

## Depleted Uranium weapons in 2001-2002

## Occupational, Public and Environmental Health Issues

# Mystery Metal Nightmare in Afghanistan?

Collected studies and public domain sources  
compiled by Dai Williams



Photo: Oleg Nikishin      The Guardian 27 Nov 2001

- **DU in smart bombs and cruise missiles**
- **Dirty DU**
- **DU in the Afghan War?**

These papers have immediate implications for the health and welfare of civilians, troops and aid workers in Afghanistan.

They question the role of Governments, UN agencies and the validity of official research studies concerning DU to date.

They raise serious questions about the global proliferation of DU in military and civilian applications.

They have fundamental implications for the classification of DU munitions as weapons of indiscriminate effect.



## Eos Life Work

January 2002

# DU weapons in 2001-2002

## PREFACE

This Report is based on analysis of public domain sources on the Internet, published news reports and correspondence concerning known and suspected Depleted Uranium (DU) weapons collected from January 2001 to date.

It is designed for on-line viewing (as well as printing) so that readers and researchers can use Internet links to check original sources, and to locate other Internet resources specialising in the health or environmental effects of DU. Some Internet pages referring to DU or hard target guided weapons have been changed or withdrawn from public access since they were first located. This is usually due to website re-design or sometimes to tighter public access controls.

The report raises public policy questions and offers facts and sources as briefing materials for social, medical, environmental, legal and political debate and research. It concerns **health and safety risk assessments** for employers with civilian or military personnel in Afghanistan.

**Parts 1-3** consolidate information about known and suspected DU weapons systems up to and including those used in the Afghan War since October 7<sup>th</sup> 2001. **Part 4** offers **seven scenarios** for the possible use of DU weapons in Afghanistan. It identifies human, environmental and political issues concerning the use of known and suspected DU weapons of immediate concern in 2002. It relates the questions and issues raised in Parts 1-3 to post-conflict interventions in Afghanistan and for Afghan refugees. It raises serious questions about DU research and policy.

The Conclusions in **Part 5** highlight the need for **immediate precautions against potential DU hazards in Afghanistan** and for **urgent international interventions for full DU risk assessments**. The issues raised here need vigilance by many governments to ensure that the **UNEP PCAU** (United Nations Environment Programme Post Conflict Assessment Unit) can conduct fast and rigorous **environmental assessments** of suspected DU contamination in Afghanistan without political, military or commercial interference. The report urges equally fast, rigorous and independent **medical and epidemiological assessments** of civilians, refugees and troops at risk of DU exposure during or after the Afghan bombing by the **WHO** and other independent aid or research organisations.

The **questions and scenarios** raised here will require updating as environmental assessments, humanitarian interventions and weapons investigations proceed. Ideally this should be done by specialists with good resources and direct access to the situation in Afghanistan. The report offers a basis for fast, wide ranging, rigorous and politically independent assessments of DU hazards in Afghanistan. It calls for re-assessment of all military training, weapons testing and conflict zones where suspected DU weapons systems have been used since 1973.

**First Edition**

**31 January 2002**

**Note: The PDF version is available in separate files for each Part, designed for printing and on-line viewing for web links at: <http://www.eoslifework.co.uk/du2012.htm>**

<b>Author</b>	Dai Williams, M.Sc C.Psychol, Independent DU researcher
<b>Publisher</b>	Eos Life-Work 32 Send Road, Send, Woking, Surrey GU23 7ET UK
<b>Email</b>	<a href="mailto:eosuk@btinternet.com">eosuk@btinternet.com</a>
<b>Website</b>	<a href="http://www.eoslifework.co.uk">http://www.eoslifework.co.uk</a> (Community projects section)
<b>ISBN</b>	<b>0 953208 3 6</b> (Hard Copy); <b>0 953208 3 7</b> (Digital format)

Copyright © Dai Williams 2002. Copyrights of all quoted sources acknowledged.  
This report will be available as a public domain resource in digital format on the Internet at no cost provided that copyright information and the author's website are included. Hard copy versions will be available at a price to cover printing and distribution costs. It may not be reproduced for commercial purposes without the author's prior agreement

**Depleted Uranium weapons in 2001-2002**  
**Mystery Metal Nightmare in Afghanistan?**

## CONTENTS

<b>Summary</b>	<b>What is the mystery metal in hard target guided weapons?</b>	<b>1</b>
	Introduction	3
<b>Part 1</b>	<b>The secret unfolds - investigations &amp; briefings</b>	<b>Feb 2001 13</b>
	Tip of the Iceberg? DU in smart bombs and missile systems	Feb 25 15
	DU in the Balkans War: UNEP, Dirty DU & missile targets	March 13 21
	Depleted Uranium in the Afghan War	Oct 30 27
	First suspected DU casualties report from Kabul (Reuters)	Oct 29 35
	DU warning to Aid Agencies (Red Cross, Oxfam)	Nov 5 37
	Mystery metal bombs may cause Afghan War Syndrome	Nov 15 41
	Bombing Afghan water supplies (New Scientist 17 Nov)	Nov 21 43
<b>Part 2</b>	<b>UK Government - DU questions answers and denials</b>	<b>45</b>
	Letter to Sir Paul Beresford MP	Oct 16 46
	Letter to the Prime Minister	Nov 1 49
	UK Government denials from Dr Lewis Moonie MP <i>and analysis</i>	Nov 19 52
	Extracts from Hansard (1) <i>September 11 - November 11, 2001</i>	Nov 11 59
	Analysis of DU questions & answers in the UK Government	Nov 13 61
	Extracts from Hansard (2) <i>November 12 - January 31, 2002</i>	Jan 31 65
<b>Part 3</b>	<b>Military uses of DU - known and suspected weapons</b>	<b>Dec 2001 73</b>
	DU and the evolution of hard target weapons	73
	Properties, advantages and hazards of DU for military use	74
	New weapons technology - known & suspected DU applications	76
	DU armour-piercing ammunition and missiles	81
	Smart or Guided bombs	84
	Hard Target Cruise missiles	86
	Other suspected DU weapon systems - cluster bombs & SSB's	91
<b>Part 4</b>	<b>DU weapons review -</b>	
	<b>Human, environmental and political issues in 2002</b>	<b>Jan 2002 93</b>
	DU scenarios: What if DU is used in hard target weapons?	93
	Re-thinking DU: effects of high load DU weapons	99
	High exposure DU health risks - identification & re-assessment	105
	Environmental impacts - assessment & radical re-assessment	111
	Humanitarian aspects of DU risks in Afghanistan	113
	Political context: deception, DU proliferation and control	115
<b>Part 5</b>	<b>Conclusions and DU priorities in 2002</b>	<b>125</b>
	Acknowledgements	139

---

<b>Tables</b>	page
1. High penetration weapon system concepts / plans, USAF July 1997	16
2. Historical context of DU - Military, Human and Political factors	126
3. DU issues in 2002 - Military, Human and Political factors	127
4. Combat use of known and suspected DU weapon systems with dense metal penetrator or shaped charge warhead technology	131

## **Figures**

1. Hard target guided weapons in 2001: Smart bombs and cruise missiles with dense metal warheads	89
2. Medical conditions associated with DU oxide exposure	106

## What is the mystery metal in hard target guided weapons?

**These investigations question one of the best kept military secrets of the last decade. The facts about DU weapons are well known to military experts and arms manufacturers in the US, UK and at least 30 other countries. But how much do politicians know about them? What have aid agencies been told? And why have the media stayed silent about new weapons in the Afghan war?**

We know that many anti-tank shells use **depleted uranium (DU)**. But what was the 'dense metal' in the GBU-31 bomb dropped near US troops on 5 December and in scores of Bunker Buster bombs from Kandahar and Kabul to Tora Bora? **What is the mystery metal** used in the new generation of hard target guided weapons - smart bombs and cruise missiles - designed to penetrate Saddam Hussein's command bunkers, tested in the Balkans War and widely used in the hunt for Bin Laden?

This report investigates the evolving technology of hard target warheads, the systems involved and UK Government statements about DU weapons. It is a dossier of questions and search results sent to the Government, some MPs, media contacts and other researchers in 2001. Yet the mystery '**dense metal**' used in hard target weapons in Iraq, the Balkans and now the Afghan War remains a strict but simple military secret. It can only be Tungsten, Depleted Uranium alloy or both.

**If it is DU, how much is used** in the warheads of the AGM-86D, AGM-65G, AGM-154C and other **hard target cruise missiles**, or in the 1 ton GBU-15, -24, -31 and 2 ton GBU-28 Bunker Buster **smart bombs**? Most of these weapons have been used extensively on Afghan towns, caves, mountains and tunnels during the last 3 months.

The UK and other European governments, the UN, WHO, IAEA, aid organisations, medical researchers and even military personnel in DU combat zones appear to be totally unaware of the suspected use of DU in bombs and missiles since 1991.

But a 2-ton DU warhead, suspected in the GBU-28 & 37 Bunker Buster bombs, would deliver **50-100 times more DU oxide contamination** per target than the 30 mm DU anti-tank shells fired by A10 aircraft in the Balkans War. This risk could totally alter previous evaluations of the health and environmental hazards of DU to civilians and troops, past present and future, in combat zones from Iraq and the Balkans to Afghanistan.

**Are politicians truly unaware**, deceived by their advisers or part of a massive cover up of the use of DU weapons from the Gulf War to Afghanistan and new ones being developed? What kind of health and environmental nightmare is unfolding in the Afghan winter if 500-1000 tons of DU weapons have been used in the US bombing? Why has the Pentagon started to leak reports about risks of Al Qaeda's "dirty bombs"? **How much DU has been used in the Afghan War? Where? And who used it?**

This report investigates suspected new sources of DU contamination as a potential occupational and public health hazard. Thousands of lives in Afghanistan - from America, Britain, Europe and many other countries but especially Afghans - depend on finding the answer to these questions NOW, as winter deepens and as international peacekeeping and aid operations begin.

Dai Williams, independent DU researcher, UK  
January 2002

## THE PEOPLE

CPTNet, January 17, 2002

KABUL, AFGHANISTAN: **Bombs by day and night**

by Doug Pritchard [extract]

The continuing US bombing of Afghanistan has the support of Afghanistan's interim government and the people.

On January 6, the CPT delegation visiting Afghanistan met with villagers in Bibihisar, ten kilometres south of Kabul to learn about their experience of the bombing. At 8 a.m. on Nov. 10, 2001, the US dropped two large bombs on a water reservoir on a mountainside above the village. One bomb destroyed the reservoir, but the other bomb split in half and failed to explode. One half of that bomb remains in the crater, but the other half, and hundreds of boulders up to 70 kgs in size, were blown into 100 nearby shops and homes. A 23 year old man named Freidun was killed by the blast while working in his field near the reservoir.

Despite this damage, villagers said they were satisfied with the US bombing since it freed them from the Taliban. One even noted that they had water again. Although the reservoir was gone, so were the al-Qaeda fighters who had blocked off the village's irrigation channels when they refused to support the fighters. [They also bombed the local Schist quarry]. The quarry-owner Merajuddin said, "We are hopeful for the future now. We feel fresh. We will have human rights, schools, and women's rights."

Source: Christian Peacemaker Teams, Chicago

## THE TECHNOLOGY

### **Guided Bomb Unit-24 (GBU-24) Paveway III**

"The **Multi-Segment Hard Target Penetrator (MSHTP)** This weapon detonates a copper cutter charge upon entering the target and cuts the rear portion of the bomb off, which then detonates. The rest of the weapon continues down to the next level."

**"BLU-116 Advanced Unitary Penetrator:** The AUP maximizes sectional density by reducing the explosive payload and using **heavy metals** in the warhead case." (pages 76-85). Source: Federation of American Scientists.

## THE POLITICS

"One site registered an elevated level of radioactivity but it appeared to be a result of depleted uranium on some warheads and not from any nuclear or radiological weapon of mass destruction", Rumsfeld said.

Source: Reuters, 16 January 2001. (see page 120).

## THE QUESTIONS

The CPT report sounds like the GBU-24 with a multi-segment warhead. Or was it a malfunction of the latest AUP version? Which bombs were dropped in Bibihisar? What is the mystery "heavy" metal in their warheads?

Has the US bombing truly liberated this village and hundreds like it? Or has it perpetually poisoned their water supplies and irrigated land with depleted uranium (dense or heavy metal) warheads? Local doctors will know within a year. Perhaps the truth should be told now.

## Introduction

The enclosed studies and sources have been compiled as a briefing for Members of Parliament, health advisers, managers of organisations with personnel in Afghanistan, the media and other researchers. They are also offered to the new **UNEP PCAU** (United Nations Environment Programme Post-Conflict Assessment Unit) that was launched on 11 December 2001. Their first task will be to evaluate the environmental aftermath of allied bombing in Afghanistan, hopefully without the delays and political interference suffered by their Balkans study team. See the UNEP website at <http://postconflict.unep.ch/press/11.12.01.html>

The report is based on a series of discussion papers, correspondence and extracts from Internet sources. These investigate the suspected use of depleted uranium (DU) in far larger weapons systems than its known use in anti-tank penetrators. Most papers in Part 1 have been published on the Internet for evaluation by other DU researchers. Some have been sent to the UK Government and MPs in four parties.

These enquiries started from first reports of the UNEP study of DU targets in the Balkans War in January 2001. They contained at least two curious anomalies:

- Why did UNEP find so little evidence of DU contamination in Kosovo when increased airborne radiation levels were reported 500 miles away in Greece soon after the Balkans bombing started?
- How did UNEP teams find DU penetrators with Beta and Gamma detectors when pure DU (U238) emits very short range Alpha radiation?

These questions led to a new analysis of potential military uses of DU in smart bombs and cruise missiles - denied by Nato during the Balkans War.

## Mystery metal in new hard target warheads

The studies revolve around one main issue: what is the "**dense metal**" that has been used in many guided weapons (mostly smart bombs and missiles) since 1989? The first clue was an Internet link to the **US Air Force Mission Area Plan** dated 1997 on the **Federation of American Scientists** (FAS) website - see **Tip of the Iceberg** in **Part 1**. This included frequent references to the use of "**dense metal ballast**" and "**dense metal penetrators**" that would double the effect of earlier hard target weapons e.g. by upgrading the BLU-109 warhead used in the GBU-31 JDAM smart bomb. This would provide a new generation of "advanced penetrator" warheads ranging from 250 pounds to 2 tons for upgrading guided bombs and cruise missiles like the AGM-86D.

The second clue was in **Jane's Defence** website: "***It is true that some guided weapons used depleted uranium to increase the penetration effect.***" (Jan 2001).

Detailed descriptions of "**smart weapons**" on the FAS website explain their design and development (see **Part 3**). An essential requirement is that the "dense metal" must be at least twice the density of steel. This enables warheads of the same length and weight to be 30% thinner, more like explosive spears than bombs, and so to penetrate twice as deep as older ones - up to 100 feet of earth or 20 feet of concrete.

Only two common metals are heavy enough for high kinetic energy weapons: either Tungsten - expensive to buy and manufacture, or Depleted Uranium - a low cost waste product from the nuclear industry and easier to manufacture. DU has the added advantage of being pyrophoric (it burns fiercely in air) - ideal for incendiary effects.



For military, technical and economic reasons DU seems the most suitable material for high-density, hard target warheads. Legal and humanitarian concerns about DU's potential health effects are political, not military considerations. DU is likely to be used as the main ballast making up 50-75%+ of the weight of the new penetrator warheads. It may be contained inside a steel alloy casing or forged to make the casing itself.

**Weapons grade DU** is alloyed with 0.75% Titanium or other metals like Molybdenum and heat-treated for hardness and strength. Tungsten may be used for warhead tips but would be an expensive option for the main ballast with no incendiary effect.

A slightly different design concept is used in the BAE-RO "BROACH" hard target warheads. These combine a first stage "shaped charge" (see below) with a second stage "dense metal penetrator" with delayed action fuze to explode inside the target. DU is likely to be used as the liner in stage 1 and main ballast or casing in stage 2.

If DU is the mystery metal in these warheads they present **serious environmental concerns** in any combat location because of their size - far bigger than any DU weapon previously known to the public or health researchers. They are of special concern in Afghanistan where hundreds of hard target weapons have been used.

