



Health Effects of Radiation: 5 Themes

# Living

Here, we introduce information about changes in the Areas under Evacuation Orders, the current state of radiation doses, and health-related information for use by people considering a return to or migration to the region.

## Living Relationship Diagram

## Removal of the designation as Areas under Evacuation Orders

(i) Removal of the designation as Areas under Evacuation Orders

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## Regional ambient dose rates

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How are ambient dose rates measured?

(ii) Distribution of ambient dose rates in the area surrounding TEPCO's Fukushima Daiichi NPS site

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(iii) Comparison to other regional ambient dose rates

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(iv) A method of measuring ambient dose rates

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## Effects on health

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Living

Removal of the designation as Areas under Evacuation Orders

Regional ambient dose rates

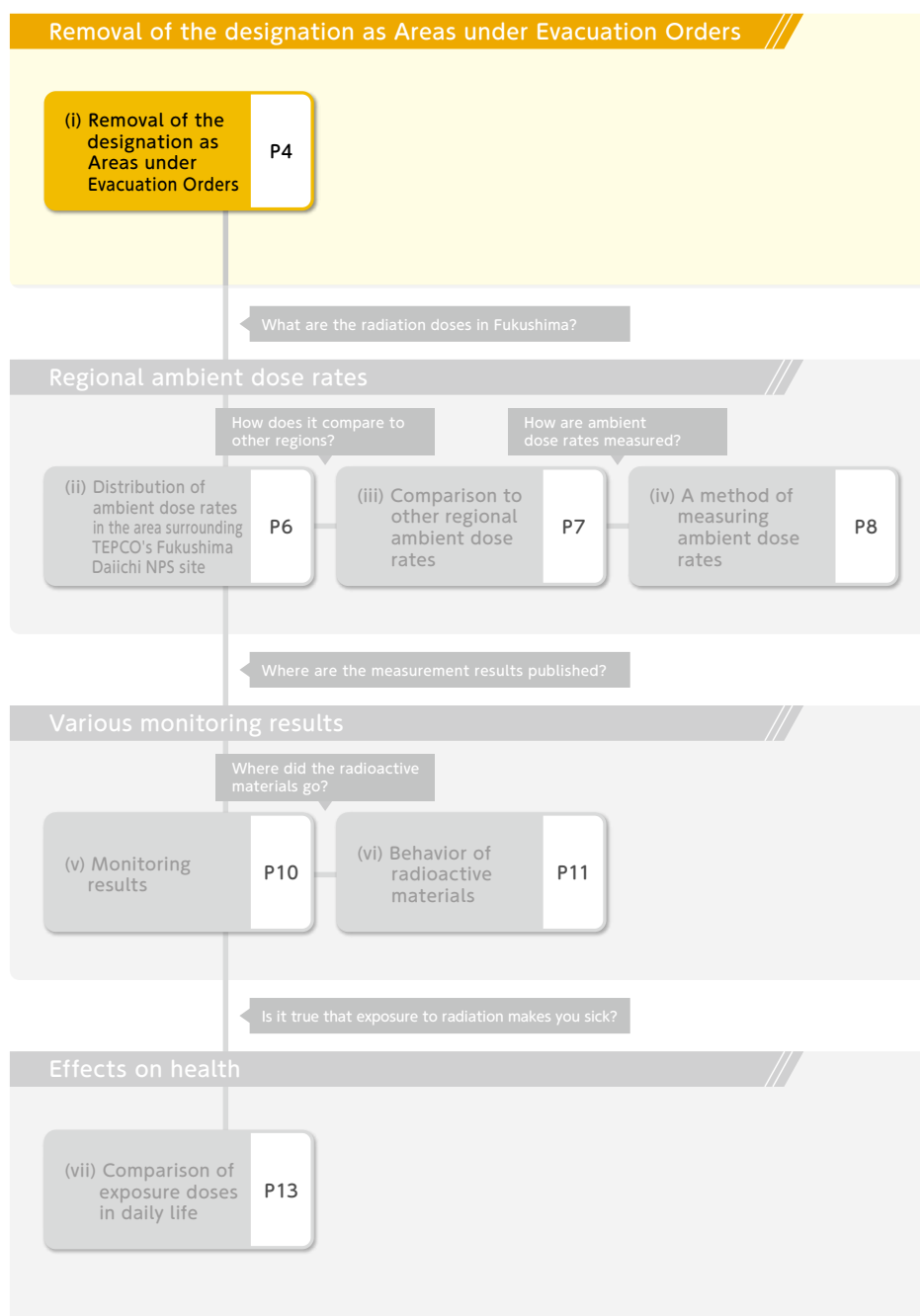
Various monitoring results

Effects on health



## Theme: Removal of the designation as Areas under Evacuation Orders

As initiatives for reconstruction such as decontamination, infrastructure rebuilding, and restoration of lifestyle foundations implemented by national and local government have progressed, evacuation orders have been gradually lifted since 2014. This section will summarize the details of this process and also touch on the requirements for lifting evacuation orders.

