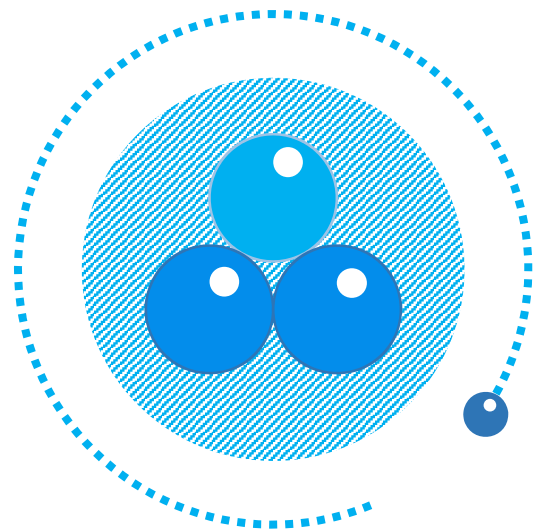


What is Tritium?

TEPCO



Could you spare a moment to
learn about tritium?

At the Fukushima Daiichi Nuclear Power Station, contaminated water that continues to be generated is being purified of radioactive materials and stored in tanks on site as ALPS treated water, etc.*

This ALPS treated water contains a radioactive material called "tritium" that cannot be removed by purification facility.

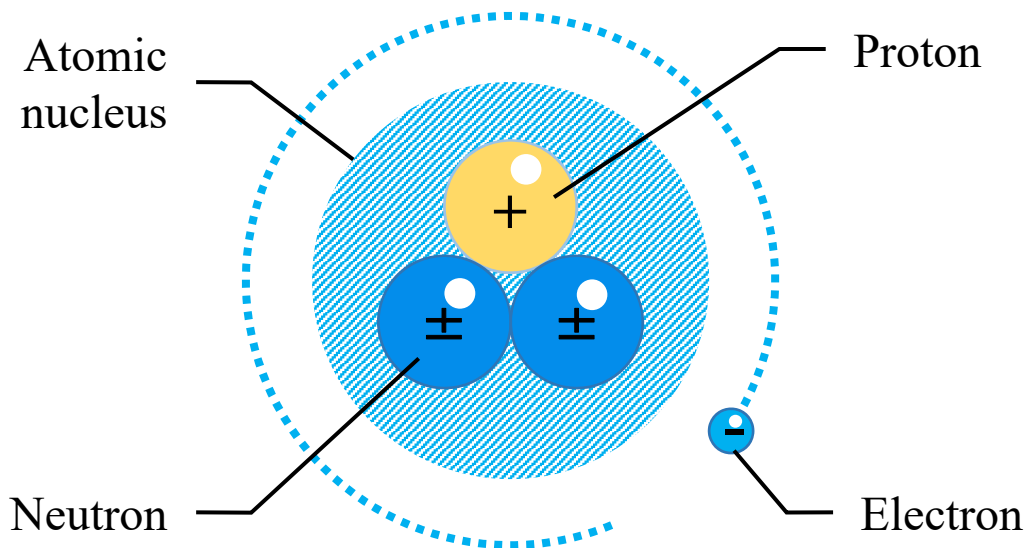
This pamphlet provides information on tritium, such as what tritium is, why it cannot be removed from ALPS treated water, and the impact that tritium has on the human body.

In accordance with the basic policy of the government, TEPCO will implement thorough measures to ensure safety and minimize the adverse impacts on reputation as we make preparations for actual discharge.

〈*Explanation of the term "ALPS treated water"〉

1. Water treated with multi-nuclide removal equipment (ALPS) so that the concentrations of radioactive materials other than tritium sufficiently satisfy regulatory standards for safety (sum of ratios of legally required concentrations, excluding tritium, is less than 1) shall be referred to as, "ALPS treated water."
2. Water that has been purified with multi-nuclide removal equipment (ALPS), but for which the concentrations of radioactive materials do not meet regulatory standards for safety (sum of ratios of legally required concentrations, excluding tritium, is 1 or higher) shall be referred to as, "Treated water to be re-purified."
3. The term "ALPS treated water, etc." shall be used when referring to both types of water defined in 1. and 2. above.

