DEPLETED URANIUM:
GENERAL INFORMATION

THIS DOCUMENT HAS BEEN CREATED USING MATERIALS PREVIOUSLY DEVELOPED BY THE DEPARTMENT OF VETERANS AFFAIRS. THIS MATERIAL HAS BEEN COMBINED WITH INFORMATION FOR THE CURRENT MILITARY OPERATIONS AND FOR ISSUES SPECIFIC TO THE ARMY MEDICAL DEPARTMENT.

What is Depleted Uranium?

Uranium is an element found naturally in soil, water, and mineral deposits. It is a weakly radioactive substance composed of 3 naturally occurring isotopes (isotopes are atoms that differ only in their number of neutrons; they have similar physical properties), ^{238}U, ^{235}U, and ^{234}U. All three isotopes are found together in Uranium ore.

Depleted uranium is what remains after the more radioactive isotopes, ^{234}U and ^{235}U, are removed from uranium ore in order to make ***enriched uranium***. Enriched uranium, which contains the more radioactive isotopes, is primarily used as fuel in nuclear reactors.

The isotopes in uranium occur in uranium and depleted uranium in the following concentrations:

	Natural Uranium	**Depleted Uranium**
Isotope	**Concentration of isotopes**	**Concentration of isotopes**
^{234}U	0.006%	0.001%
^{235}U	0.72%	0.20%
^{238}U	99.28%	99.80%
Relative Radioactivity	1.0	0.6

As you can see, ***all*** uranium, not just DU, is made up of almost all **^{238}U**.

All uranium, not just DU, is made up of almost all **^{238}U**. Natural and depleted uranium differ only in their radioactivity. Depleted uranium is roughly half (60%) as radioactive as natural uranium because the more radioactive isotopes have been removed. Their chemical properties, however, are the same. It is the chemical properties that are responsible for many of the health effects of concern, such as possible kidney effects. Depleted uranium also contains trace amounts of **^{236}U** and other trace substances such as plutonium, americium and technetium. These amounts are so small that they are very difficult to measure and have no affect on health or the environment.

How does the military use Depleted Uranium?

Depleted uranium (DU) has a wide variety of civilian and military uses. It is used in radiation detection devices and radiation shielding for medicine and industry, for components of aircraft ailerons, elevators, landing gear, and rotor blades (AEPI, 1995).

The United States Armed Forces have used DU in the manufacture of munitions, armor and armor-piercing projectiles. DU's high density, self-sharpening qualities, and pyrophoric, or easily combustible, properties make it, in projectiles, capable of readily penetrating armor made with less dense metals. Conversely, armor constructed with DU provides a high degree of shielding and resistance to penetration. During the Gulf War (GW), depleted uranium containing munitions were used on a large scale for the first time. In the manufacture of projectiles and armor, depleted uranium is alloyed with small amounts of other metals. (DoD, 1998)

How do soldiers get exposed to DU?

When a vehicle is impacted and penetrated by a DU projectile, the projectile splits into small shards, bursts into flames, and fills the insides of the vehicle with flying metal, fumes, and particulates. The bulk of a round may pass directly through the vehicle. The inside of the damaged vehicle remains contaminated with particles of DU and its oxides after the impact. In the event of a vehicular fire, the heat of the fire can cause any onboard DU ammunition to oxidize. Soldiers in struck vehicles may inhale airborne DU particles (or other combustion products), ingest DU particles, and be wounded with DU particles or fragments. Some crew members may be left with multiple tiny fragments of uranium scattered through their muscle and soft tissue. Other soldiers may be exposed to DU during operations to salvage tanks that have been disabled by DU rounds or be potentially exposed from brief "sightseeing" entry into damaged vehicles.

Simply riding in a vehicle with DU weapons or DU shielding will not expose a soldier to DU. Exposure by breathing fumes of burning DU metal only occurs if the vehicle is hit or if the soldier is near a target hit by DU munitions.

Is Depleted Uranium radioactive?

An external exposure, that is when DU is not taken directly into the body, results in minimal radiation exposure because DU has low levels of radioactivity.

The Department of Defense has studied external exposure from intact munitions and armor and has stated that the doses measured are well below the annual occupational whole-body dose limit of 5 rem per year. In handling a bare DU penetrator, an individual may receive a skin dose of 0.2 rem per hour upon contact from the beta radiation emitted. The annual occupational exposure limit for an exposure such as this is 50 rem. Exceeding this limit would require the penetrator to be in contact with the same portion of the body for 250 hours. Crew members inside an M1 or M1A1 tank fully uploaded with intact depleted uranium munitions average a dose rate between 0.00001 rem and 0.0001 rem per hour of occupancy time within the tank. Studies performed for the DoD by the Pacific Northwest National Laboratory state that it is unlikely that general population limits of 0.100 rem per year would be exceeded by personnel in the tanks. The occupational whole-body exposure limit of 5 rem per year cannot be exceeded because the dose rates are so low.

Concern about internal exposure, whether by inhalation, ingestion, wound contamination or retained shrapnel should be tempered by the understanding that DU is even less radioactive than naturally occurring uranium found in the soil. Assessment of exposure is to be included in a complete evaluation by an occupational health specialist. Veterans and active duty personnel should consult their medical care providers for questions about their specific concerns

What are the health effects of DU exposure?

Research on the human health effects of DU exposure in military occupations is limited. There are, for example, no published studies of soldiers exposed to depleted uranium dust or vapor in war time settings. Most of the knowledge about human effects is derived from studies of uranium miners and millers which is not exactly, but only generally relevant to DU exposed veterans. For example, uranium miners and millers have exposure to uranium but also possibly to radon, as well as other toxic substances present in the mines or the ores that are milled,

making their health effects experience not directly comparable to those DU exposed. Also, exposure intensity and duration of these other occupations cannot apply to the military exposures.

Chronic exposure by inhalation presents a potential radiologic hazard to the lung. Uranium miners have a long occupational history of inhaling uranium dust in closed spaces. There is an increased risk of lung cancer among uranium miners but this is thought to be due to the simultaneous exposure to radon. Animal studies are not sufficient to show whether inhalation of natural uranium causes lung cancer in animals.

The older literature documents kidney effects in over-exposed animals and in humans. The intensity of those exposures are generally higher than what has been measured in the DU-exposed Servicemen and to date, no kidney abnormalities have been documented in them.

References and Further Reading
Update in progress

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Additional Resources

Agency for Toxic Substances and Disease Registry (ATSDR). U.S. Public Health Service. Toxicological Profile for Uranium (Update). Can be ordered from:

National Technical Information Service
5285 Technical Information Road
Springfield, VA 22161
Phone: (800) 553-6847 or (703) 605-6000

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World Health Organization (WHO), Guidance On Exposure to DU- For Medical Officers and Programme Administrators, 2001.
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On The Internet:

DeploymentLINK (http://www.deploymentlink.osd.mil/) is the World Wide Web information system of the Deployment Health Support Directorate that provides the public with information concerning the health of servicemembers . Information is updated periodically and covers a wide range of topics.

* These citations can be found on the DeploymentLINK web site described above.
† Journal articles written by the DUP staff and program collaborators. URLs for the article abstracts are listed below the citations if available.