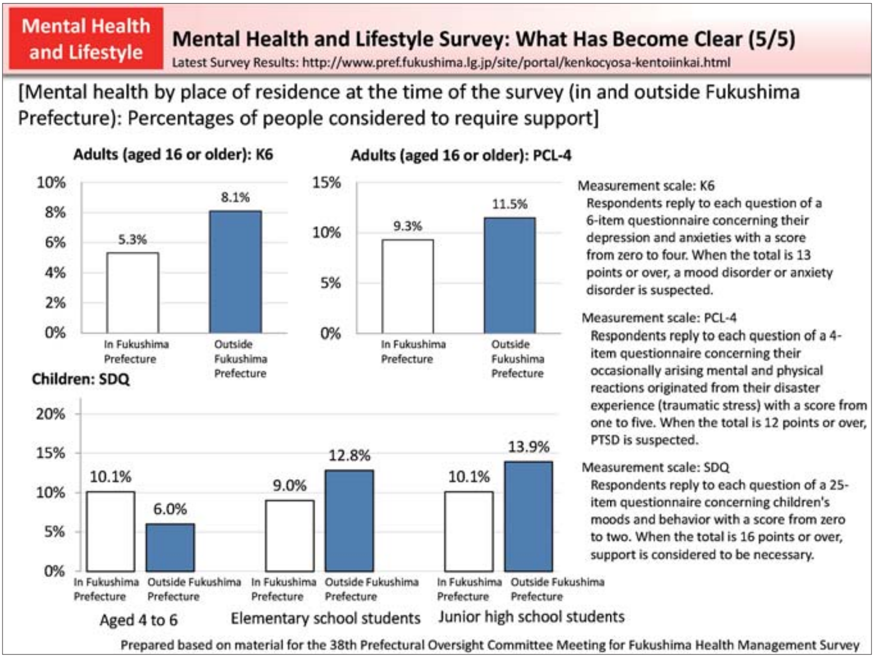
As an indicator to evaluate children's mental health conditions, SDQ[*1] is utilized.

Compared with the percentage of children showing an SDQ score over 16 (9.5%) reported in a prior study in Japan (Matsuishi et al., 2008), the percentages of high-risk children were still high for all groups except for girls aged 4 to 6 and elementary school girls in the FY2018 survey.

In the FY2018 survey, percentages of high SDQ scores decreased for all categories compared with the results of the FY2011 survey. However, the improvement slowed down and the percentages remained almost unchanged from those of the FY2012 survey.

*1: SDQ (Strengths and Difficulties Questionnaire): Respondents reply to each question of a 25-item questionnaire concerning children's moods and behavior during the past six months (such as "Gives due consideration to other's feelings" or "Is restless and cannot stay still for a long time"). This survey covers those aged 4 to 15 to judge whether they need professional support or not.

Included in this reference material on March 31, 2015
Updated on March 31, 2021



Respondents to the survey for FY2018 were classified by their places of residence into those who resided in Fukushima Prefecture and those who resided outside Fukushima Prefecture at the time of the relevant survey, and a comparison was made concerning their mental health conditions using measurement scales, K6, PCL-4, and SDQ. As a result, the percentage of people considered to require support based on the K6 scale among adults (aged 16 or over) tends to be higher for those outside Fukushima Prefecture than those in Fukushima Prefecture. Compared with the relevant percentage (3.0%) in a prior study in Japan (Kawakami, 2007), the percentage for those in Fukushima Prefecture was approximately 1.8 times and that for those outside Fukushima Prefecture was approximately 2.7 times higher. In the same manner, the percentage of people considered to require support based on the PCL-4 scale among adults (aged 16 or over) tends to be higher for those outside Fukushima Prefecture than those in Fukushima Prefecture.

As for children, the percentage of those considered to require support based on the SDQ scale tends to be higher for those outside Fukushima Prefecture than those in Fukushima Prefecture among elementary school and junior high school students.

These results are considered to show higher stress among people who have temporarily moved from Fukushima Prefecture and lived under evacuation and suggests a further need for thorough and careful support.

Included in this reference material on March 31, 2019
Updated on March 31, 2021

Pregnancy and Birth Survey

Pregnancy and Birth Survey: Purpose

"We will promote the health of pregnant women in Fukushima Prefecture."

The Pregnancy and Birth Survey was commenced in order to ascertain mental and physical health conditions of pregnant women in Fukushima Prefecture after the Great East Japan Earthquake and the subsequent accident at TEPCO's Fukushima Daiichi NPS, with the aim of alleviating their anxieties and providing necessary care.

Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University (information on the Pregnancy and Birth Survey)

Fukushima Prefecture has been conducting the Pregnancy and Birth Survey in order to ascertain mental and physical health conditions of pregnant women in the prefecture after the Great East Japan Earthquake and the subsequent accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, with the aim of alleviating their anxieties and providing necessary care, and also improving obstetric and gynecological care in Fukushima Prefecture.

Included in this reference material on March 31, 2013
Updated on March 31, 2020

Pregnancy and Birth Survey

Pregnancy and Birth Survey: Outline (1/2)

[Eligible subjects]

Pregnant women who obtained a maternity handbook within Fukushima Prefecture and those who obtained a maternity handbook somewhere else but gave birth in the prefecture during the survey period for every fiscal year

Fiscal year	Eligible subjects	Responses from
FY2011	16,001 people	9,316 people (58.2%)
FY2012	14,516 people	7,181 people (49.5%)
FY2013	15,218 people	7,260 people (47.7%)
FY2014	15,125 people	7,132 people (47.2%)
FY2015	14,572 people	7,031 people (48.3%)
FY2016	14,154 people	7,326 people (51.8%)
FY2017	13,552 people	6,449 people (47.6%)
FY2018	12,838 people	6,649 people (51.8%)

Conducted a follow-up survey in approx. 4 years after delivery

Eligible subjects	Responses from
7,252 people	2,554 people (35.2%)
5,602 people	2,021 people (36.1%)
5,734 people	2,706 people (47.2%)
5,856 people	2,719 people (46.4%)

[Survey method]

Inquiry sheets are sent to the targeted pregnant women, asking them to fill in the sheets and send them back.

(From the FY2016 survey, responses are accepted by post or online.)

Major survey items are as follows:

- Pregnant women's mental health conditions
- Present living conditions (circumstances of a refugee life or forced separation from family members)
- Situations during delivery and pregnant women's physical health conditions
- Confidence in raising children
- Attitude toward the next pregnancy

Prepared based on the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University and the materials for the 37th Prefectural Oversight Committee Meetings for Fukushima Health Management Survey

The Pregnancy and Birth Survey covers pregnant women who newly obtained a maternity handbook in Fukushima Prefecture and those who obtained a maternity handbook elsewhere but gave birth in the prefecture during the survey period.

For the former, inquiry sheets are sent based on information provided by each municipality in the prefecture. The latter may use inquiry sheets available at obstetric institutions in the prefecture or request the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University, to send them inquiry sheets.

Survey targets are asked to fill in inquiry sheets and send them back. From the FY2016 survey, responses can also be submitted online.

The number of women who become pregnant and give birth in Fukushima Prefecture decreased after the earthquake in FY2012 but temporarily increased in FY2013. However, the number has been on a decline thereafter as seen nationwide.

Included in this reference material on March 31, 2013

Updated on March 31, 2021

Pregnancy and Birth Survey

Pregnancy and Birth Survey: Outline (2/2)

[Survey procedures]

First survey (4 years after delivery): Conducted in FY2015 to FY2018 targeting respondents of the surveys conducted in FY2011 to FY2014
Second survey (8 years after delivery): Conducted in FY2019 or FY2020 targeting respondents of the surveys conducted in FY2011 or FY2012

[FY2020 Pregnancy and Birth Survey] Since the FY2016 survey, responses can be submitted online.

- Main survey
  (i) Pregnant women who obtained a maternity handbook in any municipality in Fukushima Prefecture from August 1, 2019, to July 31, 2020
  (ii) Pregnant women who obtained a maternity handbook outside Fukushima Prefecture during the period mentioned above but gave birth in Fukushima Prefecture
- Second follow-up survey
  FY2012 survey respondents

Prepared based on the leaflet on the Pregnancy and Birth Survey, and the website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University

Details of the responses are compiled by the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University, to detect people considered to be in need of support.*1 If there are any people who are considered to be in need of support, midwives, public health nurses, doctors or other specialized staff members offer consultations or other support to such people by mail or by other means.

Since January 2020, the second follow-up survey to ask about mental and physical health conditions has been conducted, targeting FY2011 survey respondents who gave birth 8 years ago.

*1: Respondents who replied that they tend to feel depressed and that they are not interested in things, or respondents who are considered to be in need of support based on the content of their free remarks (such as those who are in need of help, who are severely depressed, who need support for child rearing, who are worried about radiation doses, or who directly made requests or are requiring concrete answers)

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Pregnancy and Birth Survey

Pregnancy and Birth Survey: Achievement and Content of Support

[Changes in coverage]

Out of all respondents, for those who were judged to be in need of support from the content of their responses, support has been offered by full-time midwives, etc. by phone or mail.

