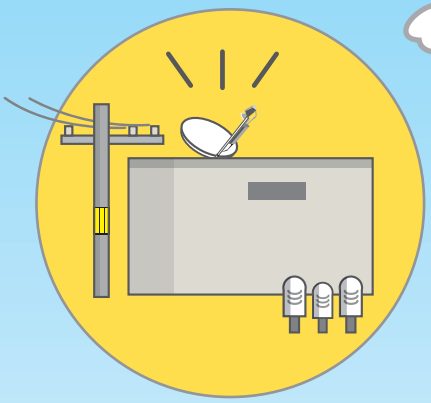
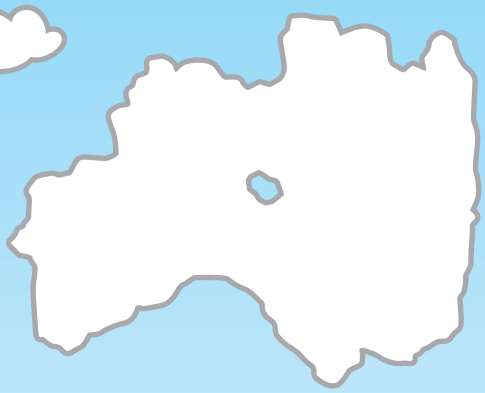
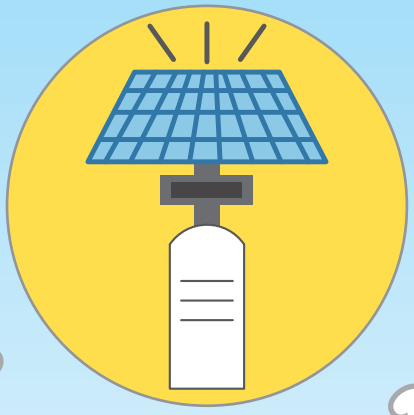
Fukushima Prefecture Newsletter on Environmental Radiation Monitoring

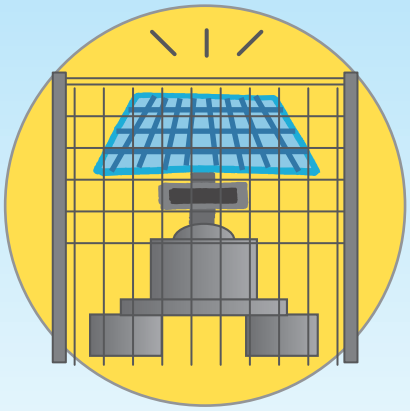
Fukumoni

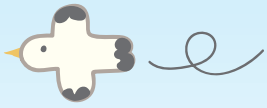
We will tell you about the current state of radiation in Fukushima Prefecture











Fukushima Prefecture

Introduction

The Great East Japan Earthquake, which occurred on March 11, 2011 severely damaged the TEPCO Fukushima Daiichi Nuclear Power Station due to onslaught of a large tsunami that accompanied the earthquake. As a result, the fuel could not be cooled, and hydrogen, a flammable gas, which was generated, produced an explosion releasing radioactive substances, such as cesium and iodine, into the atmosphere.

Fukushima Prefecture monitored environmental radiation before the Great East Japan Earthquake. After the earthquake, we have additionally installed measurement equipment, such as monitoring posts, added measurement points, and expanded the measurement area to enhance and strengthen our monitoring system.

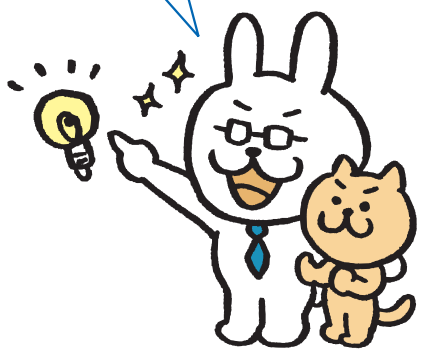
What is radiation/radioactivity?

Heat/light = Radiation (Particles and electromagnetic waves emitted from radioactive substances)

Fire = Radioactivity (Ability to emit radiation)

Firewood = Radioactive substance (Substance with the ability to emit radiation (radioactivity))

What are radiation, radioactivity, and radioactive substances? Let's imagine them as a "campfire."



Unit

Becquerel (Bq)

→A unit that expresses the level of the ability of radioactive substances to emit radiation (radioactivity)

Gray (Gy)

→A unit that expresses how much radiation energy is absorbed by a substance

Sievert (Sv)

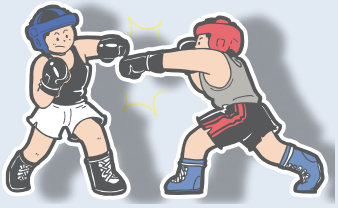
→A unit that expresses the impact on human body when exposed to radiation

0.001Sv
=
1mSv
=
1,000μSv

1mSv is 1,000 times more than 1μSv

If you compare these units of radiation to boxing ….

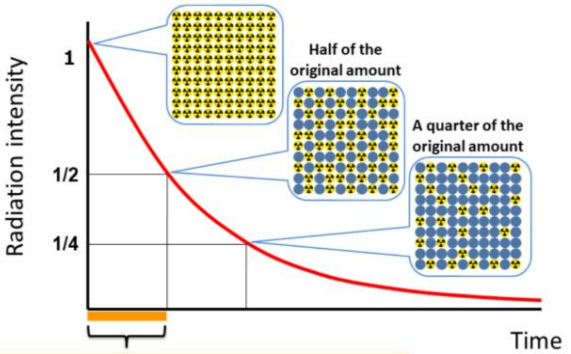
- Becquerel = The number of punches
- Gray = The power of punch
- Sievert = Body damage caused by punch



What is the half-life of a radioactive substance?

Radioactive materials emit radiation, which gradually weakens and becomes weaker until it finally emits no radiation.
The period it takes for the radioactivity to halve (reduce by 50%) is called the "half-life."

Half-life varies depending on the type of radioactive substance. It can be about eight days for iodine-131, two years for cesium-134, and 30 years for cesium-137.



