



Fact Sheet

Commonwealth of Pennsylvania • Department of Environmental Protection

Facts about Radioactive Tritium

The Bureau of Radiation Protection (BRP) has prepared this fact sheet to inform you of the facts about radioactive tritium and the hazards associated with devices containing tritium.

What is tritium?

Tritium is a radioactive isotope of the element hydrogen.

What are the properties of tritium?

Tritium is radioactive and has a half-life of about 12.5 years, which means that half of the radioactive atoms will decay naturally in that time. Although tritium can be a gas under controlled conditions, its most common form is liquid, because, like hydrogen, tritium reacts with oxygen to form water. Like ordinary water, water containing tritium, or tritiated water, is colorless and odorless. Of the three primary types of radiation, alpha, beta and gamma, tritium emits only beta radiation.

Is tritium regulated?

The United States Nuclear Regulatory Commission (NRC) requires any person to have a license to manufacture, process, produce or transfer products containing tritium. Devices containing high levels of tritium must be handled and disposed of within the requirements of the NRC license and regulations. (see 10 CFR 32.51 and 10 CFR 31.5 at www.nrc.gov)

How does tritium get into the environment?

Tritium occurs naturally in the environment in very low concentrations. Most tritium in the environment is in the form of tritiated water, which is easily distributed in the atmosphere, water bodies, soil, and rock.

In the mid-1950s and early 1960s, tritium was widely dispersed during the above-ground testing of nuclear weapons. The quantity of tritium in the environment from weapons testing peaked in 1963 and has been decreasing ever since.

Today, sources of tritium include commercial nuclear reactors, and government weapons production plants. Tritium may be released as airborne or liquid effluent from these facilities, or may leak into the underlying soil and ground water. However, such releases are usually small and are required to be within strict federal environmental limits.

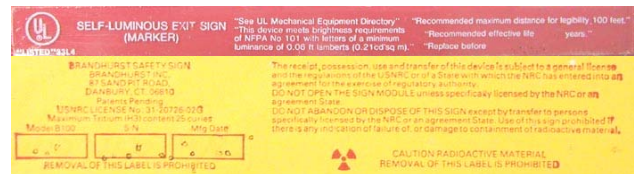
What is tritium used for?

The radioactive properties of tritium can be very useful. By mixing tritium with a chemical that emits light in the presence of radiation, a continuous light source is made. This can be applied to situations where a light is needed but where use of batteries or electricity is not practical. Wristwatch faces, rifle sights and exit signs are all examples of where this phenomenon is commonly used. Exit signs can be lifesavers if there is a loss of power.

Exit signs can be identified by a greenish glow from several sealed glass tubes forming the word "EXIT" (see below). The tubes are positioned in the channels of a backing material that also serves as a reflector. Tritium signs and devices are required to have labeling similar to that shown below, including the three-bladed radiation symbol, and the words "Caution – Radioactive Material."



Tritium Exit Sign



Exit Sign Label

The most significant military use of tritium is as a component in thermonuclear (fusion) weapons. At some point in the future, tritium may be used in fusion reactors to produce electricity.

How does tritium harm?

Tritium is a hazard only when taken inside the body (internal hazard). Tritium primarily enters the body when people drink tritiated water. People may also inhale tritium as a gas or absorb it through their skin, but exposure to harmful levels of tritium through these exposure pathways is very unlikely. Once tritium enters the body, it is quickly and uniformly distributed throughout the body, going directly into soft tissues and organs. The associated dose to these tissues is generally uniform and dependent on the tissues' water content.

The body removes tritium naturally in the same way it removes water - by excreting it in the urine. As with all ionizing radiation, in theory, we assume exposure to tritium could increase the risk of developing cancer.

Tritium in Landfills

Tritium has also been identified in landfill leachate throughout the United States and abroad. Recent studies performed by the Department of Environmental Protection's (DEP) Bureau of Radiation Protection, in cooperation with the Bureau of Waste Management (BWM), revealed tritium in landfill liquid effluents, known as leachate.

BRP suspects the cause of tritium in landfill leachate is from discarded self-luminous exit signs that have been disposed in landfills improperly. Crushed signs release the tritium gas and form tritiated water. Treated leachate concentrations, once released to the environment, are dispersed and diluted to levels acceptable under national drinking water standards. It is important to note that 20,000 picocuries per liter (pCi/L) is the Environmental Protection Agency (EPA) established maximum contaminant level for tritium in community water systems (40 CFR 141.16).

What is DEP doing about it?

Since 2003, landfills in the Commonwealth have been required to monitor all incoming waste for radioactivity. Unfortunately, it is very difficult to detect tritium by remote monitoring of waste trucks; therefore, these devices are not always identified prior to burial. DEP has contacted the NRC and the EPA concerning this issue and requested additional regulatory control requirements to ensure the safe and proper disposal of these sources in the future. DEP will continue to monitor and investigate any potential environmental tritium contamination. In addition, DEP is performing outreach to the public, owners of these devices, and landfills in an effort to educate and reduce the likelihood of these signs being improperly disposed of. This Fact Sheet is part of the educational effort.

Ownership and Disposal Responsibilities

If you own exit signs containing tritium, it is your legal responsibility to ensure the proper disposal or recycling of these products. It is illegal to abandon or dispose of self-luminous signs, except by transfer to companies licensed by the NRC or by a state authorized to administer its own comparable program (an Agreement State). Manufacturers of the devices have radioactive materials licenses, which allows them to accept the return of the devices. **The devices cannot be discarded in municipal or industrial trash, nor disposed as a hazardous waste.** Improper disposal can result in tritium releases to the environment or accidental human exposure. DEP has created a fact sheet especially for owners of these devices, entitled "Tritium Exit Sign Owner Responsibilities," 2910-FS-DEP4061, 4/2006.

In addition to ensuring proper handling and disposal, owners should consider alternative technologies when replacing these devices. The Product Stewardship Institute (PSI) was awarded an EPA grant to identify and implement product stewardship solutions for devices containing radioactive materials, and these solutions may be helpful in making replacement decisions. The PSI website contains contact information for businesses that are licensed to receive used tritium exit signs. For additional information, contact the Bureau of Radiation Protection at 717-787-2480, or visit the PSI Web site at www.productstewardship.us.

For more information regarding your responsibilities concerning these or other radioactive materials, contact your regional Bureau of Radiation Protection office, the Bureau's Central Office in Harrisburg, or visit our Web site at www.depweb.state.pa.us, Keyword: "Radiation."