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Depleted Uranium Fact Sheet, WHO

By: World Health Organization

Uranium

Metallic uranium (U) is a silver-white, lustrous, dense, weakly radioactive element. It is ubiquitous throughout the natural environment, and is found in varying but small amounts in rocks, soils, water, air, plants, animals and in all human beings.

Natural uranium consists of a mixture of three radioactive isotopes which are identified by the mass numbers 238U (99.27% by mass), 235U (0.72%) and 234U (0.0054%).

On average, approximately 90 µg (micrograms) of uranium exists in the human body from normal intakes of water, food and air. About 66% is found in the skeleton, 16% in the liver, 8% in the kidneys and 10% in other tissues.

Uranium is used primarily in nuclear power plants. However, most reactors require uranium in which the 235U content is enriched from 0.72% to about 1.5-3%.

Depleted uranium

The uranium remaining after removal of the enriched fraction contains about 99.8% 238U, 0.2% 235U and 0.001% 234U by mass; this is referred to as depleted uranium or DU.

The main difference between DU and natural uranium is that the former contains at least three times less 235U than the latter.

DU, consequently, is weakly radioactive and a radiation dose from it would be about 60% of that from purified natural uranium with the same mass.

The behaviour of DU in the body is identical to that of natural uranium.
Spent uranium fuel from nuclear reactors is sometimes reprocessed in plants for natural uranium enrichment. Some reactor-created

radioisotopes can consequently contaminate the reprocessing equipment and the DU. Under these conditions another uranium isotope, 236U, may be present in the DU together with very small amounts of the transuranic elements plutonium, americium and neptunium and the fission product technetium-99. However, the additional radiation dose following intake of DU into the human body from these isotopes would be less than 1%.

Applications of depleted uranium

Due to its high density, about twice that of lead, the main civilian uses of DU include counterweights in aircraft, radiation shields in medical radiation therapy machines and containers for the transport of radioactive materials. The military uses DU for defensive armour plate.
DU is used in armour penetrating military ordnance because of its high density, and also because DU can ignite on impact if the temperature exceeds 600°C.

Exposure to uranium and depleted uranium

Under most circumstances, use of DU will make a negligible contribution to the overall natural background levels of uranium in the environment. Probably the greatest potential for DU exposure will follow conflict where DU munitions are used.

A recent United Nations Environment Programme (UNEP) report giving field measurements taken around selected impact sites in Kosovo (Federal Republic of Yugoslavia) indicates that contamination by DU in the environment was localized to a few tens of metres around impact sites. Contamination by DU dusts of local vegetation and water supplies was found to be extremely low. Thus, the probability of significant exposure to local populations was considered to be very low.

A UN expert team reported in November 2002 that they found traces of DU in three locations among 14 sites investigated in Bosnia following NATO airstrikes in 1995. A full report is expected to be published by UNEP in March 2003.

Levels of DU may exceed background levels of uranium close to DU contaminating events. Over the days and years following such an event, the contamination normally becomes dispersed into the wider natural environment by wind and rain. People living or working in affected areas may inhale contaminated dusts or consume contaminated food and drinking water.

People near an aircraft crash may be exposed to DU dusts if counterweights are exposed to prolonged intense heat. Significant exposure would be rare, as large masses of DU counterweights are unlikely to ignite and would oxidize only slowly. Exposures of clean-up and emergency workers to DU following aircraft accidents are possible, but normal occupational protection measures would prevent any significant exposure.

Intake of depleted uranium

Average annual intakes of uranium by adults are estimated to be about 0.5mg (500 µg) from ingestion of food and water and 0.6 µg from breathing air.

Ingestion of small amounts of DU contaminated soil by small children may occur while playing.

Contact exposure of DU through the skin is normally very low and unimportant.

Intake from wound contamination or embedded fragments in skin tissues may allow DU to enter the systemic circulation.

Absorption of depleted uranium

About 98% of uranium entering the body via ingestion is not absorbed, but is eliminated via the faeces. Typical gut absorption rates for uranium in food and water are about 2% for soluble and about 0.2% for insoluble uranium compounds.

The fraction of uranium absorbed into the blood is generally greater following inhalation than following ingestion of the same chemical form. The fraction will also depend on the particle size distribution. For some soluble forms, more than 20% of the inhaled material could be absorbed into blood.

Of the uranium that is absorbed into the blood, approximately 70% will be filtered by the kidney and excreted in the urine within 24 hours; this amount increases to 90% within a few days.

Potential health effects of exposure to depleted uranium

In the kidneys, the proximal tubules (the main filtering component of the kidney) are considered to be the main site of potential damage from chemical toxicity of uranium. There is limited information from human studies indicating that the severity of effects on kidney function and the time taken for renal function to return to normal both increase with the level of uranium exposure.