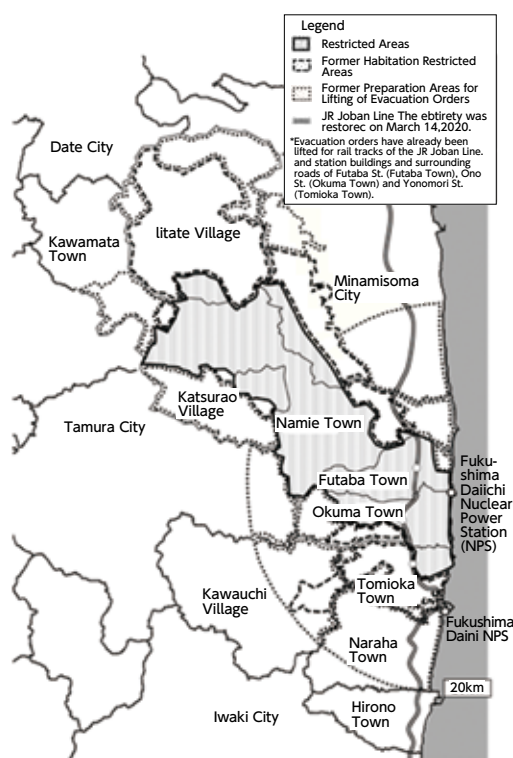


## (i) Removal of the designation as Areas under Evacuation Orders

Following the accident at TEPCO's Fukushima Daiichi NPS, an evacuation order was issued for surrounding areas. People were unable to live in the designated Areas under Evacuation Orders, and residents were forced to live as evacuees. The radiation dose has decreased over time and evacuation orders have been lifted in all regions, part from those designated as presenting difficulty for return. Evacuation orders have since been lifted in some of these areas as well.

### ● Removal of the designation as 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 as Preparation Areas for Lift of Evacuation Order 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, 2020	Okuma Town	Removal at some areas near Ono St.
March 10, 2020	Tomioka Town	Removal at some areas near Yonomori St.
June 12, 2022	Katsurao Village	Removal of Specified Reconstruction and Revitalization Base Areas
June 30, 2022	Okuma Town	Removal of Specified Reconstruction and Revitalization Base Areas
August 30, 2022	Futaba Town	Removal of Specified Reconstruction and Revitalization Base Areas

Prepared based on the 58th meeting of the Nuclear Emergency Response Headquarters (July 26, 2022), etc.

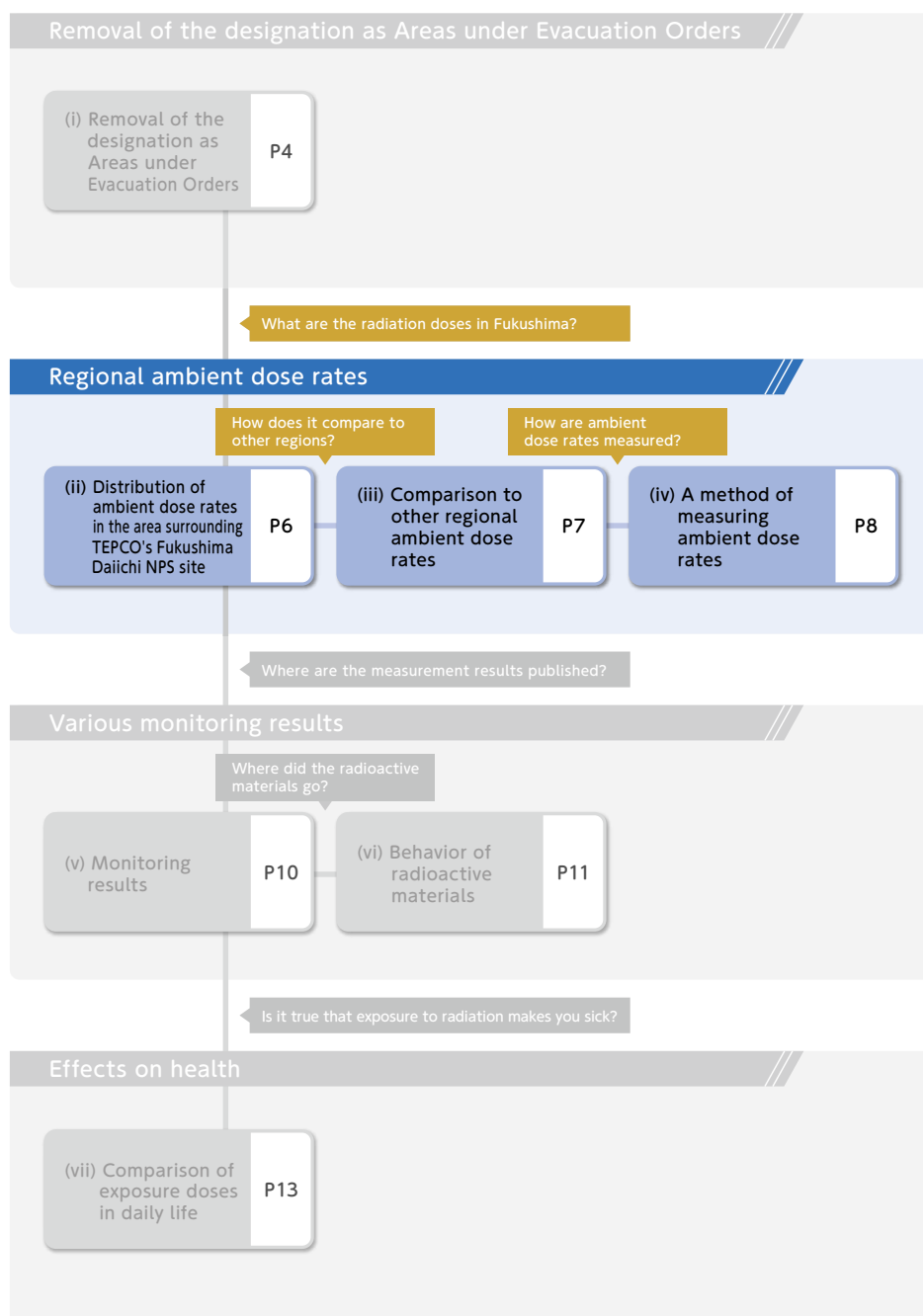
The requirements for lifting evacuation orders are as follows: (i) it is certain that annual cumulative doses will become 20 mSv or lower after removal of the designation; (ii) infrastructure and living-related services necessary for daily lives have been almost restored and decontamination work has progressed sufficiently centered on children's living environments; and (iii) consultations have been held sufficiently among relevant local governments and residents.