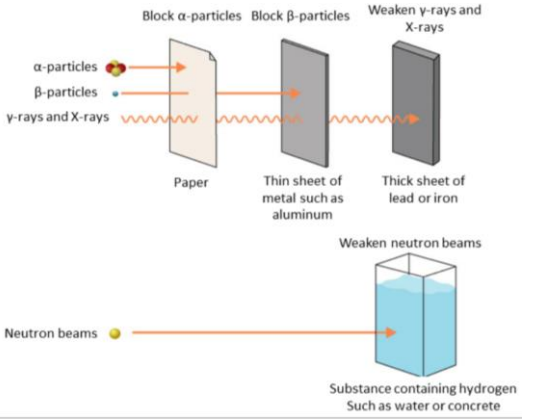
Source: "BOOKLET to Provide Basic Information Regarding Health Effects of Radiation (2021 Edition)" (The Ministry of the Environment)

Can radiation pass through things?

Radiation has the power to pass through objects; this is known as penetrating power. There are various kinds of radiation, such as α (alpha) particles , β (beta) particles, γ (gamma) rays, X rays, and neutron beams, and each one has a different level of penetrating power.

Alpha particles, the one with the weakest penetrating power, won't even pass through a sheet of paper, while it takes something like water or concrete to weaken neutron beams, the one with the strongest penetrating power.

Tritium emits β (beta) particles, but their energy is small, and won't even pass through a sheet of paper.



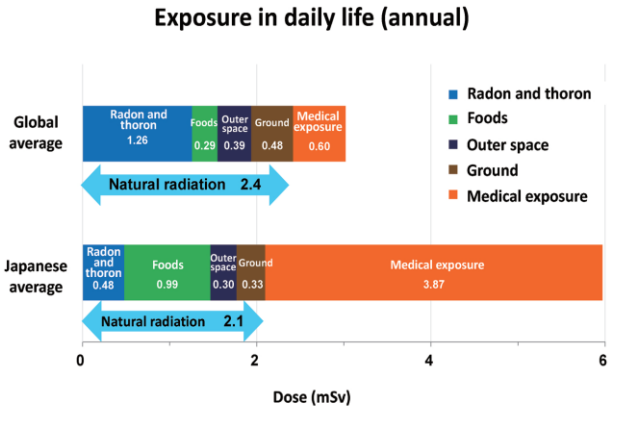
Source: "BOOKLET to Provide Basic Information Regarding Health Effects of Radiation (2021 Edition)" (The Ministry of the Environment)

How are we exposed to radiation?

Radiation originally exists in nature and is not unique to nuclear power plants or hospitals. There are two types of radiation that we receive from our surroundings: "natural radiation" and "artificial radiation."

Natural radiation refers to radiation received from space, air, the ground, food, and so on. In Japan,people are exposed to 2.1mSv of radiation on average annually (World average: 2.4mSv per year).

The higher levels of radiation contained in Japanese food compared to the world average is related to high consumption of fish, which contain a lot of natural radionuclides.



Sources: Prepared based on the 2008 UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) Report; and "Environmental Radiation in Daily Life (2011)," Nuclear Safety Research Association

Artificial radiation refers to the radiation received from abdominal (stomach, intestines, etc.) X-ray examinations, CT scans, and cancer treatments. The figure shows that, in Japan's population, the main contributor to radiation exposure comes from medical examinations and treatments, and this is related to Japan's long life expectancy and extensive medical care.

※ Radiation exposure refers to being exposed to radiation.

Monitoring of radiation in the environment in Fukushima Prefecture

Fukushima Prefecture measures the air dose rate※, analyzes radioactive substances contained in environmental samples (air, water, soil, etc.) and publishes the measurement results to ensure the safety and security of everyone concerned.

Monitoring the areas around the power plants

Fukushima Prefecture monitors the types, locations and levels of radioactive substances in the environment that came from nuclear power plants in the area.

Prefecture-wide monitoring

Fukushima Prefecture monitors various parts of the prefecture to keep track of the trends in contamination caused by the nuclear accident.

1 Monitoring of radiation in the environment

Measurement of environmental samples

We analyze radioactive substances contained in environmental samples, such as air, water and soil collected in the prefecture.

Measurement of air dose rate

● Station-type monitoring post

To monitor the radioactive substances newly released into the environment from the nuclear power plants, we have installed 42 monitoring posts in the areas within approximately 30 km from the nuclear power plants.

2 Monitoring, analysis, evaluation and confirmation of data

● Monitoring and analysis

Fukushima Prefectural Centre for Environment Creation (FPCEC) constantly monitors the air dose rate, and analyzes the collected and accumulated environmental radiation data.

● Evaluation and confirmation

Fukushima Prefecture has set up an “Environment Monitoring Evaluation Subcommittee” to evaluate the monitoring data collected from around the nuclear power plants. The subcommittee is composed of experts in radiation management, environmental radioactivity and water resources studies, and the members from national, prefectural, and municipal governments who meet on a quarterly basis.

Measurement of air dose rate

● Real-time dosimetry system

In order to monitor air radiation dosage rates in areas where children gather, 2,900 units have been installed in schools, nurseries and other locations across the prefecture.

● Portable monitoring post

We installed approximately 570 units in public facilities in the prefecture to grasp changes in the radiation level in the air.

● Mobile monitoring

We use survey meters to measure the air radiation dose rate in places where many people gather, such as tourist spots and meeting places.

● Car-borne survey

We installed radiation measuring devices in cars to measure the dose of radiation in the air along the driving route. We also installed the radiation measuring devices in some fixed-route buses for ease of radiation measurements.

3 Publication of data

- Fukushima Prefecture website
- Fukushima Prefecture Radioactivity Measurement Map, etc.