Fiscal year	Number of people who received support by phone	Percentage of those who received support among all respondents
FY2011	1,401 people	15.0%
FY2012	1,104 people	15.4%
FY2013	1,101 people	15.2%
FY2014	830 people	11.6%
FY2015	913 people	13.0%
FY2016	951 people	13.0%
FY2017	799 people	12.4%
FY2018	711 people	10.7%

	Number of people who received Support by phone	Percentage of those who received support among all respondents
Survey following up the FY2011 survey	375 people	14.7%
Survey following up the FY2012 survey	256 people	12.7%
Survey following up the FY2013 survey	393 people	14.5%
Survey following up the FY2014 survey	380 people	14.0%

[Topics of the consultations by phone]

	Main survey FY2011	FY2012	FY2013	FY2014 to FY2017 (the same ranking for both years)	FY2018	Follow-up survey FY2015 FY2011 survey respondents	FY2016 FY2012 survey respondents	FY2017 to FY2018 FY2013-2014 survey respondents
1st	Worries over radiation and its effects	Mothers' mental and physical health	Mothers' mental and physical health	Mothers' mental and physical health	Mothers' mental and physical health	Mothers' mental and physical health	Mothers' mental and physical health	Mothers' mental and physical health
2nd	Mothers' mental and physical health	Matters concerning child rearing	Matters concerning child rearing	Matters concerning child rearing	Matters concerning child rearing	Worries over radiation and its effects	Matters concerning child rearing	Matters concerning child rearing
3rd	Matters concerning child rearing	Worries over radiation and its effects	Children's mental and physical health	Matters concerning family life	Children's mental and physical health	Matters concerning child rearing	Children's mental and physical health	Matters concerning family life

Matters concerning child rearing include concerns about baby food, night crying, constipation, vaccination, etc.

Prepared based on the material for the 37th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

Immediately after the earthquake, the most frequent topic was worries over radiation and its effects, but the percentage of such consultations is declining over time. Since FY2012, consultations on mothers' mental and physical health and matters concerning child rearing have increased and now rank high.

Regarding the follow-up survey in FY2012, those who required support accounted for 12.7% of all respondents, showing a decrease from the percentage of the follow-up survey in FY2011 (14.7%). From the follow-up surveys in FY2013 onward, support was expanded to cover those considered to be in need of support based on the content of their free comments. Accordingly, the percentage requiring support increased from that in FY2012.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Pregnancy and Birth Survey

Pregnancy and Birth Survey: What Has Become Clear (1/2)

Latest Survey Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

[Percentages of premature births, low birth-weight babies, and congenital abnormalities or anomalies]

Percentages of premature births, low birth-weight babies, and congenital abnormalities or anomalies obtained through the Pregnancy and Birth Survey were almost the same as the general level and those obtained through nationwide surveys.

	Percentage of premature births (%)		Percentage of low birth-weight babies (%)		Percentage of congenital abnormalities or anomalies (%)	
	Main survey*	Nationwide survey	Main survey*	Nationwide survey	Main survey	General level
FY2011	4.6	5.7	8.6	9.6	2.85	3 to 5 (based on the 2020 Obstetric Care Guidelines)
FY2012	5.6	5.7	9.2	9.6	2.39	
FY2013	5.2	5.8	9.6	9.6	2.35	
FY2014	5.3	5.7	9.8	9.5	2.30	
FY2015	5.6	5.6	9.4	9.5	2.24	
FY2016	5.3	5.6	9.2	9.4	2.55	
FY2017	5.3	5.7	9.2	9.4	2.38	
FY2018	5.2	5.6	9.0	9.4	2.19	

* As percentages are retabulated by excluding cases of dead births, values differ from those in the reports on the surveys in FY2011 to FY2018.
Premature births: Babies born at a gestational age from 22 weeks to less than 37 weeks Low birth-weight babies: Babies born smaller than 2500g
Nationwide surveys: Annual percentages based on the Vital Statistics

Prepared based on the material for the 37th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

Radiation effects on newborn babies had been worried about, but percentages of premature births, low birth-weight babies, and congenital abnormalities or anomalies in Fukushima Prefecture after the earthquake were found to be almost the same as generally available data, including Vital Statistics collected nationally.

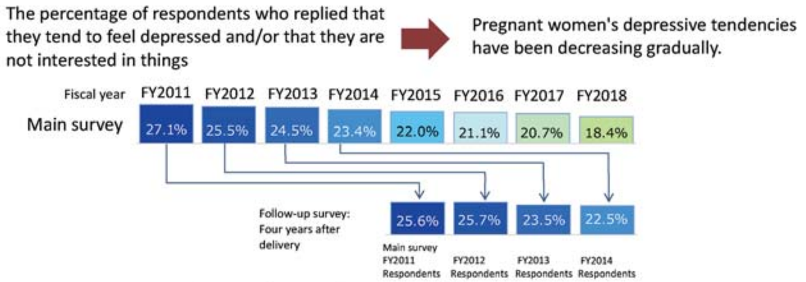
Included in this reference material on March 31, 2015
Updated on March 31, 2021

Pregnancy and Birth Survey

Pregnancy and Birth Survey: What Has Become Clear (2/2)

Latest Survey Results: http://www.pref.fukushima.lg.jp/site/portal/kenkocyosa-kentoiinkai.html (in Japanese)

[Changes in pregnant women's depressive tendencies]



[Changes in percentage of respondents who answered "Yes" to the question "Are you considering another pregnancy?"]

Nationwide survey		Main survey						
FY2010	FY2015	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018
51.0%	50.0%	52.9%	52.8%	57.1%	53.3%	54.6%	52.4%	52.2%

Nationwide survey 2010 : Percentage of respondents who are married for less than 10 years and plan to have a child in the nationwide survey, "Fourteenth Japanese National Fertility Survey in 2010" (when having any children already)
Nationwide survey 2015 : Percentage of respondents who are married for less than 10 years and plan to have a child in the nationwide survey, "fifteenth Japanese National Fertility Survey in 2015" (when having any children already)

* The 2011 survey did not contain the relevant question.

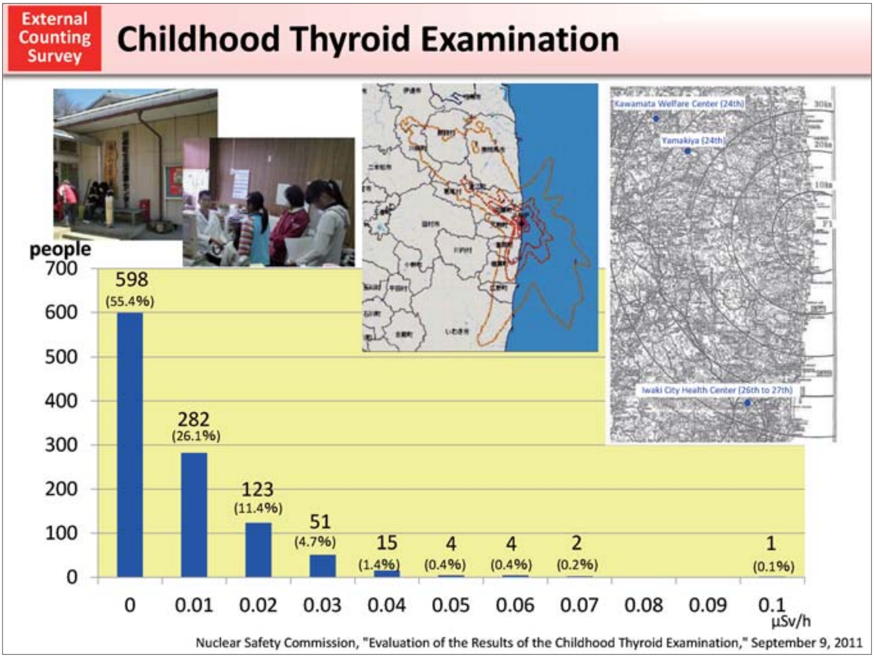
Prepared based on the material for the 37th Prefectural Oversight Committee Meeting for Fukushima Health Management Survey

For questions concerning pregnant women's depressive tendencies, respondents who replied that they tend to feel depressed and/or that they are not interested in things have been decreasing.

According to the "Healthy Parents and Children 21" (a national campaign to promote improvement of health standards of mothers and children), the percentage of postnatal depression evaluated using the Edinburgh Postnatal Depression Scale was 8.4% in FY2013 and 9.8% in FY2017 nationwide. The percentage estimated from the results of the FY2018 Pregnancy and Birth Survey was 10.2% (reference used for the calculation: Mishina H, et al. Pediatr Int. 2009; 51: 48).

The FY2018 Pregnancy and Birth Survey also revealed that respondents considering another pregnancy accounted for 52.2%. Since the FY2012 survey, more than half of the respondents wish to have more children. For reference, respondents who have been married for less than ten years and plan to have a child accounted for 60% (or 51% among those who already have any children) in the Fourteenth Japanese National Fertility Survey in 2010 and 57% (or 50% among those who already have any children) in the Fifteenth Japanese National Fertility Survey in 2015.

Included in this reference material on March 31, 2015
Updated on March 31, 2021

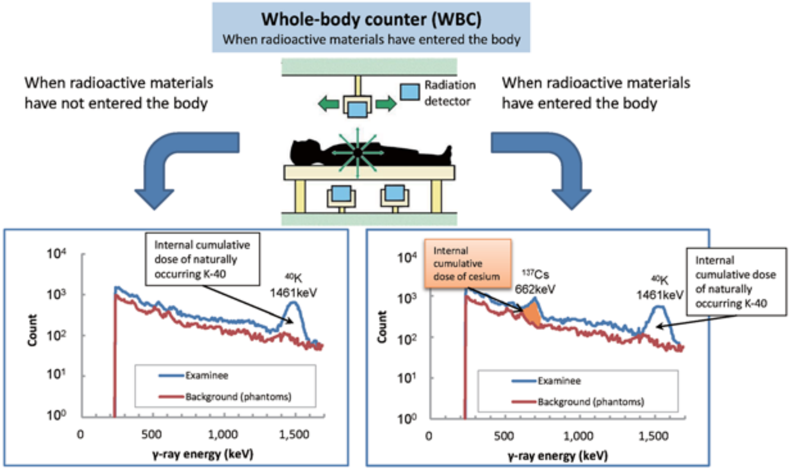


Based on estimates by SPEEDI on March 23, 2011, the Local Nuclear Emergency Response Headquarters conducted the Childhood Thyroid Examination to ascertain health effects of radiation on children in response to a request from the Technical Advisory Organization in an Emergency of the Nuclear Safety Commission of Japan (dated March 23 and 25). The figure shows the results for 1,080 children for whom measurement was conducted properly, out of 1,149 survey targets. The figure excludes the results for 66 children for whom simplified measurement was not appropriate due to environmental doses at their measuring spots (proper evaluation based on simplified measurement was difficult due to high ambient dose rates) and for three children whose ages were unknown. However, for all children who received the examination, measured values were below 0.2 μSv/h, which is set as the standard screening level by the Nuclear Safety Commission of Japan.