For more information about the evacuation order designations, see pages 108 and 110 in Vol. 2, FY2022 edition.



# Theme: Regional ambient dose rates

Radiation monitoring continues in areas around TEPCO's Fukushima Daiichi NPS. Information about the state of radiation monitoring, methods for measurement of ambient dose rate, and measuring instruments is presented here.

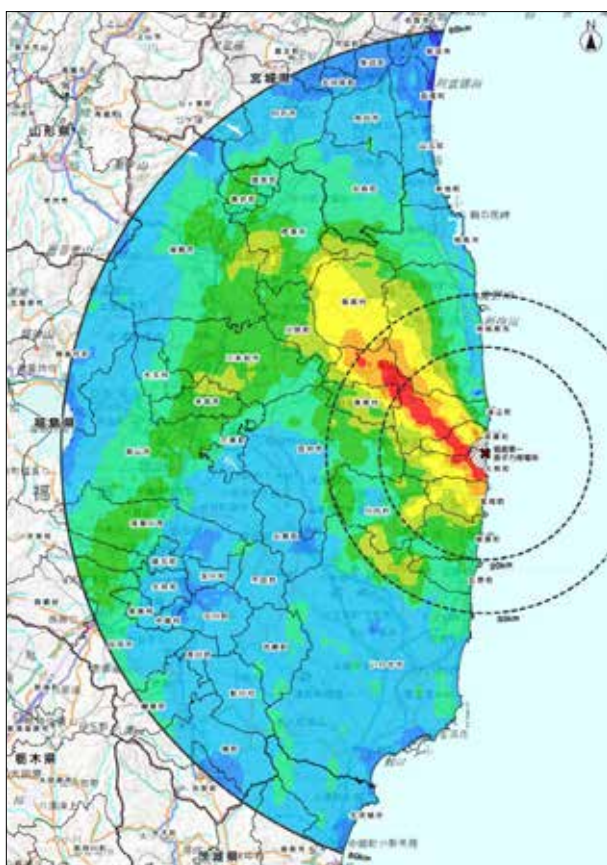


## (ii) Distribution of ambient dose rates in the area surrounding TEPCO's Fukushima Daiichi NPS site

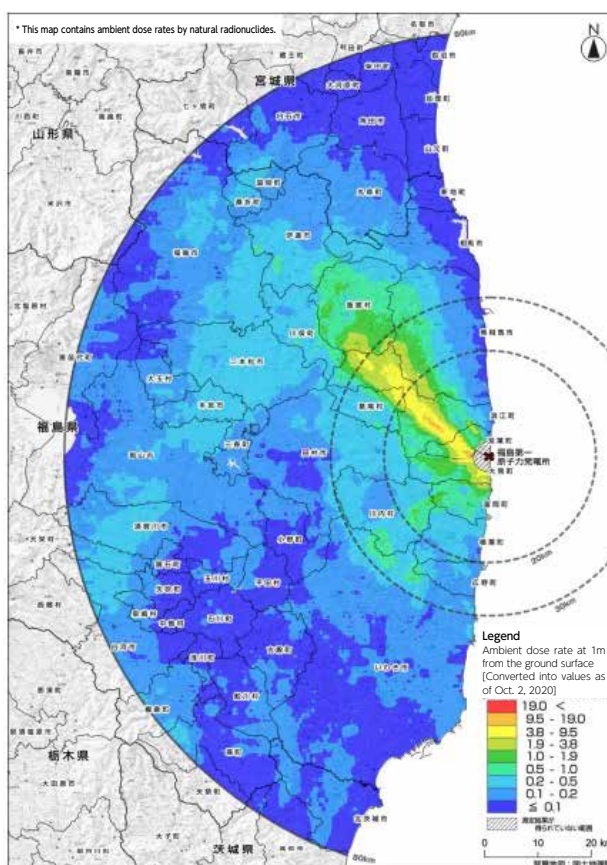
Through the implementation of decontamination efforts and the passage of time, ambient dose rate values in the area surrounding TEPCO's Fukushima Daiichi NPS site have decreased from the levels immediately after the accident.

### ● 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. 15, 2021



In order to ascertain the changes in the effect of radioactive materials, an airborne monitoring survey is being conducted continuously within an 80-km radius from TEPCO's Fukushima Daiichi NPS.

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.

For more information about the distribution of ambient dose rates, see page 24 of Vol. 2, FY2022 edition.