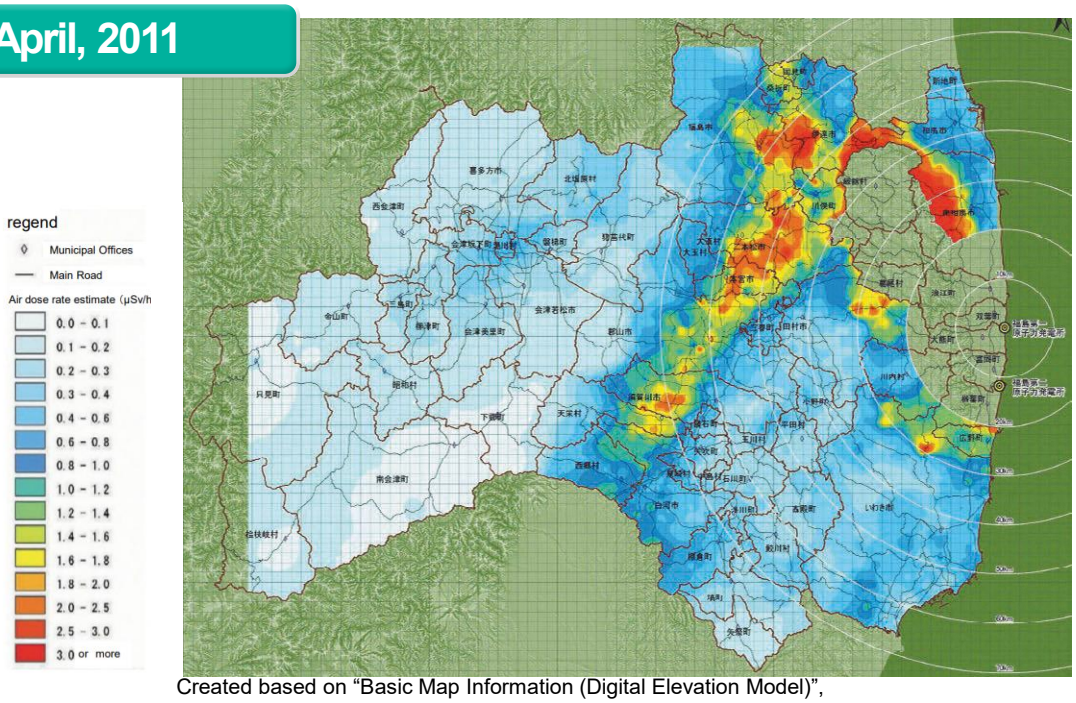
See page 11

※Air radiation dosage rate: Air radiation dosage is the amount (strength) of radiation in the air. This includes gamma radiation from the ground, cosmic radiation, etc. The air radiation dosage per unit of time (years, months, weeks, days, etc.) measured in a certain airspace is called the air radiation dosage rate.

Changes in air radiation dosage rate in Fukushima Prefecture

The air radiation dosage rate in Fukushima Prefecture has decreased significantly from that as of April 2011.

April, 2011



Created based on “Basic Map Information (Digital Elevation Model)”, (The Geographical Survey Institute) and “National Land Numerical Information (Administrative Areas, Roads)” (The Ministry of Land, Infrastructure, Transport and Tourism National Land Policy Bureau)

April ~ May,2023

Created based on the “Basic Map Information (Digital Elevation Model)”, (The Geographical Survey Institute) and “National Land Numerical Information (Administrative Areas, Roads)” (The Ministry of Land, Infrastructure, Transport and Tourism National Land Policy Bureau)

※The results of the car-borne survey conducted in ”Difficult-to-Return zone” from September to October , 2023 were added.

In the Nakadori and Hamadori regions, the effects of natural attenuation and decontamination of radioactive substances are definitely appearing. The Aizu region has been restored to the air radiation dosage level which existed before the nuclear accident.

Let's look at the numbers

Air dose rate in Fukushima Prefecture

unit: μSv/h

Measurement point※2 / Measurement date※1	Fukushima City	Koriyama City	Shirakawa City	Aizu-wakamatsu City	Minamiaizu Town	Minamisoma City	Iwaki City
Before the accident(2009)※3	0.04	0.04	0.04	0.05	0.04	0.05	0.06
Aplil 2011	1.91	1.83	0.67	0.19	0.08	0.63	0.37
September 2011	1.00	0.88	0.42	0.13	0.08	0.42	0.18
September 2012	0.69	0.51	0.21	0.09	0.06	0.37	0.10
September 2013	※4 0.33	※4 0.17	0.12	0.07	0.05	0.15	0.09
September 2014	0.24	0.14	0.10	0.07	0.05	0.12	0.08
September 2015	0.20	0.12	0.09	0.06	0.04	0.09	0.07
September 2016	0.18	0.10	※4 0.08	0.06	0.04	0.08	0.07
September 2017	0.15	0.09	0.07	0.05	0.04	※4 0.08	0.06
September 2018	0.14	0.09	0.07	0.05	0.04	0.07	0.06
September 2019	0.13	0.08	0.06	0.05	0.04	0.07	0.06
September 2020	0.13	0.07	0.06	0.05	0.04	0.06	0.06
September 2021	0.12	0.07	0.06	0.05	0.04	0.06	0.06
September 2022	0.12	0.07	0.06	0.05	0.04	0.06	0.06
September 2023	0.11	0.07	0.06	0.05	0.04	0.06	0.06

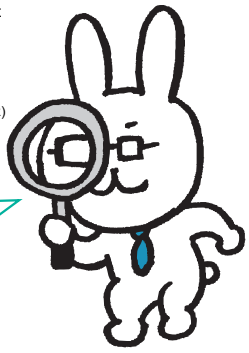
※1 Monthly averages are listed (except for 2009).

