EPA Facts about Tritium

What is Tritium?

Tritium is a form of hydrogen that is radioactive, and like hydrogen it reacts with oxygen to form water. Tritium is produced naturally in the upper atmosphere when cosmic rays strike atmospheric gases. Tritium can also be produced by man during nuclear weapon explosions, in reactors intended to produce tritium for nuclear weapons, and by reactors producing electricity.

What are the uses of tritium?

Tritium has been produced in large quantities by the nuclear military program. It is also used to make luminous dials and as a source of light for safety signs (such as EXIT signs). Tritium is used as a tracer for biochemical research, animal metabolism studies, and groundwater transport measurements.

How does tritium change in the environment?

Tritium is not a stable element. Tritium decays by emitting a beta particle and turning into helium. The release of radiation during this decay process causes concern about the safety of tritium and all other radioactive substances. The radiation from the decay of tritium is in the form of beta particles, which are of very low energy. As a result, the particles cannot pass through the skin surface.

Tritium is the only radioactive isotope of hydrogen and, like hydrogen, it reacts with oxygen to form water. The transformation of tritium to tritiated water is complex and slow.

The time required for a radioactive substance to lose 50 percent of its radioactivity by decay is known as the half-life. Tritium is a colorless, odorless gas with a half-life of 12.3 years. Tritiated water moves through the environment like ordinary water.

How are people exposed to tritium?

Although large quantities of tritium have been released into the environment, the dose to humans is small. Tritium was disbursed throughout the world by atmospheric nuclear weapons tests that took place from the mid-1950s to the early 1960s. The inventory of tritium in the atmosphere peaked in 1963 and has been decreasing rapidly since then. Levels of naturally occurring tritium in the atmosphere produced by cosmic rays are constant, and it is projected that levels of manmade tritium will be comparable to natural tritium by 2030.

Tritium is currently produced by reactors that generate electricity. Other sources of tritium include government plants that have reprocessed reactor fuels. Individuals can also be exposed to tritium via broken exit signs and luminous dial items that contain tritium.

Since tritium reacts similarly to ordinary hydrogen, it is incorporated into the body easily in the form of water.

Overall, the risk to the average person from tritium is typically not significant since current world-wide levels of tritium in the environment

from man-made and natural sources are low. Accidental exposure from elevated levels of tritium from broken exit signs or other concentrated sources, however, can pose a health risk to individuals.

How does tritium get into the body?

Most tritium in the environment is in the form of tritiated water, which is dispersed throughout the environment in the atmosphere, streams, lakes, and oceans. Tritium in the environment can enter the human body as a gas or as a liquid by ingestion and inhalation and through the skin by absorption. Once entered into the body, tritium tends to disperse quickly, so that it is uniformly distributed throughout the body. The tritium distribution in tissue depends on the amount of water contained in the tissues. Tritium is rapidly excreted over a month or two after ingestion.

Is there a medical test to determine exposure to tritium?

Since tritium is distributed throughout the body within a few hours after ingestion, levels within the body are measured by collecting a urine sample and analyzing it for tritium.

How can tritium affect people's health?

With respect to chemical reactions, tritium reacts similarly to ordinary hydrogen. Therefore, tritium dilutes through the body as ordinary water. Tritium concentration in soft tissue and the associated dose to these tissues is generally uniform and depends on the water content of the tissue. Tritium is rapidly cleared from tissues because the water content in the body turns over frequently.

What recommendations has the U.S. Environmental Protection Agency made to protect human health?

Please note that the information in this section is limited to recommendations EPA has made to protect human health from exposure to tritium. General recommendations EPA has made to protect human health at Superfund sites (the 10^{-4} to 10^{-6} cancer risk range), which cover all radionuclides including tritium, are summarized in the fact sheet "Primer on Radionuclides Commonly Found at Superfund Sites."

EPA has established a Maximum Contaminant Level (MCL) of 4 millirems per year for beta particle and photon radioactivity from man-made radionuclides in drinking water. The average concentration of tritium that is assumed to yield 4 millirems per year is 20,000 picoCuries (pCi/L). If other radionuclides that emit beta particles and photon radioactivity are present in addition to tritium, the sum of the annual dose from all the radionuclides cannot exceed 4 millirems/year.

For more information about how EPA addresses tritium at Superfund sites

Contact Stuart Walker of EPA:
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or visit EPA's Superfund Radiation Webpage:
http://www.epa.gov/superfund/resources/radiation/