



Health Physics Society
Specialists in Radiation Safety

Depleted Uranium

In recent years, depleted uranium (DU) is frequently noted in the news because of extensive use on the battlefields of Kosovo and Iraq. There is a great deal of concern about the medical effects of DU exposure. In this fact sheet, we will try to explain the significance and validity of these concerns.

What is depleted uranium?

Uranium (U) is a dense, weakly *radioactive** metallic element that exists naturally in our environment. Uranium is found everywhere in nature and particularly in rocks, soil, water, and air, as well as in all plants, animals, and humans.

Natural uranium consists of a mixture of three *isotopes*, which are identified by the mass numbers ^{238}U (99.27 percent of atoms), ^{235}U (0.72 percent), and ^{234}U (0.0054 percent).

Enriched uranium is used as fuel in nuclear power reactors generating electricity. The content of ^{235}U must be enriched (or increased) from 0.72 percent (as is found in natural uranium) to about 1.5-4.6 percent. This material cannot be used to make nuclear explosives. After removal of the enriched fraction, the remaining uranium contains about 99.8 percent ^{238}U , 0.2 percent ^{235}U , and 0.001 percent ^{234}U by mass. This is referred to as depleted uranium or DU.

Highly enriched uranium

contains 20 percent or more ^{235}U by weight and can be used to make nuclear explosives.

Depleted uranium is uranium whose isotopic composition has been changed by removal of the ^{235}U and

^{234}U such that the fraction of ^{238}U increases. Depleted uranium is less radioactive than natural uranium.

Spent uranium fuel from certain nuclear reactors (not commercial reactors) is sometimes reprocessed in plants for uranium enrichment. Some reactor-created radionuclides may consequently contaminate the reprocessing equipment and the resulting DU. Under these conditions, another uranium isotope, ^{236}U , may be present in the DU together with trace amounts of other elements.

What is depleted uranium used for?

Civilian uses –

Due to its high density, about 60 percent more dense than lead, the main civilian uses of DU include counterweights in aircraft and containers for the transport of radioactive materials. Some depleted uranium is used industrially as stabilizers in boats and yacht keels.

Military uses –

DU is used for armor-penetrating bullets and penetrators because of its high density, its ability to self-sharpen as it penetrates

its target, and its propensity to ignite on impact at temperatures exceeding 600 degrees centigrade. It is also used as defensive armor plate on the M1 Abrams tank.



M1 Abrams tanks

photo courtesy of DOD FHPR

*Words in italics are defined in the Glossary on page 3.

Are there any health effects associated with exposure to DU?

In general, natural uranium and DU are considered to be a chemical hazard to the kidney instead of a *radiation* hazard. Therefore, inhalation and/or ingestion of these materials should be minimized.

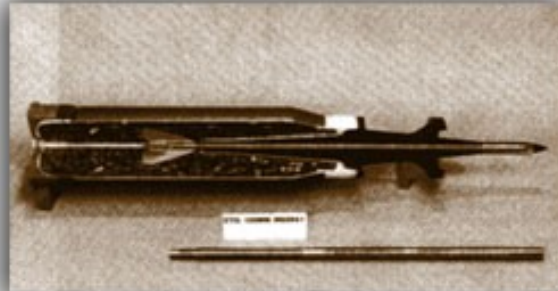
However, DU is a radiation hazard when it is inhaled in the form of tiny *insoluble* particles, which lodge in the lungs and remain there for very long times. DU is less of a radiation hazard than natural U because it is less radioactive than natural U. Direct (external) radiation from DU is very low and only of concern to workers who melt and cast U metal.

DU used in commercial civilian applications does not present a significant health hazard because it is usually in solid form and not available for inhalation or ingestion. Military operations with DU, however, may contaminate soil, groundwater, and breathing air. When used as a weapon, small particles of DU may be produced. These particles have high density and most fall to the ground very close to where they are produced.

Studies have been conducted of workers and other persons who have ingested or inhaled uranium, and there is no known association between low-level DU exposure and adverse health effects, including birth defects. In large quantities, DU exposure can cause skin or lung irritation, but only soldiers in the immediate vicinity of an attack that involves DU are potentially exposed to these levels of contamination. Soldiers with wounds

containing fragments of DU shrapnel may develop effects at the wound sites. The health consequences decrease quickly once the DU is removed, but it is almost impossible to remove all DU fragments. Persons exposed to very large inhalation doses of uranium have shown minor, transitory kidney effects, which typically disappear within days to a few weeks after exposure.

Persons inhaling insoluble particulates that lodge in the lung may be at elevated risk of developing lung cancer many years later, particularly if they are smokers. But an excess of lung cancer has yet to be demonstrated in uranium workers or others exposed acutely or chronically to uranium.



Depleted uranium

photo courtesy of DOD FHPR

A group of Gulf War veterans who have DU fragments still in their bodies continue to be medically followed by the Department of Veterans Affairs' Depleted Uranium Follow-up Program to determine whether there will be long-term health effects. As of early 2007, only subtle but clinically insignificant changes in kidney function have been observed. One common observation is a persistent elevation in the amount of uranium measured in the urine more than 16 years after exposure. This reflects the continued presence of embedded DU in wound sites and its ongoing low-level mobilization and absorption to blood.

In summary, some minor health problems have been observed following exposure to DU, but ONLY with high levels of exposure. Exposures to airborne DU or to contaminated soil following military use are not known to cause any observable health or reproductive effects.

Glossary

Insoluble

Incapable of being dissolved.

Isotope

One of two or more atoms with the same number of protons but different number of neutrons.

Radiation

Energetic particles or waves that are emitted during radioactive decay.

Radioactive

An unstable nucleus that decays by the spontaneous emission of radiation.

Resources

For detailed information on DU, refer to:

- The United Nations Web site: http://www.who.int/ionizing_radiation/env/du/en. Accessed 22 March 2010.
- The VA DU Follow-up Program Web site: http://www.publichealth.va.gov/exposures/depleted_uranium/followup_program.asp. Accessed 22 March 2010.
- The U.S. Military Deployment Health Clinical Center, "Depleted Uranium": <http://www.pdhealth.mil/du.asp#rl>. Accessed 22 March 2010.
- The March 2009 issue of the Health Physics Society's journal, *Health Physics*, with a series of technical articles on hazards from armor-piercing penetrators.

The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Formed in 1956, the Society has approximately 5,500 scientists, physicians, engineers, lawyers, and other professionals. Activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. The Society may be contacted at 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101; phone: 703-790-1745; fax: 703-790-2672; email: HPS@BurkInc.com. The Society's Media Liaison can be contacted at 507-284-4407 (office) or 507-254-8444 (cell); email: media@hps.org.