Tritium is a relative of hydrogen.

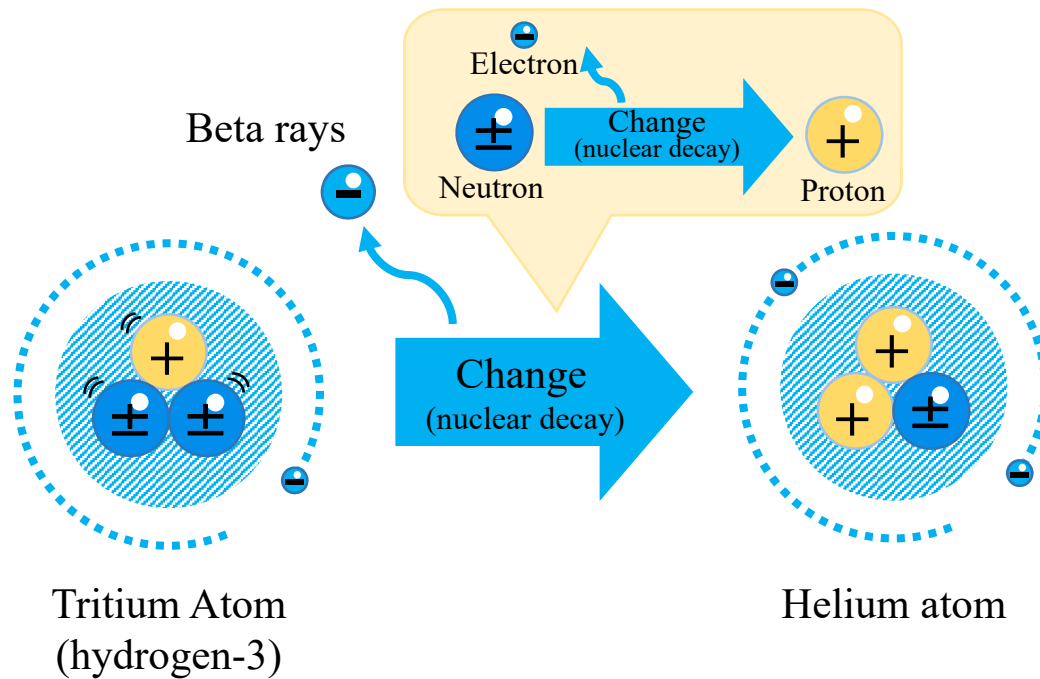


Atoms*¹, such as oxygen and carbon atoms, are made up of an atomic nucleus, which contains protons and neutrons, and electrons. Atoms of the same element*² can have a different number of neutrons. For example, tritium is a hydrogen atom that has two more neutrons, and is therefore considered a relative of hydrogen. And, hydrogen with one extra neutron is referred to as deuterium, or “heavy hydrogen.”

*1 Atom: Small particles from which all matter is made.

*2 Element: Types of atoms (example: oxygen (O), hydrogen (H), etc.)

Tritium emits weak radiation.



Tritium has two more neutrons than a normal hydrogen atom. This makes its atomic nucleus unstable. As a result, one of these neutrons releases electrons and changes into a proton thereby changing from tritium into helium. The electrons emitted are beta rays, a type of radiation. These beta rays are a weak type of radiation that can only travel about 5mm through the air.