## Mystery metal in other hard target warheads

If DU is used in new hard target penetrator warheads where else has it been used? One clue to its suspected use in other (and older) bombs and missiles was another quote on Jane's Defence website in January 2001. This stated that DU is also used as **"liners in shaped charge warheads"**. This comment has since been removed.

Enquiries in the last 2 months indicate that new "heavy metal" warheads may have developed from earlier guided weapons in the 1980's e.g. the hard-target version of the Maverick cruise missile, AGM-65G and the TOW 2A/B fly-by-wire anti-armour missile.

These, and a number of sub-munitions in cluster bombs, use **"shaped charges"**. The explosive is contained inside a cone-shaped metal liner so that its explosive force is focused in one direction (Part 3 page 78). This concept dates back to World War II. A variation uses a shaped charge at the back of a warhead to create a "boosted penetrator". [ Kinetic energy is a function of mass and velocity:  $KE = 0.5mv^2$  ].

Shaped charge technology is used in a range of armour-piercing or hard-target munitions and in some cluster bombs. A dense metal like DU offers maximum inertia to focus the blast. Its melting point makes it interchangeable with Copper that is known to be used in shaped charge liners to project a jet of molten metal at very high velocity - an explosively formed penetrator. Thousands of these weapons were used during and since the Gulf War. The quantity of DU involved may range from a few kilograms up to 135 kg in the Maverick G warhead. So the total tonnage of DU contamination in recent conflicts may be far higher than previously disclosed. Independent researchers suspect that 800 tons of DU may have been used in the Gulf War, not the 320 reported by the US Government. This report also questions whether DU weapons have been used in other bomb and missile attacks on Iraq since 1991.

If DU is used in shaped charges and penetrator warheads then there may be much more DU contamination than the 3.3 tons in Bosnia or the 10 tons in the Balkans War reported by the US. If DU has been used in earlier guided weapon systems this would totally alter the evaluation of DU exposure in these conflicts. They were used in many other locations as well as tank battlefields (to date the only known DU risk zones), so health effects will need to be re-assessed for veterans and civilians alike.



## Dirty DU

Another issue raised by the [UNEP Balkans study](#) was the presence of Plutonium and U236 as part of the "isotopic mix" in some of the penetrators found in the Balkans. Depleted Uranium is never "clean" or pure U238. In theory it is natural uranium with 70% of the U235 removed for military or energy use. This reduces U235 from 0.7% to about 0.2%. But Plutonium and U236 are not present in natural Uranium ore. This contamination can only come from nuclear reactors. The UNEP samples confirmed that weapons grade DU is contaminated with Uranium 236, Plutonium 239/240 and other transuranic metals produced by recycling spent fuel rods from nuclear reactors.

Until the UNEP report most statements about DU by the US Government and NATO have trivialised its radiation hazards. For example NATO spokesman Major Badger said that a DU penetrator contains "the amount of Uranium that would go into for example a glow in the dark type of watch, - a very minuscule amount, very inconsequential in relative terms." (BBC Radio 4, 7 May 1999). 30mm PGU-14 penetrators are solid DU, 99% U238, not tipped or plated with Uranium (see Part 3, page 81). Each contains 0.275 kg of DU alloyed with 0.75% (2 grams) of Titanium and including 0.5 gram of U235. They are fired in bursts of 100-200 rounds per strike.

The US Department of Energy confirmed Plutonium contamination in DU to the US campaign group the **Military Toxics Project** (MTP) in January 2000 see [DoE letter](#) on their website. Although Plutonium quantities in the UNEP samples are very small they add to the radiation output of DU (see page 158 of the UNEP report). Any particles of Plutonium dust in the lungs or body represent a serious internal radiation hazard.

The health hazards of inhaling or ingesting DU oxide dust are the most widely disputed field of DU research. An employer's legal liability for health and safety of staff or the public commences when a risk exists or is suspected. **This report investigates newly suspected sources of DU exposure in combat zones - from different and larger weapon systems.** The history of DU weapons and the health hazards associated with DU exposure are best explained in other studies available on the Internet. For example the MTP website includes Dan Fahey's report **Don't Look, Don't Find** - a comprehensive review of Gulf War Veterans and US depleted uranium studies from 1990-2000 at <http://www.miltoxproj.org/DU/IOM-cover.htm>. Dr Chris Busby's website contains the latest **Low Level Radiation** research at <http://www.llrc.org>.

**DU contamination with highly radioactive isotopes is likely to vary widely between batches produced at different times, from different plants and in different countries.** DU quality control was likely to be less rigorous before DU health hazards became a public issue raised by Gulf war veterans in the 1990's. This has implications for re-examining DU contamination and exposure hazards to troops and civilians in every conflict zone since the first combat use of US DU shells by Israel in the Yom Kippur War in 1973. International comparisons of DU produced in the US, UK, Russia, Israel etc are urgently needed. The Dirty DU issue has equally serious implications for commercial plans to widen the use DU in civilian applications. **This is an issue for international assessment, publication and control.**

**Analysis of Dirty DU will be an important part of the UNEP study in Afghanistan if evidence of DU contamination is found, whether from US or Al Qaeda sources.** DU from other countries e.g. Russia or Pakistan may have significantly higher contamination than permitted in US nuclear reprocessing, increasing the health risks of any DU exposure. **The isotopic mix of DU (the percentages of U238, 234, 235, 236, Plutonium and other metals) will provide a 'fingerprint' to identify sources of DU.**

## Internet sources

Information about the weapon systems investigated in this study (in **Parts 1** and **3**) has been collected from the **Federation of American Scientists** and **Jane's Defence** websites, both regarded as reliable sources, and from manufacturers' web sites, e.g. Raytheon and Boeing. Reports about weapons used in the Afghan bombing come from the **Center for Defence Information** web site in Washington, and from Jane's.

**UK Government** comments about DU in guided weapons, Dirty DU and DU in the Afghan war, have been taken from **Hansard Online**, the official daily record of the UK Parliament, and from a written reply to DU questions raised via my MP. See **Part 2**.

The following reports contain Internet links to these and other DU research websites. When digital versions of this report are viewed on computer these links will go direct to the original Internet sources while they are available.

## Immediate priority: DU in Afghanistan?

The 3,767 civilian deaths in Afghanistan up to 6 December are documented in Professor Marc Herold's **Dossier on Civilian Victims of United States Aerial Bombing of Afghanistan** at [http://www.cursor.org/stories/civilian\\_deaths.htm](http://www.cursor.org/stories/civilian_deaths.htm).

The immediate purpose of this report is to draw attention to **the possible risk of widespread use of depleted uranium weapons in Afghanistan - potentially 500-1000 tons**. It offers a basis for more rigorous questioning of governments, armed forces and manufacturers involved with the production, sale or use of DU in any weapons system. It questions previous studies of DU health and environmental hazards for troops and civilians. If DU is used in guided weapons systems this also raises questions about the independence of international agencies like the WHO and IAEA that have either failed to investigate, identify or disclose wider use of DU to date.

The US and UK military and governments are likely to continue to deny DU use in Afghanistan. The US may impede independent UN investigations as they did after the Balkans War. **Other governments and aid organisations sending personnel to the Afghan relief operation cannot afford to risk lives while waiting for the truth about DU use.** They are urged to take precautions to protect troops and aid workers.

Airborne DU dust hazards may be lower in the Afghan winter. But if water and buildings are contaminated these will create immediate risks. It may be significant that the US Government is reluctant to take part in the Afghan "clean-up" operation and is paying Afghans to inspect the heavily bombed Tora Bora caves. Donald Rumsfeld knows what has been used. He said it was a "dirty war". If DU weapons have been used with indiscriminate health effects these will have been war crimes.

It may be significant that the UK Government plans to remove its troops by the end of the winter. I sent them DU warnings in October (see Part 2). By now they should know the scale of DU use and its potential hazards in Afghanistan - winter and summer. **But what are the risks for other people in Afghanistan - local citizens, expatriates and refugees returning? Will suspected DU contamination spread in the summer?**

## Background to the studies

I am a concerned citizen, not an arms expert. But as an Occupational Psychologist my work has included aspects of occupational health and safety. In March 1999 Dr Rosalie Bertell, a Canadian environmental epidemiologist, sent an Internet warning that US forces were likely to use **DU weapons in the Balkans War**. She was right.

My suspicions were aroused because in 1982-3 I was responsible for implementation of Shell Canada's occupational health monitoring programme in Vancouver refinery, with a toxicologist and an occupational health physician. So I became more aware that low doses of hazardous substances or "**bad actors**" over an extended period can lead to cancers or other serious health problems. The study included health screening.

Internet searches showed that Depleted Uranium weapons were strongly suspected as a potential cause of **Gulf War Syndrome** despite government-sponsored studies claiming otherwise. I studied many reports on government, research, media and Gulf War veteran websites and talked to Doug Rokke, involved in DU clean-up and training.

Internet research requires careful cross checking to establish original sources and facts. Inconsistencies can reveal key issues. I forwarded summaries and sources to the BBC who rapidly followed up the DU issue with questions to UK Government and NATO spokesmen, plus several BBC Online reports and a documentary by Alex Kirby.

But one question evaded most DU researchers in 1999: **Was DU used in bombs and missiles in the Balkans War?** Nato denied this. In the absence of further information I concentrated on alerting the UK media to the use of DU anti-tank munitions and the need for troops and civilians to avoid potential exposure to DU targets in the Balkans.

Later in 1999, the **Military Toxics Project** in the USA (<http://www.miltoxproj.org>) used the US freedom of information procedure to ask the US Navy if DU was used in **Tomahawk missiles**. The answer was no, except as dummy nuclear warheads in test flights. This may have been correct at the time. However the advanced penetrator and sub-munition options in the latest Tactical Tomahawks are now suspected DU systems.

The question should not have been restricted to Tomahawks. **Part 3 of this report identifies 10 guided weapon systems used in the Balkans that are suspected of containing DU warheads or sub-munitions.** The GBU-24 and 28 and JDAM guided bombs were definitely used according to US Government and FAS websites. Over 30 AGM-86 and some AGM-142 cruise missiles were used. The AGM-86D was at prototype stage, competitively evaluating its two hard target warhead options.

The first independent researcher to analyse possible effects of DU warheads in the Balkans was a physicist, Dr Theodore Liolios in Greece who wrote "**Assessing the risk from DU weapons used in Operation Allied Force**" (November 1999). He used FAS website data and modelled potential fallout plumes from 100 kg DU warheads. I did not see his paper until November 2001 so most of this investigation was a parallel study. His updated analysis is due for publication in Greece this month.

The first two studies in **Part 1 - Tip of the Iceberg** and questions about the UNEP study - **DU in the Balkans War** - were copied to UNEP and UK media contacts in March 2001. They were updated in June but there was no media interest in them. I dropped these enquiries until 11 October when **Bunker Buster bombs were first reported in the Afghan war**. This provided a new line of investigation into DU in guided bombs and the urgent need for answers to the following questions:

- What is the mystery metal that has doubled the effectiveness of a new generation of "hard target" smart bombs and cruise missiles? (see page 89).
- How many weapons systems use DU - past, present and future?
- How much DU has been used in the Afghan War?
- What are the likely health and environmental effects of DU bombs for the people of Afghanistan?

- How many DU bombs or missiles have been used in Iraq and the Balkans since 1990? Where else have they been used?
- Why is there so much secrecy and deception by the US and UK governments about DU weapons if, as they claim, DU presents 'minimal' hazards to humans?
- How widely have DU weapons been traded by the world arms industry?

**These questions and warnings were sent to the UK Government** via my MP on **16th October** and to the Prime Minister and several MPs in four parties on 1st November, see **Part 2**. This report offers some answers and asks more questions.

Dr Lewis Moonie, UK minister responsible for DU and veterans affairs, replied on **19th November**. He denied any use of DU in the Afghan War and denied knowledge of the dense metal used in hard target weapons. He thought DU would present a "minimal" risk if it is used. **Part 2** contains this correspondence and **recent DU questions and answers in the UK Parliament**. 17 MPs have raised DU questions since 1999.

## What next?

There is an **urgent need for independent environmental and health monitoring** programmes in Afghan towns and in other bombed areas. **The UNEP Post Conflict Assessment Unit** can do **environmental monitoring** but this time all bombed areas need to be assessed, not just a small sample as in the Balkans. Ongoing air and water monitoring is an additional requirement if large DU weapons have been used. Latest reports suggest that the PCAU will go to Afghanistan in February 2002. Ideally a pilot study team should be sent there immediately.

Military environmental monitoring teams from the US and the UK started surveys of suspected NBC (Nuclear, Biological and Chemical warfare) targets in November. The US and UK governments cannot be trusted to disclose their full findings (see Part 4).

The new Afghan Government may need to set up a permanent environmental monitoring organisation if DU has been widely used. This is likely to be opposed, or controlled by the US military to minimise publication of adverse results. The US Congress needs to consider what moral and legal obligations the USA has to the environmental health and safety of the people of Afghanistan in the aftermath of the bombing, including the possible effects of DU contamination in water, soil and air.

Until independent surveys are done **all organisations employing expatriates would be wise to take DU precautions for their staff and civilians in Afghanistan**. An alert was sent to the UK Red Cross and Oxfam on 5 November (see Part 1, page 37). This report encourages all international employers to question or investigate the risks of DU environmental contamination in Afghanistan.

**Medical health monitoring** is equally important and urgent, but medical aid teams are unlikely to have time or resources to do this systematically. Ideally the **World Health Organisation** should send in **epidemiological teams** to monitor health problems and causes of death including potential symptoms of DU oxide exposure. They need a public health equivalent of the UNEP PCAU. **Does such a team exist?** Unfortunately the WHO does not seem to regard DU as a priority issue, possibly compromised by its links to the International Atomic Energy Authority with its nuclear industry connections. (refer Robert James Parsons report in The Nation of 9 April 2001). **Will the UK and other UN member states support the WHO in setting up an Afghan health study?**

If DU has been used in guided weapons in the Afghan War this is likely to be on a **larger scale than in Iraq or the Balkans** because much of the campaign has involved bomb and missile attacks on hard or deeply buried targets. Also if DU has been used, **the size of these weapons represents up to 100 times greater risk of DU contamination per target than assessed in any published environmental or health study to date** (see **Figure 1** re "dense metal" warhead sizes on page 89).

Such levels of exposure for people in hard target bombing zones may involve **acute doses and health effects of a kind not previously associated with depleted uranium weapons**. Medical personnel need to be alerted to this possibility.

**DU may add the problems of toxic and low-level radiation exposure to illnesses already expected by aid organisations in the Afghan winter. Acute exposure cases are unlikely to survive the winter.** They may appear to die of "common respiratory disorders" before accurate diagnosis is made, conveniently concealing the potential scale of casualties exposed to high doses of DU contamination. According to Rosalie Bertell this strategy was used in 1945 to conceal mortality figures at Hiroshima and Nagasaki for 6 years. (see <http://www.mothersalert.org/bertell2.html> ).

**Intermediate exposure cases** (downwind of explosion clouds) who survive the winter may develop Leukaemia and similar disorders within a year. For others living in DU contaminated areas subject to atmospheric or water pollution it may be several months or years before radiation-related health disorders reach significant proportions, though possibly faster than in Iraq if large DU warheads have been used.

In the absence of a WHO PCAU study team other **international medical aid teams** may have relevant data e.g. Medecins Sans Frontieres, the International Red Cross and independent health researchers. Ideally DU testing is needed with analysis of illnesses and fatalities, plus autopsies of fatalities suspected of acute DU exposure. Parallel studies are needed for recent **Afghan refugee groups** in Pakistan and Iran, and for **expatriates** returning from recent Afghan assignments.

If large areas have been contaminated with DU this has **profound implications for the civilian population**. UN and other international aid agencies have **only 2-3 months to evaluate these risks** and options for relocating communities before hot weather and high winds may stir DU pollution into the atmosphere again. This is likely to increase chronic exposure risks and to affect more people each summer as dust contamination spreads. **Meteorological analysis** of recent winds, rain and haze or smog is essential, for correlation with details of weapons used and target locations.

