

What is Plutonium?

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Plutonium is a chemically reactive, ductile, silvery-gray metal. It is a radioactive chemical element with an atomic number of 94 belonging to the actinide series of elements. It is a very dense metal weighing approximately 75% more than lead (and resembles the appearance of lead).

Plutonium does not occur naturally and is typically produced by irradiation in a nuclear reactor. It was discovered in 1940 and named after the planet Pluto. Plutonium, abbreviated "Pu," has a number of isotopes with varying uses.

- Pu 239, the most common and well-known isotope, is used in nuclear weapons and as nuclear reactor fuel because of its fissile properties. The Pu 239 fission process releases large amounts of energy. Pu 239 has a half-life of 24,100 years.

- Pu 238 is an isotope with a high specific activity that creates a great deal of heat by alpha particle decay. Pu 238 has a half-life of 87.7 years. The Pu 238 heat generation makes it useful for thermoelectric generators and has been used to provide power for deep space missions, heart pacemakers, and remote long-lived batteries.

- Pu 242 and Pu 244 are other isotopes of plutonium that are used in material research and in the production of unusual heavy elements such as americium, curium, and californium.

Notes of interest from an SRS perspective:

- Most of the Pu 239 used for the US nuclear weapons program was produced at SRS during the Cold War era.

- Many space missions have thermoelectric generators using Pu 238 produced at SRS. This material was generated by the irradiation of neptunium, a by-product of the Pu 239 production.

- Pu 239 was produced at SRS in up to 5 nuclear production reactors through the irradiation of Uranium 238. While tons of uranium were irradiated in the reactors, this process produced only gram quantities of Pu 239. With the cessation of the Cold War, excess Pu 239 will be dispositioned by one of two methods:

- Use of the Pu 239 as a fuel for private reactors using MOX fuel (Pu 239 combined with uranium) to produce energy.

- Disposition in a federal repository after being stabilized for long-term disposition.

- As a result of its technical expertise and capabilities SRS is the most capable DOE site to prepare any plutonium for stabilization and ultimate disposition.

What is Tritium?

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Tritium is a member of the hydrogen family (known as an isotope of hydrogen). Tritium is rarely found in nature.

Hydrogen has three isotopes:

- Protium- ordinary hydrogen which has one proton and one electron in the atom. When two atoms of hydrogen are combined with one atom of oxygen, water is formed.

- Deuterium- 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." Heavy water is about 11% heavier than normal water.

- Tritium- a radioactive isotope of hydrogen that has two neutrons in addition to the proton and electron. Water formed with this isotope is known as tritium oxide.

Tritium's radioactive properties include decay to a different element (helium) with the emission of a so-called beta particle. Tritium has a half-life of 12.3 years, an annual decay rate of 5.5%. The beta particle is a weak form of radiation and can be

stopped with a few sheets of paper.

Tritium reacts with other matter in chemical reactions just as basic hydrogen does. However, the nuclear properties of tritium make it useful for the nuclear weapons program hence tritium is produced and is included in every U. S. nuclear weapon. Tritium is generally produced through the irradiation of lithium-6 in nuclear reactors. Since tritium has a relatively short half-life, it must be continually produced and replenished in the nuclear weapons stockpile.

Tritium is also used in some "Exit" signs which do not have or require a power supply and is used in some medical and biological studies.

Notes of interest from an SRS perspective:

- SRS was built to provide the nation with tritium for the nuclear weapons program.

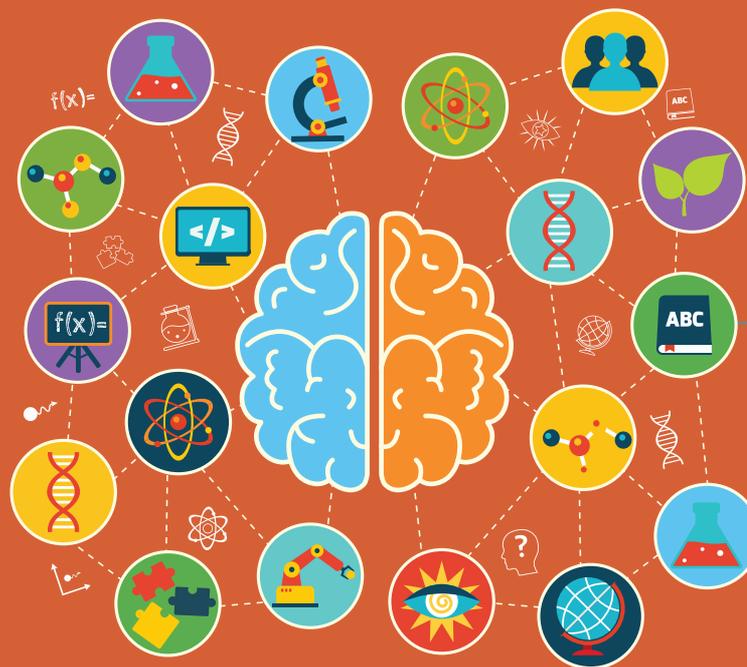
- Tritium was produced at SRS over a 40 year period (1950s to 1990).

- Tritium is no longer produced at SRS, but SRS continues to be the primary resource in DOE for the extraction and recycle of all tritium in US nuclear weapons.

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