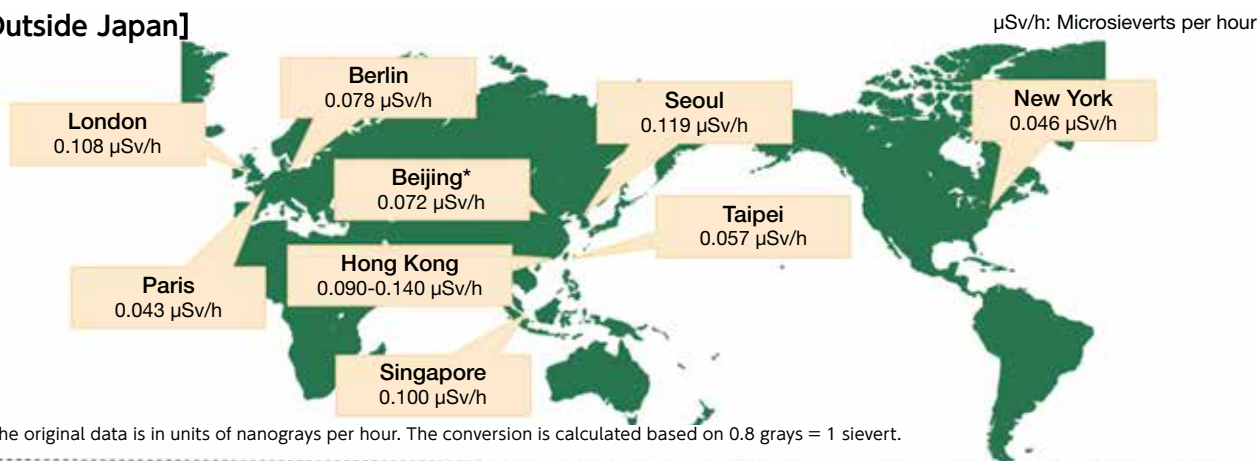


### (iii) Comparison to other regional ambient dose rates

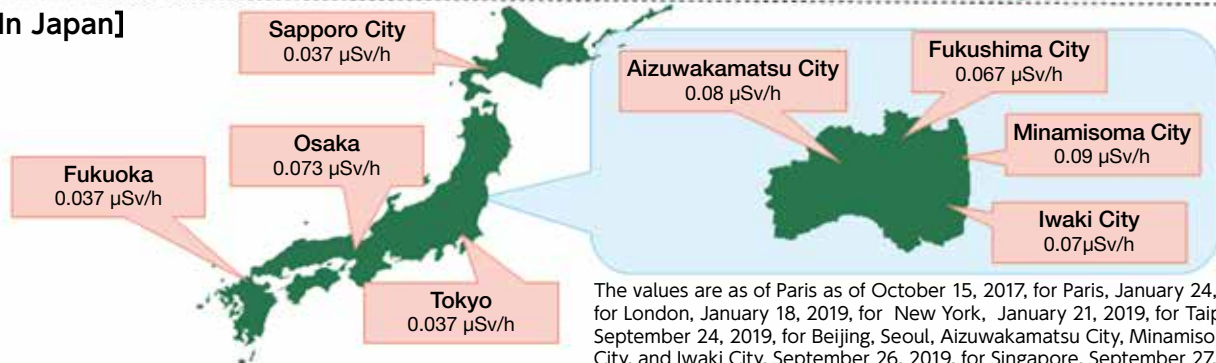
Comparing the ambient dose rates shown here for 4 municipalities in Fukushima Prefecture and other major cities inside and outside of Japan shows that as a result of decontamination efforts and physical attenuation of radioactive materials, the levels are roughly the same.

#### ● Measurement results for ambient dose rates in major cities

##### [Outside Japan]



##### [In Japan]



The values are as of Paris as of October 15, 2017, for Paris, January 24, 2018, for London, January 18, 2019, for New York, January 21, 2019, for Taipei, September 24, 2019, for Beijing, Seoul, Aizuwakamatsu City, Minamisoma City, and Iwaki City, September 26, 2019, for Singapore, September 27, 2019, for Berlin and Hong Kong, and September 18, 2019, for the rest.

Source: Prepared based on data by the Japan National Tourism Organization (<https://www.japan.travel/en/news/post-2011-3-11-general-information/>, as of December 2018)

This figure shows ambient dose rate measurements for major cities in Japan and other parts of the world in 2017 or 2018. Radiation dose can be seen to vary by region. This is due to variations in the amount of ground radiation, mainly caused by differences in soil and rock composition.

For more information about ambient dose rate measurement results for major cities, see page 69 of Vol. 1, FY2022 edition.

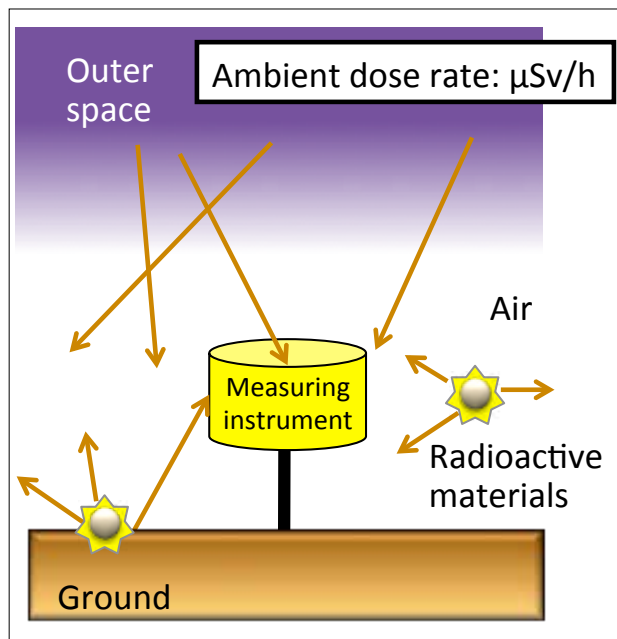


## (iv) A method of measuring ambient dose rates

Ambient dose rates are being measured at the radiation monitoring posts set up in various areas within Fukushima Prefecture.

This section will explain how ambient dose rates are measured at the radiation monitoring posts and introduce some other survey meters used for ambient dose rate measurement.