If DU has been widely used in Afghanistan the **US Government and military** may be looking for ways of explaining **several hundred tons of toxic and radioactive 'dirty' Uranium oxide dust** (i.e. contaminated with traces of U235, U236, Plutonium etc). This is to be suspected in scores of locations hit by hard target guided bombs or missiles and in down-wind areas. Oxides may be dispersed over wide areas as fine dust in air, sand, soil and water - in effect as low-grade nuclear fallout. In the next few months they may also have to explain symptoms of **Afghan War Syndrome** among troops who inspected bombed targets, friendly fire casualties and Afghan allies.

On 4 December US intelligence sources released reports that Al Qaeda has stock-piled and tested "**dirty bombs**" made of nuclear waste and capable of contaminating "several city blocks" (International Herald Tribune, 5 December 2001). See <http://www.ihf.com/cgi-bin/generic.cgi?template=articleprint.tmplh&ArticleId=40891>



On 21 December "low grade uranium" was reported in an Al Qaeda store near Kandahar airport (Kansas City Star). On 16 January Don Rumsfeld gave the first report of " **an elevated level of radioactivity but it appeared to be a result of depleted uranium on some warheads and not from any nuclear or radiological weapon of mass destruction**" (see pages 120-1). What warheads and whose?

If DU contamination is found in parts of Afghanistan we may be told that these were Al Qaeda test sites, that DU ammunition stores were hit by "clean" US weapons, or that the Taliban used them in a "scorched earth" retreat. See **DU scenarios** on page 95.

**If these reports about Al Qaeda DU weapons are true they indicate an immediate need for independent DU health and environmental monitoring in Afghanistan** and for refugees in neighbouring countries - even if there was no DU in US guided weapons. They also indicate the need for **immediate public health precautions**, especially for water supplies and catchment areas that may have been contaminated.

**Health problems in Iraq** since the Gulf War may offer a model for the public health effects of widespread DU contamination in a population over a number of years. Countries that recently voted down a UN study of DU in Iraq (mostly countries that have suspected DU weapons systems?) may need to reconsider whether they can afford to ignore Iraq's experience of DU, especially if they have staff in Afghanistan.

I was suspicious about DU in guided weapons in January 2001. My enquiries over the last 3 months documented in this report increase my concern. They raise **questions that affect every government sending personnel to Afghanistan, United Nations agencies covering health, environment, refugees and arms control and all organisations that have conducted DU research in the last 10 years.**

I would like to be wrong. I hope that none of the hard target weapons identified here use DU. This would be one less problem for the humanitarian disaster in Afghanistan.

But I have seen too many errors of fact, misleading statements and inconsistencies in government statements and official studies in this investigation to trust any official reassurances about DU weapons and DU health hazards. They point to **a major international cover-up** regarding DU weapons of all kinds and their hazards. Robert James Parsons' article **DU Balkans cover-up** warned of this in The Nation, 9 April 2001, see [http://urbana.indymedia.org/front.php3?article\\_id=3601&group=webcast](http://urbana.indymedia.org/front.php3?article_id=3601&group=webcast).

**If the mystery metal in any guided weapon proves to be DU then all systems with the same warhead technology must be questioned.** If DU has been used in large explosive warheads the resulting toxic and radioactive contamination and their permanent hazards to life and health would clearly identify them as "**weapons of indiscriminate effect**". One example may be the bombing of Afghan 'Kerez' (underground water tunnels) reported in New Scientist (see page 43). These targets and water supplies will need rigorous inspection for DU contamination. The potential human and environmental hazards of DU in any weapons system should be obvious to everyone involved in their design, manufacture, testing, approval and operational use.

Hard target guided weapons now represent **several billion \$ of existing weapons inventory** plus new versions on order or under development in the US, UK and other countries. If these use DU warheads then many governments, military and commercial organisations have **a vested interest in keeping the issue of DU in guided weapons secret.** If DU is involved then governments and manufacturers may face huge compensation claims from 300,000+ war veterans and from civilian populations. Some could face criminal prosecution.

The hazards of DU, long delays in acknowledging them, and potential compensation claims have much in common with the history of the asbestos industry. Recent US allegations about potential weapons of mass destruction in Iraq and Afghanistan may be intended to deflect attention away from their use of weapons of indiscriminate effect.

----

With one exception **the UK media** has declined to raise any of these questions about DU in guided weapons over the last 9 months or during the Afghan War due to "lack of firm proof". But these investigations identify **specific weapon systems** using the "mystery dense metal" and **errors of omission, ignorance or deliberate deception that conceal its identity and use**, see **Parts 2 and 4**. They involve government ministers and international agencies. Obvious errors of fact should cast serious doubt on government denials if the DU issue is raised in national or international courts. They may indicate negligence for duties of care to military and civilian employees. DU weapons may involve criminal liability for death or incapacitation of civilians including birth defects in children. Risk assessment starts with suspicion of hazards, not proof.

Until now governments have concealed these issues by classifying the mystery metal in hard target guided weapons as **a military secret**. Since September 2001 they have been able to rely on the international media, through censorship or self-censorship in a time of war, not to publish these questions. That delay was sufficient for the bombing to continue without being seriously questioned, potentially at the cost of thousands more civilian lives. The initial trauma of September 11<sup>th</sup> 2001 won international support for the war in Afghanistan. If DU weapons have contaminated communities, water and land this support may change to outrage. The media silence cannot last indefinitely.

If DU has been used in guided weapons in Afghanistan or in previous conflict zones, this will become evident when more thorough, independent health studies are conducted for civilian and military populations. To date **UNEP, IAEA and NATO investigation teams** have not commented on DU contamination in hard target bombing locations in the Balkans. Perhaps they did not look. Perhaps they have been told to conceal the information they have found. Either they should re-survey these areas or publish the information they already possess without political interference. This may require a mandate from the UN General Assembly or the International Court.

The **wall of silence** surrounding military use of DU makes it difficult for independent researchers to give the media conclusive evidence about these suspect weapons until medical or environmental sampling can be done. Catch 22 is that unless a direct legal challenge is put to governments, the military or arms manufacturers they can rely on secrecy legislation to deny the existence of DU in guided weapons.

Most official DU research seems to be based on "[Don't look, don't find](#)" methodology. To ensure there is not another cover-up in Afghanistan like the Balkans studies the suspected use of DU weapons must be challenged by the media, in parliaments and in the United Nations. Hopefully these will be backed up by questions from academic and professional institutions around the world e.g. in Medicine and Environmental Science.

The technology of upgraded hard target warheads described in **Part 3** indicates **a high probability that DU is the mystery metal involved in several weapons systems**. Only DU alloy or Tungsten can match the physical properties required for dense metal penetrators and only DU where incendiary effects are required (HDBTDC page 73).

For different reasons - the properties of DU, Jane's report and illustrations of DU products - this report also concludes that DU may also be used in several **shaped charge warheads** (page 79-80) and possibly in other explosive penetrator weapons



e.g. in anti-tank cluster bombs and mines (page 91). Other metals are also used in some shaped charges but this does not exclude DU from full investigation. All these weapons require rigorous public scrutiny for DU, including earlier systems and new weapons under development as well as those used in Afghanistan.

These questions have grim and immediate implications for millions of people living or working in Afghanistan in the last 3 months, staff about to be assigned there and refugees planning to return. Wider implications need to be checked by other analysts.

The **military and political secrecy about DU** must be questioned and exposed for full, independent and international scrutiny. This is not just an issue for the USA. Companies in the UK, France and Israel as well as the United States have developed some of the systems identified in Part 3. Russia and China also have DU anti-tank munitions and are probably developing similar hard target guided weapons. The arms industry has traded some of these suspected DU guided weapons to 20-30 countries.

If DU is used in guided weapons warheads any further delays, denials or deception by governments, the military or manufacturers are likely to carry a high economic and political price. Suspicions about DU are growing in many countries. DU weapons may become a scandal like Agent Orange with thousands of victims in several countries.

If my suspicions are correct then **shrewd military analysts and medical advisers have already begun to recognise the consequences of using DU in Afghanistan**. This may explain delays in deploying ground forces. If DU weapons have been widely used in the group-think belief that DU is "safe" they may already realise that this was a grave strategic error. If highly trained special forces and other troops from the US, UK, Australia and other countries are getting sick or have children with birth defects in the next year this may devastate troop morale and recruitment. The US and UK Navy's have already started to replace DU rounds with Tungsten despite the extra cost.

**Preliminary health and environmental assessments in Afghanistan** must be given the highest priority. Initial assessments must be completed and published for analysis by the UN and aid organisations within 3 months. This must be done before the winter snow and ice melts, potentially recycling hundreds of tons of uranium oxides into the environment in Afghanistan and neighbouring states by wind and water. Mobile laboratories would enable faster analysis of water, air and soil than in the Balkans.

**Full health and environmental assessments** may be needed for years. Ideally the governments responsible for the bombing should pay for these assessments. But to ensure truth and impartiality it is essential that they are funded through the UN and co-ordinated by countries not involved in the Afghan War or the DU weapons industry.

The bombing in Afghanistan continues. These questions need to be published now so that UN agencies and other researchers can start to assess the implications of DU in guided weapons and other previously unsuspected systems. **Part 4** develops seven DU Scenarios for Afghanistan and strategic issues including immediate health and safety priorities. These need to be updated as new information becomes available. But they already highlight **the need for UNEP and WHO assessments to proceed rapidly and without political interference**. The draft report has been sent to them and other UN agencies. It offers a basis for urgent action in Afghanistan and rigorous investigations in many countries.

Dai Williams

31 January 2002

## Part 1

### The secret unfolds - DU investigations & briefings in 2001

This section contains the three main studies that provided the basis for questioning the suspected use of DU in hard target systems, hence in the Afghan War. It also contains two very significant media reports (from Reuters and New Scientist) and two DU warnings posted by the author in November. These show the early evolution of this study as new information became available. Most were written as one-off briefings for other DU researchers, politicians or the media so some basic information and links are repeated. Timing is relevant to actions or inaction by the people or organisations they were sent to e.g. questions to the UK Government included in Part 2.

<b>Tip of the Iceberg?</b> DU in smart bombs and missile systems	<i>Feb 25</i>	15
<b>DU in the Balkans War:</b> UNEP, Dirty DU & missile targets	<i>March 13</i>	21
<b>Depleted Uranium in the Afghan War</b>	<i>Oct 30</i>	27
<b>First suspected DU casualties report from Kabul</b> (Reuters)	<i>Oct 29</i>	35
<b>DU warning to Aid Agencies</b> (Red Cross, Oxfam)	<i>Nov 5</i>	37
<b>Mystery metal bombs may cause Afghan War Syndrome</b>	<i>Nov 15</i>	41
<b>Bombing Afghan water supplies</b> (New Scientist 17 Nov)	<i>Nov 21</i>	43

End of section & notes.

## Internet searches

25 February 2001

## Tip of the Iceberg? - apparent use of Depleted Uranium in bombs and missile systems

Dai Williams

These two sources were the first clues to potential use of depleted uranium (DU) in hard target versions of smart bombs and cruise missiles.

### 1. Extracts from Janes' Defence website (February 2001)

Key phrases highlighted in red.

DU is a heavy metal that, when alloyed with titanium (up to 0.75% by weight), becomes a material with a density (18,600kg/m<sup>3</sup>) and ductility suited to making penetrators for kinetic energy anti-tank munitions, or liners for shaped-charge warheads.

During the Balkans operations from 1992 to 1996, only the US Air Force acknowledges its use in some of its 30mm cannon shells fired from the GAU-8A cannon. It is true that some guided weapons used depleted uranium to increase the penetration effect and that the 20mm Phalanx close-in weapon system, used to protect warships at sea from sea-skimming missiles, also has a percentage of DU rounds.

[http://www.janes.com/defence/news/jdw/jdw010108\\_1\\_n.shtml](http://www.janes.com/defence/news/jdw/jdw010108_1_n.shtml)

(Note: This link still has the second paragraph in January 2002. The first paragraph seems no longer available in public pages of the website, most of which is subscription only).

---

### 2. Extracts from the Federation of American Scientists website

This search contains verbatim extracts from the following website. The Table on the next page summarises the key systems involved and key phrases re dense metal components.

**Source: High penetration weapon system concepts / plans (including "dense metal" penetrators)**

[http://fas.org/man/dod-101/usaf/docs/mast/annex\\_f/part26.htm](http://fas.org/man/dod-101/usaf/docs/mast/annex_f/part26.htm)

**Air Force Mission Area Plan (MAP)**

ANNEX F Common Solution/Concept List (U) [as of 11 July 1997 - Rev 10]

#### Questions arising:

1. Which of the following systems use Depleted Uranium as the "dense metal" referred to?
2. How many of these system concepts have been produced in prototype or production form?
3. How many of these systems or their derivatives have been used in military operations since Operation Desert Storm?
4. How many countries have stocks of these systems?

**Summary: High penetration weapon system concepts / plans, USAF July 1997**

<b>WPNS Project #</b>	<b>Device</b>	<b>Delivery</b>	<b>Notes</b>
104	20,000 lb direct attack bomb	B-52, B-2	Dense metal ballast
113	2250 lb guided bomb unit (gbu) - boosted penetrator warhead	F-117 F-16, F/A-18C/D B-52, B-2	Dense metal warhead
114	1000 lb GBU-32 dense or ballasted penetrator	F22, JSF F-15, F-16, F117 B-1, B-2, B-522	Dense metal case or dense metal ballast for maximum penetration
115	1000 lb penetrator with precursor in GBU-32. Multistage warhead:	F22	shaped charges with follow through penetrator. (see BROACH)
158	LODIS/SWAK/DASS/ Boosted Penetrator. High leverage munitions, mini missiles, Small Smart Bomb 250 lb.	Potential payload for Tomahawk	High density payloads. Same penetration capabilities as a 2000 lb BLU-109 but with only 50 lb of explosives.
169	JASSM (Joint Air-to-Surface Missile) P31 1000 lb advanced penetrator.  The next generation cruise missile.	B-52, F-16, F/A-18 B-1, B-2, F-15E, F117 S3, P3, JSF	Dense metal case or dense metal ballast for maximum penetration.
170	Unitary CALCM - Block II (became AGM-86D). Shaped charge precursor. Precision Strike variant. Feasibility concluded April 97. FCT - UK BROACH warhead .	B-52	Block II programme incorporates a penetrating warhead.
506	AUP 1000 Advance Unitary Penetrator. 2000 lb class penetrator Replaces BLU-109.	Option to BROACH for CALCM  B-52	Applications requiring increased penetration.
510	JASSM w/multistage warhead GBU-32. Develops the BROACH warhead for possible use on numerous platforms.	Multiple	Dual stage, shaped charge with follow-through penetrator.

**WPNS104 -- 20,000 Pound Direct Strike hard Target Weapon**

**DESCRIPTION:** This concept is a 20,000 lb. class precision guided, adverse weather, direct attack bomb employed on the B-52 and B-2 aircraft. It will make use of the GCU developed by the JDAM program which uses GPS aided INS for adverse weather guidance. Precision accuracy will be attained by using differential GPS (DGPS) technology demonstrated on programs such as Enhanced Differential GPS for Guidance Enhancement (EDGE) and Miniature Munition Technology Demonstration (MMTD). The weapon will make use of the JDAM interface under development for the B-52 and B-2 aircraft and would be carried internally using new suspension hardware within the bay. **The warhead will be a 20,000 lb. penetrator with dense metal ballast.** This concept uses the Hard Target Smart Fuze (HTSF), an accelerometer based electronic fuze which allows control of the detonation point by layer counting, distance or time. The accelerometer senses G loads on the bomb due to deceleration as it penetrates through to the target. The fuze can distinguish between earth, concrete, rock and air.

**WPNS113 -- 2250 lb Boosted Penetrator**

**DESCRIPTION:** The boosted penetrator is based on achieving maximum penetration without sacrificing operational flexibility. Total system weight will be less than 2,250 pounds so that it can be carried by all AF tactical aircraft and bombers as well as the Navy's F/A-18. The goal is to achieve greater penetration than the GBU-28 with a near term, affordable design. **A dense metal warhead will be used** with a wraparound rocket motor to allow internal carriage in the F-117. Advanced explosives will be used to compensate for the reduced charge weight. This concept integrates the boosted penetrator warhead with a JDAM guidance kit with an adverse weather Synthetic Aperture Radar (SAR). JDAM utilizes a GPS aided INS packaged in a tailkit for accurate navigation and guidance in adverse weather and other battlefield obscurants. The SAR seeker mitigates target location errors and GPS errors improving overall system accuracy. Employing the seeker also gives JDAM a capability against the GPS jamming threat. JDAM is an autonomous direct attack weapon integrated on F-16 C/D, F/A-18 C/D, B-52, F-117, and B-2 aircraft with plans for integration on F-15E and B-1. It is capable of inflight (in route to target area) retargeting and engagement of both horizontal and vertical targets. This concept uses the Hard Target Smart Fuze (HTSF), an accelerometer based electronic fuze which allows control of the detonation point by layer counting, distance or time. The accelerometer senses G loads on the bomb due to deceleration as it penetrates through to the target. The fuze can distinguish between earth, concrete, rock and air.

