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International Coalition to Ban Uranium Weapons
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Uranium Weapons Briefing

What is depleted uranium and how is it used in weapons?

Depleted Uranium (DU) is nuclear waste. Uranium naturally occurs as three different isotopes U234, U235 and U238. Isotopes are atoms of the same element that have different numbers of neutrons but the same number of protons. This means that they behave in the same way chemically, but different isotopes release different amounts and kinds of radiation.

The radioactive properties of DU, which is chiefly uranium 238, differ from those of uranium 235. Unlike U238, U235 is fissionable. This means that it is so unstable that firing neutrons at it can produce a self-sustaining series of nuclear reactions, releasing huge amounts of energy. This is the basis of nuclear weapons and nuclear power. However, before U235 is used, it needs to be concentrated as it only makes up a small proportion of naturally occurring uranium, around 0.7%. U238 makes up more than 99% of natural uranium and is less radioactive. After natural uranium has had most of the U235 removed from it, it is called 'depleted uranium' i.e. uranium depleted in the isotope U235. Each kilo of reactor ready enriched uranium produced leaves you with about 7 kilos of DU.

Depleted Uranium itself is a chemically toxic and radioactive compound, which is used in armour piercing munitions because of its very high density. It is 1.7 times denser than lead, giving DU weapons increased range and penetrative power. They belong to a class of weapons called kinetic energy penetrators. The part of the weapon that is made of DU is called a penetrator: this is a long dart weighing more than four kilograms in the largest examples: it is neither a tip nor a coating. The penetrator is usually an alloy of DU and a small amount of another metal such as titanium and molybdenum. These give it extra strength and resistance to corrosion.

Three U.S. companies produce large calibre DU tank rounds: Alliant Techsystems (120mm), Day & Zimmermann (120mm) and the former Primex Technologies, now General Dynamics Ordnance and Tactical Systems (105mm and 120mm). Other companies – located in China, France, India, Serbia, the former Soviet Union, and Pakistan – also produce large calibre tank rounds. Alliant Techsystems, the largest ammunition manufacturers in the US also produce small calibre rounds (25mm, 30mm) for guns on U.S. aircraft and fighting vehicles. The UK-based firm BAE Systems produced 120mm shells for the UK armed forces until 2003, when they ceased production on 'environmental' grounds.[1]

In addition to armour-piercing penetrators, DU is used as armour in US M1A1 and M1A2 battle tanks and in small amounts in some types of landmines (M86 PDM and ADAM), both types contain 0.101g of

DU as a catalyst. 432 ADAM antipersonnel landmines were used on the Kuwaiti battlefields during the 1991 Gulf War. Both M86 PDM and ADAM mines remain in U.S. stockpiles. Patents exist for the use of a 'dense metal' as ballast in large 'bunker busting' bombs; such weapons have been deployed but it is unclear whether they contain DU, tungsten or a third high density substance, as their contents remain classified.

Where has depleted uranium been used and who uses it?

Governments have often initially denied using DU because of public health concerns. It is now clear that DU was used on a large scale by the US and the UK in the Gulf War in 1991, then in Bosnia, Serbia and Kosovo, and again in the war in Iraq by the US and the UK in 2003. It is suspected that the US also used DU in Afghanistan in 2001, although both the US and UK governments have denied using it there. However, leaked transport documents suggest that US forces in Afghanistan have DU weapons.[2] The continued use of A10 'Warthog' aircraft in support of NATO ground troops indicates that DU may be being used there.

At least 17 countries are thought to have DU weapon systems in their arsenals. These include: UK, US, France, Russia, Greece, Turkey, Israel, Saudi Arabia, Bahrain, Oman, Egypt, Kuwait, Pakistan, Thailand, China, India and Taiwan. Many of them were sold DU ammunition by the US while others, including France, Russia, Pakistan, China and India developed it independently.

Why is it a problem?

The DU oxide dust produced when DU munitions burn has no natural or historical analogue. This toxic and radioactive dust is composed of two oxides: one insoluble, the other sparingly soluble. The distribution of particle sizes includes sub-micron particles that are readily inhaled into and retained by the lungs. From the lungs uranium compounds are deposited in the lymph nodes, bones, brain and testes. Hard targets hit by DU penetrators are surrounded by this dust and surveys suggest that it can travel many kilometres when re-suspended, as is likely in arid climates. The dust can then be inhaled or ingested by civilians and the military alike. It is thought that DU is the cause of a sharp increase in the incidence rates of some cancers, such as breast cancer and lymphoma, in areas of Iraq following 1991 and 2003. It has also been implicated in a rise in birth defects from areas adjacent to the main Gulf War battlefields.

Soft target impacts, typical of aircraft strikes, tend to leave the penetrators partially intact as the vast majority miss their targets. In the Balkans more than 31,000 30mm penetrators were fired; UNEP reported that these corroding penetrators were likely to contaminate groundwater and drinking water supplies and should be removed.[3]

While we have a reasonable idea how much DU was used in the Balkans (12,700kg) and the 1991 Gulf War (290,300kg), there is little data on the extent of its use following the 2003 invasion in Iraq. One estimate put the total at 140,000kg by early 2004; with far more being used in urban areas than in 1991.