In a number of studies on uranium miners, an increased risk of lung cancer was demonstrated, but this has been attributed to exposure from radon decay products. Lung tissue damage is possible leading to a risk of lung cancer that increases with increasing radiation dose. However, because DU is only weakly radioactive, very large amounts of dust (on the order of grams) would have to be inhaled for the additional risk of lung cancer to be detectable in an exposed group. Risks for other radiation-induced cancers, including leukaemia, are considered to be very much lower than for lung cancer.

Erythema (superficial inflammation of the skin) or other effects on the skin are unlikely to occur even if DU is held against the skin for long periods (weeks).

No consistent or confirmed adverse chemical effects of uranium have been reported for the skeleton or liver.

No reproductive or developmental effects have been reported in humans.

Although uranium released from embedded fragments may accumulate in the central nervous system (CNS) tissue, and some animal and human studies are suggestive of effects on CNS function, it is difficult to draw firm conclusions from the few studies reported.

Maximum radiation exposure limits and their limited application to uranium and depleted uranium

The International Basic Safety Standards, agreed by all applicable UN agencies in 1996, provide for radiation dose limits above normal background exposure levels.

The general public should not receive a dose of more than 1 millisievert (mSv) in a year. In special circumstances, an effective dose of up to 5 mSv in a single year is permitted provided that the average dose over five consecutive years does not exceed 1 mSv per year. An equivalent dose to the skin should not exceed 50 mSv in a year.

Occupational exposure should not exceed an effective dose of 20 mSv per year averaged over five consecutive years or an effective dose of 50 mSv in any single year. An equivalent dose to the extremities (hands and feet) or the skin should not surpass 500 mSv in a year.

In case of uranium or DU intake, the radiation dose limits are applied to inhaled insoluble uranium-compounds only. For all other exposure pathways and the soluble uranium-compounds, chemical toxicity is the factor that limits exposure.

Guidance on exposure based on chemical toxicity of uranium

WHO has guidelines for determining the values of health-based exposure limits or tolerable intakes for chemical substances. The tolerable intakes given below are applicable to long-term exposure of the general public (as opposed to workers). For single and short-term exposures, higher exposure levels may be tolerated without adverse effects.

The general public's intake via inhalation or ingestion of soluble DU compounds should be based on a tolerable intake value of 0.5 µg per kg of body weight per day. This leads to an air concentration of 1 µg/m3 for inhalation, and about 11 mg/y for ingestion by the average adult.

Insoluble uranium compounds with very low absorption rate are markedly less toxic to the kidney, and a tolerable intake via ingestion of 5 µg per kg of body weight per day is applicable.

When the solubility characteristics of the uranium compounds are not known, which is often the case in exposure to DU, it would be prudent to apply 0.5 µg per kg of body weight per day for ingestion.

Monitoring and treatment of exposed individuals

For the general population, neither civilian nor military use of DU is likely to produce exposures to DU significantly above normal background levels of uranium. Therefore, individual exposure assessments for DU will normally not be required. Exposure assessments based on environmental measurements may, however, be needed for public information and reassurance.

When an individual is suspected of being exposed to DU at a level significantly above the normal background level, an assessment of DU exposure may be required. This is best achieved by analysis of daily urine excretion. Urine analysis can provide useful information for the prognosis of kidney pathology from uranium or DU. The proportion of DU in the urine is determined from the 235U/238U ratio, obtained using sensitive mass spectrometric techniques.

Faecal measurement can also give useful information on DU intake. However, faecal excretion of natural uranium from the diet is considerable (on average 500 µg per day, but very variable) and this needs to be taken into account.

External radiation measurements over the chest, using radiation monitors for determining the amount of DU in the lungs, require special facilities. This technique can measure about 10 milligrams of DU in the lungs, and (except for souble compounds) can be useful soon after exposure.

There are no specific means to decrease the absorption of uranium from the gastrointestinal tract or lungs. Following severe internal contamination, treatment in special hospitals consists of the slow intravenous transfusion of isotonic 1.4 % sodium bicarbonate to increase excretion of uranium. DU levels in the human, however, are not expected to reach a value that would justify intravenous treatment any more than dialysis.

Recommendations

Following conflict, levels of DU contamination in food and drinking water might be detected in affected areas even after a few years. This should be monitored where it is considered there is a reasonable possibility of significant quantities of DU entering the ground water or

food chain.
Where justified and possible, clean-up operations in impact zones should be undertaken if there are substantial numbers of radioactive projectiles remaining and where qualified experts deem contamination levels to be unacceptable. If high concentrations of DU dust or metal fragments are present, then areas may need to be cordoned off until removal can be accomplished. Such impact sites are likely to contain a variety of hazardous materials, in particular unexploded ordnance. Due consideration needs to be given to all hazards, and the potential hazard from DU kept in perspective.

Small children could receive greater exposure to DU when playing in or near DU impact sites. Their typical hand-to-mouth activity could lead to high DU ingestion from contaminated soil. Necessary preventative measures should be taken.

Disposal of DU should follow appropriate national or international recommendations.