EPA Facts about Uranium

What is uranium?

Uranium is a radioactive metal that is present in low amounts in rocks, soil, water, plants, and animals. Uranium and its decay products contribute to low levels of natural background radiation in the environment. Significant concentrations of uranium occur naturally in some substances such as phosphate deposits and uranium-enriched ores.

How does uranium change in the environment?

Natural uranium is found in the environment in three forms, called isotopes: uranium-234, uranium-235, and uranium-238. Ninety-nine percent of natural uranium occurring in rock is uranium-238. Uranium-235 accounts for just 0.72 percent of natural uranium, but it is more radioactive than uranium-238. Uranium-234 is the least abundant uranium isotope in rock.

Uranium is not a stable element. As uranium decays, it releases radiation and forms decay products. Uranium-238 decay products include uranium-234, radium-226, and radon-222. See "EPA Facts about Radon and Radium" for additional information on these radionuclides.

Natural uranium releases alpha particles and low levels of gamma rays. Alpha particles can travel only short distances and cannot penetrate human skin. 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. The half-life for uranium-238 is about 4.5 billion years, uranium-235 is 710 million years, and uranium-234 is 250,000 years. Because of the slow rate of decay, the total amount of natural uranium in the earth stays almost the same, but radionuclides can move from place to place through natural processes or by human activities. Rain can wash soil containing uranium into rivers and lakes. Mining, milling, manufacturing, and other human activities also release uranium to the environment.

What are the uses of uranium?

Uranium-235 is used in nuclear weapons and nuclear reactors. Depleted uranium (natural uranium in which almost all of the uranium-235 has been removed) is used to make ammunition for the military, guidance devices and compasses, radiation shielding material, and X-ray targets. Uranium dioxide is used to extend the lives of incandescent lamps used for photography and motion pictures. Very small amounts of other uranium compounds are used in photography for toning, in the leather and wood industries for stains and dyes, and in the wool industries. Uranium has also been used in the past in ceramics as a coloring agent.

How are people exposed to uranium?

Uranium-238 and members of its decay chain, which include uranium-234, radium-226, and radon-220, are present in nature. The members of the decay chain in undisturbed soil are present, often at concentrations that approximate that of the parent uranium-238.

Uranium ore contains all the daughter elements of uranium-238 and uranium-235, but the uranium-238, uranium-234, and uranium-235 are extracted and chemically separated during processing. This concentrated uranium product, which is generated at uranium mill tailing sites and uranium processing facilities, is a potential source of exposure to individuals and the environment and is a primary concern for cleanup of these sites. Potential individual exposure at these sites may be from different pathways, but the groundwater pathway is of particular concern because of the mobility of uranium.

How does uranium get into the body?

Uranium can enter the body when it is inhaled or swallowed or through cuts in the skin. About 99 percent of the uranium ingested in food or water will leave a person's body in the feces, and the remainder will enter the blood. Most of this uranium will be removed by the kidneys and excreted in the urine within a few days. A small amount of the uranium in the bloodstream will be deposited in a person's bones, where it will remain for several years.

Alpha particles released by uranium cannot penetrate the skin, so natural uranium that is outside the body is less harmful than that which is inhaled, swallowed, or enters through the skin. When uranium gets inside the body, radiation and chemical damage can lead to cancer or other health problems, including kidney damage.

Is there a medical test to determine exposure to uranium?

Tests are available to measure the amount of uranium in a urine or stool sample. These tests are useful if a person is exposed to a larger-than-normal amount of uranium, because most uranium leaves the body in the feces within a few days. Uranium can be found in the urine for up to several months after exposure. However, the amount of uranium in the urine and feces does not always accurately show the level of uranium exposure. Since uranium is known to cause kidney damage, urine tests are often used to determine whether kidney damage has occurred.

How can uranium affect people's health?

In addition to the risks of cancer posed by uranium and all other radionuclides, uranium is associated with noncancer effects, and the major target organ of uranium's chemical toxicity is the kidney. Radioactivity is a health risk because the energy emitted by radioactive materials can damage or kill cells. The level of risk depends on the level of uranium concentration.

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

EPA has established a Maximum Contaminant Level (MCL) of 30 micrograms per liter (µg/liter) for uranium in drinking water. For uranium mill tailing sites, EPA has established 30 picoCuries per liter (pCi/L) for uranium-234 and -238 as standards for protecting groundwater. The EPA document "Use of Uranium Drinking Water Standards under 40 CFR 141 and 40 CFR 192 as Remediation Goals for Groundwater at CERCLA Sites" provides guidance regarding how these two standards should be implemented as an Applicable or Relevant and Appropriate Requirement (ARAR) at Superfund sites. This document is available online at: http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/9283_1_14.pdf.

Also for uranium mill tailing sites, EPA has established 5 picoCuries per gram (pCi/g) of radium as a protective health-based level for the cleanup of the top 15 centimeters of soil. These regulations under 40 Code of Federal Regulations (CFR) Part 192.12 are often ARARs at Superfund sites. The EPA document "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites" provides guidance to EPA staff regarding when 5 pCi/g is an ARAR or otherwise recommended cleanup level for any 15 centimeters of subsurface soil contaminated by radium other than the first 15 centimeters. This document is available online at: http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/umtrcagu.pdf.

If regulations under 40 CFR Part 192.12 are an ARAR for radium in soil at a Superfund site, then Nuclear Regulatory Commission (NRC) regulations for uranium mill tailing sites under 10 CFR Part 40 Appendix A, I, Criterion 6(6), may be an ARAR at the same site, particularly if uranium-234 or uranium-238 is a contaminant at the site.

Criterion 6(6) requires that the level of radiation, called a "benchmark dose," that an individual would receive be estimated after that site was cleaned up to the radium soil regulations under 40 CFR Part 192.12. This benchmark dose then becomes the maximum level of radiation that an individual could be exposed to from all radionuclides, except radon, in both the soil and buildings at the site. The EPA document "Remediating Goals for Radioactively Contaminated CERCLA Sites Using the Benchmark Dose Cleanup Criterion 10 CFR Part 40 Appendix A, I, Criterion 6(6)" provides guidance regarding how Criterion 6(6) should be implemented as an ARAR at Superfund sites, including using a radium soil cleanup level of 5 pCi/g in both the surface and subsurface when estimating a benchmark dose. This document is available online at: http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/part40.pdf.

For more information about how EPA addresses uranium at Superfund sites

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