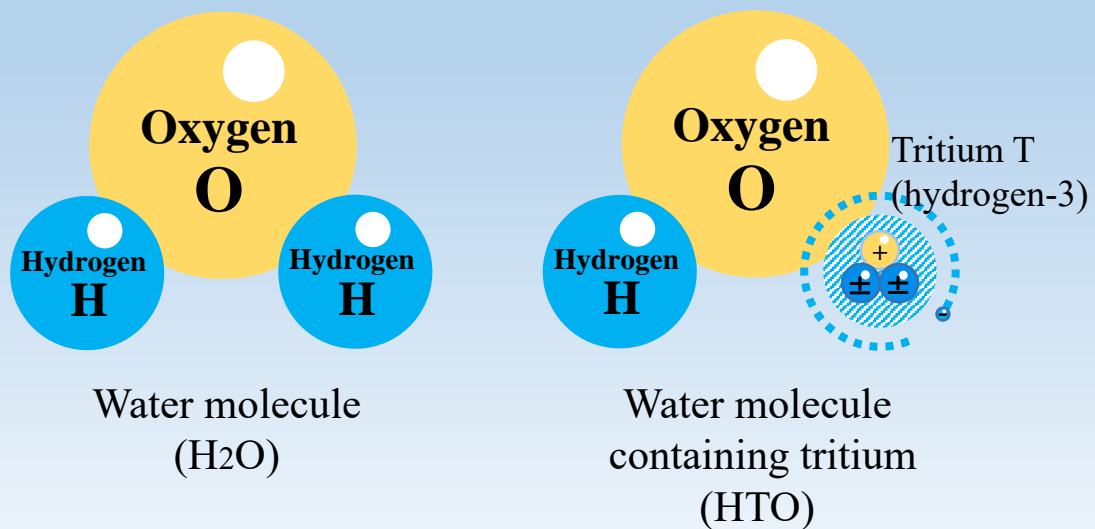
Source: Agency for Natural Resources and Energy website (Japanese only)

<https://www.enecho.meti.go.jp/about/special/johoteikyo/osensuitaisaku02.html>

“BOOKLET to Provide Basic Information Regarding Health Effects of Radiation FY2018 EDITION”

(Ministry of the Environment)

Most tritium exists as water.



Like hydrogen, most tritium bonds with oxygen to form water. The characteristics of normal water and water that contains tritium are almost identical. So, separating the tritium from this water is technically very difficult.

Tritium is all around us.