This was chiefly a product of a move towards asymmetric warfare but also an increasingly casual approach to DU's use. The US consistently refused to release data on the locations of DU strikes to UNEP and post-conflict instability has made assessing the true extent of contamination virtually impossible.

The health effects of depleted uranium: radioactivity

The chief radiological hazard from uranium 238 is alpha radiation. When inhaled or ingested, alpha radiation is the most damaging form of ionising radiation. However, as U238 decays into its daughter products thorium and protactinium, both beta and gamma radiation are released, increasing the radiation burden further. Therefore DU particles must be considered as a dynamic mixture of radioactive isotopes.

Inside the body alpha radiation is incredibly disruptive. The heavy, highly charged particles leave a trail of ionised free radicals in their wake, disrupting finely tuned cellular processes. In one day, one microgram, (one millionth of a gram), of pure DU can release 1000 alpha particles. Each particle is charged with more than four million electron volts of energy; this goes directly into whichever organ or tissue it is lodged in. It only requires 6 to 10 electron volts to break a DNA strand in a cell and these emissions cover a sphere with a radius of 6 cells.[4]

Novel effects from internal emitters are highlighting the hazards posed by exposure to internal alpha radiation.[5] This includes the Bystander Effect - whereby cells adjacent to those struck by alpha particles also exhibit signs of radiation damage, and Genomic Instability, where the descendents of radiation damaged cells show increased rates of mutations: the precursor to cancer growth. Ionizing radiation is a human carcinogen at every dose-level, not just at high doses; there is no threshold dose and any alpha particle can cause irreparable genetic damage.

The health effects of depleted uranium: chemical toxicity

Detailed research into uranium's chemical toxicity began in the 1940s, since then it has become clear that, like many other heavy metals, such as lead, chromium, nickel and mercury, uranium exposure can be damaging to health. While many studies have only investigated the possibility of kidney damage, since 1991, and triggered by concerns over DU, dozens of papers have highlighted other, more worrying effects of uranium toxicity. Repeated cellular and animal studies have shown that uranium is a kidney toxin, neurotoxin, immunotoxin, mutagen, carcinogen and teratogen. Compared to the uranium naturally present in the environment and the ore in mine workings, DU dust is a concentrated form of uranium.

Uranium has been shown to cause oxidative damage to DNA.[6] Recent studies in hamsters found that uranium formed uranium-DNA adducts (bonds), these make it more likely that the DNA will be repaired incorrectly.[7] If this occurs, adducts can lead to genetic mutations that may be replicated leading to carcinogensis. In mice, uranium has been shown to irreparably damage white blood cells and alter gene expression.[8] In 2007 DU compounds were shown to damage experimental human lung cells and disrupt

DNA repair.[9, 10]

Such findings, and others, suggest that not only is DU highly toxic, but that its toxicity and radioactivity may combine to create a synergistic effect, amplifying each other, and thereby increasing the damage caused to cellular structures and mechanisms - which in turn express themselves as tumours or a range of whole-body symptoms. [11]

International Commission on Radiological Protection

The ICRP is an undemocratic, self-sustaining body, which issues recommendations to governments and supranational bodies on radiological protection. They make political choices between dose received and the benefit obtained to society; a job that many would say should be left to politicians. While its members appear strong on radiation physics, they have been criticised for being significantly weaker on radiobiology. The ICRP uses data from the Hiroshima and Nagasaki blasts to estimate radiation health risk. Japanese bomb victims were mainly exposed to an acute burst of external gamma rays and neutrons. As has been shown, long-term environmental DU contamination leads to chronic internal exposure from alpha radiation, thus rendering the ICRP's whole body and organ dose rates largely irrelevant. Furthermore, their dose estimates are based on the 'average man' in spite of the fact that young children and pregnant mothers are at a much greater risk from ionising radiation.

World Health Organisation

In 2001 the WHO released a report claiming that, except in exceptional circumstances, DU exposure was not a public health concern.[12] Subsequently it has emerged that key papers by the US Department of Defence on DU's genotoxicity were excluded from the report. Dr Keith Baverstock who worked with the WHO's Radiological Protection Unit believes that pressure to ignore the research came from the highest levels.[13] It is clear that the WHO is only as strong as it is allowed to be by the member states that financially support it. Further confusion comes from its relationship to its sister agencies, such as the International Atomic Energy Agency, whose remit is to promote the use of nuclear power. The report used the same ICRP models that have been shown to be incapable of accurately modelling the effects of internal radioactive emitters.