Included in this reference material on March 31, 2013
Updated on March 31, 2017

Internal Exposure Measurement Using a Whole-body Counter

Whole-body counter (WBC): A device to measure radiation from radioactive materials within the body
It can measure radionuclides emitting γ-rays, such as Cs-134 and Cs-137.



keV: kilo-electron volts

A whole-body counter is a device to measure γ-rays emitted from the body. As γ-ray energy differs by radionuclide, if a specific amount of energy, for example, 1,461 keV, which is the γ-ray energy of radioactive potassium (K-40), is counted, this can be interpreted as γ-rays emitted from K-40 in the body. The γ-ray energy of Cs-137 is 662 keV.

Potassium is an essential element for a living organism and approximately 0.01% of it is radioactive. Radioactive potassium is mainly dissolved in cellular water and exists in muscles but not so much in fat cells that contain little water.

As radioactive cesium spreads all over the body, the internal dose of cesium is measured using a whole-body counter.

(Related to p.60 of Vol. 1, "Instruments for Measuring Internal Exposure")

Included in this reference material on March 31, 2013
Updated on March 31, 2016

External Counting Survey

Results of the Internal Exposure Measurement Using a Whole-body Counter

Targeting the residents of the Evacuation Areas and the areas where internal and external exposure doses are likely to be higher than in other areas based on the results of the environmental monitoring survey, etc. (Yamakiya District in Kawamata Town, Iitate Village and Namie Town), the internal exposure measurement using a whole-body counter commenced on June 27, 2011. The targeted areas were expanded sequentially, and measurements were conducted for a total of 343,830 people by November 30, 2019. For over 99.9% of them, committed effective doses due to Cs-134 and Cs-137 were below 1 mSv and even the maximum measured value was below 3 mSv. Measured values were all unlikely to cause any health effects.

(i) Targeted local governments: All 59 municipalities in Fukushima Prefecture

(ii) Organizations that conducted the measurement

Fukushima Prefecture; Hirosaki University Hospital; Minamisoma City General Hospital; Japan Atomic Energy Agency; Niigata Prefecture Radiation Examination Office; Hiroshima University Hospital; Nagasaki University Hospital; Japanese Red Cross Otsu Hospital; Mori no Miyako Industrial Health Association; National Hospital Organization Kanazawa Medical Center; Ehime University Hospital; and the National Institute of Radiological Sciences

(iii) 'Mobile measurement' using whole-body counter vehicles outside Fukushima Prefecture

Fukushima Prefecture runs whole-body counter vehicles for mobile measurement so that evacuees outside the prefecture can also receive measurement. By March 2016, mobile measurement was conducted in 38 prefectures including the Tokyo Metropolis (other than Aomori, Ibaraki, Niigata, Ishikawa, Shiga, Hiroshima, Aichi and Nagasaki Prefectures), where there is no permanent organization to which Fukushima Prefecture commissions the measurement.

(iv) Measurement results (committed effective doses) (Results up to November 2020 were released on December 24, 2020.)

	Jun. 27, 2011 – Jan. 31, 2012	Feb. 1, 2012 – Nov. 30, 2020	Total
Less than 1 mSv	15,384 people	330,015 people	345,399 people
1 mSv	13 people	1 person	14 people
2 mSv	10 people	Zero	10 people
3 mSv	2 people	Zero	2 people
Total	15,409 people	330,016 people	345,425 people

* Committed effective dose: Assuming that until the end of January 2012, a person ingested radiation once on March 12, 2011, and, from February 2012 onward, a person orally ingested the equal amount of radiation every day from March 12, 2011, to the day preceding the measurement date, the person's lifetime internal doses are calculated by summing up the doses for fifty years in the case of an adult and for the years elapsed until becoming 70 years old in the case of a child.

Prepared based on the website of Fukushima Prefecture, "Results of the Internal Exposure Measurement Using a Whole-body Counter"

Targeting the residents of the Evacuation Areas and the areas where internal and external exposure doses are likely to be higher than in other areas based on the results of the environmental monitoring survey, etc. (Yamakiya District in Kawamata Town, Iitate Village and Namie Town), the internal exposure measurement using a whole-body counter commenced on June 27, 2011. The targeted areas were expanded sequentially, and the measurements were conducted for a total of 345,399 people by November 30, 2020. For over 99.9% of them, committed effective doses due to Cs-134 and Cs-137 were below 1 mSv and even the maximum measured value was below 3 mSv. Measured values were all unlikely to cause any health effects.

Included in this reference material on March 31, 2013

Updated on March 31, 2021

External Counting Survey

Internal Exposure due to Foods

- Radioactive cesium is eliminated from the body over time.
- The internal exposure measurement using a whole-body counter being conducted at present examines the effects of radiation that is ingested orally on a daily basis.
- Measured values exceeding 1 mSv are considered to be mostly caused by radiation derived from wild plants or animals. Since March 2012, values exceeding 1 mSv have not been detected.

* Reference:p.82 of Vol. 2, "Mushrooms, Wild Plants and Wild Bird and Animal Meat"

Q. What if the measurement using a whole-body counter detected any value exceeding the detection limit?

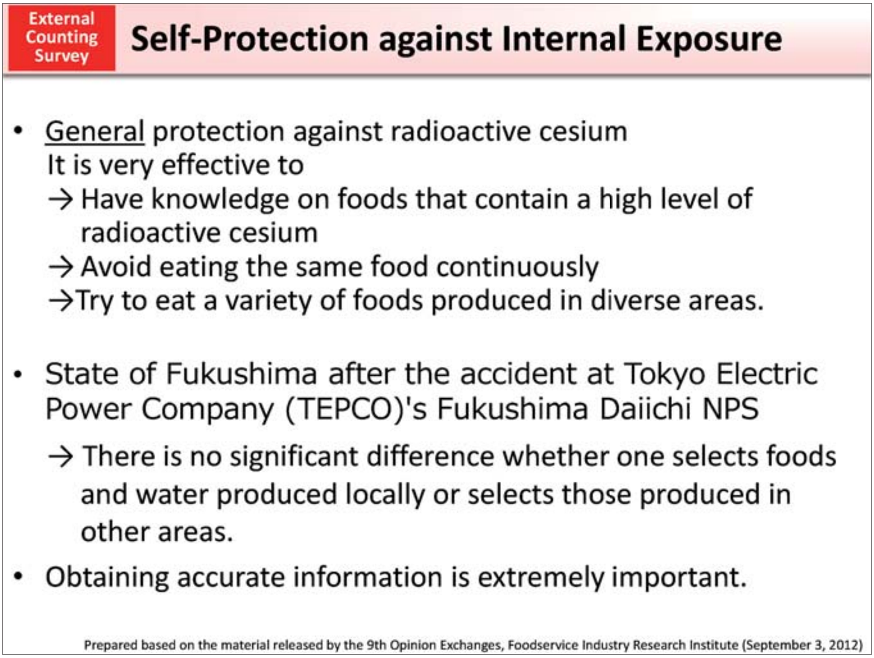
A. The relevant person may have eaten a lot of foods – not allowed in commercial markets – that contain radioactive cesium at high concentrations, e.g., wild mushrooms, wild plants, wild bird and animal meat (wild boars, bears, etc.).

Prepared based on the following:
Masaharu Tsubokura, et.al. "Reduction of High Levels of Internal Radio-Contamination by Dietary Intervention in Residents of Areas Affected by the Fukushima Daiichi Nuclear Plant Disaster: A Case Series," PLoS One. 2014; 9(6): e100302., US National Library of Medicine, National Institutes of Health, Published online 2014 Jun 16

As radioactive cesium is eliminated from the body over time, the radioactive cesium that people ingested immediately after the earthquake has mostly been eliminated.

The internal exposure measurement using a whole-body counter being conducted at present examines the effects of radiation that is ingested orally on a daily basis. Measured values exceeding 1 mSv per year are considered to be mostly caused by radiation derived from wild plants and animals. As long as people eat only foods distributed through regulated commercial marketplaces, their annual internal doses will not exceed 1 mSv. If the annual internal dose exceeds 1 mSv, the relevant person may have eaten a lot of foods – not allowed in commercial markets – that contain radioactive cesium at high concentrations. In particular, cases have been reported where wild mushrooms are suspected to cause high internal doses.

Included in this reference material on March 31, 2013
Updated on December 31, 2017



In order to avoid further internal exposure, it is effective to have knowledge on foods that contain a high level of radioactive cesium, avoid eating same food continuously, and try to eat a variety of foods produced in diverse areas. Obtaining accurate information is extremely important.