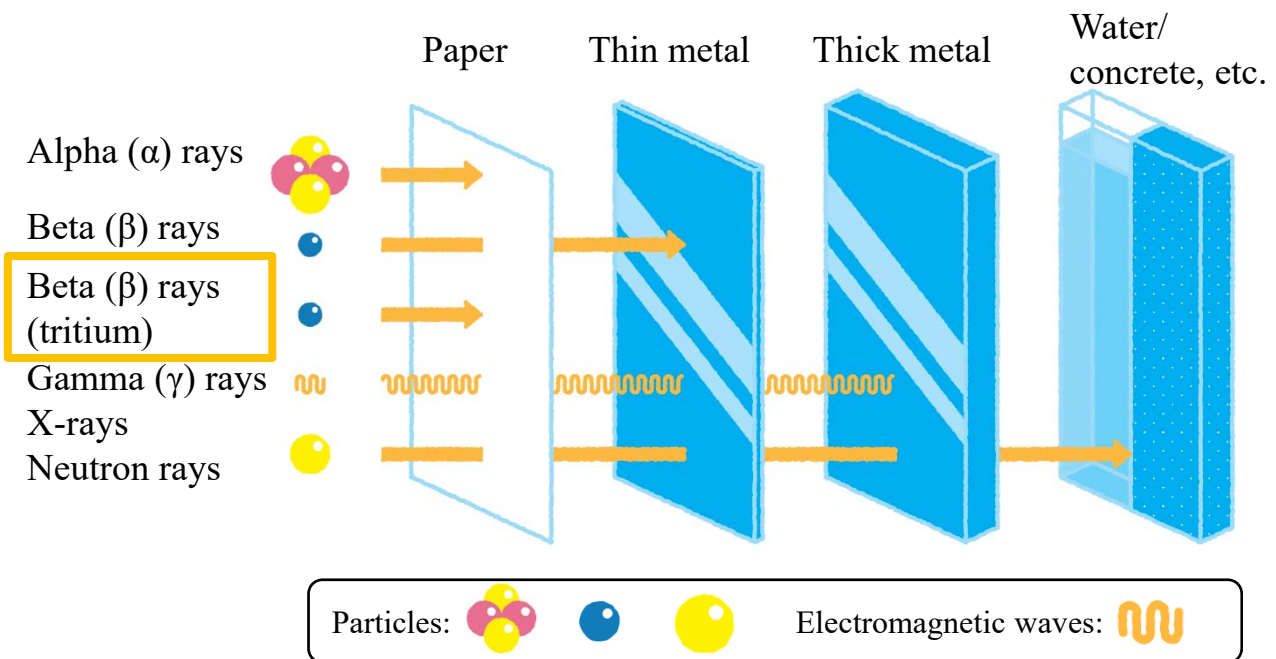


Tritium is formed every day on earth by the cosmic radiation from space, and exists in our environment as water. Tritium is also formed by radiation at nuclear power facilities both within and outside of Japan. The rain that falls on us, the water in our rivers, and even our drinking water, contains 0.1~1 becquerels*¹ of tritium*² per liter. The time it takes for the radioactivity of tritium to fall to half its original value (“half-life”) is 12.3 years.

*1 Unit for measuring the ability of radioactive materials to give off radiation. (Refer to page 10 for more details)

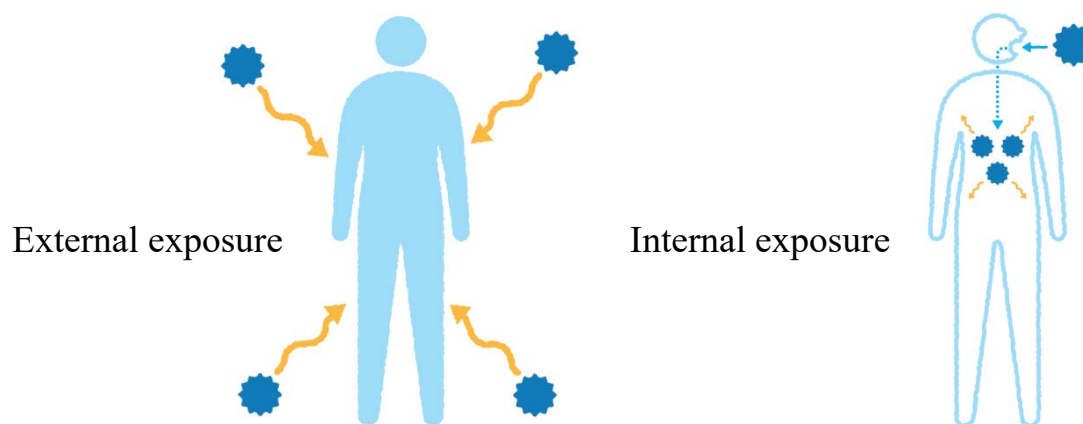
*2 According to the WHO “Guidelines for Drinking-water Quality”, the indicator (guidance level) of tritium in drinking water is 10,000 Bq/liter

There are many types of radiation, such as alpha, beta, and gamma.



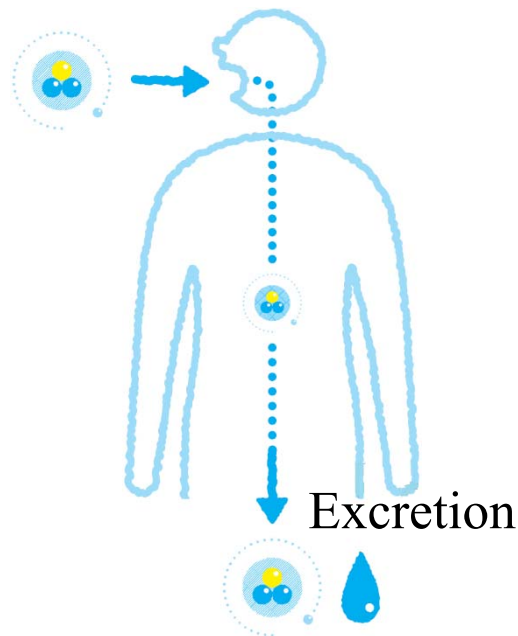
There are many types of radiation, such as alpha rays, beta rays, gamma rays, and x-rays. The ability of radiation to pass through different types of matter depends on the type. In the case of tritium, only beta rays are emitted and the energy is so weak that it can be stopped by a single sheet of paper.