### ● Ambient dose rate measurement



Ambient dose rate measures  $\gamma$  (gamma) rays in the air  
Indicated in microsieverts per hour ( $\mu\text{Sv/hr}$ )



Actual measuring instrument  
(radiation monitoring post)

The ambient dose rate is obtained by measuring  $\gamma$ -ray doses in the air, and is indicated in microsieverts per hour. The measured value is not limited to the amount of radiation derived from accidents. Natural radiation mainly comes from the ground and cosmic rays.

Normally, a measuring instrument is placed at a height of about 1 m from the ground, because most important internal organs are located at this height in the case of an adult. The height of measuring instruments may be set to 50 cm from the ground in places mainly visited by children, such as schools and pre-schools.

For more information about ambient dose rates, see page 52 of Vol. 1, FY2022 edition.

### ● Examples of survey meters used for measuring ambient dose rates

Type		Purpose	
<b>Ionization chamber survey meter (ionization)</b>		<b><math>\gamma</math>-ray ambient dose rate</b>	Most accurate but unable to measure low dose rates like a scintillation type can
<b>NaI (Tl) scintillation survey meter (excitation)</b>		<b><math>\gamma</math>-ray ambient dose rate</b>	Accurate and very sensitive; Suitable for measuring $\gamma$ -ray ambient dose rates from the environment level up to around $10 \mu\text{Sv/h}$

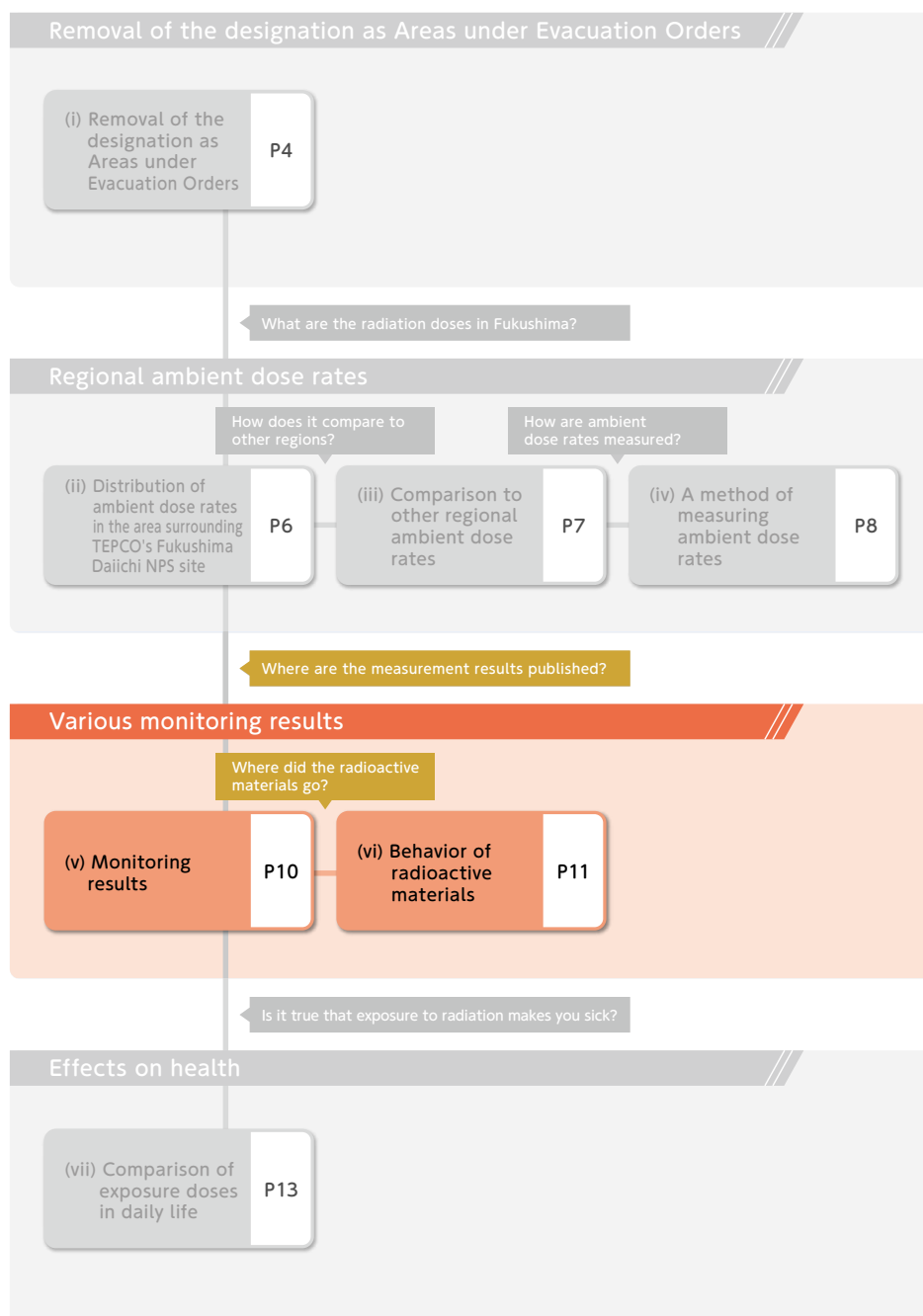
For more information about measuring instruments, see page 48 of Vol. 1, FY2022 edition.





# Theme: Various monitoring results

We introduce a variety of monitoring surveys carried out in connection to the accident at TEPCO's Fukushima Daiichi NPS. We also explain the movements of released radioactive materials within the environment.



## (v) Monitoring results

Within Fukushima Prefecture, monitoring of various data in addition to ambient dose measurements is being conducted in order to maintain awareness of radiation dose and radioactive materials.