Included in this reference material on March 31, 2013
Updated on March 31, 2020

Abbreviations

Act on Special Measures Concerning Nuclear Emergency	Act on Special Measures Concerning Nuclear Emergency Preparedness
Act on Special Measures (Concerning the Handling of Environment Pollution by Radioactive Materials)	Act on Special Measures Concerning the Handling of Environment Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District - Off the Pacific Ocean Earthquake that Occurred on March 11, 2011
ADI	Acceptable Daily Intake
ALARA	As Low As Reasonably Achievable
ALPS	Advanced Liquid Processing System
BMI	Body Mass Index
BSS	Basic Safety Standards
CT	Computed Tomography
DDREF	Dose and Dose Rate Effectiveness Factor
DNA	Deoxyribonucleic Acid
EEG	Electroencephalogram
EUROCAT	European Surveillance of Congenital Anomalies
GM counter	Geiger-Müller counter
HPCI	High Pressure Coolant Injection System
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ILO	International Labour Organization
INES	International Nuclear and Radiological Event Scale
IQ	Intelligence Quotient
IXRPC	International X-ray and Radium Protection Committee
JAEA	Japan Atomic Energy Agency
JESCO	Japan Environmental Storage & Safety Corporation
J-RIME	Japan Network for Research and Information on Medical Exposure
LNT model	Linear Non-Threshold model
MRI	Magnetic Resonance Imaging

MRL	Maximum Residue Levels
NAS	National Academy of Sciences
ND	Not Detected
OECD/NEA	Organisation for Economic Co-operation and Development/Nuclear Energy Agency
PET	Positron Emission Tomography
PFA	Psychological First Aid
PTSD	Posttraumatic Stress Disorder
RCIC	Reactor Core Isolation Cooling System
SDQ	Strengths and Difficulties Questionnaire
SPEEDI	System for Prediction of Environmental Emergency Dose Information
TDI	Tolerable Daily Intake
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WBC	Whole Body Counter
WHO	World Health Organization

■ Units

Sv	Sievert
Bq	Becquerel
Gy	Gray
eV	electron volt
J	Joule

SI prefixes

Symbol	Reading	Exponential (decimal notation)
T	tera	10^{12} (1 000 000 000 000)
G	giga	10^{9} (1 000 000 000)
M	mega	10^{6} (1000 000)
k	kilo	10^{3} (1 000)
d	deci	10^{-1} (0.1)
c	centi	10^{-2} (0.01)
m	milli	10^{-3} (0.001)
μ	micro	10^{-6} (0.000 001)
n	nano	10^{-9} (0.000 000 001)

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A

Act on Special Measures Concerning the Handling of Environment Pollution by Radioactive Materials

The radioactive materials released due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi Nuclear Power Station (NPS) after the Great East Japan Earthquake caused environmental pollution. This Act aims to promptly reduce the influence of this environmental pollution on human health and living environments, and provides for the monitoring and measurement of the environmental pollution, disposal of waste contaminated with radioactive materials, decontamination of soil and other countermeasures. (Based on the website of the Ministry of the Environment)

Actinoid

The actinoid (actinide) series encompasses the 15 elements with atomic numbers from 89 to 103, namely Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, and Lr. All actinoids are radioactive and release energy upon radioactive decay. Naturally occurring uranium and thorium and artificially produced plutonium are the most abundant actinides on Earth.

Additional doses

The term "additional dose" refers to a dose received from radioactive sources that were unintentionally generated. After the TEPCO's Fukushima Daiichi NPS Accident, the additional dose often refers to the dose from the artificial radionuclides (e.g., Cesium-137) distinct from the dose from naturally existing radionuclides (e.g., Potassium-40).

Advanced Liquid Processing System

Multi-nuclide removal equipment (known as the Advanced Liquid Processing System, or ALPS) that removes 62 kinds of radioactive materials other than tritium. "ALPS treated water" refers to water that has been treated by the Advanced Liquid Processing System (ALPS) and other equipment and has been purified to a level where contained radioactive materials, except for tritium, satisfy the regulatory standards for environmental discharge. Prior to the treatment using ALPS, contaminated water is purified to remove cesium, strontium, etc.

ALPS treated water

See "Advanced Liquid Processing System".

Ambient dose

An ambient dose refers to the amount of radiation in the air. Gamma rays from radioactive materials on or near the ground surface and gamma rays from radioactive materials in the air affect ambient dose levels.

Areas under Evacuation Orders

Areas for which evacuation orders were issued based on Article 15, paragraph (3) of the Act on Special Measures Concerning Nuclear Emergency Preparedness; Areas under Evacuation Orders consisted of Deliberate Evacuation Areas and the 20-km zone of the Nuclear Power Station. The areas were reviewed and were newly organized as Preparation Areas for Lift of Evacuation Order, Habitation Restricted

Areas, and Restricted Areas.

Areas where Returning is Difficult
See "Restricted Areas".

Artificial radionuclides
Man-made radionuclides produced by a nuclear reactor and an accelerator in contrast to naturally-occurring radionuclides. (Based on the website of the Nuclear Fuel Cycle Engineering Laboratories, JAEA)

Atmospheric nuclear testing
Nuclear testing conducted on the ground, at sea or in the air; There are also underwater nuclear testing, underground nuclear testing and exoatmospheric nuclear testing. Nuclear testing other than that to be conducted underground was all banned under the Partial Test Ban Treaty (PTBT), which was signed in 1963. (Based on the website of Japan Atomic Energy Agency)

B

Basic Survey
The Basic Survey is a questionnaire survey targeting roughly 2,050,000 residents of and visitors to Fukushima Prefecture as of March 11, 2011. Estimated external radiation doses were calculated based on recorded movements of respondents in the four months following the nuclear accident. (Based on the website of the Radiation Medical Science Center, Fukushima Medical University)

C

Calibration constant
Calibration means to clarify the relationship between a correct value and instrument readings, and such relationship expressed in a ratio is referred to as a calibration constant. When measuring radiation, correct values are to be obtained by multiplying instrument readings by a calibration constant. A calibration constant is generally indicated on a calibration label attached to a radiation meter.

Cell degeneration
Passing from a state of goodness to a lower state by losing qualities desirable for normal cell function that results in, for example, deformity or malfunctioning.

Cesium
Cesium (Caesium) is a chemical element with atomic number 55. Cesium-137 (Cs-137) and Cesium-134 (Cs-134) are radioisotopes of cesium and their physical half-lives are about 30 and two years, respectively. Cs-137 decomposes to Ba-137 through beta decay associated with gamma radiation (0.662 MeV), and then to nonradioactive barium. Cs-137 is generated as one of the fission products, whereas Cs-134 is generated through neutron capture of stable cesium. The biological half-life of cesium is about 70 to 100 days for adults and is shorter for children. Cs-137 and Cs-134 were released into the environment due to the TEPCO's Fukushima Daiichi NPS Accident as well as other radioisotopes such as radioiodine. On the other hand, Cs-137 is commonly used as a gamma emitter in industrial application.

Chernobyl Nuclear Power Station Accident

A nuclear reactor accident that occurred at Unit 4 of the Chernobyl Nuclear Power Station in the Ukrainian Republic on April 26, 1986.

Chronic exposure

Chronic exposure means continuous or intermittent exposure to radiation over a long period of time. In contrast to acute exposure, tissue reactions caused by exposure are less severe if the total radiation dose is the same.

Codex Alimentarius Commission

An intergovernmental body created in 1963 by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) for the purpose of protecting consumers' health and ensuring fair-trade practices in the food trade, etc.; The Commission establishes international standards for foods.

Cold shut-down

A situation where a fission reaction has been suppressed through the insertion of control rods and the temperature in the reactor is stably maintained at 100°C or lower by continued cooling.

Committed effective dose

The sum of the products of the committed organ or tissue equivalent doses and the appropriate tissue weighting factors (w_T). The commitment period is taken to be 50 years for adults, and to age 70 years for children. (Cited from ICRP, 2007) (See p.56 in Vol. 1 (Chapter 2) for details)

Committed effective dose coefficient

The coefficient is indicated as a committed effective dose for a person who has ingested or inhaled 1Bq of radioactive materials considering type of radionuclide, intake route (ingestion, inhalation, etc.), and age group (adults, young children, infants). The coefficient differs by age group because time integrated dose is taken into account for a period of 50 years for adults and for a period of becoming up to age 70 for children, and also because biological half-lives and sensitivity differ between adults and children.

Intake (Bq) × (Committed) effective dose coefficient (mSv/Bq) = (Committed) effective dose (mSv)

(Based on the website of the Food Safety Commission of Japan)

Committed effective doses per unit intake (Bq)

See "Committed effective dose coefficient".

Comprehensive Health Checkup

The program aims at early detection and treatment of diseases as well as prevention of lifestyle-related diseases. Its main target includes 210,000 former residents of evacuation zones whose lifestyle changed drastically after the accident. Additional tests such as differential leukocyte count are performed apart from the routine tests included in the general medical check-up at the workplace or by the local government. (Based on the website of the Radiation Medical Science Center, Fukushima Medical University)

Confidence interval
In "frequentist inference", a confidence interval is an interval defined in terms of the sampling distribution of a statistic of interest (i.e. the distribution of estimates of the statistic that would arise from repeated—generally hypothetical—realizations of data generated from the same underlying distribution as the observed data) such that, for example, the probability that a 95% confidence interval for a given parameter contains the true value of that parameter is 0.95. (Cited from UNSCEAR, 2017)

Confinement function
A function as a protective wall to prevent diffusion of radioactive materials into the environment; At a reactor, even if radioactive materials leak from the primarily cooling system by pipe rupture, etc., it should be ensured that the confinement function of the reactor containment vessel works properly to prevent diffusion of radioactive materials into the environment.

Containment vessel
Steel vessel enclosing a nuclear reactor containing radioactive material. It is designed, in any emergency, to keep radioactive materials inside of the vessel and to prevent the release thereof when the radioactive material is discharged from nuclear reactor.

Contaminated water
Contaminated water is water containing radioactive materials of fuel debris. It is generated due to continued water injection for cooling fuel that had been melted and solidified (fuel debris) and due to the inflow of rainwater and groundwater into the reactor building. Contaminated water has been generated every day since the accident at TEPCO's Fukushima Daiichi NPS. Contaminated water is treated using cesium adsorption equipment and a desalinator. Separated clean water is repeatedly used for cooling fuel debris. (See p.15 in Vol. 2 (Chapter 6) for details)

Controlled disposal sites
One type of disposal site where countermeasures have been taken to prevent contamination of groundwater and public waters caused by seeping water from radioactive waste. One of the countermeasures is water shielding work that covers the sides and bottom of the disposal site with plastic sheets, etc. Disposal sites are categorized into three types depending on methods of reducing influence of the waste to be landfilled on the surrounding environment, i.e., controlled type, isolated type, and stabilized type. (Based on the website of the EIC Network)

Cooling system
A system to remove the heat generated in a reactor; There are the primary core cooling system and the emergency core cooling system.