External exposure from tritium is not really a concern.



When the human body is subjected to radiation, we refer to it as, “exposure.” There are two types of exposure, external and internal. External exposure refers to being subjected to radiation from radioactive materials that exist outside of the body, such as on the surface of the ground or in the air. Internal exposure refers to being subjected to radiation from radioactive materials that have been ingested through the mouth or nose, etc. Since the radiation given off by tritium is very weak and cannot even penetrate our skin, external exposure from tritium is not really a concern. So, let’s concentrate on internal exposure.

If tritium is ingested it is excreted just like water.

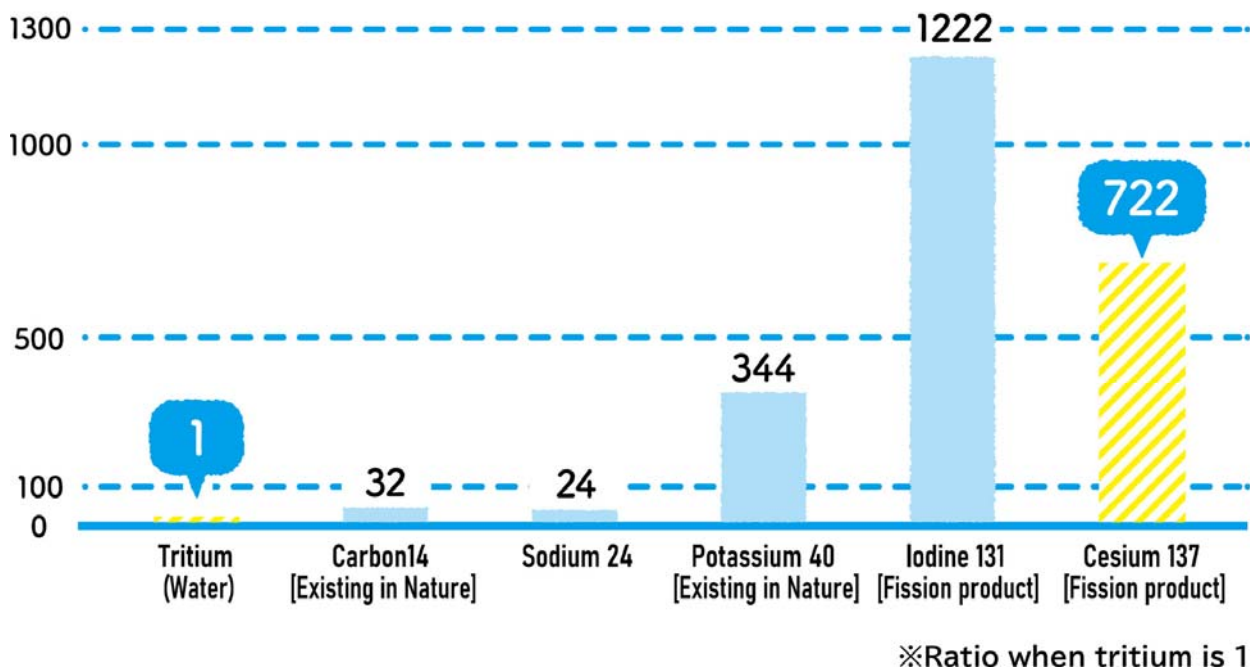


Since most tritium exists as water, it is excreted from the body in the same manner as water. Tritium does not accumulate or condense inside the body. If tritium is ingested, in approximately 10 days half the radiation will have been excreted. Even tritium that is ingested after bonding with organic substances, such as proteins (organically bound tritium), is excreted in about 40 days*.

*1 It can take as much as one year to excrete some of the organically bound tritium.

Tritium has little impact on the human body compared to other radioactive materials.