**WPNS114 -- 1000 lb Dense or Ballasted Penetrator in GBU-32**

**DESCRIPTION:** This concept is **a 1000 pound dense or ballasted penetrator** integrated with a GBU-32 guidance kit using compressed carriage for internal carriage in advanced fighters (F-22, JSF) or carriage in cruise missiles (JASSM, CALCM, ACM, ATACMS, Tomahawk.) **The warhead would either be designed with a dense metal case or contain dense metal ballast for maximum penetration.** The warhead will be filled with an advanced insensitive explosive to compensate for the reduced charge weight. The warhead will be integrated with the GBU-32, the JDAM tail kit for 1,000 lb class warheads. JDAM utilizes a GPS aided INS packaged in a tailkit for accurate navigation and guidance in adverse weather and other battlefield obscurants, day or night operations. JDAM is capable of inflight (in route to target area) retargeting and engagement of both horizontal and vertical targets. This weapon is designed for internal carriage on the F-22. It is also compatible with the following aircraft: F-15E, F-16, F-117, JSF, B-1, B-2, B-52H, F-14, F/A-18, S3, P3, AV-8B.

This concept uses the Hard Target Smart Fuze (HTSF), an accelerometer based electronic fuze which allows control of the detonation point by layer counting, distance or time. The accelerometer senses G loads on the bomb due to deceleration as it penetrates through to the target. The fuze can distinguish between earth, concrete, rock and air.

#### **WPNS115 -- 1000 lb Penetrator with Precursor in GBU-32**

**DESCRIPTION:** This concept is a 1000 pound multistage warhead involving two shaped charges with a follow through penetrator warhead. The warhead will be integrated with the GBU-32, the JDAM tail kit for 1,000 lb. class warheads. JDAM utilizes a GPS aided INS packaged in a tailkit for accurate navigation and guidance in adverse weather and other battlefield obscurants, day or night operations. JDAM is capable of inflight (in route to target area) retargeting and engagement of both horizontal and vertical targets. This weapon is designed for internal carriage on the F-22. It is also compatible with the following aircraft: F-15E, F-16, F-117, JSF, B-1, B-2, B-52H, F-14, F/A-18, S3, P3, AV-8B. This concept uses the Hard Target Smart Fuze (HTSF), an accelerometer based electronic fuze which allows control of the detonation point by layer counting, distance or time. The accelerometer senses G loads on the bomb due to deceleration as it penetrates through to the target. The fuze can distinguish between earth, concrete, rock and air.

#### **WPNS158 -- LODIS/SWAK/DASSL/Boosted Penetrator**

**DESCRIPTION:** The High Leverage Munitions (HLM) concepts are a class of next generation weapons designed to efficiently package small, highly lethal mini missiles of the future. They employ direct dispense technology being developed under WL/MN Low Cost Dispensing (LODIS) program as a means of high density loadouts for both internal and external carriage. This low observable/low drag container is capable of incremental or salvo dispensing and has virtual interface capability. Air bags are used to eject the mini missiles. The dispenser serves as a shipping/stores container. Electrical interface to the mini missiles is made via a single 1553 bus. This concept integrates Small Smart Bombs with LODIS for attacking fixed targets. The Small Smart Bomb is a 250 pound weapon that has the same penetration capabilities as a 2000lb BLU-109, but with only 50 pounds of explosive. With the INS/GPS guidance in conjunction with differential GPS (using all 12 channel receivers, instead of only 5) corrections provided by GPS SPO Accuracy Improvement Initiative (All) and improved Target Location Error (TLE), it can achieve a 5-8m CEP. The submunition, with a smart fuze, has been extensively tested against multi-layered targets by Wright Laboratory under the Hard Target Ordnance Program and Miniature Munitions Technology Program. The length to diameter ratio and nose shape are designed to optimize penetration for a 50lb charge. This weapon is also a potential payload for standoff carrier vehicles such as Tomahawk, JSOW, JASSM, Conventional ICBM, etc. This concept upgrades the SSB to add a low cost solid state LADAR (LASER RADAR), which is a terminal, autonomous seeker that is used in the guidance near the end of flight in order to take out the Target Location Error. This seeker is based on the Wright Lab Demonstration of Advanced Solid State LADAR (DASSL) program. The LADAR will provide a three dimensional image of the target. Coupled with INS/GPS during the midcourse guidance, this terminal seeker can reduce the CEP to <3m. This concept incorporates a solid rocket motor to increase the impact velocity of the SSB which will result in increased penetration performance. Two designs are under investigation; one with an inline motor and the other with a wrap around rocket motor to minimize total weapon length. The inline design was extensively tested against multi-layered targets during WL Hard Target Ordnance Program.



### WPNS169 -- JASSM P3I Penetrator

**DESCRIPTION:** This concept is a P3I to the Joint Air-to-Surface Standoff Missile (JASSM) to replace the baseline warhead with **an advanced penetrator** that meets or exceeds the objective penetration requirement specified in the JASSM Operational Requirements Document (ORD) and to add a synthetic aperture radar (SAR) seeker for adverse weather precision attack capability. JASSM is the next generation cruise missile to destroy the enemies war-sustaining capabilities outside the ranges of the area air defenses. The Standoff capability allows us to target key enemy centers of gravity without putting the warfighter in harms way, well beyond the range of current assets. **The warhead concept is a 1000 pound dense or ballasted penetrator. The warhead would either be designed with a dense metal case or contain dense metal ballast for maximum penetration.** The warhead will be filled with advanced insensitive explosive to compensate for the reduced charge weight. The JASSM will be compatible with the B-52, F-16, F/A-18 (threshold), B-1, B-2, F-15E, F-117, S3, P3 and JSF (objective). This concept uses the Hard Target Smart Fuze (HTSF), an accelerometer based electronic fuze which allows control of the detonation point by layer counting, distance or time. The accelerometer senses G loads on the bomb due to deceleration as it penetrates through to the target. The fuze can distinguish between earth, concrete, rock and air.

### WPNS170--UNITARY CALCM--BLOCKII with Shaped Charge Precursor

**DESCRIPTION:** The Conventional Air Launched Cruise Missile (CALCM) is a highly affordable, very long range standoff missile which is produced by modifying surplus AGM 86B, Air Launched Cruise Missiles (ALCM). The CALCM Block I missile, currently in production, incorporates a 3000 LB Class blast fragmentation warhead and Global Positioning System (GPS) receiver for navigation. The Block I system, when launched from CONUS based B-52 aircraft is highly effective against soft, above ground targets like Surface-to-Air Missiles (SAM) or radar sites. **The Block II program is the Precision Strike variant of CALCM. It incorporates a penetrating warhead,** updated state of the art, near-precision, GPS guidance, and a modified terminal area flight profile to maximize the effectiveness of the warhead. The penetrating warhead is augmented with two forward shape charges. To maximize the warheads effectiveness against hardened targets, the Block II will maneuver and dive onto its target in a near vertical orientation. The updated guidance system will increase the systems lethality by obtaining a less than 5 meter CEP. The Precision Strike variant of CALCM was successfully demonstrated in December 1996. A CALCM modified with a new precision GPS implementation flew for 4.5 hours, performed a newly developed steep terminal dive, and impacted the target within 2.5 meters of the aim point. The demonstration clearly showed that CALCM is capable of delivering it's warhead with precision accuracy from extremely long standoff ranges.

**A feasibility study was concluded in April 1997**, in which it was determined the BROACH Warhead on CALCM would offer very significant hard target capabilities. Foreign Comparative Test (FCT) funds have been provided by DoD for a demonstration of **the UK's BROACH Warhead**. The FCT will conclude in early 1998.

The current Block II program is structured for EMD to begin in first quarter FY99 with missile production to commence in third quarter FY00. Total procurement is for 130 missiles.

### JUSTIFICATION:

This program will provide the warfighter a hard and deeply buried target defeat capability from outside theater defenses. The Block II CALCM will be capable of holding at risk high priority assets essential to the enemy's warfighting ability. The system can prosecute these target from standoff ranges well outside theater defenses thereby ensuring deploying aircraft are not placed in harms way.

### WPNS506 -- **AUP 1000** pound Warhead Development

**DESCRIPTION:** Advanced Unitary Penetrator (AUP) is a 2000lb class penetrator warhead intended as an upgrade/replacement for the BLU-109 warhead in applications requiring increased penetration. The AUP is designed to provide increased penetration capability over the BLU-109 warhead while maintaining the same overall weight, mass properties, dimensions, and physical interfaces associated with the BLU-109. This warhead is compatible with the Hard Target Smart Fuze (HTSF) or the Joint Programmable Fuze (JPF). The HTSF is an accelerometer based electronic fuze which allows control of the detonation point by layer counting, distance or time. The accelerometer senses G loads on the bomb due to deceleration as it penetrates through to the target. The fuze can distinguish between earth, concrete, rock and air.

### WPNS510 -- JASSM w/multi-Stage Warhead, GBU-32

**DESCRIPTION:** Program develops the BROACH warhead for possible use on numerous platforms. BROACH is a dual stage, shaped charge with a follow through penetrator.

---

**Above extracts from ANNEX F Common Solution/Concept List (U) 11 July 1997 Rev 10**

At [http://fas.org/man/dod-101/usaf/docs/mast/annex\\_f/index.html](http://fas.org/man/dod-101/usaf/docs/mast/annex_f/index.html)

#### **Related Internet sources**

<http://www.fas.org/man/dod-101/sys/smart/index.html> - FAS Smart weapons Index

<http://fas.org/man/dod-101/sys/smart/agm-86c.htm> - AGM-86C/D

[http://www.af.mil/news/factsheets/GBU\\_15.html](http://www.af.mil/news/factsheets/GBU_15.html) - variant BLU 109

[http://www.af.mil/news/factsheets/AGM\\_65\\_Maverick.html](http://www.af.mil/news/factsheets/AGM_65_Maverick.html) - variants E/F/G/K 300 lb

[http://www.boeing.com/news/releases/1999/news\\_release\\_991202o.htm](http://www.boeing.com/news/releases/1999/news_release_991202o.htm) - Boeing chooses UAP9 for AGM-86D

---

Discussion paper

13 March 2001, updated 5 June

## **Use of Depleted Uranium in the Balkans War: Will the UNEP report include "Dirty" DU and missile targets?**

Dai Williams

The international debate about hazards of DU munitions poses a problem for the US, UK and other governments (and munitions manufacturer) with a high investment in DU weapons systems. Expert denials have been used to reduce public concern about hazards of DU weapons.

The UNEP report on its brief study of 11 DU target zones in the Balkans due out today (13<sup>th</sup> March 2001) may raise more concerns, or may come to similar conclusions as the recent EU expert report that supported current US and UK government positions.

The following assessment based on current Internet sources (mainly Jane's defence website) re-visits concerns that began during the Balkans war. Newly located information raises some very serious questions that may or may not be covered in the UNEP report.

### ***Contaminated (or 'Dirty') DU***

The preliminary UNEP report already provided important new clues to the potential hazards of DU - the "Dirty DU" issue. The first lead to this was their location of DU by use of Beta and Gamma detectors (pure DU emits Alphas radiation). This was explained by an interim analysis indicating contamination with fission products that could only come from recycled uranium from reactor rods - U236 and Plutonium. This possibility was picked up by the Military Toxics Project in 1999 but UNEP's study was the first report of this in a DU target zone. US Government analyses suggest percentages are very small and present "minimal risks" to troops and civilians. However it seems possible that older US stocks of DU munitions e.g. used in the Middle East and Bosnia, and those manufactured by other governments e.g. Russia, the UK and Israel may have had minimal quality control for this contamination.

This issue suggests that earlier DU target zones may have contained significant levels of contamination by highly radioactive isotopes in addition to pure DU (U238). Expert and government denials of DU risks based on Alpha radiation hazards only are invalid for "cocktails" of multiple radioactive substances. Theoretically they might have some validity for pure U238. Practically and ethically they have been misleading by error or deliberate omission.

Other Internet sources indicate that other toxic materials like Beryllium may also be used in some DU munitions. This requires a complete toxicological assay of munitions and target zones - not only for Uranium elements and isotopes. These secondary substances, even in small traces, need to be considered in all future further epidemiological studies of suspected DU exposure. Any reference to these or similar materials in the UNEP analyses could be very important.

### ***Use of DU in missiles***

In 1999 Nato spokesmen denied that DU was used in cruise missiles in the Balkans War. Reports that DU had been used in some Tomahawk cruise missiles were discounted on the basis that it was only used as dummy warhead ballast in tests of nuclear versions.

After these enquiries and denials about the possible use of DU in missiles dropped out of subsequent discussions on the Internet (e.g. DU list) and in the media.

However the following points concern me:

### ***Lost DU***

Several countries in the Balkans region reported increased levels of airborne radioactivity during the Balkans air war in April-May 1999. For sufficient quantities to be detected over hundreds of miles suggests there must have been significant quantities at source.

These observations seem inconsistent with government, Nato statements and the latest EU Commission Report that radiation levels and hazards in DU target zones in the Balkans were minimal. Will the UNEP studies indicate sufficient ground radiation levels to explain wide dispersion of radioactive dust in the region? If not where did the reported increases in airborne radiation come from in spring 1999?

One explanation for could be that DU was not only used in 30mm shells armour piercing shells as Nato claims but also in missiles. This might account for a substantial tonnage of "lost DU".

### ***Other missile systems***

Enquiries to governments about use of DU in missiles need to cover weapon systems involved - not restricted to Tomahawks.

A recent Internet investigation indicated that in 1996 Boeing started to convert nuclear armed AGM-86B missiles to conventional (i.e. non-nuclear) versions re-named **CALCM** (Conventional Air Launched Cruise Missiles) - **AGM-86C**.

One version of these - the **AGM-86D** - uses an "**advanced penetrating warhead to quickly provide theater commanders with a long range weapon to precisely attack an enemy's most valuable facilities.**" (source Jane's website and Boeing via: <http://www.defence-discovery.com> and search for "Defeat of High Value Targets". See also Boeing CALCM AGM-86C).

In the USA in 1998 Lockheed Martin developed an Advanced Unitary Penetrator (**AUP-3M**).

In the UK British Aerospace Royal Ordnance developed a penetrating warhead system known as **BROACH**/Multiple Warhead System (**MWS**). In May 1998 ground tests in Wales indicated that this could penetrate a 12-foot thick concrete target. It was selected for US AGM-86 systems.

Both warhead systems were under competitive evaluation in 1998-99 to win contracts for re-equipping AGM-86 systems. In December 1998 Operation Desert Fox was an ideal opportunity to test these systems in combat. The Balkans war presented many more opportunities in April-May 1999.

High penetration of targets requires high kinetic energy munitions i.e. made of high- density materials. DU and Tungsten are the most commonly referred to materials in reports on kinetic energy munitions. DU has three advantages over Tungsten: easy availability, far lower cost (it is a waste product of nuclear processing) and its pyrophoric quality that makes it an effective incendiary as well as high penetration material.

BROACH warheads weigh approximately 400 kilograms of which 90 are explosives. After control systems this leaves 150+ kilos of penetrating material. If this is DU (clean or dirty) it would create a far higher volume of Uranium oxide dust than A10 anti-tank attacks. Just 20 missiles would match the total quantity of 10,000 GAU-8/A 30mm armour piercing shells that the US admitted to using in the Balkans war (the DU penetrators in these shells weigh just under 0.3 kilograms). Since deep penetration missile warheads also contain explosive charges the likelihood that DU would oxidise is likely to be higher than the percentage of 30mm shells fired that hit hard targets and burned into DU oxide dust.