Core fuel
There is an area to load fuel assemblies in the inside of the reactor pressure vessel. This area is referred to as a reactor core. Nuclear fuel in the area is referred to as core fuel.

Core melt
A situation where fuel assemblies overheat due to abnormal deterioration of the

cooling capacity of a reactor, and the fuel assemblies in the reactor core or core internals melt down. (Based on the website of Fukushima Prefecture [d])

Cosmic rays

High energy ionizing particles such as protons, neutrons, etc. from outer space. These particles produce complex compositions at the surface of the earth through nuclear reaction with nitrogen or oxygen in the air.

Count per minute (cpm)

Number of counts per unit time when measuring radiation using a counting device (a device to count the amount of incident radiation); Number of counts per minute is indicated as cpm and number of counts per second is indicated as cps. (kcpm=1000cpm) (Based on the website of Fukushima Prefecture [d])

D

Decay (disintegration)

The process of spontaneous transformation of a radionuclide from unstable to more stable states. Radiation of alpha-ray, beta-ray, gamma-ray etc. occurs in the process. (Cited from the website of Public Health England, Radiation Protection Services)

Declaration of a nuclear emergency situation

A declaration of an emergency situation that the Prime Minister issues based on the Act on Special Measures Concerning Nuclear Emergency (see the Act on Special Measures Concerning Nuclear Emergency Preparedness) for the purpose of protecting citizens' lives, bodies and property from a nuclear disaster; Based on the declaration, the national government establishes the Nuclear Emergency Response Headquarters (headed by the Prime Minister) and provides instructions necessary for protecting citizens to nuclear operators, government organizations and relevant local governments, etc.

Decommissioning

Dismantling a nuclear reactor and the other related facilities for which it has been decided to discontinue operation or make adjustments to ensure that they pose no risks into the future.

Deliberate Evacuation Areas

Areas in municipalities located within 20km to 30km in radius from TEPCO's Fukushima Daiichi NPS where exposure doses are highly likely to reach 20 mSv in one year after the accident; The designation of Deliberate Evacuation Areas is one of the physical protection measures taken after the accident at the NPS. (Based on the website of Fukushima Prefecture [d])

Designated waste

Contaminated waste that is confirmed to be over 8,000 Bq/kg of radioactive concentration and is designated by the Minister of the Environment. The Minister of the Environment designates the waste when it is contaminated with more than 8,000 Bq/kg, based on the investigation results of the contamination status of incinerated ash and such or an application submitted by the owner of the waste.

Detection limit

The minimum amount or concentration of a targeted radioactive material in a test sample that can be detected by a certain analysis method under appropriate management and operation. (Based on the website of the Food Safety Commission of Japan)

Deterministic effect

Health effects that only appear if a threshold level of dose is exceeded, e.g. radiation-induced erythema (burns). Deterministic effects will appear within the hours, days or weeks following a high radiation exposure.
(Cited from the website of Public Health England, Radiation Protection Services)

Directional dose equivalent

The dose equivalent at a point in a radiation field that would be produced by the corresponding expanded field in the ICRU sphere at a depth, d, on a radius in a specified direction, X. The unit of directional dose equivalent is joule per kilogram (J kg^{-1}) and its special name is sievert (Sv). (Cited from ICRP, 2007)

Director General of the Nuclear Emergency Response Headquarters

In the event of a nuclear emergency situation as prescribed in Article 15 of the Act on Special Measures Concerning Nuclear Emergency, the Prime Minister issues a declaration of a nuclear emergency situation. The national government establishes the Nuclear Emergency Response Headquarters (headed by the Prime Minister), provides necessary instructions to nuclear operators, government organizations and relevant local governments, etc., and also establishes the Local Nuclear Emergency Response Headquarters (headed by the Vice-Minister) at an off-site center and formulates the Joint Council for Nuclear Emergency Response. (Based on the website of Fukushima Prefecture [d])

Dissolved Cs

See "Cesium".

Distribution Restrictions

Based on the Act on Special Measures Concerning Nuclear Emergency Preparedness, when any agricultural products containing radioactive materials at levels exceeding the standard values are found, the national government issues distribution restrictions to prevent the distribution of products from the relevant production areas for each of such areas (for each of the present or former municipalities; regarding fishery products, additionally for each sea area, lake or river).

Dose constraint

A prospective and source-related restriction on the individual dose from a source, which provides a basic level of protection for the most highly exposed individuals from a source, and serves as an upper bound on the dose in optimisation of protection for that source. For occupational exposures, the dose constraint is a value of individual dose used to limit the range of options considered in the process of optimisation. For public exposure, the dose constraint is an upper bound on the annual doses that members of the public should receive from the planned operation of any controlled source. (Cited from ICRP, 2007)

Dose-response relationship

Relationship between the magnitude of a dose and the biological response in an organism, system or (sub)population. (Cited from WHO, Health Risk Assessment, 2013)

Dosimeter

A device for measuring an individual's exposure to ionizing radiation. (Cited from UNSCEAR, 2013)

E

Electron

An elementary particle with low mass, 1/1836 that of a proton, and unit negative electric charge. Positively charged electrons, called positrons, also exist. (Cited from the website of Public Health England, Radiation Protection Services)

Emergency core cooling system

A safety system to cool a reactor core in the event of pipe rupture in the reactor cooling system, etc. by immediately injecting coolant into the reactor core; Even if a nuclear fission chain reaction is stopped by insertion of control rods immediately in an emergency, fission products continue to generate decay heat and the fuel assemblies need to be cooled. An emergency core cooling system is used for this purpose.

Energetically unstable (Unstable energy state)

See "Nucleus Stability/Instability".

Enriched uranium

See "Uranium".

Environmental monitoring

The measurement of external dose rates due to sources in the environment or of radio-nuclide concentrations in environmental media. (Cited from WHO, Health Risk Assessment, 2013)

Environmental radiation

Naturally occurring radiation or artificial radiation in the living environment; Naturally occurring radiation includes cosmic rays from the outer atmosphere and radiation deriving from naturally occurring radioactive elements that constitute the earth's crust. Part of artificial radiation that is referred to as environmental radiation is radiation released from fallout from past nuclear testing and radiation that was generated at nuclear facilities and exists in the environment. (Based on the website of Japan Atomic Energy Agency)

Epidemiological Studies

Studies of the distribution in a population of disease and other health issues as related to age, sex, race, ethnicity, occupation, economic status, or other factors. (Cited from the website of the United States Environmental Protection Agency)

Exposure dose

A situation where a human body is exposed to radiation is referred to as exposure and the amount of radiation that a person has received is referred to as an exposure dose, which is expressed in Grays (Gy) or Sieverts (Sv). (Based on the website of Japan Atomic Energy Agency)

F

Fine-needle aspiration cytology

This diagnostic procedure entails puncturing a fine needle into suspicious lesions, aspirating cells from the lesions through a needle and inspecting the nature of the cells, i.e., malignant or not, under the microscope. (Based on the website of the National Cancer Center Japan)

Food Sanitation Act

An Act for securing food safety and preventing the occurrence of sanitary hazards caused by eating and drinking. (Based on the website of the Ministry of Health, Labour and Welfare [b])

Frozen soil wall

A frozen soil wall is made by freezing the surrounding ground like a wall. Thereby the flow of the underground water is blocked. The frozen soil wall reduces the inflow of underground water into reactor buildings and inhibits the generation of contaminated water. This mechanism was adopted as one of the countermeasures to inhibit the generation of contaminated water at TEPCO's Fukushima Daiichi NPS. (Based on the website of Fukushima Prefecture [d])

Fuel cladding

A thin circular tube covering fuel; A fuel clad prevents radioactive fission products from leaking from the fuel into the coolant. Zircalloy is used for fuel clads of a light-water reactor's fuel rods. (Based on the website of Japan Atomic Energy Agency)

Fuel debris

"Fuel debris" is a complex of fuel, metallic cladding, channel boxes, etc. that were melted out from fuel assemblies and were re-solidified afterwards. Fuel debris needs to be cooled continuously as its thermal energy increases due to the radiation emitted therefrom. When handling fuel debris, which emits radiation, radiation shielding is required.

Fukushima Health Management File

An A4-sized Fukushima Health Management File is composed of three parts: the first part contains individual records such as dose measurements, health status, health checkup data, and hospital records, the second part contains leaflets about radiation etc., and the third part is "clear holders" as a storage space for record sheets. The file has been provided to each Fukushima resident so as to utilize the file for individual health management. In addition, it is an individual database about long-term health status, laboratory measurements, etc. that can be informative for future study. (Based on the website of Fukushima Prefecture [c])

G

Gaseous cesium

See "Cesium" and "Plume".

Germanium semiconductor detector

A radiation detector using a germanium semiconductor; A germanium semiconductor detector has excellent energy resolution and is widely used for gamma-ray spectrometry to identify radionuclides.

Groundwater drain

A well pumping up groundwater.

H

Habitation Restricted Areas

Areas designated by municipal mayors as areas where entry should be restricted and evacuation is ordered for the purpose of preventing risks on residents' lives and bodies; After the accident, areas within a 20-km radius from TEPCO's Fukushima Daiichi NPS were designated as former Restricted Areas. (Based on the website of Fukushima Prefecture [d])

Hand-held dose-rate instrument

An easy-to-carry-around instrument to measure ambient dose rates (e.g., a NaI (Tl) survey meter).

High Pressure Coolant Injection System (HPCI)

A safety system to cool a reactor core in the event of a loss of coolant in the reactor core by immediately injecting coolant into the reactor core at high pressure; One of the multiple safety systems contained in the emergency core cooling system.

High-dose radiation

According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), a total dose exceeding 2,000 mGy (2 Gy) is referred to as high-dose radiation. (Based on UNSCEAR, 1993)

Hydrogen explosion

A phenomenon where hydrogen precipitously reacts with oxygen to explode.