※2 Fukushima City is measured at Ken-poku Public Health and Welfare Office, and others are measured at the prefectural joint government building. (except for 2009)

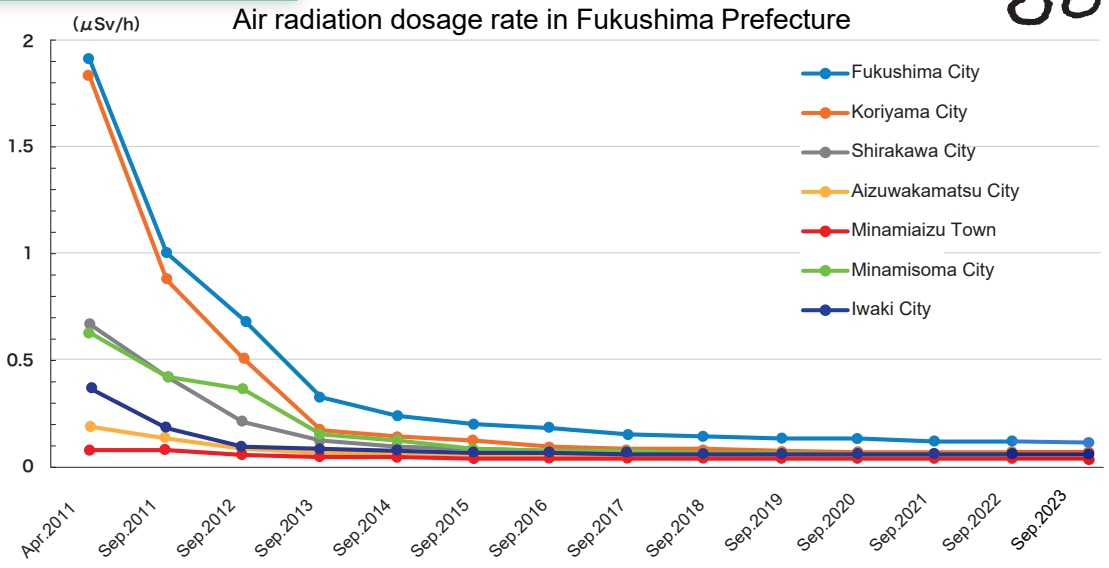
※3 2009 figures are the results of the radiation level survey.
Fukushima City : August 18, 2009 (Prefectural East Branch Office)
Shirakawa City: August 11, 2009 (Shirakawa Joint Government Building)
Minamiaizu Town: August 11, 2009 (Maruyama Park)
Iwaki City: August 18, 2009 (Iwaki Joint Government Building)
Koriyama City: August 11, 2009 (Hayama Park)
Aizuwakamatsu City: August 19, 2009 (Aizu Tsurugajo Castle Park)
Minamisoma City: August 19, 2009 (Nishiki Park)

※4 Decontamination was conducted in Fukushima City and Koriyama City from April to May 2013, Shirakawa City in June 2016, and Minamisoma City in December 2016.

※Difficult-to-return Zones are not included in the above measuring points.



Let's look at the graph



※Monthly averages are listed.
※For measurement locations, prefectural north health and welfare office for Fukushima City, and prefectural joint government buildings for other cities.
※Decontamination was conducted in Fukushima City and Koriyama City from April to May 2013, Shirakawa City in June 2016, and Minamisoma City in December 2016.

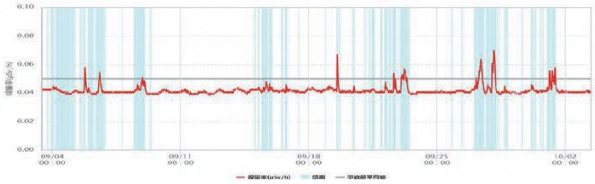
Trivia

● Changes in radiation dose due to weather

The radiation dose varies depending on the weather.

For example, when it rains, naturally occurring radioactive substances in the atmosphere can fall to the ground, increasing the radiation dose. When snow accumulates, the radiation dose may fall because the radiation from the ground is blocked.

Air radiation dosage rate at Kaibama Bureau, Minamisoma City (September 3, 2023 to October 3, 2023)

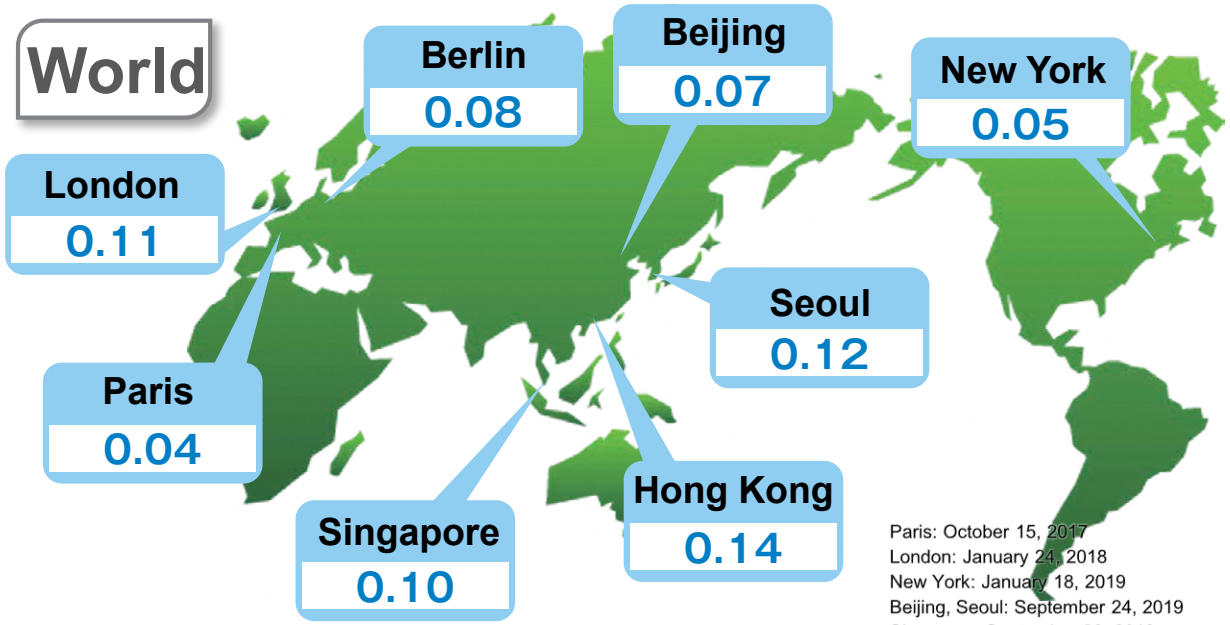


↑The light blue lines indicate the time when it rained.
It can be seen that the rain increases the air radiation dosage rate (red line).