It seems likely that the AGM-86D system was tested in attacks on command bunkers during Operation Desert Fox in December 1998. Photographs showed that occupants were incinerated suggesting incendiary as well as blast effects.

The map of DU targets in the Balkans war shows a high concentration on the Kosovo - Albanian border. This area is reported to have many deep bunkers built during Tito's regime. If Serb forces used these bunkers they would have been regarded as strategic targets, hence justifying high penetration cruise missile attacks. Even if they were unoccupied they would have been ideal targets for combat testing of the new AGM-86D systems.

If cruise missiles did use DU then the tonnage of DU pollution in parts of the Balkans may be far higher than that declared so far by Nato. And the UNEP team may have been directed away from the most heavily contaminated DU target zones.

#### **Questions to ask the US Government:**

- a) How many AGM-86C or D missiles were fired in the Balkans air war in 1999?
- b) How many of these were equipped with high penetration warheads? (BROACH, AUP-3M or other).
- c) Which and how many sea-launched missile systems used deep penetration warheads?
- d) How many of any high penetration warheads contained Depleted Uranium?
- e) What was the total tonnage of DU munitions used during the Balkans war of ALL munitions containing DU - in addition to the 30 mm shells so far declared?
- f) What were the target locations of all air- or sea-launched cruise missiles, including strategic or system testing targets in Kosovo and Serbia?

#### **Questions to ask UNEP, or look for in their report:**

- a) How many of the 11 sites inspected had experienced cruise missile as well as A10 attacks?
- b) Was UNEP given the option to visit cruise missile targets?
- c) The discovery of one or two 30 mm DU penetrators in each location indicates a need for more detailed study when resources permit. 30 mm shells are fired in bursts of 50-100 shells per attack. What happened to the rest?
- d) If the 11 sample locations did not include cruise missile targets will UNEP endeavour to do a follow up study of deep penetration cruise missile target sites as well this year?

### **Questions to ask the UK Government**

- a) Does the BROACH warhead system use Depleted Uranium?
- b) Did the BROACH warhead tests in South Wales include some experiments with Depleted Uranium components?
- c) If DU is not used in the BROACH system what high-density material is used instead?
- d) If DU is used in the BROACH system what environmental precautions have been taken to protect staff and local communities in South Wales or any other testing location in the UK?
- e) Where are the BROACH warheads manufactured in the UK? Have there been any accidents or incidents during their manufacture? Have these been fully investigated?
- f) Were UK manufactured missile warheads used in Operation Desert Fox or in the Balkans war?
- g) What is the full chemical analysis of components in the BROACH and any other UK manufactured weapon system using Depleted Uranium? i.e. what level of contamination from other radioactive or toxic elements exists?
- h) What UK missile systems use MWS technology (BROACH or other warheads)?

### **Conclusions**

1. In "Defeat of High Value Targets" on the Janes website ***"the unique advantages of MWS (multi-warhead system) technology are set to make it the preferred system for cruise missiles throughout the world."*** In April 1999 the US Government awarded Boeing contracts to convert 95 surplus ALCM's to CALCM's.

If DU is being used extensively in high penetration missile systems it is easier to understand the US and UK governments' strong opposition to a global ban on the use of DU in weapons systems. Armour piercing shells can use tungsten as a substitute - as in the Phalanx naval gun system. But deep penetration cruise missiles are of major tactical importance. They would be very reluctant to loose this capability.

2. If DU has been used in cruise missile systems in the Middle East or Balkans wars they may added significantly to the tonnage of DU oxide in the atmosphere around target zones - and hence radiation exposure to troops and civilians.
3. If questions are asked of the US, UK or other governments, or Nato, about the use of Depleted Uranium then every weapon system with high penetration or incendiary effects has to be questioned. They should not be expected to volunteer information.
4. Each military operation is an opportunity to field test new weapons systems in action. The UK Government will use the Official Secrets Act to suppress disclosure of the weapons system it is using or developing. The USA has more public disclosure of information. This information is readily available to potential arms purchasers and the public through Internet information services like Janes. The UK Government's use of the Official Secrets Act to conceal use of controversial weapons systems including Depleted Uranium has to be questioned in the public interest.

5. Tactically and economically DU weapons have many advantages for military purposes, and to reduce nuclear waste stockpiles. It is understandable why they wish to retain the option to use DU munitions.
6. In humanitarian and environmental terms I am deeply sceptical about the completeness and sponsorship of scientific research claiming that DU oxides - alone or in combination with agents - pose no risk to human health.
7. Whether or not our countries should be armed with DU munitions should be a matter for Parliaments, not the military to decide. To make these decisions the public must have full access to the scale of testing, hazards and combat use of DU munitions.
8. If DU has also been used in missile systems in conflicts in the Middle East and Balkans then concealing its use will have put additional people at risk in each target location.
9. The new generation of MWS deep-penetration warheads was only in its trial period during the Balkans war. How many of the world's current stocks of cruise missiles are equipped with depleted uranium warheads? And how many countries have the US and UK exported these systems to?

Other DU researchers may have answers to some of these questions. I look forward to the UNEP report but suspect that the UNEP team did not have all the information they needed to do a full evaluation of DU use in the Balkans war.

30 mm anti-tank shells may be only the tip of the DU iceberg. If we ask the wrong questions we get the wrong answers.

---

#### **Footnote** (update on 5 June 2001)

This analysis was first prepared in March 2001 after researching suspected use of DU in smart bomb and missile systems (refer previous paper "Tip of the iceberg? - apparent use of DU in bombs and missile systems).

The final UNEP report indicated low levels of DU contamination on the sites visited and remarkably few 30 mm penetrators. One subsequent report suggests that KFOR troops had partially cleaned up these locations before they were disclosed to UNEP for inspection.

However if DU was used in some cruise missile and smart bomb systems in the Balkans war these would have involved quite different locations, including locations in Serbia as well as Kosovo.

Full disclosure on the nature of the "dense metal" used in any weapons system in the Balkans war is needed to re-evaluate targets zones involved, communities at risk and potentially wider geographic dispersal of DU oxide dust.

Earlier enquiries about the use of DU in bomb and missile systems met official denials. Current data suggests that earlier systems need review for potential DU content and that pre-Balkans War conflict zones - at least since the Gulf War - may need re-evaluation for the levels of DU contamination involved and subsequent exposure risks to civilians and troops.

This paper was forwarded to UNEP on 20 March 2001. Further investigation and wider public discussion are required.



End of section & notes

## **Depleted Uranium in the Afghan War:**

### **Are ground troops and civilians at risk in "hard target" smart bomb and cruise missile target zones?**

Dai Williams, 30 October 2001

## **Summary**

Internet sources from 1997 to date indicate that several 'hard target' versions of smart bomb and guided missile systems used by Allied forces in Afghanistan may contain Depleted Uranium (DU) as a major component to increase their penetration effect.

Of particular concern are systems that use the US "Advanced Unitary Penetrator" technology, or UK developed MWS technology with "shaped charge" penetrators.

Reports from the Center for Defence information suggest that at least 500 tons of smart bombs and cruise missiles have been used in the first three weeks of the Afghan war. They are most likely to have been used on "high value targets" e.g. Taliban and Al-Qaeda command centres, airfields and other military installations.

This information is offered for verification with governments and military authorities out of concern for potential DU exposure to UK, US and other Allied ground troops expected to be involved in search missions for Osama bin Laden and other Al-Qaeda or Taliban leaders. Also due to concerns for potential exposure to local civilians, international aid workers and media personnel.(1)

The US and UK governments take the view that use of Depleted Uranium in weapons presents no significant hazards to human health. They have also denied that it is used in missile systems. However information from Jane's Defence indicates that it has been used in at least one anti-tank missile system and in "shaped charge warheads".(2) Analysis of multiple sources suggest that it may be a key component of several recent guided weapon system upgrades.

## **Internet Sources**

This report is based on three direct Internet sources plus links to manufacturers' websites from these prime sites:

- **Jane's Defence Information** <http://www.janes.com>  
General information about weapons systems, manufacturers bulletins and actions in the Balkans (4). Huge range of subjects, informed summaries but detailed information about weapons systems only available to subscribers. More DU information was available during the Balkans war. Good access.
- **Federation of American Scientists** <http://www.fas.org>  
Extensive information about weapons systems (5), historical records of government procurement plans and weapons development. Some pages seem quite old so need verification for most recent progress from other sources (e.g. Jane's).
- **Center for Defence Information**, Washington <http://www.cdi.org>  
Very concise strategic summaries of US military information by ex-military personnel. Its Terrorism Project gives a daily assessment of Afghan war operations and prime systems (6). Not as detailed as Jane's or FAS but easy to access, good links and useful for cross-referencing with other sites.

## **Military uses and health aspects of Depleted Uranium**

DU has been used in weapons systems in the USA, UK, Russia and Israel for at least 15 years and exported to over 20 nations. It has two special qualities for use in military applications:

- a) Very high density (1.7x heavier than lead) which gives it high kinetic energy for its volume.
- b) Pyrophoric properties - DU ignites at high temperature, melting through armour and adding incendiary effects to its munitions.

Depleted Uranium (Uranium 238) is the main by-product of refining Uranium ore for nuclear fuel. It emits high energy but very short range Alpha radiation. In its pure metallic state it is relatively stable and safe to handle (e.g. if ammunition is handled with gloves). However it presents two main health hazards:

- DU ignites at high temperature and burns into DU Oxide - a fine, Alpha-radioactive, toxic dust, easily inhaled, widely dispersed by wind and water, very hard to detect and to remove from the environment or the lungs.
- Military DU is not pure. It includes small quantities of highly radioactive and toxic isotopes including U236 and Plutonium due to recycling nuclear fuel rods in DU processing. It was probably these other elements that enabled the UNEP survey team to trace DU in Balkans target zones.(3)

DU oxide contamination has been suspected as one source of Gulf War syndrome for several years. Other recently acknowledged radioactive elements may be an additional factor in long-term illnesses, cancers and birth defects suffered by civilians and veterans or their children exposed to DU during the Gulf War, and in Leukaemia deaths of some NATO troops following the Balkans war.

## **Suspected of DU in hard target guided weapons**

Since the Gulf War it has been known that several weapons systems use DU e.g. 30 mm armour piercing shells fired by A10 planes and 120 mm shells fired by tanks. Both were used in the Gulf war. 30 mm shells were the only DU munitions declared by the USA / Nato during the Balkans war.

The use of DU in smart bombs and cruise missiles was denied by Nato spokesmen during the Balkans war. However, as a result of anomalies between UNEP findings early this year and radiation reports during the Balkans war this possibility was researched again in January and February this year.(2)

The US and UK governments have been reluctant to discuss military uses of DU and its potential hazards. Both declare that research proves DU is not a hazard to troops or civilians but take radiation precautions when using it in test situations.

In April 1999 Greek scientists reported a dramatic increase in atmospheric radiation levels two weeks after the start of the Balkans air war. I have been informed that they subsequently lost their jobs and their research was closed down.

One explanation for the Greek measurements might be that DU has been used in larger weapons systems, and therefore in far larger quantities and different locations than previously declared or studied.

## Hard target guided weapons used to date in the Afghan War

First clues to the potential use of DU in guided weapons were picked up in the following document on the FAS website:

[Air Force Mission Area Plan (MAP)]

**ANNEX F Common Solution/Concept List (U)**

**[as of 11 July 1997 - Rev 10]**

at [http://fas.org/man/dod-101/usaf/docs/mast/annex\\_f/part26.htm](http://fas.org/man/dod-101/usaf/docs/mast/annex_f/part26.htm)

This included references to introducing or upgrading at least 9 systems to include "dense metal" penetrators or ballast to increase their penetration effect and hard target capability. NB most cruise missile and guided bomb systems have several warhead options e.g. for blast, sub-munitions (e.g. cluster bombs) or hard target capability. It is the hard target versions that are of concern here.

Only two high-density metals are usually mentioned in descriptions of kinetic energy weapons - DU and Tungsten. Both are similar in density (Specific Gravity 18+) but very different in material and manufacturing costs. They may also be used in alloys.

Study of the Jane's, FAS and CDI websites indicates a number of smart bomb and guided missile systems with upgraded features matching those described in the 1997 concept document. [NB: Abbreviated names / code numbers may be confusing. Some refer to guidance systems, some to the main vehicle and some to warhead types. The following notes have tried to make these distinctions clear].

Of these hard target systems the following have been reported on the CDI website, or expected to have been used by the Jane's website, in Afghanistan since 7 October 2001.

**For health and safety reasons the crucial question to ask the US and UK governments is this: Is the 'dense metal' used in any of these systems Depleted Uranium, or an alloy including DU?**

### 1. Laser or GPS Guided Bombs

**GBU 28 Bunker Buster bombs** and the upgraded version **GBU 37**: 5000 lb bombs of which 4,400 are "dense metal" penetrators. The GBU-37 upgrade uses a **BLU-113 penetrator**, improving on the converted gun barrels used for the original GBU-28 version improvised in the Gulf War.

CDI's Action Update for Oct 11 refers: "Underground bunkers were also targeted using the 5,000 lb bunker buster... B-52's and B-1's with cluster and other penetrating bombs (possibly the BLU-109 and BLU-113 - DoD would not specify); enormous secondary explosions reported."

**GBU 24 Paveway III**. 2000 lb bombs using the **BLU-116 Advanced Unitary Penetrator (AUP)** weighing 1700 lbs. "The AUP features an elongated narrow diameter case made of a tough nickel-cobalt (steel) alloy called Air Force 1410. The AUP maximises sectional density by reducing the explosive payload and using heavy metals in the warhead case." (Note: this FAS description is the most explicit about the combination of alloy casing and dense metal ballast that seems to define the AUP penetrators, produced in several sizes). Designed to destroy hardened aircraft hangers and underground bunkers. Designed to replace the BLU-109.

## 2. Joint Direct Attack Munitions (JDAM)

GBU 29, 30, 31, 32 feature 250, 500, 2000 and 1000 lb bombs respectively with all-weather GPS guidance systems. Originally designed by adding control fins to the BLU-109 and 110 hard target bombs. The new AUP warheads are designed to be direct substitutes for the 109 and equivalent bombs with twice the penetration power for the same size and weight. Refer 1997 proposed specifications on the FAS website and summary table in Tip of the Iceberg (2). Are AUP warheads now in use in JDAM systems?

CDI reported 500 JDAMs used in week 1.

## 3. Cruise missiles

**AGM-86D CALCM** (air-launched cruise missile). New version converted by Boeing from earlier nuclear warhead versions to include a **2000 lb** Lockheed Martin **Advanced Unitary Penetrator** (AUP-3M) using "dense metal ballast". Long range missiles for hard target capability e.g. underground command bunkers. Most likely for targeting command posts in mountain caves as well as open locations.

Jane's reports expects use of CALCM's in the Afghan operation but CDI reports do not mention them, except perhaps included in total cruise missile numbers (50-60 in week 1).

US Navy sources denied use of DU in BGM-109 **Tomahawk missiles** during the Balkans war except for testing dummy nuclear warheads. But the **Tactical Tomahawk Penetrator Variant** commissioned in May 1999 "will be modified to incorporate the government-furnished penetrator warhead (AUP?) and the hard-target smart fuze". Delivery was scheduled for 2003 so it seems less likely that DU has been used in Tomahawk attacks in Afghanistan yet - unless for testing pre-production prototypes. This increases the likelihood that the AGM 86D has been the cruise missile of choice for strategic "high value targets".

The 1997 procurement plans included a series of **Small Smart Bombs (SSB's)** weighing 250 lbs with 'the same penetration capabilities as the BLU 109' - using "boosted penetrators with high density payloads". Proposed applications included delivery as sub-munitions by Tomahawks and Joint Stand Off Weapons (JSOWs). Whether these have been actually been developed for use in Tomahawks or JSOW's is not known.

Jane's refer to other guided systems in Afghanistan that include sub-munitions options with anti-armour capability or shaped charge penetrators e.g. the **AGM-154 JSOW** (Joint Standoff Weapon), and **SLAM-ER** (Standoff Land Attack Missile - Expanded Response). There is insufficient data to know whether these systems include suspected DU components. However the UK BROACH warhead system (see below) was evaluated for the JSOW in 1998.

