



# EPA Facts about Plutonium

## ***What is Plutonium?***

Plutonium is a radioactive metal that exists as a solid under normal conditions. It is produced when uranium absorbs an atomic particle such as a neutron. Small amounts of plutonium occur naturally, but large amounts have been produced in nuclear reactors as a result of neutron irradiation.

Plutonium occurs in several forms called isotopes. The most common plutonium isotopes are plutonium-238, plutonium-239, and plutonium-240.

## ***What are the uses of plutonium?***

Plutonium-238 is used as a source of heat to generate thermoelectric power for electronic systems in satellites and for heart pacemakers. Plutonium-239 is used primarily in nuclear weapons. Plutonium-239 and plutonium-240 are two of the most common byproducts of weapons testing.

## ***How does plutonium change in the environment?***

Plutonium is not a stable element. As plutonium decays, it releases radiation and forms decay products. For example, the decay products of plutonium-238 and plutonium-239 are uranium-234 and uranium-235. The decay process continues until a stable, non-radioactive decay product is formed.

Radiation is released during the decay process in the form of alpha and beta particles and gamma radiation. Alpha particles can travel only short distances and generally will not penetrate human skin; however, internal exposure to alpha radiation is a concern. Beta particles are generally absorbed in the skin and do not pass through the entire body. Gamma radiation, however, can penetrate the body.

The time required for a radioactive substance to lose 50 percent of its radioactivity by decay is known as the half-life. Plutonium-238, plutonium-239, and plutonium-240 are isotopes of plutonium, and have half-lives of 87 years for plutonium-238, 24,065 years for plutonium-239, and 6,537 years for plutonium-240.

## ***How are people exposed to plutonium?***

Plutonium has been released to the environment primarily by atmospheric testing of nuclear weapons and by accidents at facilities where plutonium is used. The amount of plutonium introduced into the environment through nuclear weapons production operations is very small compared with those released during testing of nuclear explosives.

Plutonium-238, plutonium-239, and plutonium-240 are alpha emitters. As a result, the potential for direct exposure from these isotopes is minimal. When mixed in soil on the ground, these plutonium isotopes pose a potential risk that is predominantly from inhalation and ingestion.

### ***How does plutonium get into the body?***

Plutonium can enter the body when it is inhaled or swallowed. Once it is inhaled, the amount of plutonium that remains in the lungs depends on the particle size and the chemical form of the plutonium. The chemical forms that dissolve less easily may be absorbed or may remain in the lung. The forms that dissolve less easily are often swallowed. Plutonium swallowed with food or water is poorly absorbed from the stomach, so most of it leaves the body in the feces.

### ***Is there a medical test to determine exposure to plutonium?***

Tests are available that can reliably measure the amount of plutonium in a urine sample, even at very low levels. There are also tests to measure plutonium in soft tissues (such as body organs), feces, and bones. These measurements can be used to estimate the total amount of plutonium present in the body. These tests are not routinely available in a doctor's office because special laboratory equipment is required. Other medical tests for plutonium include whole body counting for americium-241 and nasal smears.

### ***How can plutonium affect people's health?***

Plutonium may remain in the lungs or move into the bones, liver, or other body organs. The plutonium that is not readily extracted stays in the body for decades and continues to expose the surrounding tissue to radiation. Plutonium inhaled or ingested will increase a person's chance of developing cancer, but these cancer

effects may not become apparent for several years.

### ***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 plutonium. 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 plutonium, are summarized in the fact sheet "Primer on Radionuclides Commonly Found at Superfund Sites."

EPA has established a Maximum Contaminant Level (MCL) of 15 picoCuries per liter (pCi/L) for alpha particle activity, excluding radon and uranium, in drinking water. Plutonium is covered under this MCL.

**For more information about how EPA addresses plutonium at Superfund sites**

*Contact Stuart Walker of EPA:*

*(703) 603-8748 or [walker.stuart@epa.gov](mailto:walker.stuart@epa.gov),*

*or visit EPA's Superfund Radiation Webpage:*

*<http://www.epa.gov/superfund/resources/radiation/>*