Comparison of the impact of tritium and well-known radioactive nuclides on living organisms
(Unit radioactivity during oral ingestion)

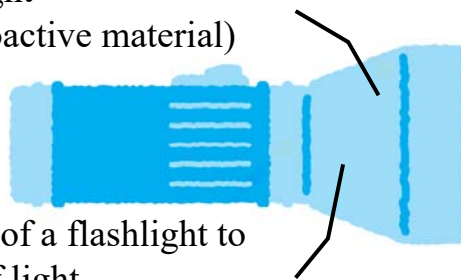


The impact of tritium on the human body is approximately 1/700 that of radioactive cesium-137, which is used as a radioactive material for setting standards for food products.

What do “radiation,” “radioactive material,” and “radioactivity” mean?

Flashlight
(= radioactive material)

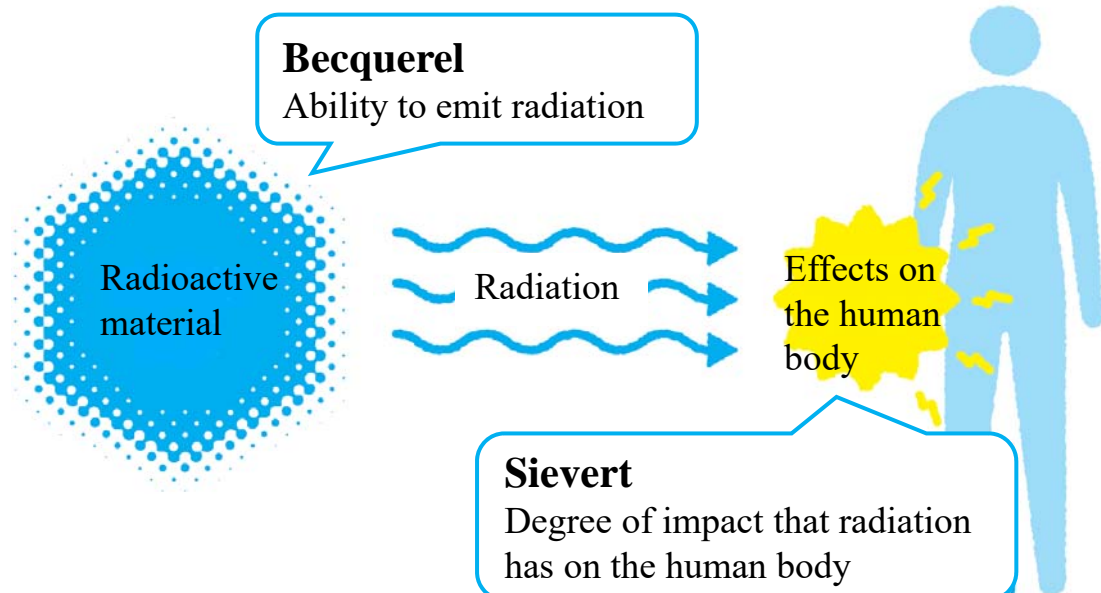
Ability of a flashlight to
give off light
(= radioactivity)



Light given off
(= radiation)

“Radiation” refers to the flow of electromagnetic waves and particles. Something that gives off radiation is referred to as a “radioactive material” and the ability of it to emit radiation is referred to as “radioactivity.” If we use a flashlight as an analogy, the flashlight is the radioactive material, the light it emits is radiation, and the ability of the flashlight to emit light is radioactivity.

What are becquerels (Bq) and sieverts (Sv)?



Becquerel is a unit for measuring the ability of a radioactive material to emit radiation. In contrast, a sievert is a unit for measuring the amount of impact that radiation has on the human body. Even if the number of becquerels is equal, the impact on the human body may differ, or in other words, the number of sieverts may differ, depending on the type of radioactive material and the part of the body that is exposed to the radiation. Sieverts allow us to assess the impact that a type of radiation has on the human body numerically.