The **AGM-158 JASSM** (Joint Air to Surface Standoff Missile) has not been referred to in Jane's or CDI reports. However its 1000 lb P31 penetrator with "dense metal case or dense metal ballast" was specifically identified in the 1997 procurement list. So far there is insufficient information to know whether it has been discontinued, is under development, or has been used in prototype or production form in Afghanistan. It may be included in the unspecified air launched systems used in Afghanistan. If so it is another potential DU based missile system. Further information required.

## Potential UK involvement in DU guided weapons systems

Another form of hard target system is the UK developed **BROACH** two stage MWS (Multiple Warhead System) with a "shaped charge" penetrator.

The **2000 lb** version was developed to prototype trial stage in summer 1998 for competitive evaluation with the Lockheed Martin AUP for the upgraded **Boeing AGM 86D CALCM**. It was ground tested in South Wales and may have been field tested in the Operation Desert Fox and the Balkans War. But British Aerospace Royal Ordnance lost the Boeing contract to Lockheed Martin later in 1999.

The 1997 procurement list source suggested that a **1000 lb** version of this alternative **MWS** hard target technology was also under consideration for other applications e.g. the AGM 158 JASSM. It is not known whether BAE-RO have continued development or production of BROACH /MWS warheads.

The BROACH system needs similar DU investigation with the UK government, even if it has been discontinued. If it is currently in use, in production or prototype form, and if it has or may be used in Afghanistan, its "dense metal" specifications need to be investigated. It is very curious that Jane's' description of DU uses included "shaped charge warheads" in February 2001 (quote below) but that this description has been edited out of the current website version (link below):

### Extracts from Jane's Defence website (Feb 2001)

DU is a heavy metal that, when alloyed with titanium (up to 0.75% by weight), becomes a material with a density (18,600kg/m<sup>3</sup>) and ductility suited to making penetrators for kinetic energy anti-tank munitions, or liners for shaped-charge warheads. \*

During the Balkans operations from 1992 to 1996, only the US Air Force acknowledges its use in some of its 30mm cannon shells fired from the GAU-8A cannon.

It is true that some guided weapons used depleted uranium to increase the penetration effect and that the 20mm Phalanx close-in weapon system, used to protect warships at sea from sea-skimming missiles, also has a percentage of DU rounds.

Current description at [http://www.janes.com/defence/news/jdw/jdw010108\\_1\\_n.shtml](http://www.janes.com/defence/news/jdw/jdw010108_1_n.shtml)

\* Note: the reference to shaped charge warheads has been removed since February (see original quote in Tip of the Iceberg). These are referred to in Mavericks and the first stage of the BROACH MWS warhead.

## Evaluation of potential DU hazards in Afghanistan

One disturbing comment from Jane's was that the Military do not always know the materials used by manufacturers since some may be used interchangeably. Since the US DoD and UK MoD both take a public view that DU is not hazardous (at least in its metallic form) then the Military do not need any special instructions for munitions that may contain DU. If this logic is sustained there is no reason to conceal the past or current use of DU in smart bomb or cruise missile systems.

However if Military commands from any of the Allied forces have doubts about the potential use of DU munitions against hard targets in Afghanistan this will be a matter for urgent and full information exchange between the forces and governments concerned.

Note: although this paper concerns guided weapons that may contain DU any use in conventional systems e.g. armour-piercing shells from the AC 130 gunship matter too. The immediate operational concern is the likelihood that Special Forces will be expected to enter and inspect strategic target locations, underground bunkers and caves if accessible. Unlike anti-tank shells which leave distinctive entry holes there may not be obvious way for troops to distinguish potentially DU contaminated locations from other bomb damage.

Local geography and climate may be important if significant quantities of DU have been used. Afghanistan has more in common with Iraq than the Balkans - arid terrain prone to strong winds and dust storms. 300 tons of DU was declared in the Gulf War. Elevated radiation readings are still reported in some areas, years later.

The new generation (post 1997) of guided bombs and cruise missiles with hard target capability may be using DU in considerable quantities to achieve the increased penetration effects claimed by several upgraded systems - possibly 50% of the overall weight.

The majority of hard target bombing appears to have been accomplished in the first two weeks of the campaign. What's done is done. Potential DU use remains to be acknowledged, quantified and target locations identified. The 18 months delay for the UNEP survey after the Balkans war will not be psychologically or politically acceptable in the current conflict. However if DU has been used and this becomes known to the Taliban and Al Quaeda it may encourage them to evacuate strategic target locations at the earliest opportunity, and not attempt to return.

If DU munitions have been used in populated areas then contamination levels need to be assessed at the earliest opportunity - not only for Allied troops but for the welfare of local civilians, aid and media workers. Scarce water supplies are a special concern.

Unlike anti-tank shells guided bombs and missiles containing DU seem likely to oxidise most of the ballast load and to dissipate the resulting DU oxide (and embedded isotopes) over a considerable area in debris and dust-clouds.

Weapons designers and commissioning forces should have already evaluated these effects if the DoD and MoD acknowledge the potentially toxic and carcinogenic effects of DU oxide dust. No DU safety evaluation data for these systems has been located yet.

## Questions for the US and UK Governments

The basic questions asked in Tip of the Iceberg remain to be asked and answered publicly:

1. Which guided weapons systems (i.e. guided missiles, smart bombs and sub-munitions) use Depleted Uranium as the "dense metal" involved in hard target penetrators, by itself or in alloy with other metals?
2. How many of the 1997 hard target system concepts have been produced in prototype or production form, or are still under development?
3. How many of these systems or their derivatives have been used in live tests and military operations since Operation Desert Storm?
4. How many countries currently have stocks of DU in guided or other weapons systems?



And now these questions about its suspected use in Afghanistan:

5. Which and how many weapons containing DU have already been used in the current Afghan War, and where? Have DU weapons been used there before?
6. What is the estimate dispersal pattern of DU oxide fallout for each weapon? Will independent observers e.g. UNEP be allowed to commence environmental monitoring immediately?
7. What precautions will be taken to protect Allied ground troops from potential exposure to DU contamination?
8. What precautions will be taken to protect civilians and international aid teams, media, water supplies and agricultural land in potentially contaminated regions?

These concerns were submitted to the UK Government by Sir Paul Beresford MP at my request last week. Their answers are urgent in view of the imminent despatch of UK and other Allied ground forces, and the welfare of those already there.

These questions also have implications for communities and veterans involved in several recent conflicts who may have been in the vicinity of smart bomb or cruise missile targets. They may require fundamental re-evaluation of the consequences of DU health hazards and whether DU weapons systems comprise weapons of indiscriminate effect.

The potential use of DU in hard target guided weapons has obvious tactical military advantages. But its potential effects in large scale bombing campaigns may cause long term hazards for troops and civilians that seriously outweigh most military justifications.

Dai Williams, independent researcher  
Surrey, UK

#### **References to previous discussion papers available from the author**

1. Need for a DU Civilian Safety Handbook. 10 January 2001
2. Tip of the Iceberg? - apparent use of Depleted Uranium in bombs and missile systems. 25 Feb 2001. Includes more links to original sources.
3. Use of Depleted Uranium in the Balkans War: will the UNEP report include "Dirty" DU and missile targets? 13 March 2001, updated 5 June 2001

#### **Links used in this report**

4. Janes report on Air and Missile strikes in the Afghan war  
[http://www.janes.com/security/international\\_security/news/jdw/jdw011007\\_1\\_n.shtml](http://www.janes.com/security/international_security/news/jdw/jdw011007_1_n.shtml)
5. FAS links to guided missile and bomb specifications:  
<http://www.fas.org/man/index.html>
6. CDI Terrorism Project Action Update:  
<http://www.cdi.org/terrorism/actionupdate.cfm>

End of section & notes

First suspected DU casualties report from Kabul

October 29, 2001

## **Taliban Claim U.S. Using Chemical Weapons**

by Sayed Salahuddin

KABUL (Reuters) - Afghanistan's ruling Taliban accused the United States on Monday of using chemical weapons and invited foreign observers to check the claim.

But one deputy minister acknowledged that the war-shattered country did not have the facilities to test for chemical use. "We have some patients with superficial injuries with symptoms of chemical weapons," doctor Wazir of Kabul's Wazir Akbar Khan hospital, told a news conference.

Public Health Minister Mullah Abbas also said the hardline Muslim militia had proof that chemical weapons were being used. "Our findings prove that this is true. These bombardments have radioactive rays and chemical materials that also cause cancer," he told the same news conference.

Both men cited cases of chemical poisoning. None of the claims could be independently verified.

Deputy public health minister, Sher Mohammad Abbas Stanikzai, said the government did not have testing facilities and would welcome outside observers. "If there are more cases coming, we hope to be able to invite delegations to verify it and test it," he told Reuters Television.

Doctors said such cases had been reported in several hospitals across Afghanistan, and Stanikzai cited between 10 and 15 cases. "We can give details to people and doctors who understand for explanation. But we have several cases of acute diarrhea and also cases of breathing problems. In some of the cases it happened that people died," Stanikzai said.

"We do not have sophisticated laboratories in Afghanistan to test the blood of people and analyze it," he said, adding that the Taliban could not trust neighboring countries to carry out the testing because they backed U.S.-led attacks against them.

Wazir described the case of a 10-year-old boy with superficial wounds, but with respiratory problems who died after six hours. He said a 50-year-old woman who had minor injuries had also died.

"They were both toxic cases," he said. "We don't have the ability to make a diagnosis, but clinically we see symptoms as such."

Source: [http://dailynews.yahoo.com/h/nm/20011029/wl/attack\\_afghan\\_health\\_dc\\_1.html](http://dailynews.yahoo.com/h/nm/20011029/wl/attack_afghan_health_dc_1.html)  
(Yahoo & Reuters)

### **Other reports**

Another report of this press conference is on the khilafa.com website, source AFP at <http://www.khilafah.com/1421/category.php?DocumentID=2528&TagID=6>

This referred to three other patients who only had slight injuries but died with hours of arriving at the hospital after developing breathing problems and internal bleeding - "two girls aged 12 and 15 and a boy aged 15". The Public Health Minister said "the Taliban was also worried that US forces were using depleted uranium shells and that areas of Afghanistan would be left permanently contaminated".

---

End of section & notes

**DU Warning to Aid Agencies**  
**Message to Red Cross and Oxfam in UK**  
5 November 2001

Re my call I attach my most recent analysis of suspected Depleted Uranium (DU) use in the Afghan war and a copy of my letter to the Prime Minister on the same topic of last Thursday.

**Context**

I am an independent Occupational Psychologist with parallel interests in Occupational Health. I was involved in introducing an occupational health monitoring scheme in Shell's Vancouver refinery some years ago so I may be a little more concerned than most about low dose toxic substances.

I became concerned about the military use of DU at the start of the Balkans War and discovered extensive Internet sources, mostly starting from concern for Gulf War syndrome. These vary greatly in reliability so I double or triple check sources, including phone calls to key researchers. My analyses were used by BBC Radio 4 and Alex Kirby for raising the DU issue during and after the Balkans war.

I encountered widespread prevarication and dis-information from official sources in the US and UK during these researches. There are powerful vested interests involved - military, political and commercial - as well as the angst of veterans groups and some over-enthusiastic if not subversive organisations. These were illustrated by the 18 month delay before UNEP were allowed to survey Balkans DU target zones last November.

Anomalies in the UNEP reports alerted me to the possibility that DU was used in much larger weapons systems than declared by Nato / US during the Balkans conflict. Further research indicated that these were likely to be the new generation of "hard target" smart bombs and cruise missiles. (These systems come in several versions - not all have hard target capability). I asked my MP to seek clarification from Government on 16 October. No reply has been received yet.

I attach my most recent report - DU in the Afghan war (30 Oct 01) - circulated to other DU researchers, the media and several MPs last week. This explains my concerns and the questions that need to be answered by the US and UK governments.

I also attach my letter to The Prime Minister of last Thursday with potential implications for troops, civilians and of potential concern for yourselves - Aid workers.

To date the UK media have declined to report these concerns except Radio 4 Any Answers on Saturday. However the same concerns are being expressed, though less precisely, in Australia and Pakistan yesterday.

I am contacting my Occupational Health network contacts in the UK and International Forums for Organisational Health to evaluate these issues from a Health perspective. **The new weapons systems involved, and increasing evidence of contaminated or 'Dirty DU' alter all previous health risk assessments.** Re-assurances in the UNEP and Royal Society reports this year are compromised for failing to evaluate these dimensions. (I advised these concerns to UNEP in February but they have been ignored in subsequent statements).

## Practical implications for Aid organisations

The first point is that I am raising questions about the possible use of DU in these new weapons systems. No precise data is available about the "dense metal" they are based on. But it could only be DU or Tungsten in view of their enhanced performance (double impact for the same size implies double density materials). I am not scare-mongering. But I find sufficient evidence to make me deeply concerned for the health of anyone exposed to hard-target weapons target zones - sufficient to risk my professional reputation in raising the issue publicly.

## DU risk scenarios in Afghanistan

There are two main scenarios for these risks:

1. That DU is still only used in systems already declared - 25 or 30 mm armour piercing shells used by the AC-130 gunships against armoured vehicles. This would be equivalent to the reported use in the Balkans. Immediate target zones are potentially hazardous, requiring similar precautions for troops and civilians as recommended after the Balkans war.

Basically stay clear of wrecked armoured vehicles. Overall risk relatively low compared to other war hazards e.g. cluster bombs. (Some cluster bombs also use DU but this is a technicality for casualties injured by them).

2. That DU is being used in some, but not all, hard target munitions. The prime suspect systems concerned are identified in the attachments. The majority of hard target locations were hit in the first 2-3 weeks e.g. command centres, bunkers, ammunition supplies etc. These locations should be fairly evident by their prior use, bomb craters etc. The new hazard is that these targets may have far higher concentrations of DU contamination (100x greater) than low calibre anti-tank targets in the Balkans. Where possible it would be wise for all civilians to stay well away from these areas (several hundred yards) and any water supplies near them.

Weather conditions at the time of bombing could be highly significant. Winds can carry DU oxide up to 25 miles from studies in the US. Downwind areas are suspect.

## DU casualty Symptoms

The nature of injuries and sickness reported by civilians and aid workers may give clues to exposure to toxic hazards. Low doses of Depleted Uranium are one suspected source of Gulf War syndrome. They may include **flu-like symptoms** in the first few days, then slow developing ailments with non-specific causes. Medical personnel will be aware of previous reports of these symptoms, and that they may have non-DU causes. Relatively low short-term risk but long term health monitoring seems desirable.

**Of increasing concern is the possibility of more severe symptoms developing far more rapidly than previously associated with DU.** The far higher concentration of DU (if it has been used) could accelerate respiratory and toxic disorders, either due to the chemical toxicity of Uranium Oxide and related contaminants (Plutonium etc) or depending on the level of contamination in the DU batch due to radiation exposure.

Such **acute exposures** could cause serious illness within days, and death within months as reported for some Nato troops after the Balkans War (Italy, Spain, Portugal).

Their deaths were said not to be related to DU. But since DU was not suspected in bomb and missile targets this was omitted from analysis of their cases (i.e. their levels of exposure).

A Reuters report from Kabul last Monday was consistent with acute DU exposure (see separate report). Unfortunately Taliban sources are not considered reliable but this seemed like a naive account of potentially significant symptoms.

These latter points are probably most relevant for alerting medical personnel in the field, or treating staff who have returned from DU combat zones to the possibility of more acute versions of DU poisoning. It may also be relevant for epidemiological follow-up of personnel involved in previous conflict zones e.g. Iraq, Bosnia and the Balkans.

## Scenarios for Government disclosure

There are two scenarios for government disclosure:

- 1) **Denial** - probably expected in view of the political consequences of disclosure.
- 2) **Disclosure** - with the opportunity to establish hazardous locations, environmental and epidemiological implications.

I hope that media concern and parliamentary questions will get some disclosure of the suspected use of DU in Afghanistan. But it would seem appropriate for Aid organisations to approach the Government (Foreign Office or Ministry of Defence) for facts and advice e.g. areas to avoid, as eventually happened in the Balkans war.