US Armed Forces Radiobiology Institute

Between 2000 and 2003, Dr Alexandra Miller of AFFRI was at the forefront of US Government sponsored research into DU's chemical toxicity and radioactivity. Through a series of peer-reviewed papers, Dr Miller and her colleagues demonstrated for the first time that internalised DU oxides could result in "a significant enhancement of urinary mutagenicity", that they can transform human cells into cells capable of producing cancerous tumours in mice with suppressed immune systems and that DU was capable of inducing DNA damage in the absence of significant radioactive decay, i.e. through its chemical toxicity alone. In one study, 76% of mice implanted with DU pellets developed leukaemia.[14]

The legal status of depleted uranium weapons

Although no sole treaty explicitly banning the use of DU is yet in force, it is clear that using DU runs counter to the basic rules and principles enshrined in written and customary International Humanitarian Law. This relates to:

The general principle on the protection of civilian populations from the effects of hostilities; the principle that the right of the parties to an armed conflict to choose their methods or means of warfare is not unlimited; the principle that the employment in armed conflicts of weapons, projectiles, and material and methods of warfare of a nature likely to cause superfluous injury or unnecessary suffering is forbidden; the prohibition of the use of poisonous weapons according to Art. 23 para.1 of the Hague Regulations and the rules of the Poison Gas Protocol; the prohibition of widespread damage to the natural environment and unjustified destruction according to the Hague Regulations and the First Additional Protocol to the Geneva Conventions; the principle of 'humanitarian proportionality', which is contained in the St. Petersburg Declaration.

Additionally both Humanitarian Law and Environmental Law are based on the principle of precaution and proportionality, to which at the very least, states should adhere. Two resolutions of the Sub-Commission to the UN Commission on Human Rights (1996/16 and 1997/36) state that the use of uranium ammunition is not in conformity with existing International and Human Rights Law.[15]

There is increasing worldwide support for a DU ban. In 2007 Belgium became the first country in the world to ban all conventional weapons containing uranium with other states set to follow their example.[16] Meanwhile the Italian government agreed to a 170m Euro compensation package for personnel exposed in the Balkans.[17] Later that year the UN General Assembly passed a resolution highlighting serious health concerns over DU and in May 2008, an overwhelming majority in the European Parliament strengthened four previous calls for a moratorium by calling for a DU ban treaty in a wide-ranging resolution.[18, 19]

ICBUW - The International Coalition to Ban Uranium Weapons

With more than 96 member organisations in 26 countries worldwide, ICBUW represents the best opportunity yet to achieve a global ban on the use of uranium in all conventional weapon systems. Even though the use of weapons containing uranium should already be illegal under International Humanitarian, Human Rights and Environmental Laws, an explicit treaty, as has been seen with chemical and biological weapons, landmines and cluster bombs, has proved the best solution for confirming their illegality. Such a treaty would not only outlaw the use of uranium weapons, but would include the prohibition of their production, the destruction of stockpiles, the decontamination of battlefields and rules on compensation for victims.

ICBUW has prepared a draft treaty, which contains a general and comprehensive prohibition of the development, production, transport, storage, possession, transfer and use of uranium ammunition,

uranium armour-plate and of any other military use of uranium.[20] The draft treaty also outlines obligations concerning the abolition of uranium weapons and the destruction of uranium weapons construction facilities. In addition it obliges states to ensure a rapid decontamination of radioactive battlefields and test ranges, emphasising the protection of, and assistance to, civilians living in these areas and obliges states to compensate the victims.

In propagating a draft treaty for a ban on uranium weapons, ICBUW is following the successful example of the Cluster Munition Coalition. ICBUW's grassroots member organisations lobby at a national level, while ICBUW itself works with supranational bodies such as the European Parliament and the United Nations. Our work is supported by EUROMIL - the European Military Union and has received the backing of the His Holiness the Dalai Lama.[21, 22]

ICBUW is currently sponsoring two projects in Iraq: the Basra Epidemiological Study and the Iraqi Children's Tooth Project.[23] The former seeks to directly quantify for the first time the scale of the cancer epidemic around Basra in southern Iraq, by the careful examination of pre and post 1991 cancer records. Meanwhile the Iraqi Children's Tooth Project aims to assess the geographical and temporal extent of DU pollution across Iraq, through analysing children's milk teeth for uranium isotopes. You can donate to either project online at www.bandepleteduranium.org.

There is a growing consensus among civil society groups, scientists and some military organisations that the health risks from DU have been seriously underestimated. Establishment scientific bodies have been slow to react to the wealth of new research into DU and policy makers have been content to ignore the claims of researchers and activists. Deliberate obfuscation by the mining, nuclear and arms industries has further hampered efforts to recognise the problem and achieve a ban. The past failure of the UN Convention on Certain Conventional Weapons to deal with landmines and cluster bombs suggests that an independent treaty process is the best route to limiting the further use and proliferation of uranium weapons. As enshrined in the Geneva Conventions, the methods and means of warfare are not unlimited. We must not allow the short term military advantage claimed for uranium weapons to override our responsibility for the long-term welfare of people and planet.

Ideas for Action

Write to your political representative or Defence Minister about your concerns.
1. Contact ICBUW for more information.
2. Organise a fundraising event to support ICBUW.
3. Support independent DU research online at bandepleteduranium.org.
4. Sign the International Ban DU petition online at bandepleteduranium.org
5. Start a group and join ICBUW.

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