I

ICRP Recommendations

The basic idea (concept) and numerical standards for radiological protection recommended by the International Commission on Radiological Protection (ICRP); These are collectively referred to as ICRP Recommendations. (Based on the website of Japan Atomic Energy Agency)

Inert element

An inert element does not readily enter into chemical combination with other elements. Examples are helium, argon, krypton, xenon and radon. (Cited from WHO, Health Risk Assessment, 2013)

Infrared

A kind of electromagnetic wave in region of the spectrum comprising wavelengths in the range 700 nm to 1 mm. This wave does not ionize material but makes material warm.

Inspection of All Rice Bags

Fukushima Prefecture measures the radioactive cesium level of rice produced in the prefecture in 2012 or later. The rice is tested on a bag-by-bag basis with radiation detectors prepared by the prefectural government. Each bag, containing 30 kilograms of rice, is inspected for safety before shipment so as to prevent the distribution of rice whose radioactive cesium level exceeds the safety standard limit. (Based on the website of Fukushima Prefecture [b])

Intake

The activity of a radionuclide taken into the body (by inhalation or ingestion or through the skin) in a given time period or as a result of a given event. (Cited from WHO, Health Risk Assessment, 2013)

Intensive Contamination Survey Areas

Areas where municipalities take the initiative in decontamination work; Of municipalities including areas where measured ambient dose rates were 0.23 μSv/h or higher, 86 municipalities in eight prefectures are designated as Intensive Contamination Survey Areas (as of the end of January 2022).

Interim storage facility

A facility to manage and store the soil and waste containing radioactive materials safely and intensively until their final disposal.

International Atomic Energy Agency (IAEA)

An autonomous international organization within the United Nations system for scientific and technical co-operation in the nuclear field concerning nuclear safety, nuclear energy, nuclear security, etc. The headquarters is located in Vienna, Austria.

International Basic Safety Standards (BSS)

The BSS is an IAEA document of General Safety Requirements published in collaboration with other international bodies such as WHO, ILO, OECD/NEA, etc., that is issued for IAEA member states in order to materialize the ICRP's recommendations on radiation protection into actual laws and guidelines. The latest version published in 2014 that incorporates the ICRP 2007 Recommendation.

Intervention level

An intervention level is the level of avertable dose at which a specific protective action or remedial action is taken in an emergency exposure situation or chronic exposure situation. (Cited from IAEA, 1999)

Inversion tillage

Replacement of topsoil with subsoil, thereby radioactivity concentrations are reduced in the soil layer where plants take root.

Iodine

Iodine is a chemical element with symbol I and atomic number 53. It is the fourth halogen below fluorine, chlorine, and bromine. Stable and non-radioactive iodine is an essential nutrient that humans need and get through intake of food. Iodine is essential for the thyroid gland to function properly and produce thyroid hormones. Radioiodine, such as I-131, I-125, is used as a radioactive tracer in research and clinical diagnosis in nuclear medicine for diagnostic tests as well as in radiotherapy for hyperactive thyroid gland (hyperthyroidism). I-131 also plays a major role as a radioactive isotope present in nuclear fission products, and was a significant contributor to the health hazards from the Chernobyl NPS Accident. Radioactive iodine can disperse in gaseous or particulate form. In soil, however, it combines easily with organic materials and moves more slowly through the environment.

Ionizing radiation

Ionizing radiation is a more precise name of all types of radiation with energy large enough to ionize a molecule. Included under this designation are radiation from radioactive sources, X-rays, short wavelength UV, particles from accelerators, particles from outer space and neutrons. Ionizing radiation is categorized into direct (primary) ionizing radiation and indirect (secondary) ionizing radiation. The former includes charged particles such as α-particles, β-particles (electrons), positrons and the latter includes γ-rays, X-rays, neutrons. (Cited from Henriksen & Maillie, 2002, p.20)

Isotope

Nuclides with the same number of protons but different numbers of neutrons. Not a synonym for nuclide. (Cited from the website of Public Health England, Radiation Protection Services)

J

Japan's national doses

The average exposure doses received by one Japanese person; Radiation sources include naturally occurring radiation and artificial radiation (medical radiation and radiation derived from nuclear power plant accidents, etc.). Japan's national dose is evaluated to be 2.1 mSv on average from naturally occurring radiation and 3.87 mSv on average from medical radiation (for diagnosis) per year. (Based on NSRA, 2011)

K

Kerma

Unit of exposure that represents the kinetic energy transferred to charged particles per unit mass of irradiated medium when indirectly ionizing (uncharged) particles, such as photons or neutrons, traverse the medium. If all of the kinetic energy is absorbed "locally", the kerma is equal to the absorbed dose. The quantity (K) is expressed in μGy/h at 1 m. (Cited from WHO, Preliminary Dose Estimation, 2012)

L

Lanthanoid

The lanthanoid (lanthanide) series of chemical elements comprises the 15 metallic chemical elements with atomic numbers 57 through 71. They are called lanthanoids because the elements in the series are chemically similar to lanthanum.

Linear non-threshold (LNT) model

The assumption that the risk of cancer increases linearly as radiation dose increases. This means, for example, that doubling the dose doubles the risk and that even a small dose could result in a correspondingly small risk. Using current science, it is impossible to know what the actual risks are at very small doses. (Cited from the website of the United States Environmental Protection Agency)

Local exposure

A situation where part of the body, not the whole body, is mainly exposed to radiation.

M

Medical exposure

Exposure incurred by patients as part of their own medical or dental diagnosis or treatment; by persons, other than those occupationally exposed, knowingly, while voluntarily helping in the support and comfort of patients; and by volunteers in a programme of biomedical research involving their exposure. (Cited from ICRP, 2007)

Melt of nuclear fuel

Melting of core fuel from overheating that occurs in a severe nuclear reactor accident.

Mental Health and Lifestyle Survey

The survey aims to provide adequate care mainly for evacuees who are at a higher risk of developing mental health problems (e.g., post-traumatic stress disorder, depression, anxiety disorder) and lifestyle-related issues (e.g., obesity, problem drinking, sleep difficulties).

N

NaI scintillation spectrometer

A gamma-ray measurement system that detects scintillation consisting of NaI crystals is generally referred to as an NaI scintillator. (Based on the website of Japan Atomic Energy Agency)

Naturally occurring radioactive materials

Materials found in nature that emit ionizing radiation that have not been moved or concentrated artificially. K-40 is one natural radioactive material and exists in plants and human bodies.
(Cited from the website of the United States Environmental Protection Agency)

Neutron

An elementary particle with unit atomic mass approximately and no electric charge. (Cited from the website of Public Health England, Radiation Protection Services)

Noble gas

An inert radioactive gas that does not readily enter into chemical combination with other elements. Examples are helium, argon, krypton, xenon and radon. (Cited from WHO, Health Risk Assessment, 2013)

Nuclear and Industrial Safety Agency

An organization that the national government established in the Agency for Natural

Resources and Energy, Ministry of Economy, Trade and Industry, for the purpose of ensuring safety of nuclear power and other types of energy and securing industrial safety; The Agency was abolished as part of the full-fledged revision of the safety regulation system in response to the accident at TEPCO's Fukushima Daiichi NPS in March 2011. (Based on the website of Japan Atomic Energy Agency)

Nuclear fuel rods

A nuclear fuel rod consists of nuclear material covered with a metal clad. Multiple rods constitute a fuel assembly and multiple fuel assemblies constitute a reactor core. For light-water reactors, uranium dioxide is used for nuclear material and zircalloy is used for metal clads.

Nuclear reactor

A device used for electricity generation. Nuclear fission can be sustained in a self-supporting chain reaction involving neutrons. In thermal reactors, fission is brought about by thermal neutrons. Nuclear energy is released by fission reactions of nuclear material. This energy is used for the electricity generation. (Cited from the website of Public Health England, Radiation Protection Services)

Nuclear Safety Commission

The Nuclear Safety Commission was established in the Cabinet Office in 1978 as an organization that plans, deliberates and decides how to ensure safety concerning research, development and utilization of nuclear power. The accident at TEPCO's Fukushima Daiichi NPS in March 2011 triggered fundamental reform of the safety regulation system, and the Nuclear Regulation Authority was newly established as an administrative organ that integrally regulates nuclear safety on September 19, 2012, and the Nuclear Safety Commission was abolished. (Based on the website of Japan Atomic Energy Agency)

Nucleus stability/instability

Whether a nucleus is stable or unstable depends on the numbers of its constituent protons and neutrons. An unstable nucleus emits radiation to change into a nucleus that is energetically more stable.

Nuclide

A species of atom characterised by the number of protons and neutrons and, in some cases, by the energy state of the nucleus. (Cited from the website of Public Health England, Radiation Protection Services)

Nuclide concentration

The concentration of radioisotopes in certain materials, such as soil, water, air, foodstuff, and so on.

O

Ordinance on Prevention of Ionizing Radiation Hazards

The Ordinance on Prevention of Ionizing Radiation Hazards aims to minimize the health hazards out of radiation for workers and was established based on the Industrial Safety and Health Law. (Based on the website of the Ministry of Health, Labour and Welfare [a])

Organization for Economic Cooperation and Development / Nuclear Energy Agency (OECD/NEA)

An international organization that aims to contribute to the development of nuclear energy as an economic energy source; A subordinate agency of the Organization for Economic Cooperation and Development (OECD).

P

Particulate cesium

See "Cesium" and "Plume".

Personal dose equivalent

An operational quantity: the dose equivalent in soft tissue (commonly interpreted as the 'ICRU sphere') at an appropriate depth, d, below a specified point on the human body. The unit of personal dose equivalent is joule per kilogram ($J\ kg^{-1}$) and its special name is sievert (Sv). The specified point is usually given by the position where the individual's dosimeter is worn. (Cited from ICRP, 2007)

Physical attenuation

A phenomenon that the number of radioactive isotopes decrease due to radioactive decay.