In the meantime I offer this information as a factor that your HR and Occupational Health advisers may wish to check. It may be prudent to put medical staff on alert for possible DU-related symptoms and in some way to alert field personnel to report unexpected health problems in recent bombing locations. I appreciate the need to avoid undue anxiety beyond the obvious hazards they already face.

Please contact me if you would like copies of the two earlier reports that contain further sources that led to these concerns. You are welcome to copy, forward or refer this message and attachments as you think appropriate.

yours sincerely

Dai Williams, Chartered Occupational Psychologist  
Woking, Surrey UK

---

*Layout edited and corrected from original Email message*



End of section & notes

## Mystery metal bombs may cause Afghan war syndrome

Media release 15 November 2001, Dai Williams

The rapid retreat of the Taliban may be partly due to a **mystery metal** used in new "hard target" weapons in the Afghan bombing campaign. It has been kept secret by the US and UK governments since 1997 but latest analysis of Afghan war reports and military information websites indicate that it is probably **Depleted Uranium (DU)**.

If DU has been used then UK troops, aid-workers and media teams in former Taliban locations may be entering toxic disaster areas. Without immediate environmental monitoring they risk the same health hazards suffered by Gulf War veterans and Iraqi civilians - an **Afghan War syndrome**. So what is the mystery metal? The UK Government was asked this question three weeks ago but has not answered it.

### Hard target weapons

The new generation of "hard target" smart bombs and cruise missiles can penetrate 10 feet of reinforced concrete before exploding. They were used to attack Taliban bunkers, caves, command centres, fuel and ammunition stores. They use "dense metal" warheads to double their penetrating power on hard targets.

The 2 ton GBU-37 Bunker Busters and 2000 lb GBU-24 Paveway smart bombs, plus the Boeing AGM-86D, Maverick AGM-65G and AGM-145C hard target capability cruise missiles all use "advanced unitary penetrators" (AUP-113, AUP-116, P31) or BROACH warheads with the mystery high density metal in alloy casings.

### Uranium or Tungsten?

The mystery metal must be hard and at least 2x as heavy as steel. Tungsten and Depleted Uranium (DU) are the main options. Both are used by US and UK forces for armour piercing shells. DU is preferred because it burns inside the target to become an incendiary bomb and is far cheaper and easier to manufacture.

### Uranium hazards and Dirty DU

DU (U238) is reprocessed nuclear waste. It burns in military targets and plane crashes to produce Uranium oxides as a fine, toxic, alpha-radioactive dust. The "Dirty DU" found in Balkans War target sites was contaminated with variable traces of U235 plus U236 and Plutonium from reactors. It presents a perpetual health hazard similar to asbestos - especially in the lungs. The UNEP report of DU used in the Balkans War played down its risks. They did not inspect bomb or missile targets.

Uranium oxide dust is a suspected cause of **Gulf War syndrome** and the epidemic of cancers and birth defects in Iraq since the Gulf War where 300 tons of DU were used. UK EOD (bomb disposal) teams in the Balkans were instructed to use full radiation protection (NBC) equipment when inspecting DU targets (Hansard).

### 50-100 times greater hazard than in the Balkans

Reports from the Center for Defence Information in Washington indicate that several hundred tons of smart bombs and cruise missiles have been used in the Afghan bombing including many of the hard-target weapons above.

The mystery metal is 50-75% of the weight of the bombs - up to 1.5 tons in the GBU-37 Bunker Buster bombs. If this is DU then target zones will be 50-100x more contaminated than by the pencil-sized 30 mm (0.27 kg) anti-tank shells used in the Balkans War, and more like the DU ammunition fire in the Gulf War. DU oxide is known to travel up to 25 miles by wind so large areas may be affected by each bomb.

### Government in denial about DU?

The UK Government is aware of the problem. They were asked to identify the mystery metal in hard target guided weapons by DU researcher Dai Williams via his MP on 17th October and direct to the Prime Minister on 1<sup>st</sup> November. No answers have been received.

On 24 October Defence Minister Geoff Hoon told Parliament that "we do not rule out the use of depleted uranium ammunition in Afghanistan, should its penetrative capability be judged necessary in the future" (Hansard). He denied that DU has been used, at least by UK forces, on 1<sup>st</sup> and 5<sup>th</sup> November. Can he speak for US forces?

Hard target bombs and missiles have been used extensively in Afghanistan since 7th October. Until the mystery metal involved is identified and independently verified Mr Hoon's denials are not convincing. He is responsible for military, not humanitarian policies. After the bombing political responsibility for the truth is shared by the Cabinet.

### Political responsibility: minimising a potential health disaster

This question is an immediate occupational and public health issue for the 4000 UK troops plus aid and media teams about to enter Afghanistan, for those already there and for the civilian population. The first warning was a dying child who led a Taliban doctor to suspect that US forces were using radioactive or chemical weapons (Reuters, 28 October). Many Taliban troops near bombing targets will already be affected if DU has been used. This may be one reason for their rapid retreat.

The US and UK Governments have an immediate political responsibility to disclose the mystery metal used in the Afghan bombing. If DU has been used this will become obvious soon from medical reports. Precautionary action is essential now to minimise a potential health disaster. There is no cure for inhaling DU dust.

In 1999 the UK media questioned the use of DU in the Balkans so troops and aid teams were alert to its potential hazards. They have had copies of this analysis for two weeks but have stayed silent about the mystery metal question in Afghanistan.

In the USA a Bill submitted to the US Congress on 18 October has called for a total ban on DU and facts about its use in Afghanistan. Veteran and environmental groups are waiting for the US Department of Defence's reply.

The Red Cross and Oxfam have been alerted to these potential risks. International aid organisations and allied forces would be wise to assume that the mystery metal is depleted Uranium until there is firm evidence otherwise. DU precautions apply as after the Balkans war (e.g. bottled water) plus avoiding bombed Taliban locations.

---

Full analysis and sources available from Dai Williams on 01483-222017 or by Email to [eosuk@btinternet.com](mailto:eosuk@btinternet.com) . Internet links include:

- **Jane's** report on Air and Missile strikes in the Afghan war  
[http://www.janes.com/security/international\\_security/news/jdw/jdw011007\\_1\\_n.shtml](http://www.janes.com/security/international_security/news/jdw/jdw011007_1_n.shtml)
  - **FAS** (Federation of American Scientists) smart bomb and cruise missile specifications:  
<http://www.fas.org/man/index.html>
  - **CDI** (Center for Defense Information, Washington) Terrorism Project Action Update:  
<http://www.cdi.org/terrorism/actionupdate.cfm>
-

## **Bombing Afghan Water supplies**

Extract from New Scientist and copy of message to DU researchers on 21 Nov 2001

### **Dying of thirst**

**New Scientist** 17 Nov 2001, page 7

by Fred Pearce

#### **The plight of Afghans will get even worse if water-supply tunnels are targeted with bunker-busting bombs**

"The US bombing raids on Afghanistan could dramatically increase water shortages in this drought-stricken country.

Military authorities are increasingly talking of introducing a new phase to the bombing campaign, using "bunker bombs" to flush out Osama bin Laden, his al-Qaeda group and Taliban fighters from hillside tunnels that riddle the landscape. These same ancient tunnels are a vital source of water for hundreds of villages.

And last month an American bombing raid damaged a hydroelectric power station close to the Kajaki dam, Afghanistan's largest. As well as supplying electricity to the region, the station drives machinery that controls the flow of water along the Helmand, the country's longest river. Concerns are now growing that the attack, or a repeat strike, may damage an irrigation system fed by the dam's reservoir. The system waters the fields that support some half a million people.

Afghanistan, which is in the third year of an unprecedented drought, relies on a mixture of ancient and modern water-supply systems. As well as relying on the Kajaki dam, the south of the country is peppered with hundreds of water-supply tunnels, often running for tens of kilometres into hillsides to tap water reserves deep underground.

The tunnels, known in Pashto as *karez*, are now a target for American warplanes. Military strategists claim that bin Laden and Taliban troops may now be hiding out in the *karez*, many of which are wide enough to accommodate companies of men. They say the *karez* made impenetrable hideouts for the mujahedin during their guerrilla war with Soviet occupiers in the 1980s.

Most of the *karez* are identifiable from the air by the access wells set at regular intervals above them. But a concerted blitz on these tunnels - possibly using the US's much-touted "bunker-buster" bombs - would cause immense harm to rural communities that increasingly rely on them for water supplies.

Often abandoned in favour of more modern water-supply systems, *karez* have become a vital resource as shallower water sources have dried up. Earlier this year the aid organisation Islamic Relief encouraged locals to renovate 75 *karez* in the drought-parched Helmand province in southern Afghanistan, by offering food aid in return for work in the tunnels. Some *karez* were also rejuvenated in Kajaki province, close to the dam hit by the US."

Full article is in the DU Archive at <http://www.newscientist.com> . Archive access requires a subscription - 7 days free subscription available through the site.

**Message sent to DU researchers re New Scientist article,** 21 November 2001

This (article) may explain why bombing continues after most of the Taliban have retreated.

Fred Pearce's report adds urgency to my question to the US and UK governments - What is the dense metal that the GBU-37 bunker buster bombs (and other hard target guided weapons e.g. GBU-24, AGM-86D etc) rely on for their penetration effect?

If water supply tunnels are bombed with DU weapons (1.9 ton dense metal penetrator per GBU 37) they may perpetually poison these water supplies. If they intend to send troops into these underground tunnels to flush out Taliban or Al Queda troops after using DU weapons they will need to operate in full NBC equipment if they are not to risk severe uranium oxide contamination.

This also means that water supplies in the affected regions could be extremely hazardous to the aid teams and troops that the US, UK and other Governments are planning to send to Afghanistan. The DU question must be put to all Governments and aid organisations involved and preferably to the UN. Water pollution monitoring seems an immediate precaution.

Dai Williams

Note: The analysis **DU in the Afghan War** was sent to New Scientist in reply to this article on 21 November, received without comment. A number of New Scientist archive reports about Depleted Uranium were temporarily unavailable for Internet search soon after this article was published but were available again recently.

-----

## Part 2

### UK Government: DU questions, answers and denials re suspected use in guided weapons and the Afghan War

	Page
1. <b>Letter to Sir Paul Beresford MP</b> , 16 October 2001 requesting information from the UK Government after first reports of Bunker Buster bombing in Afghanistan.	46
2. <b>Letter to the Prime Minister</b> before the House of Commons debate about bombing in the Afghan War, 1 <sup>st</sup> November 2001.	49
3. <b>Reply from Dr. Moonie</b> , Under Secretary of Defence responsible for depleted uranium questions and veterans affairs, to Sir Paul Beresford, 19 November 2001. Plus <b>analysis of his reply</b>	52
4. <b>Recent extracts from Hansard* (1)</b> regarding use of DU weapons and Government replies - September 11th - November 11th, 2001. * (Hansard is the official record of proceedings in the UK Parliament)	59
5. <b>Analysis of previous DU questions in the UK Parliament</b> (pre-Sept 2001) - denials and evasive answers re DU. <b>New questions</b> for Government re suspected use of DU in guided weapons, in Afghanistan and re DU contamination ' <b>dirty DU</b> '. Message to other DU researchers on 13 November 2001.	61
6. <b>Latest extracts from Hansard (2)</b> - 12 <sup>th</sup> November to 31 <sup>st</sup> January 2002. These include several questions from MP's seeking clarification on questions in (5) as circulated on the Internet.	65

**1. Letter to Sir Paul Beresford MP**, 16 October 2001 requesting information from the UK Government after first reports of Bunker Buster bombing in Afghanistan.

---

Sir Paul Beresford MP  
House of Commons  
Westminster  
LONDON SW1A 0AA

16 October 2001

Dear Sir Paul

**Information request:  
Use of Depleted Uranium in Guided Weapons in Afghanistan**

I watch events in Afghanistan with grave concern. I would appreciate your help on one issue that has received no public discussion - the probable use of Depleted Uranium in guided weapons systems in the current conflict.

This possibility is of considerable importance to the welfare of UK and other ground troops expected to follow through in ground operations in the immediate future, as it was for KFOR troops entering Kosovo after the Balkans War. It is of obvious concern to civilians in target areas and to the personnel of aid organisations already operating in the region, or likely to go there as soon as hostilities cease.

**I ask your help to ascertain exactly what the "dense metal" (or combination of metals) is that is used in most guided weapons systems with hard target penetration capabilities.** There are two main possibilities: Depleted Uranium or Tungsten, both with densities approximately 1.7 times greater than lead.

"Dense metal" is used because these weapons rely on kinetic energy for their effectiveness. However I am unable to find any public source of information to identify the materials used. The weapons concerned are in use by both the US and UK armed forces.

Some of these munitions have been developed or manufactured by British Aerospace Royal Ordnance. I therefore consider it reasonable the UK public to ask what materials are used, where they have been tested and where they have been used in combat.

**Context**

I have researched the use of Depleted Uranium in weapons systems since the start of the Balkans War. This is a personal interest as a humanitarian concern, perhaps heightened by my awareness of toxicological hazards from my past work in the oil industry. I helped to introduce an occupational health monitoring scheme in Shell Canada in 1982-3. As an Occupational Psychologist I have an ongoing interest in Occupational Health.

*/continued ...*



Depleted Uranium (DU) is known to be used by US, UK and several other countries mainly in armour piercing munitions e.g. 30 mm anti-tank shells and larger tank shells.

## Use of DU in guided weapons

The use of DU in guided weapons systems e.g. cruise missiles and smart bombs was questioned by the media during the Balkans War but official sources denied that they had been used except in field trials of cruise missiles as a substitute for nuclear warheads. At the time this explanation was accepted by DU researchers and the media.

However, on **Jane's Defence** website (the world's leading authority on global weapons systems) the following quote is given in their section on Depleted Uranium - FAQ's:

**"It is true that some guided weapons use depleted uranium to increase their penetration effect".** See attached web page.

In January this year I came across the following report on the FAS (Federation of American Scientists) website:

**High penetration weapon system concepts / plans** [Air Force Mission Area Plan (MAP)] ANNEX F Common Solution/Concept List (U) [as of 11 July 1997 - Rev 10]

This appeared to be a procurement list for development of new guided weapons systems. It has been in the public domain on the Internet for some time.

The common theme to at least 9 weapons systems - smart bombs and cruise missiles - is the use of "**dense metal**" penetrators or ballast. See attached **report "Tip of the Iceberg"** that I compiled from the website.

Some of the systems described have been manufactured and used in combat e.g. the Boeing AGM 86C cruise missile. British Aerospace developed the Broach warhead for this system in 1998 and it was used in competitive trials in 1998-99, though the final contract was won by Lockheed Martin's Advanced Unitary Penetrator in Dec 99. Boeing's website says that this missile was used in Desert Fox and the Balkans War. It seems very likely that prototype versions of the AGM 86D (hard target penetration version) were field tested in both conflicts.

How many of the 9 systems listed went into production or combat use? I do not know but it is evident is that "dense metal" penetrators are an integral part, in fact the prime component, of a whole generation of cruise missiles and smart bombs.

The GBU-28 "Bunker buster" bombs used last week in Afghanistan are another high penetration, smart bomb weapons system. Their penetrator weighs 4400 lbs. If this is made of, or includes Depleted Uranium it would generate a substantial quantity of DU oxide dust that would disperse over a wide area, contaminating soil and water supplies.

/continued ...

According to Janes the exact material specification for metal penetrators is often not published by manufacturers. They know it to be used in some anti-tank missile systems (e.g. the TOW system). "In some cases Copper and Depleted Uranium have been used interchangeably. Even the military are not always aware which metals have been used".

Janes are not aware of DU use in hard target systems but say they use hardened steel casings for structural strength. In view of the variable use of the terms "penetrator" and "ballast" in weapons descriptions it seems very likely that these contain DU as dense metal ballast to increase their kinetic effect, together with its incendiary effect on detonation.

### **Request for full disclosure of DU use**

In view of the potentially adverse health and environmental effects of Depleted Uranium I would ask that it seems important that the UK and US Governments should investigate and disclose all weapons systems that contain Depleted Uranium.

This is a matter for immediate concern in Afghanistan. It also raises serious questions about the extent to which DU was used in the Balkans war, in addition to the 10 tonnes of 30 mm anti-tank shells declared by the US Government, and where.

As my local MP I would be grateful if your could seek clarification from the Government on these questions.

