Tritium

Tritium is an isotope of hydrogen that occurs naturally in very small quantities. Hydrogen has three isotopes:

- **Protium** Ordinary hydrogen with one proton and one electron in the atom. When two atoms of protium are combined with one atom of oxygen, water is created.
- **Deuterium** Sometimes called "heavy hydrogen," a non-radioactive isotope that has a neutron in the atom, in addition to the proton and electron. Water made with this isotope is called "heavy water."
- **Tritium** A radioactive isotope of hydrogen that has two neutrons in addition to the proton and the electron. Water made with this isotope is called tritium oxide. Tritium is the only one of the three hydrogen isotopes that is radioactive.

Radioactive elements such as tritium will spontaneously change into a different atom in a process referred to as radioactive decay. When tritium decays, it changes into an isotope known as helium-3. This decay process changes about 5.5 percent of the tritium into helium-3 every year. The time that it takes a radioactive isotope to decay to half the original amount is called the **half-life**. Tritium has a half-life of 12.3 years.

When tritium decays, it emits a form of radiation known as a beta particle, a negatively charged particle similar to an electron. This is a very weak form of radiation and can be stopped by a thin sheet of metal or a few sheets of paper.

WHY IS TRITIUM IMPORTANT TO DOE/NNSA?

The National Nuclear Security Administration (NNSA) is responsible for supplying nuclear materials for national security needs and ensuring that the nuclear weapons stockpile remains safe and reliable. Tritium, a radioactive isotope of hydrogen, is an essential component of every weapon in the U.S. nuclear weapons stockpile. T ritium decays at a rate of 5.5 percent per year. Accordingly, as long as the Nation relies on a nuclear deterrent, the tritium in each nuclear weapon must be replenished periodically. Because tritium is so rare in nature, useful quantities of tritium must be produced (see "Tritium Production and Environmental Impacts" fact sheet).

IS TRITIUM HAZARDOUS?

The two forms of tritium most likely to be encountered are tritium gas and tritium oxide, a form of water with tritium replacing one or both of the protium atoms that make the hydrogen molecule. If tritium oxide enters the body by inhalation, ingestion, or absorption through the skin, it immediately mixes with body fluids. Tritium is eliminated from the body over time, with about half being eliminated in 10 days. Drinking a lot of fluids can speed up the elimination process. Because water is found everywhere in our bodies, any tritium oxide ingested disperses throughout the body.

The health effects from tritium result from the beta radiation it emits. Radiation can cause a variety of damaging health effects in people. The most significant effects are induced cancer fatalities. These effects are referred to as "latent" cancer fatalities because the cancer may take many years to develop. Because beta radiation is weak and cannot penetrate skin, health effects would only result if tritium were absorbed or ingested into the body. External exposure to tritium does not pose a significant health risk. If tritium is absorbed or ingested into the body, the beta radiation emitted by tritium decay could cause damage to surrounding cells.

DOES TRITIUM HAVE OTHER USES?

A portion of the tritium produced in the United States is used to make "Exit" signs, some watch dials, and instrument dials that do not require a power supply in ships and aircraft.

Tritium is also used in medical and biological research for tracer studies. It may also be used in the production of electricity by fusion, which is currently in the experimental stage.

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