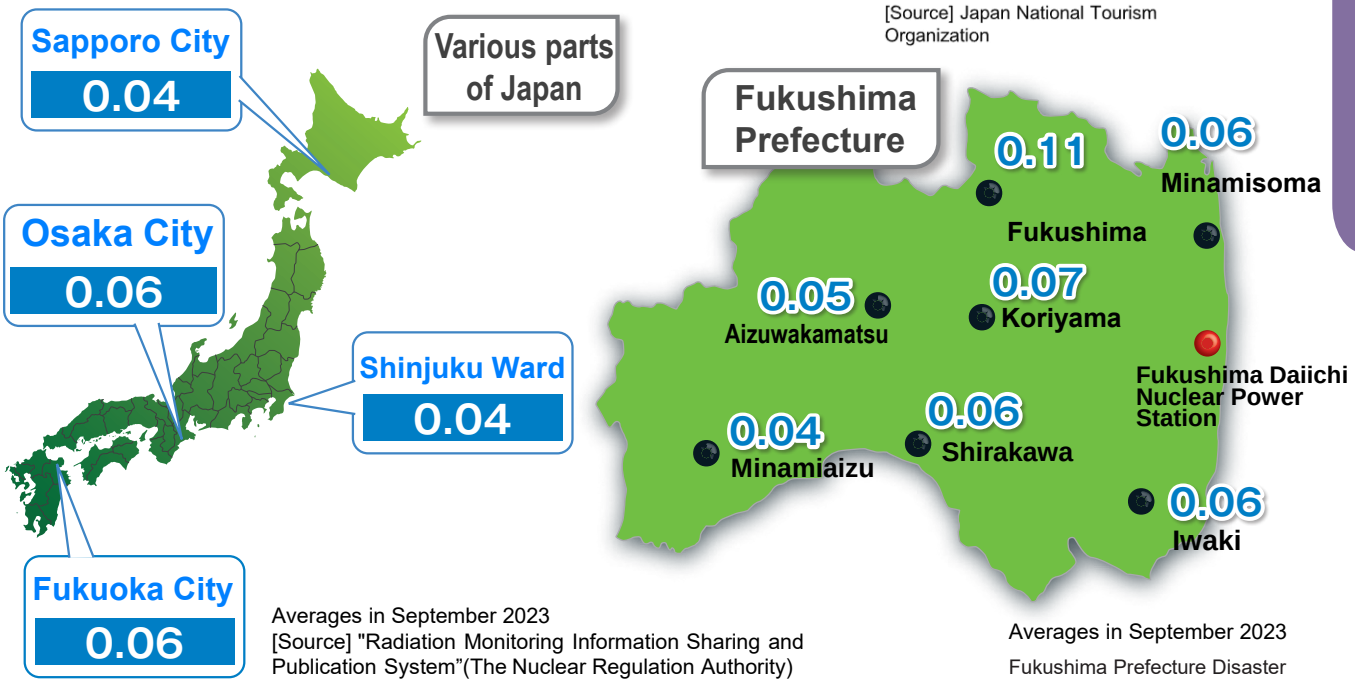
Comparison of Air Radiation Dosage rates in Fukushima Prefecture to major cities in the world

The air radiation dosage rate in Fukushima Prefecture (excluding the areas where evacuation was ordered) is now about the same level as that of major cities in the world.

Unit: μSv/h



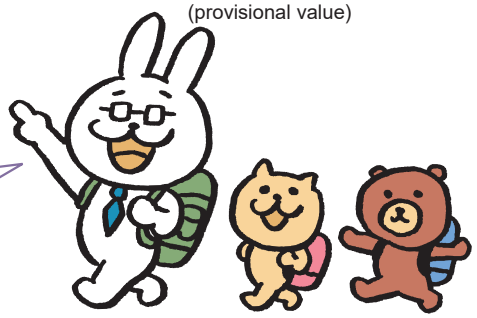
Paris: October 15, 2017
London: January 24, 2018
New York: January 18, 2019
Beijing, Seoul: September 24, 2019
Singapore: September 26, 2019
Berlin, Hong Kong: September 27, 2019
[Source] Japan National Tourism Organization



Averages in September 2023
[Source] "Radiation Monitoring Information Sharing and Publication System"(The Nuclear Regulation Authority)
(https://www.erms.nsr.go.jp/nra-ramis-webg/)

Averages in September 2023
Fukushima Prefecture Disaster Countermeasures Headquarters (provisional value)