### ● Comprehensive Radiation Monitoring Plan and Information Disclosure

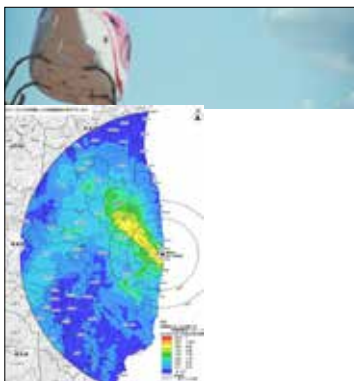
At the Monitoring Coordination Meeting held at the Nuclear Emergency Response Headquarters, a Comprehensive Monitoring Plan was determined, and monitoring is being carried out in coordination with related organizations and nuclear operators. The results are posted on the websites of these organizations and updated as needed.

#### ● Real-time Dose Measurement System



Ambient dose rates measured at mobile monitoring posts nationwide and by the Real-time Dose Measurement System 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.

Nuclear Regulation Authority radiation monitoring information <https://radioactivity.nra.go.jp/ja/>  
Taken from the comprehensive radiation monitoring plan <https://radioactivity.nra.go.jp/ja/list/511/list-1.html>

For more details about the comprehensive radiation monitoring plan, see page 23 of Vol. 2, FY2022 edition.

The major results from the monitoring implemented in accordance with the comprehensive radiation monitoring plan are shown below.

#### ● Changes in ambient dose rates in Fukushima Prefecture forest areas



Average ambient dose rate values at 362 continuously-measured areas show a significant decline, falling to 20% or less of the values measured immediately after the accident.

#### ● Fukushima Prefecture well water inspection results



Radioactive materials have never been detected from well water in the inspections conducted so far. Inspection results have all been "ND" (not detected; below the detection limit).

#### ● Monitoring results for public water areas in Fukushima Prefecture and the surrounding region\*1



Monitoring has been conducted at about 600 sites. At all but a very small number of these, no radioactive materials are detected.

#### ● Tap water monitoring results for Fukushima Prefecture and the surrounding region\*2



There has been no report of radioactive cesium detection at a level exceeding 10 Bq/kg since June 2011.

\*1: All of Fukushima Prefecture, Miyagi Prefecture, Ibaraki Prefecture, Tochigi Prefecture, and Gunma Prefecture, as well as parts of Iwate Prefecture and Chiba Prefecture

\*2: Fukushima Prefecture and 10 neighboring prefectures (Miyagi, Yamagata, Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, and Niigata)

For more information about the results of inspections, see pages 30, 33, 36, and 41 in Vol. 2, FY2022 edition.