Plume (Radiation plume)

Mass of air and vapour in the atmosphere carrying radioactive material released from a source. (Cited from WHO, Preliminary Dose Estimation, 2012)

Plutonium

Plutonium is a radioactive chemical element with symbol Pu and atomic number 94. It is an actinide metal and is produced by a nuclear reaction of uranium. Pu-239 is a fissile isotope and can be used for nuclear fuels and nuclear weapons. Man-made plutonium existing in the environment originates from radioactive fallout associated with nuclear weapon tests in the past. (Based on the website of Fukushima Prefecture [d])

Post-Traumatic Stress Disorders (PTSD)

Post-traumatic stress disorder (PTSD) is a mental disorder triggered by a terrifying event, causing flashbacks, nightmares and severe anxiety for prolonged periods. (Based on the website of the Ministry of Health, Labour and Welfare [c])

Potassium

Potassium is a chemical element with symbol K and atomic number 19. It is one of the alkali metals. Potassium in nature occurs only in ionic salts and is chemically similar to sodium. Naturally occurring potassium is composed of three isotopes, of which K-40 is the most common radioisotope in the human body. Natural potassium contains 0.0117% of K-40, which exists in animals and plants. About 4,000 Bq of K-40 is contained in the body of an adult male. Potassium ions are vital for the functioning of all living cells. Potassium is also used for agricultural fertilizer. Potassium and cesium are alkali metals and cesium absorbed in plants shows behavior similar to potassium. Therefore, after the accident at TEPCO's Fukushima Daiichi NPS, potassic fertilizer is used for crops as a measure to inhibit radioactive cesium absorption. (Based on the website of Fukushima Prefecture [d])

Precautionary Evacuation Areas

A term used in the 2013 Report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), which refers to areas where evacuation orders were issued from March 12 to March 15, 2011; Specifically, the term refers to Futaba, Okuma, Tomioka, Naraha, Hirono, Minamisoma, Namie, Tamura, Kawauchi and Katsurao. (Based on UNSCEAR, 2013)

Pregnancy and Birth Survey

The survey aims to provide appropriate medical care and support to mothers who were given a Maternal and Child Health Handbook and to their children. (Based on the website of the Radiation Medical Science Center, Fukushima Medical University)

Preparation Areas for Lift of Evacuation Order

Areas where it has been confirmed that annual accumulated doses will surely be below 20 mSv and efforts are to be made for early return of residents; Passing on major roads and temporary return of residents are flexibly permitted. Physical protection measures, such as screening and dose management, are not necessary in principle upon temporary entry. (Based on the website of Fukushima Prefecture [d])

Provisional regulation values

Provisional regulation values were regulation values that were used provisionally for regulation of the radioactivity in foodstuffs just after the accident at TEPCO's Fukushima Daiichi NPS because there had been no standard values. The provisional regulation values were used until the start of use of the standard values newly determined by the government.

Public exposure

Exposure incurred by members of the public from radiation sources, excluding any occupational or medical exposure and the normal local natural background radiation. (Cited from ICRP, 2007)

Q

Quantitation limit

The minimum amount or concentration of a nuclide whose quantity can be determined by a certain analysis method. (Based on the website of the EIC Network)

R

Radiation Dose Map

See "Spatiotemporal Distribution of Ambient Dose Rates".

Radiation effects

There are two major types of radiation effects: somatic effects and heritable effects. Somatic effects are classified into acute effects, which include hair loss and sterility, and late effects, which include cataracts and cancer. From the perspective of protection against radiation, somatic effects are also classified as deterministic effects (tissue reactions) and stochastic effects (cancer and heritable disorders).

Although heritable effects have been demonstrated in animal studies, the effects have not been found among the offspring of atomic bomb survivors or cancer survivors treated with radiation. (Based on the website of the National Institute of Radiological Sciences)

Radiation fluence

Radiation (particle) fluence is defined as the quotient of dN by da, where dN is the number of particles incident upon a sphere of cross-sectional area da. (Cited from ICRP, 2007)

Radiation management

Measures and control to protect workers in charge of operations at nuclear/radiation facilities and residents living near such facilities from radiation exposure. (Based on the website of Japan Atomic Energy Agency)

Radiation monitoring posts

A facility installed for monitoring environmental radiation around the nuclear facilities; In general, a facility for only measuring ambient dose rates is referred to as a monitoring post, and a facility for also measuring radioactive concentrations and meteorological data is referred to as a monitoring station. (Based on the website of Fukushima Prefecture [d])

Radiation protection

Radiation protection is the means for protection of people from harmful effects of exposure to ionizing radiation or contamination with radioactive materials. (Based on the website of Japan Atomic Energy Agency)

Radiation protection culture

Health-promoting lifestyle of people living in the contaminated area by radioactive materials, lifestyle which is backed up with knowledge and skills about radiation and radiation protection.

Radiation weighting factor

A dimensionless factor by which the organ or tissue absorbed dose is multiplied to reflect the higher biological effectiveness of high-LET radiations compared with low-LET radiations. It is used to derive the equivalent dose from the absorbed dose averaged over a tissue or organ. (Cited from ICRP, 2007)

Radioactive Cesium

See "Cesium".

Radioactive cloud (plume) immersion

See "Plume".

Radioactive decay

See "Decay (disintegration)".

Radioactive disintegration

See "Decay (disintegration)".

Radioactive Iodine

See "Iodine".

Radioactive strontium

See "Strontium".

Radiosensitivity (radiation sensitivity/sensitivity to radiation/sensitive to radiation)

Proneness of cells to be killed by radiation; As a rule, radiation exposure kills cells more easily that are dividing or programmed to divide many times in the future or in a developmentary immature stage. (Based on the website of Japan Atomic Energy Agency)

Reactor building

A concrete building that houses major equipment of a reactor.

Reactor core

The area in a reactor where fuel assemblies are loaded and fission reaction occurs actively.

Reactor core isolation cooling System

A safety system for boiling-water reactors that provides cooling water to a reactor core using a pump powered by steam in a reactor when an abnormal incident in the reactor results in preventing the ordinary system from supplying water to the reactor. (Based on the website of Japan Atomic Energy Agency)

Reactor pressure vessel

A steel vessel that houses nuclear fuel, a moderator, coolant and other major components and wherein high-pressure steam is produced by fission energy. (Based on the website of Fukushima Prefecture [d])

Reconstruction Agency

The national government's administrative agency that was organized for proactively carrying out reconstruction work with due consideration to areas severely damaged by the Great East Japan Earthquake with the aim of achieving reconstruction as early as possible. (Based on the website of the Reconstruction Agency [b])

Recriticality

Criticality is a situation where a fission reaction continues without supply of neutrons from the outside. Recriticality is a phenomenon where changes in the temperature, shape or composition of a reactor core results in criticality again. (Based on the website of Japan Atomic Energy Agency)

Recycling of the removed soil

On the premise of securing radiation safety, "recycling" here means to make the soil and waste removed through off-site decontamination work into materials again after volume reduction. These materials are to be used for construction, such as the basic structure of banks in public projects which are assumed not to change shape artificially for a long time. Also, areas which use the removed soil are supposed to be managed by an appropriate administrator and responsibility-taking system.

Reduction coefficient (Dose reduction coefficient)

A ratio between the ambient dose rate due to artificial radioactive materials measured inside a building and that measured outside, when contamination by artificial radioactive materials inside the building and under the floor can be ignored; It is a value specific to a building and is also referred to as a shielding coefficient.

Reference level

In an emergency exposure situation or an existing exposure situation, the level of dose, risk or activity concentration above which it is not appropriate to plan to allow exposures to occur and below which optimization of protection and safety would continue to be implemented. (Cited from WHO, Preliminary Dose Estimation, 2012)

Repair enzymes (DNA repair enzymes)

Enzymes necessary for repairing DNA damage. Genetic mutation affecting such enzymes induces cancer proneness. There are several DNA repair mechanisms such as mismatch repair, nucleotide excision repair, homologous recombination repair, non-homologous end joining repair and so on, and each mechanism utilizes unique or shared enzymes to repair DNA damage.

Restricted Areas

Areas where annual accumulated doses are currently over 50 mSv and are highly likely to be over 20 mSv even six years after the accident at TEPCO's Fukushima Daiichi NPS; Residents who temporarily enter these areas must undergo thorough screening, manage their own individual doses and wear protective gear. The term "Areas where returning is difficult" was formerly used instead of "Restricted Areas" as a literal translation from Japanese. (Based on the website of Fukushima Prefecture [d] and the website of the Ministry of Economy, Trade and Industry)

* Areas formerly called "Restricted Areas" were areas within a 20km radius of TEPCO's Fukushima Daiichi NPS as designated in April 2011. In March 2012, this area designation was reviewed in consideration of radiation doses and region-specific problems for individual areas and the designation was lifted for all areas formerly designated as Restricted Areas by August 2013.

Risk communication

Risk communication is a component of risk management, which is the selection of risk control options. It is the process that provides the information on which government, industry, or individual decision makers base their choices. Successful risk communication does not guarantee that risk management decisions will maximize general welfare; it only ensures that decision makers will understand what is known about the implications for welfare of the available options. (Cited from Improving Risk Communication, 1989)

S

Scintillation counter

A device used for radiation measurement. It contains material that emits light flashes when exposed to ionizing radiation. The flashes are converted to electric pulses and counted. The number of pulses is related to dose. (Cited from the website of Public Health England, Radiation Protection Services)

Screening

In the field of health and medical care, "screening" means to provisionally identify persons with a disease or disorder by rapid and high through-put laboratory tests or procedures. In the field of analysis and inspection, "screening" means to provisionally select samples containing target substances or organisms, etc. by rapid and high through-put laboratory tests. Screening results are not conclusive, and further detailed examinations or diagnoses, etc. are needed to reach the final conclusions. (Based on the website of the Food Safety Commission of Japan)

Secretariat of the Nuclear Regulation Authority (NRA)

An organization that functions as the secretariat of the Nuclear Regulation Authority newly inaugurated in September 2012 after the accident at TEPCO's Fukushima Daiichi NPS

Self-shielding effect

An effect in measurement in a situation where radiation in the air is shielded by a person or sample subject to the measurement; For example, when a person wears a personal dosimeter around his/her chest, radiation from behind is shielded by the person him/herself upon the measurement.