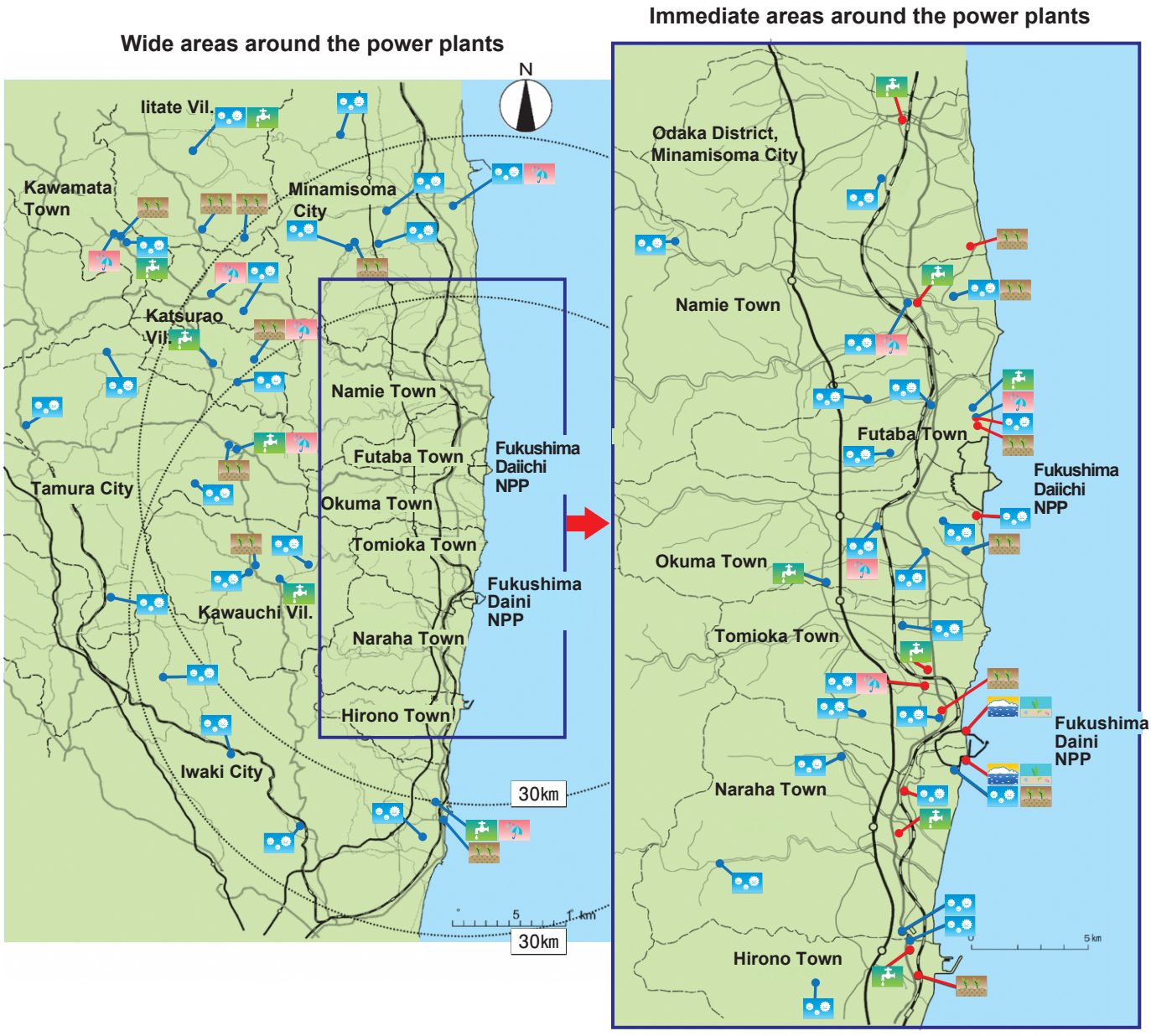
Environmental radiation monitoring work was carried out all over Japan even before the nuclear accident.
Monitoring posts are also installed all over the country.



Environmental samples in Fukushima

In Fukushima Prefecture, the concentration of radioactive materials is measured in environmental samples, including the air, water, and soil, around the power plant.

Sampling points for environmental samples



Dust
Fallout
Soil
Drinking water
Seawater※
Marine soil※
Measured before the accident
Measured after the accident

※Refer to page 10 for the sampling locations of seawater and marine soil around the Fukushima Daiichi NPP.

Look at the measurement results from 2022

Tips on how to read the graph

Radioactivity of environmental samples

Range of measurement values in 2022

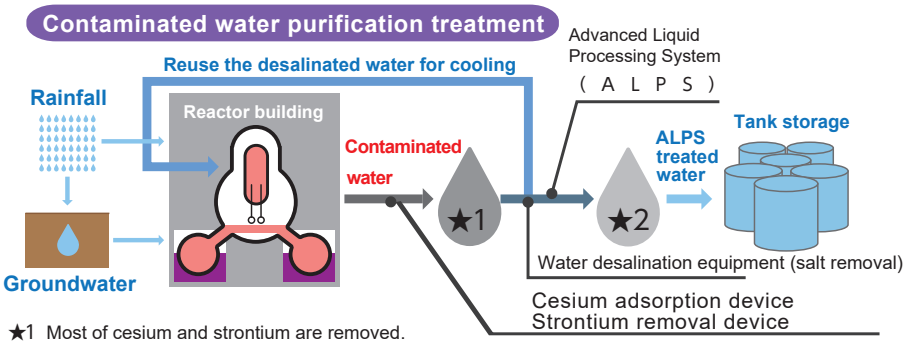
Types	Radioactive materials detected	Measurement results	Results for 2022: Measurement values	Results for 2022: Trends	Measurement values from 2019 to 2022	Maximum value after the accident (Apr., 2011-Mar.,2022)	Range of measurement values before the accident (since 2001)
Dust	Unit (mBq/m³)	0.01 0.1 1 10 100 1,000 10,000					
	Cs-134		ND~0.027	Decreased	ND~0.16	1,100	ND
	Cs-137		ND~0.89	Decreased	ND~2.4	990	ND
Rainfall	Unit(mBq/m² month)	0.1 1 10 100 1,000 10,000 100,000					
	Cs-134		ND~5.4	Decreased	ND~49	5,000,000	ND
	Cs-137		0.38~240	Decreased	0.46~700	5,600,000	ND~0.15
Soil	Unit (Bq/kg dry)	1 10 100 1,000 10,000 100,000 1,000,000					
	Cs-134		ND~9,900	Decreased	ND~20,000	230,000	ND
	Cs-137		58~330,000	Decreased	7.7~400,000	400,000	ND~16
	Unit (Bq/kg dry)	1 10 100					
	Sr-90		ND~55	Remained at the same level	ND~45	81	ND~3.5
	Unit (Bq/kg dry)	0.01 0.1 1					
	Pu-238		ND~0.05	Same level as before the accident	ND~0.10	0.10	ND~0.03
	Pu-239+240		ND~0.36	Same level as before the accident	ND~0.54	1.4	ND~0.44
Tap water	Unit (Bq/L)	0.1 1 10					
	Cs-134		ND	Decreased	ND~0.005	0.17	ND
	Cs-137		ND~0.036	Decreased	ND~0.043	0.29	ND
	Tritium		ND~0.60	Same level as before the accident	ND~0.60	0.96	ND~1.2
	Unit (Bq/L)	0.0001 0.001 0.01					
	Sr-90		ND~0.0013	Same level as before the accident	ND~0.0014	0.002	0.001~0.002
	Pu-238	Pu-238 was not detected.	ND	ND	ND	ND	-
	Pu-239+240	Pu-239+240 was not detected.	ND	ND	ND	ND	ND
Seawater	Unit (Bq/L)	0.001 0.01 0.1 1					
	Cs-134		ND~0.006	Decreased	ND~0.028	2.4	ND
	Cs-137		ND~0.18	Decreased	0.002~0.38	5.0	ND~0.003
	Tritium		ND~0.66	Same level as before the accident	ND~1.4	6.2	ND~2.9
	Sr-90		ND~0.015	Decreased	ND~0.035	2.9	ND~0.002
	Unit (mBq/L)	0.01 0.1 1					
	Pu-238		ND	ND	ND	0.010	-
	Pu-239+240		ND~0.014	Same level as before the accident	ND~0.019	0.020	ND~0.013
Marine soil	Unit (Bq/kg dry)	1 10 100 1000					
	Cs-134		ND~10	Decreased	ND~26	450	ND
	Cs-137		ND~350	Decreased	17~390	1,000	ND~0.97
	Unit (Bq/kg dry)	0.01 0.1 1 10					
	Sr-90		ND~0.28	Decreased	ND~0.44	4.6	ND
	Pu-238		ND~0.01	Remained at the same level	ND~0.02	0.02	-
	Pu-239+240		0.09~0.50	Same level as before the accident	0.11~0.52	0.61	0.15~0.61