## (vi) Behavior of radioactive materials

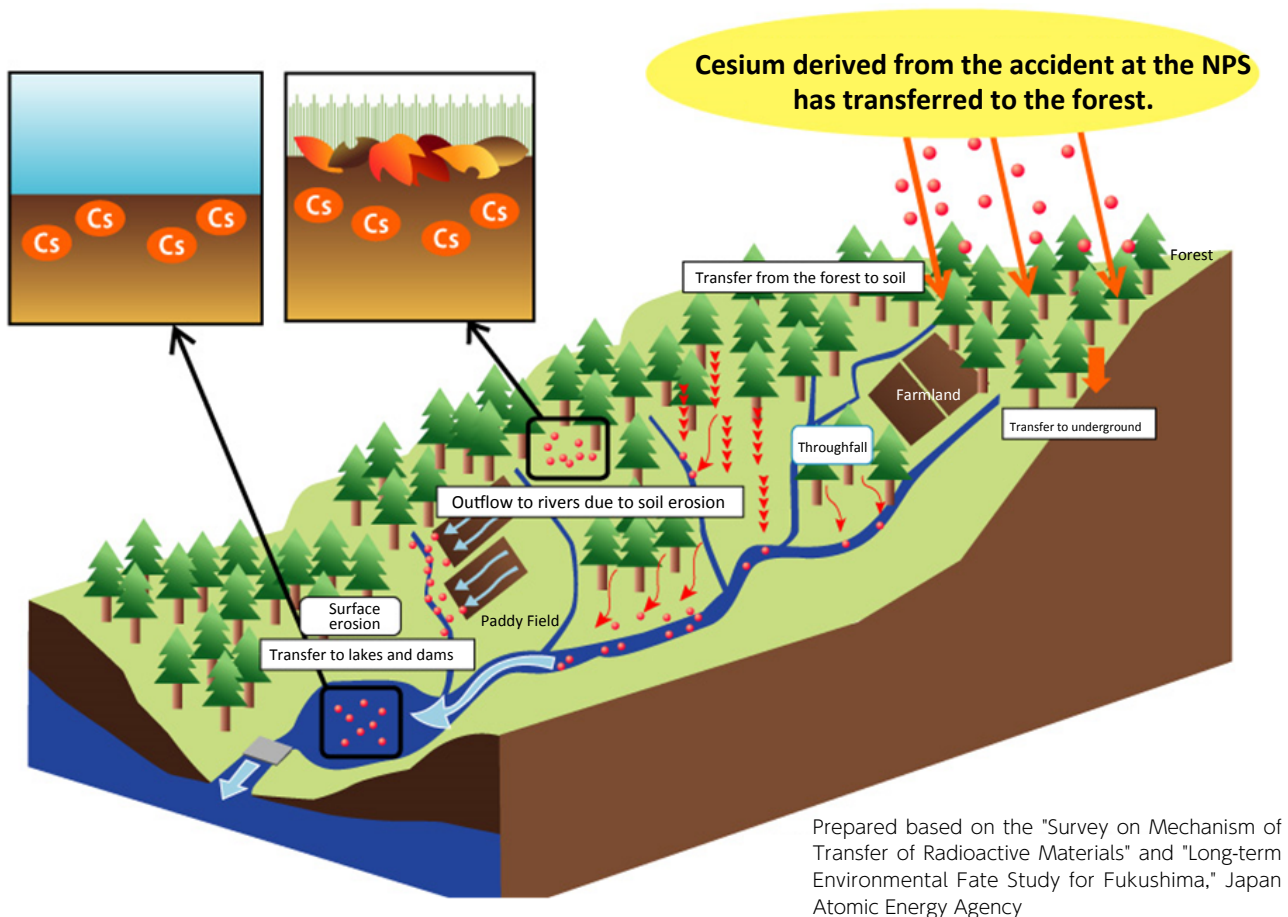
Living

Removal of the designation as  
Areas under Evacuation OrdersRegional ambient  
dose ratesVarious monitoring  
results

Effects on health

In various monitoring results, radioactive material detection is decreasing.  
Where has the cesium released into the environment gone?

### ● Transfer of Fallen and Deposited Cesium in the Environment



The above figure illustrates the process of fallen and deposited cesium in the forest flowing from upstream to a downstream dam lake. The two enlarged pictures show the forest floor and the sediment at the bottom of the dam lake, both indicating that the cesium is deposited in the surface layer of soil.

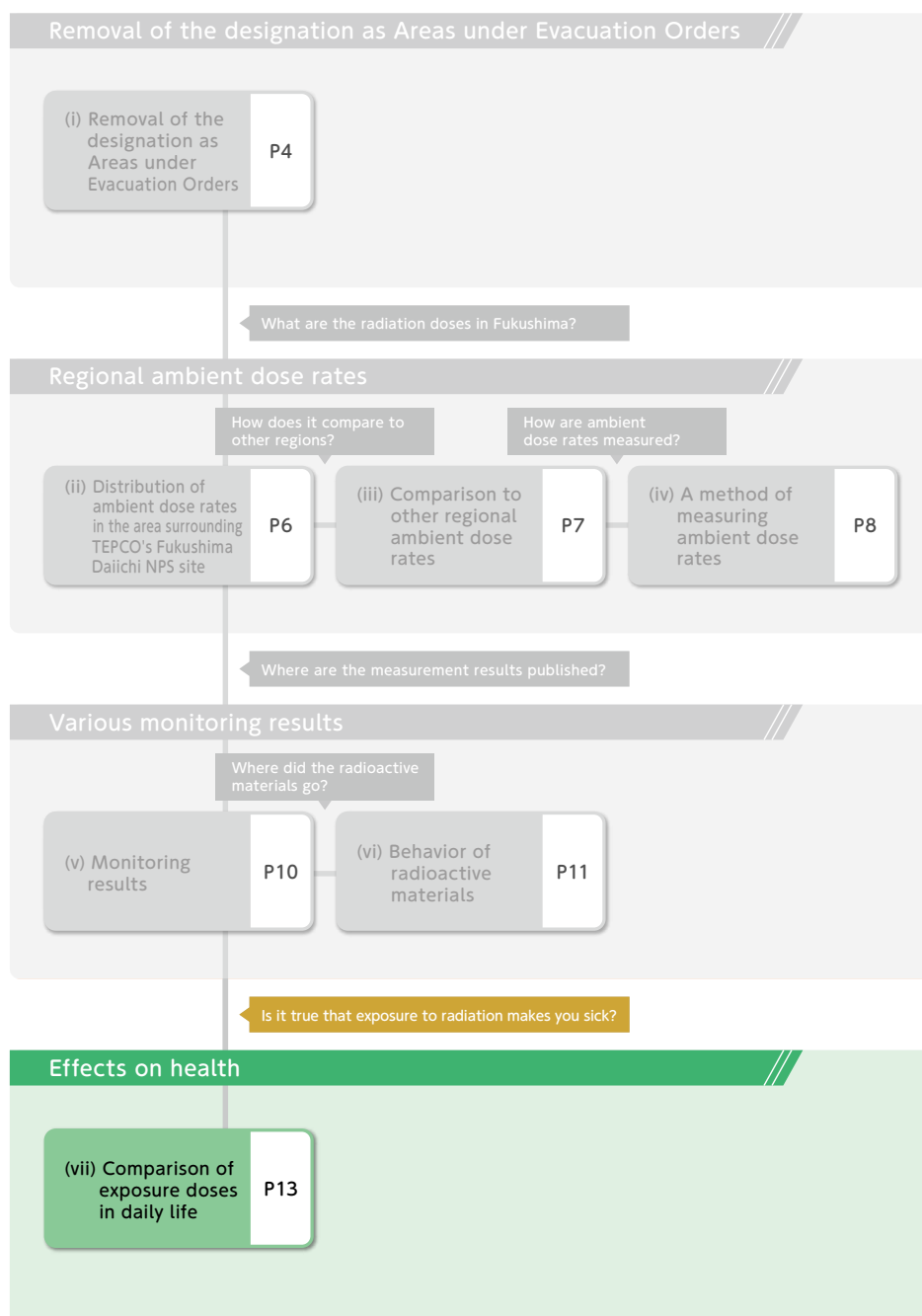
Distribution of radioactive cesium released into the environment due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS has changed significantly over time. Cesium that adhered to tree bark, branches and leaves immediately after the accident transferred onto the forest soil due to leaf fall and precipitation, etc. At present, over 90% is found to be located within a depth of 5 cm from the ground surface.