Solid cancers

Cancers originating in solid organs, as opposed to blood cancers such as leukaemia. (Cited from WHO, Health Risk Assessment, 2013)

Source term

The types, quantities, and chemical forms of the radionuclides that encompass the source of potential for exposure to radioactivity; After a nuclear accident, a source term including its release rate is critical for risk assessment. (Based on the US Health Physics Society)

Spatiotemporal distribution of ambient dose rates

Ambient dose rates change with time and place due to the physical decay and environmental migration of radionuclides. (Based on the website of Fukushima Prefecture [d])

Special Decontamination Areas

Areas where the national government directly conducts decontamination work; Basically, 11 municipalities in Fukushima Prefecture which were once designated as a former Restricted Area or a Deliberately-Evacuated Settlement are designated.

Specific Spots Recommended for Evacuation

Areas that do not fall under former Restricted Areas or Deliberately-Evacuated Settlements but where accumulated doses are highly likely to be over 20 mSv in one year after the accident were designated as Specific Spots Recommended for Evacuation and the national government recommended evacuation. The designation of these areas was lifted on December 28, 2014. (Based on the website of Fukushima Prefecture [a])

Specified Reconstruction and Revitalization Base Areas

Zones among Restricted Areas for which evacuation orders are lifted and where people are allowed to reside; As a result of the amendment of the Act on Special Measures for the Reconstruction and Revitalization of Fukushima (in May 2017), it was made possible to designate these zones. (Based on the website of the Reconstruction Agency [a])

Spent fuel pool

A spent fuel pool is a storage where nuclear spent fuels are cooled until their heat production due to the remaining radioactivity (after shutdown of a reactor) decreases sufficiently.

Stable cold shut-down conditions

See "Cold shut-down".

Stable iodine tablets

A drug containing a certain amount of non-radioactive or "cold" sodium iodide or potassium iodine; If one takes an adequate amount of the drug before inhalation or consumption of radioactive iodine after a nuclear accident, "cold" iodine fills the thyroid organ and prevents the accumulation of radioactive or "hot" iodine into the thyroid. (Based on the website of Japan Atomic Energy Agency)

Stochastic (health) effect

Health effect whose probability of occurrence depends on the dose received. Occurrence is usually many years after the exposure, and there is believed to be no threshold level of dose below which no effect will occur. (Cited from the website of Public Health England, Radiation Protection Services)

Stripping of topsoil (Topsoil removal)

Topsoil of farmland is to be shallowly (4 - 5cm) stripped using a tractor or other equipment to remove radioactive cesium. Radioactive cesium that fell down onto farmland is easily absorbed into soil and remained in the surface layer. Therefore, stripping and removing topsoil is effective.

Strontium

Strontium is the chemical element with symbol Sr and atomic number 38. Strontium has physical and chemical properties similar to those of calcium. Sr-90 is a radioisotope with a physical half of 28.8 years and is produced as a fission product in a nuclear reactor. Sr-90 is one of the concerned radionuclides in a nuclear accident because it is likely to accumulate in bones in a similar manner to calcium. (Based on the website of Fukushima Prefecture [d])

Subdrain

A well installed for adjusting groundwater levels around a reactor building. (Based on the website of Fukushima Prefecture [d])

Sum of ratios of concentrations required by law

For water that contains multiple nuclides, the regulatory standards for discharge state that the sum of the ratios of their concentrations to the limits respectively required by law must be less than one. This concentration limit applies to the discharge of radioactive waste to the environment, which is stipulated in the Regulation for Enforcement the Reactor Regulation Act (Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors).

Suppression chamber

Torus-shaped steel equipment that is located at the lower part of a reactor containment vessel and stores a large amount of water; A rectangular version made of concrete is referred to as a suppression pool. It is important safety equipment that provides water for the emergency core cooling system (ECCS) in the event of a loss of cooling water due to such reasons as a primary pipe rupture accident. A suppression chamber suppresses pressure increases in a nuclear reactor. When the pressure within a reactor containment vessel increases, steam is sent to a suppression chamber to reduce the increased pressure. A suppression chamber also removes particulate radionuclides upon releasing pressure.

Suppression pool

See "Suppression chamber".

Suspended Cs

See "Cesium".

T

The Act on Special Measures Concerning Nuclear Emergency Preparedness

The Act was enacted and enforced in 1999 for the purpose of protecting citizens' lives, bodies and property in consideration of the unique characteristics of nuclear disasters. The Act specifies various matters concerning nuclear disasters and provides that in an emergency due to a nuclear disaster, the Prime Minister is to issue a declaration of a nuclear emergency situation and establish the Nuclear Emergency Response Headquarters.

The Fukushima Health Management Survey

The accident that occurred at the TEPCO's Fukushima Daiichi NPS after the Great East Japan Earthquake on 11 March 2011 has resulted in long-term, ongoing anxiety among the residents of Fukushima, Japan. Soon after the disaster, Fukushima Prefecture launched the Fukushima Health Management Survey to investigate long-term low-dose radiation exposure caused by the accident. Fukushima Medical University took the lead in planning and implementing this survey. The primary purpose of this survey is to monitor the long-term health of residents, promote their future well-being, and confirm whether long-term low-dose radiation exposure has health effects. (Based on the website of the Radiation Medical Science Center, Fukushima Medical University)

The Nuclear Emergency Response Headquarters

See "Director General of the Nuclear Emergency Response Headquarters".

The radiation exposure dose

See "Exposure dose".

Thermal electrons

Electrons which emit from the surface of highly heated metal.

Threshold

Minimal absorbed radiation dose that will produce a detectable degree of any given effect. (Cited from WHO, Health Risk Assessment, 2013)

Thyroid Ultrasound Examination
Thyroid Ultrasound Examination covers roughly 380,000 residents aged 0 to 18 years at the time of the nuclear accident. The Preliminary Baseline Survey has been performed within the first three years after the accident, followed by complete thyroid examinations to detect newly growing tumors from 2014 onward, and the residents will be monitored regularly thereafter. (Based on the website of the Radiation Medical Science Center, Fukushima Medical University)

Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi Nuclear Power Station (NPS) Accident (2011)
An accident at TEPCO's Fukushima Daiichi NPS located on the Pacific coast in Fukushima Prefecture, which was caused by the Great East Japan Earthquake that occurred at 14:46 on March 11, 2011, and the subsequent massive tsunami. (Based on the website of Fukushima Prefecture [d])

Trench
An underground tunnel for storing utility equipment such as power cables and pipes.

Tritium
Tritium is a radioisotope of hydrogen composed of one proton and two neutrons. Tritium, which combines with oxygen and comprises water molecules in the same manner as ordinary hydrogen, often exists around us while being contained in water molecules. It is created in nature as a result of the reaction of cosmic rays with nitrogen and oxygen in the air, in addition to be artificially created through the operation of a nuclear power plant. In nature, tritium is contained in rainwater, sea water, and tap water, and also exists in the human body as tritium water.

Tritium emits β-particles, one type of radiation, but β-particles emitted from tritium only have weak energy (18.6 keV at the largest) and can be shielded with a piece of paper. Therefore, external exposure from tritium is unlikely to exert any influence on the human body. A biological half-life for water containing tritium is ten days, and even if it is ingested, it will be eliminated from the body promptly and will not accumulate in any specific organs. (See p.79 in Vol. 1 (Chapter 2) for details)

Turbine building
At a nuclear power plant, steam pressure is converted into rotational energy by a turbine, which is further converted into electricity by a power generator. A building that houses a turbine and a power generator is referred to as a turbine building.

U

Undifferentiated
The developmental state of cells or organs that are immature or not differentiated. Any kind of tissues in the body contains stem cells capable of dividing and producing intermediately differentiated cells that further differentiate into mature functioning cells. In this case, stem cells are undifferentiated cells while mature functioning cells are differentiated cells.

UNSCEAR
United Nations Scientific Committee on the Effects of Atomic Radiation

Uranium

Uranium is a chemical element with symbol U and atomic number 92. In nature, uranium is composed of U-238 (99.275%), U-235 (0.72%) and U-234 (0.005%). The half-lives of U-238 and U-235 are about 4.47 billion years and 704 million years, respectively. U-235 is the only naturally occurring fissile isotope, which makes it widely used in nuclear reactors.

Enriched uranium is a type of uranium in which the percent composition of U-235 has been increased through the process of isotope separation. Enriched uranium is a critical component for both civil nuclear power generation and military nuclear weapons. (Based on the website of Fukushima Prefecture [d])

V

Vent

An operation to reduce pressure in a reactor containment vessel when the pressure increases abnormally, by way of discharging the inner gas.

W

Waste within the Management Areas

Waste within areas designated by the Minister of the Environment that meet certain requirements, such as areas that are highly contaminated and require special treatment.

Water-zirconium reaction

Zircalloy is used for fuel clads for light-water reactors. If fuel is exposed from cooling water, it becomes hot and this triggers a chemical reaction of zirconium in the fuel clad with water vapor to generate hydrogen. The phenomenon where hot zirconium reacts with water vapor and generates hydrogen in this manner is referred to as a water-zirconium reaction. (Based on the website of Japan Atomic Energy Agency)

WHO

World Health Organization

Whole-body counter

A device to measure the amount of radioactive materials taken into and deposited inside the human body from outside for the purpose of examining the internal exposure dose. (Based on the website of Fukushima Prefecture [d])

Whole-body exposure

A situation where the whole body is evenly exposed to (external) radiation; This term is used in contrast to local exposure, which refers to a situation where only part of the body is exposed to radiation. (Based on the website of Japan Atomic Energy Agency)

Z

Zeolite

Zeolite is Aluminosilicate, a kind of clay mineral. It comprises porous crystals. Fine pores are usually around 0.2 to 1.0 nm in diameter. Zeolite has ion-exchange capacity and adsorptive capacity.

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