※ND: less than limit of detection

Discharging ALPS treated water into the sea

What is ALPS treated water?

At the Fukushima Daiichi NPP (Units 1-3), water is injected into the reactors to cool the fuel debris that melted and solidified during the accident. This cooling water becomes contaminated with radioactive materials when it comes in contact with the fuel debris. Even more “contaminated water” is produced when it mixes with groundwater or rainwater flowing into the reactor building.



★1 Most of cesium and strontium are removed.
★2 The water has been purified and treated to the extent that radioactive materials other than tritium are below the minimum safety standard.

The contaminated water in the buildings is treated to remove cesium and strontium, and some of it is reused to cool the fuel debris in the reactor after the salt is filtered out (desalination). The remaining water is purified using the 'Advanced Liquid Processing System' (ALPS). This 'ALPS treated water,' which has been treated and purified to radiation levels below the minimum safety standards for radioactive materials (other than tritium), is stored in on-site tanks.

Why do we need to dispose of ALPS treated water?

There are over 1,000 giant tanks storing ALPS treated water at the Fukushima Daiichi NPP.

Disposing of the treated water and reducing the number of tanks is essential for decommissioning (shutting down) the plant. It is necessary in order to make room to construct facilities required for the future decommissioning processes.

In April 2021, the government decided to discharge ALPS treated water into the sea under a policy created after repeated discussions by experts on the handling of the treated water. The ocean discharge began on August 24, 2023.

It was carried out in compliance with safety standards, and is not expected to have any adverse effects on the environment or human health. However, it is very important to take measures to ensure safety by checking the operation status of the discharge facilities and tritium concentrations in ALPS treated water. Careful monitoring of the ocean area must also be done, due to the long period of time involved.

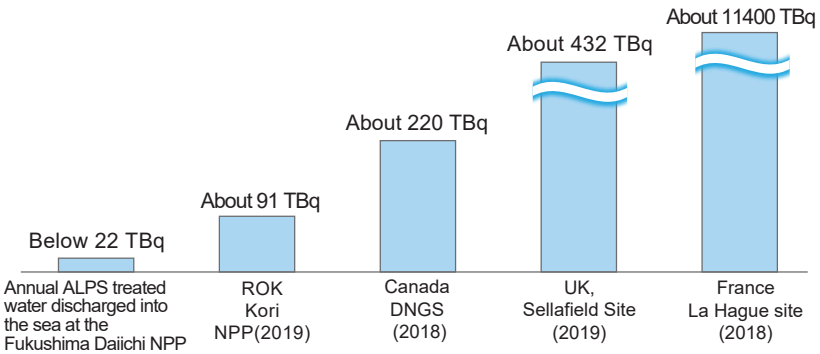
What is tritium?

Tritium is a common form of hydrogen (hydrogen-3), that occurs naturally every day. It can be found in rainwater, tap water, and the human bodies. It is a radioactive material that is broadly present in the natural environment.

Tritium exists as a liquid that combines with oxygen and has almost the same properties as water, making it difficult to separate from water.

How much is tritium being discharged by each country around the world?

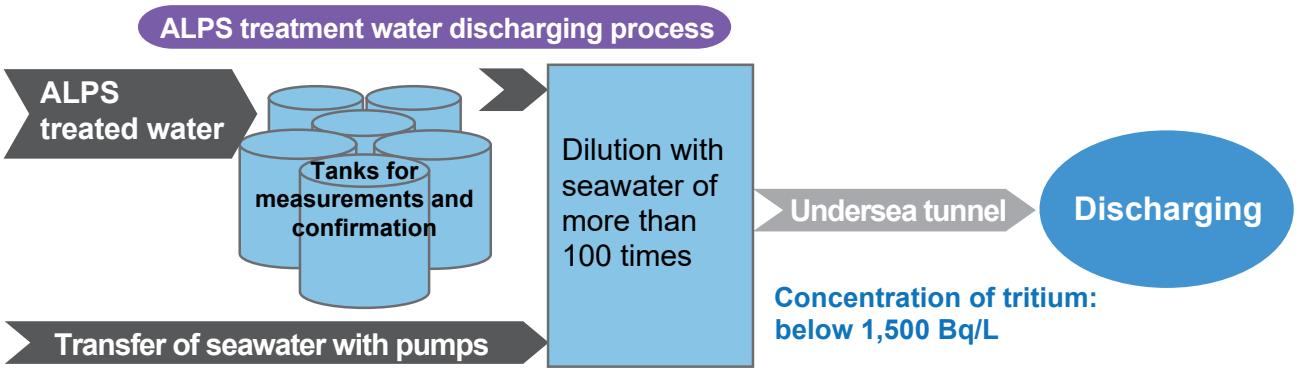
Many nuclear facilities around the world release tritium in compliance with safety standards.