For more information about transfer of cesium in the environment, see page 184 of Vol. 1, FY2022 edition.



# Theme: Effects on health

This is a summary of the radiation exposure in daily life.

Removal of the designation as  
Areas under Evacuation OrdersRegional ambient  
dose ratesVarious monitoring  
results

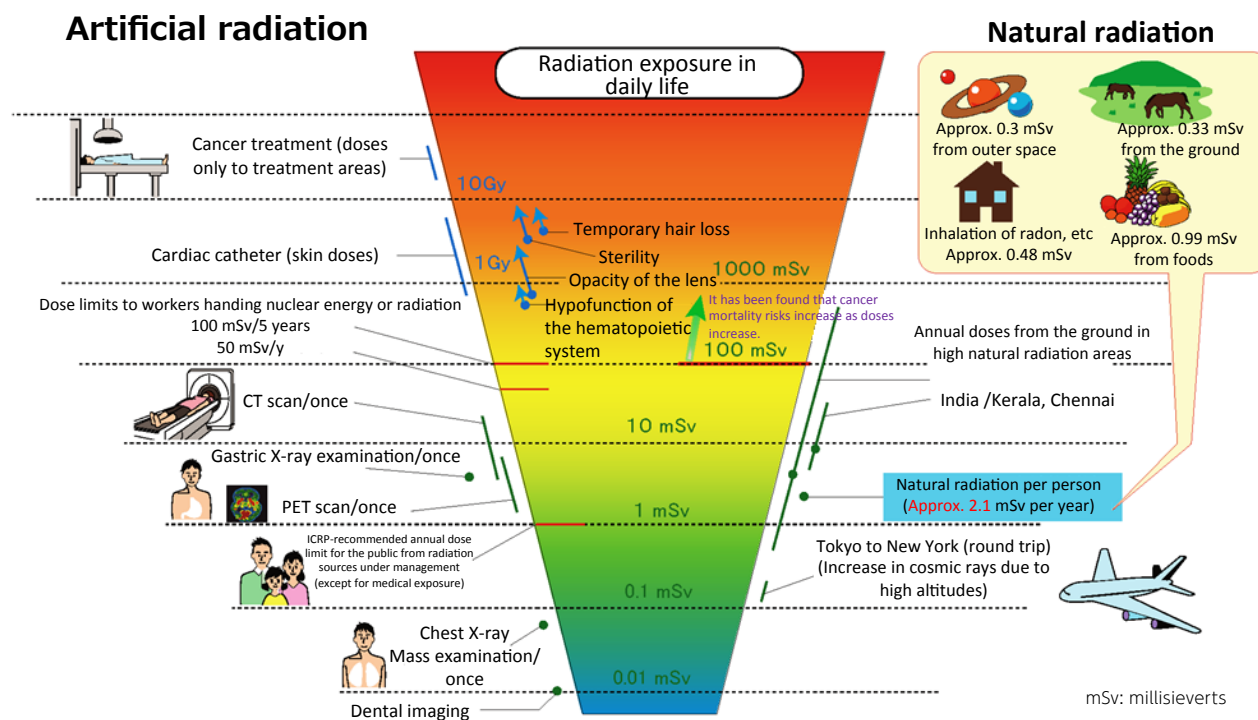
Effects on health



## (vii) Comparison of exposure doses in daily life

What exposure doses are present in daily life?

### ● Comparison of Exposure Doses (Simplified Chart)



Sources:

- The 2008 UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) Report
  - The 2007 ICRP (International Commission on Radiological Protection) Report
  - The exposure guideline of the Japan Association of Radiological Technologists
  - "Life Environmental Radiation (Calculation of the National Dose)," new edition
- Prepared by the National Institute of Radiological Sciences based on the sources above (May 2018)

For more information about comparison of exposure doses, see page 77 of Vol. 1, FY2022 edition.

Exposure doses found to have health effects on people are considered to be at levels exceeding 100 millisieverts.

For more information about survey results, see page 117 of Vol. 1, FY2022 edition.





## Portal site regarding the health effects of radiation

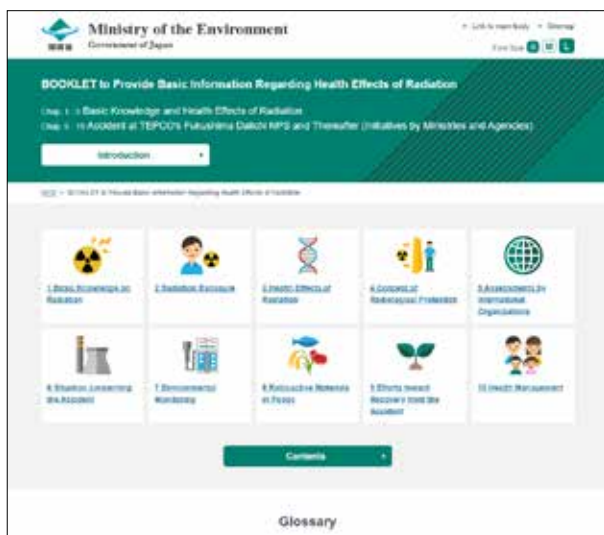
Additional resources such as the “BOOKLET to Provide Basic Information Regarding Health Effects of Radiation” which this digest document summarizes, Q&As, the latest information concerning the effects of radiation on health, and other related documents and articles are available in a searchable format on the portal site.



<https://www.env.go.jp/en/chemi/rhm/portal/>



## BOOKLET to Provide Basic Information Regarding Health Effects of Radiation



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