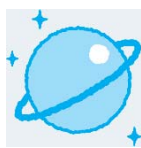
Radiation exposure in our daily lives

Natural radiation

Amount of natural radiation per person

Japan average
2.1mSv per year

World average
2.4mSv per year



From space
0.30mSv



From the ground
0.33mSv



From radon in the air
0.48mSv



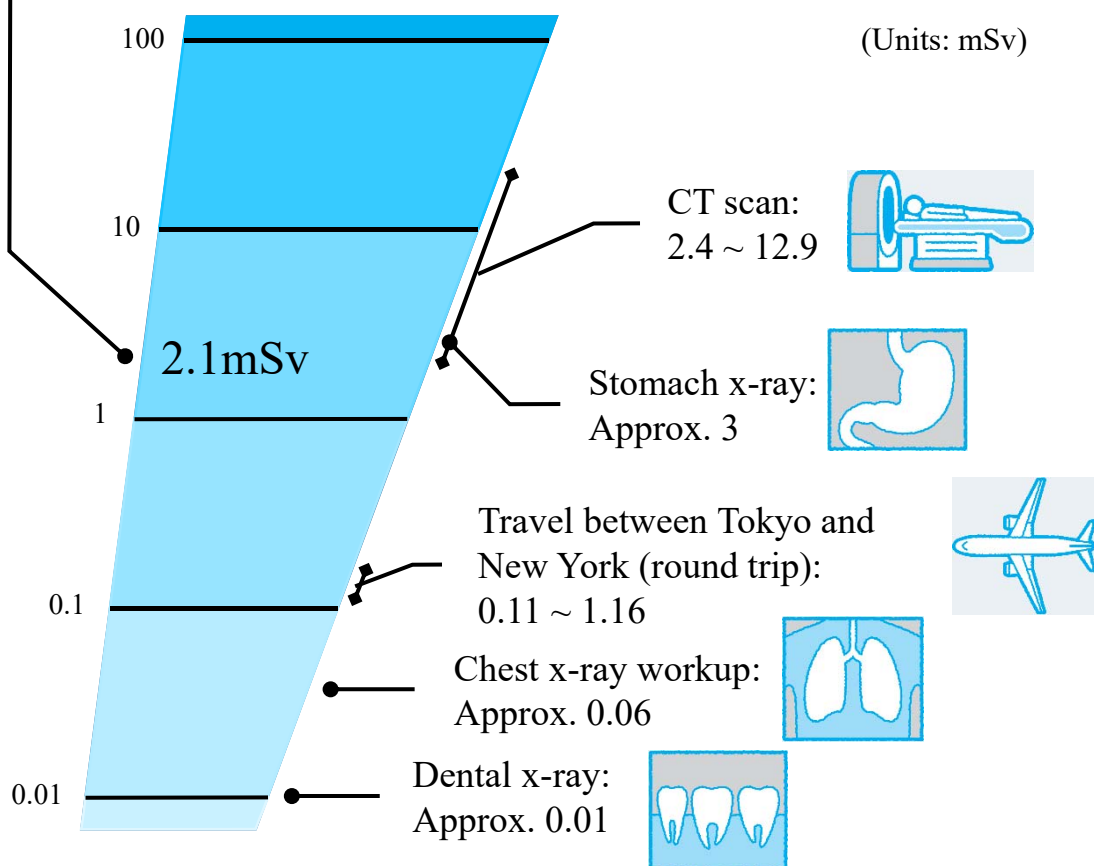
From food
0.99mSv

Oral ingestion

Breakdown of the 0.99mSv from food

Radioactive material	Effective dose
Primarily Lead-210/Polonium-210	0.80
Tritium	0.0000082
Carbon-14	0.01
Potassium-40	0.18
Total	0.99mSv

Other radiation in our daily lives



Source: "BOOKLET to Provide Basic Information Regarding Health Effects of Radiation FY2019 EDITION"
(Ministry of the Environment)

Reference: National Institutes for Quantum and Radiological Science and Technology (QST) "Dose Scale"

Thank you for taking the time to read this pamphlet.

In this pamphlet we have explained that tritium is a relative of hydrogen that is prevalent in our natural environment, emits weak radiation, and has little impact on the human body compared to other radioactive materials.

We hope that this information will be useful to better understand the scientific nature of tritium among the society.



<Please tell us your opinions about treated water and what you'd like to see done with it.>

Please go to the “Opinions and Requests” section in the Treated Water Portal Site on TEPCO’s website.

The opinions and comments received will be extremely useful in improving the information that we provide in the future.

Treated Water Portal Site

Search