Prepared based on ”Let’s learn and think about the decommissioning and future of the Fukushima Daiichi NPP!” published by the Agency for Natural Resources and Energy

How high is the tritium concentration that's discharged into the sea?

Before discharging, the concentration of tritium is reduced to 1,500 Bq/L, through a dilution of more than 100 times with seawater.



What is the tritium concentration when discharging ALPS treated water into the sea?

Below 1/40 of the Regulatory Standards (60,000Bq/L)
Below 1/7 of the WHO Standards for Drinking Water (10,000 Bq/L) ※

※Guidelines for drinking-water quality, 4th edition

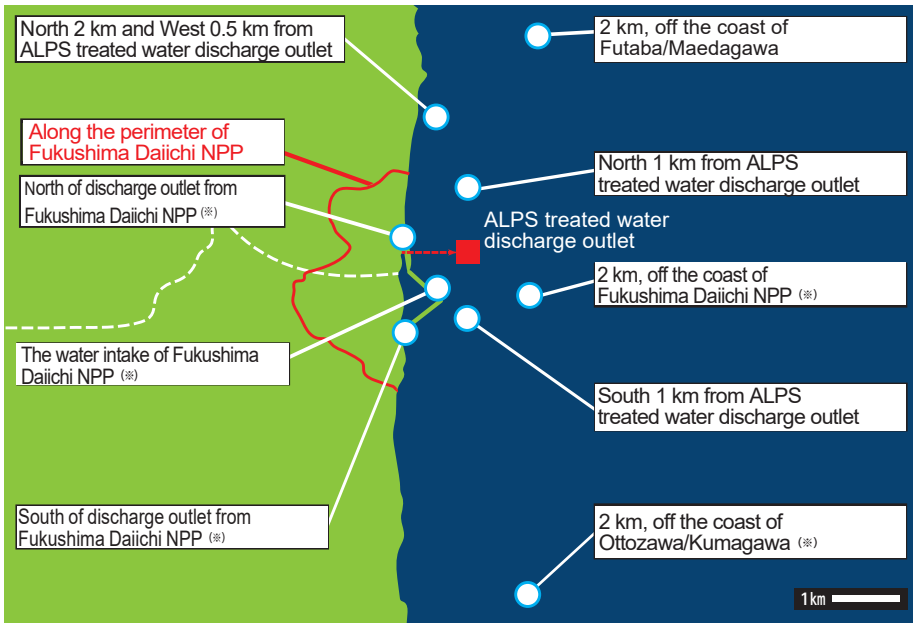
Is discharging into the sea really safe?

Fukushima Prefecture conducts sea area monitoring at nine locations around the Fukushima Daiichi NPP to assess the impact of discharging ALPS treated water into the sea.

The monthly analysis of tritium in seawater after discharging into the sea has consistently remained below 20 Bq/L or the maximum value for seawater in Japan since 2015. Additionally, the analysis results of other radioactive materials, such as radioactive cesium and radioactive strontium, have shown values within the range of those measured before discharging (April 2022 to August 2023).

Results of tritium analysis

After discharging into the sea (September -November, 2023)	Before discharging into the sea (April, 2022 -August, 2023)
Below the detection limit (＜0.05) ~ 1.6Bq/L	Below the detection limit (<0.04) ~ 0.66Bq/L

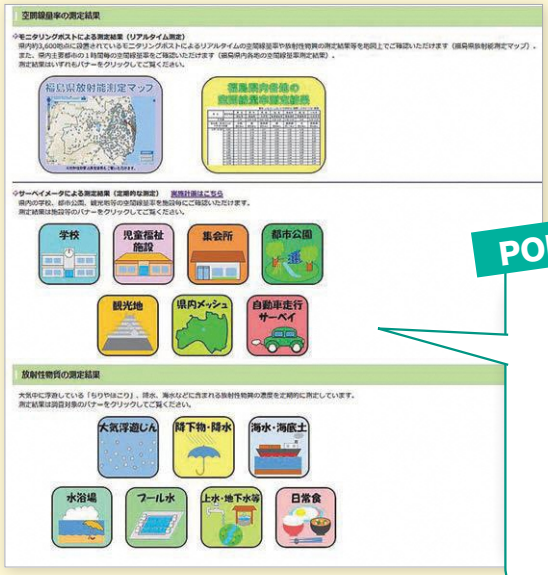


（※）Measured before the accident

Seawater monitoring results map

Fukushima Prefecture website

https://www.pref.fukushima.lg.jp/sec/16025d/



You can see the results of measurement by the monitoring posts and measurement of environmental samples on the “Fukushima Prefecture website” and “Fukushima Prefecture Radioactivity Measurement Map.”

POINT

Click the desired icon and check the results of measurement of radioactive substances with monitoring posts or survey meters.

You can also see the report on the measurement results of environmental radioactivity around the nuclear power plants and the materials of the Environmental Monitoring Evaluation Subcommittee.

Fukushima Prefecture Radioactivity Measurement Map

http://fukushima-radioactivity.jp/pc/

POINT foreign language

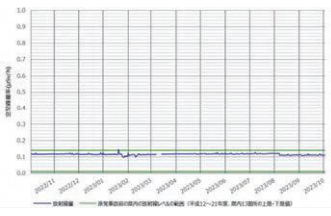
Information is also available in English, Chinese, and Korean.

POINT Other date and time Search

You can search for measurement results for other dates and times.

POINT See the graph

Displays a graph of air radiation dosage rate.



POINT

The icon colors are displayed according to the air radiation dosage rate.

POINT

The icons are displayed according to the measurement method. You can check the measurement results by clicking a desired icon.

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