Yours sincerely

Dai Williams

**2. Letter to the Prime Minister** before the House of Commons debate about bombing in the Afghan War on 1<sup>st</sup> November 2001.

---

The Rt. Hon Tony Blair MP  
10 Downing Street  
LONDON SW1A 2AA

1 November 2001

FAX MESSAGE

Dear Prime Minister

**Use of Depleted Uranium in the Afghan War:  
Potential hazards to civilians and ground forces**

I respect the moral support you have given to the people and government of the USA following their tragedies on September 11<sup>th</sup> and the remarkable energy you are putting into international diplomacy at this time.

I do not doubt your sincerity but I was saddened by your decision to support the USA in large scale military action in Afghanistan. I wrote to you on 9<sup>th</sup> March regarding priorities for "stabilising crises in the UK, Middle East and potentially the USA ... through the next 6 months" based on psychological forecasts in my Power or Peace study. The downside-risk scenarios of international terrorism and war in the forecasts have occurred creating new hazards and opportunities.

**Is Deleted Uranium being used in guided weapons systems?**

This letter concerns the current bombing campaign from an occupational and public health perspective. My researches indicate a high probability that most of the smart bombs and cruise missile systems with "hard target capability" being used by US and possibly UK forces may contain Depleted Uranium.

The basis for this suspicion is given in my attached study ***Depleted Uranium in the Afghan War*** completed on Tuesday, updating researches earlier this year. I asked my MP Sir Paul Beresford to raise these concerns with the Ministers involved on 16 October so some staff in the MoD or No.10 may already be aware of them. I wonder if you have been told?

In the last week I have made further searches and discovered several upgraded guided weapons systems that are most likely to be based on DU penetrators. These include the GBU 37, GBU-24 and GBU-32 smart bombs and AGM 86D and Tactical Tomahawk Penetration Variant cruise missiles. These match several procurement specifications published in 1997 using "dense metal" penetrators, ballast or shaped charge warheads e.g. AUP-113, AUP-116, P31 and UK developed BROACH / MWS variants.

I have also studied reports of the munitions used in the first 3 weeks of the Afghan bombing and correlated these with earlier data. The attached report sharpens the concerns sent to my MP. I think it requires a Government statement.

/continued ..

## Implications for the current bombing campaign

I do not have precise details of how many smart bombs and cruise missiles with hard target capability have been used. Over 1000 tons of munitions have been used to date (basis CDI and other reports). If only a third of these were based on Depleted Uranium enhanced penetrators then the total tonnage of DU used already could be match the total in the Gulf War.

A new issue is that these munitions (from 1000 - 4000 lbs. each) may contain far larger quantities of DU per target location (50-100x more) than in previous campaigns using 30 mm anti-tank shells. Potential contamination for humans in target zones may be far higher and hence potential toxic and radiological effects may be faster and more severe.

These implications for UK special forces, follow-up forces, local communities and other civilians including international aid and media workers are far more immediate and serious than those in the Balkans War.

## Immediate conclusions

In this situation I draw several immediate conclusions:

1. You will need full disclosure of the "dense metals" used in all hard target guided munitions from the MoD and DoD.
2. If these metals include Depleted Uranium you will need:
  - a) an **immediate environmental impact and health hazard assessment** of all hard target munitions target zones in Afghanistan. This will need on-the-ground as well as theoretical assessment.
  - b) to decide whether or not to call for **immediate cessation to the use of all DU munitions** in Afghanistan until their effects have been fully assessed. This to include any prototypes being evaluated in combat.
  - c) to ensure that all **ground forces** expected to enter DU target zones are fully equipped and subject to frequent occupational health monitoring.
  - d) to decide **what precautions are needed to protect civilians** in target zones e.g. immediate evacuation, with potential refugee considerations.
  - e) to decide **what specialist decontamination and medical support is needed for civilians** already exposed in DU target zones.
  - f) to assess the **likely wider spread of DU contamination throughout Afghanistan** subject to prevailing wind and weather conditions such as dust storms. The spread and persistence of contamination in Southern Iraq gives some indication of the scale of this hazard.
  - g) to **re-assess the military and political objectives of the Afghan war** in the light of potentially widespread DU contamination and the re-location of civilian populations this may involve.

*/continued ..*

## International political implications

If DU has been used in considerable quantities in Afghanistan this is likely to have significant humanitarian and political implications.

The use of cluster bombs and the effects of collateral damage to civilian communities are morally abhorrent to many people. Fighting terror with terror seems to me a tragic error of judgement, though not surprising in view of the severe trauma and stresses on yourself, President Bush and your respective administrations.

If it transpires that DU has been used on a similar scale to the Gulf War the potential long-term public health disaster that may follow is appalling. It could involve many thousands of innocent victims directly through cancer and other disorders and indirectly through birth defects as seems the case in Iraq. These victims may include UK troops and civilians as well - as happened after the Gulf War.

Your advisers may recommend trying to cover up the suspected use of DU in hard target guided weapons systems in Afghanistan. But if it has been used this will only delay the possibility of limiting health hazards to troops and civilians.

What's done is done. I hope that DU has not been used in any operations in Afghanistan. If I am correct however, this raises serious occupational health issues for UK forces and civilians involved. Its potential repercussions for the health of civilian communities would invalidate any moral basis for the current military response to international terrorism.

I respect your real concerns about the threat of international terrorism. However I ask you to develop Plan B. Psychologically this alternative could be more effective based on the principles of peace and justice with aid and poverty reduction\*. This would stabilise communities in crisis whilst marginalising the terrorist elements they currently tolerate. Military force must be a last resort, best used for peacekeeping, detecting and apprehending suspect terrorists as in Northern Ireland and the Balkans.

Yours sincerely

Dai Williams, M.Sc C.Psychol

attached in same fax:

***Depleted Uranium in the Afghan War, 30 October 2001 (see Part 1)***

### 3. UK Government denials

19 November 2001

#### **Reply from Dr Moonie to Sir Paul Beresford, regarding use of DU weapons in Afghanistan and the 'dense metal' in guided weapons.**

---

From: **Dr Lewis Moonie MP**,  
Under Secretary of State for Defence and Minister for Veterans Affairs,  
Ministry of Defence, London

To: **Sir Paul Beresford MP**

Thank you for your letter of 24 October to Adam Ingram enclosing correspondence from Mr Dai Williams of 32 Send Road, Send, Woking about the use of depleted uranium (DU) in munitions used in the conflict in Afghanistan. I am replying as this matter falls within my responsibility.

First and foremost, let me make it clear that to date no DU-based munitions have been used in the current operations in Afghanistan. Further, we are not aware of any plans for them to be used. However, that does not rule out the use of DU munitions.

Two types of DU-based munitions are available to British Forces, a 120 mm anti-tank round and 20 mm round used by some Royal Navy ships. DU-based anti-tank ammunition was brought into service by the Ministry of Defence for use against the most modern types of main battle tank armour because of its unique capability as a kinetic (or moving) penetrator. At present, no satisfactory alternative material exists to achieve the level of penetration needed to defeat the most modern battle tanks, although research is continuing into more effective alternatives. The use of DU-based ammunition remains an important option in military operations conducted by the UK armed forces. If the safety of British troops in any operation were to require such a capability against Main Battle Armour, DU-based ammunition would be deployed and used. The Phalanx DU round is currently being replaced by a superior tungsten variety and DU stocks will be exhausted by 2004.

In his letter, Mr Williams provides a summary of information extracted from the Internet containing details on guided bombs and asks for information concerning the use of the term "dense metal". The Ministry of Defence cannot confirm the specific composition of these types of munitions. However, there is a range of heavy metals that could be considered under that term including hardened steel and titanium. However, one heavy metal most associated with that term is, as Mr Williams mentions, tungsten, which is available in a number of varieties - the most common being tungsten heavy alloy. These types of metal are used in order to maintain the ground (or concrete) penetration capability of the munition, an option not suited to the softer DU metal. Therefore, DU would not be expected to be used for this capability. There are suggestions that DU might be used in small quantities to act as ballast in some munitions, however, we are unable to confirm whether or not this is the case at this time.

*/continued ...*

Whether DU is used in munitions for the United States forces is a matter for the US Government. However, the legality of weapons is assessed by reference to international treaties and principles of International Humanitarian Law. Weapons containing DU are not banned by a specific international treaty. Further, it is considered that weapons containing DU are not "of a nature to cause superfluous injury or unnecessary suffering" within the meaning of Article 35 of the first Protocol additional to the Geneva Conventions of 1949. Neither are they considered illegal by virtue of Article 55 of the same Protocol which prohibits the use of weapons that are intended or may be expected to cause "widespread, long term and severe damage" to the natural environment. The use of all weapons in armed conflict is subject to legal restrictions on the circumstances in which they are deployed.

DU is not a new issue: DU-based ammunition has been around in the UK since the early 1980's, and the risks (minimal as they are) have been acknowledged and handled throughout that period. There are two potential hazards arising from the use of DU: a low level radiation hazard, (DU's level of radioactivity is lower than most man-made radionuclides, such as the americium used in domestic smoke detectors); and a chemical toxicity hazard, similar to that posed by other heavy metals such as lead. So far there is no scientific or medical evidence linking DU with the ill health of Gulf veterans or with ill health in Balkan peacekeepers, although we continue to remain open minded.

Many independent reports have been produced that consider the battlefield effects of using DU munitions. These include work by the US RAND Corporation, the US Agency for Toxic Substances and Disease Registry, the US Institute of Medicine, the Royal Society, the European Commission, the United Nations Environment Programme and the World Health Organisation. (Assessments on the environment and personnel were also undertaken by a number of nations contributing troops to Kosovo). None have found a connection between DU exposure and leukaemia or other illnesses, and none have found widespread DU contamination sufficient to impact the health of the general population or deployed personnel.

Dr Lewis Moonie MP

---

### **Analysis of Dr Moonie's reply** (re Dai Williams questions)

There are several curious inconsistencies and errors of fact in Dr Moonie's reply:

#### **a) Unsound denial**

How can Dr Moonie be confident that DU weapons have not been used in Afghanistan if the Ministry of Defence "cannot confirm the specific composition of these types of munitions"? This either means they don't know or are unwilling to tell Sir Paul Beresford, a member of the UK Parliament.

#### **b) Complacency**

How can the UK Government protect the health and safety of UK troops and civilians in Afghanistan if they take the view that "Whether DU is used in munitions for the United States forces is a matter for the US Government"?

### c) Errors of fact re dense metals

We are told that the Ministry of Defence is "unable to confirm" the nature of the "dense metal" in hard target guided weapons. But Dr Moonie then states that "there is a range of heavy metals that could be considered under that term including **hardened steel** and **titanium**." These are not high-density metals.

The increased penetration effectiveness of these new weapons (double that of previous versions) relies on the basic physics that they must be at least 2x the density of previous hardened steel warheads of the same total weight.

Uranium 238 is 2.1 times heavier than Nickel or Cobalt and 2.4 times heavier than Iron. These are the main components of the alloy outer casing (Air Force 1410) of the AUP-116 advanced penetrator used in the GBU-24 guided bomb. U238 is 4.2 times heavier than Titanium. The density of U238 is approximately 19.0 compared to 19.25 for Tungsten. Military DU alloy (U-0.75Ti) is 18.6.

Is Dr Moonie, or whoever wrote the letter for him, unaware of the design principles for the new generation of hard target weapons used by US forces in Afghanistan, purchased by the UK Government, and manufactured by BAE-Royal Ordnance? If so how can they make reliable judgements and statements about the potential use and hazards of Depleted Uranium weapons in the war?

The MoD must know the facts about its weapons and materials. Does this data represent the briefings that Dr Moonie and Geoff Hoon have been given? Has the MoD misled Ministers of Defence Geoff Hoon and Dr. Moonie?

Or is the MoD and the UK Government represented by Dr Moonie well aware of the facts? If so why have they deliberately mislead Sir Paul Beresford MP in replying to my questions? Misleading or deceiving a Member of Parliament indicates that the MoD and UK Government are unwilling to tell the truth about DU to MPs and the public. Why such secrecy about this metal?

Since Tungsten and DU are the only practical options for the dense metal in question this deception suggests that DU **is** the dense metal concerned.

### d) Errors of fact re the hardness of DU

Another error of fact is the statement that "These types of metal are used in order to maintain the ground (or concrete) penetration capability of the munition, an option not suited to the **softer** DU metal."

Even basic Uranium 238 is a **hard** metal, the second hardest common metal to Tungsten apart from rare metals like Osmium. It is 2 times harder than Titanium and 3 times harder than Iron, depending on the type of hardness being tested. These are Vickers hardness figures. The hardness and strength of military grade DU is increased in various alloys e.g. with 0.75% of Titanium for maximum hardness in anti-tank penetrators. DU is also alloyed with Molybdenum or Niobium. The harness, strength and ductility of DU alloys are controlled by special manufacturing processes e.g. heat treatment or forging. DU alloy is used for anti-tank penetrators and for armour plating in tanks because of its hardness.

A Jane's representative also told me that DU was too "soft" for hard target missiles. Perhaps this is a standard mis-information briefing given to the arms industry to discourage questions about the use of DU in hard target weapons systems. From Dr Moonie's reply it may be part of the briefing for politicians who don't know about, or have to deny the use of DU in new hard target warheads.



**e) Errors of fact about quantities of DU ballast**

Another error of fact in Dr Moonie's reply is in this statement: "There are suggestions that DU might be used in small quantities to act as ballast in some munitions, however, we are unable to confirm whether or not this is the case at this time."

The term "ballast" is vague. But it is used several times in the project specification for hard target weapon upgrades in the US **Air Force Mission Area Plan (MAP) ANNEX F Common Solution/Concept List**, 11 July 1997 quoted in Tip of the Iceberg (see pages 15-20). For example in:

**WPNS114 -- 1000 lb Dense or Ballasted Penetrator in GBU-32**

This concept is a 1000 pound dense or ballasted penetrator integrated with a GBU-32 guidance kit using compressed carriage for internal carriage in advanced fighters (F-22, JSF) or carriage in cruise missiles (JASSM, CALCM, ACM, ATACMS, Tomahawk.) The warhead would either be designed with a dense metal case or contain dense metal ballast for maximum penetration.

The dense metal ballast or casing in new warheads has to be 50-70% of their mass to increase their overall density. In warheads weighing up to 2 tons in the GBU-28 Bunker Buster this is not a "small" quantity.

Ballast may also refer to the casing involved in shaped charge warheads see Part 3, page 79. Smaller quantities than in the guided bombs, but still much potentially a much larger DU load than 5 kg anti-tank penetrators.

As with factual errors about the density and hardness of the "mystery metal" involved this statement suggests ignorance of the technology or a deliberate attempt to mislead Sir Paul Beresford by understating the significance of DU or whatever the mystery metal is in guided weapons used in Afghanistan.

**f) Acknowledgement that DU might be used**

Dr Moonie's acknowledgement that there "are suggestions that DU might be used" contradicts his first statement - "let me make it clear that to date no DU-based munitions have been used in the current operations in Afghanistan."

How can he make that assertion if he is aware of suggestions that it might be used even in small quantities? Geoff Hoon has also firmly denied the use of DU in Afghanistan - once in the House of Commons and several times in written answers recorded in Hansard (see following Hansard reports).

It is almost certain that DU armour piercing munitions have been used in ground support operations in Afghanistan by the **AC-130U Spooky** gunship. DU armour piercing rounds are standard ammunition for the **25 mm GUA-12 cannon** on that aircraft and would be first choice in attacking light armoured targets in combat.

**g) Legality of DU as weapons of indiscriminate effect**

It is interesting that Dr Moonie wanted to emphasise that DU weapons are legal. If they have not been used this would not be an issue. "Weapons containing DU are not banned by a specific international treaty. Further, it is considered that weapons containing DU are not 'of a nature to cause superfluous injury or unnecessary suffering' within the meaning of Article 35 of the first Protocol additional to the Geneva Conventions of 1949."

But if DU is used in explosive warheads the resulting radioactive contamination by uranium oxides will cover large areas in ways that cannot be economically cleaned up. The US Government has abandoned plans to clean up DU on the Jefferson Proving Ground due to the estimated cost of \$7.8 billion. If DU weapons have been used to bomb underground aqueducts that supply drinking and irrigation water then the permanent radioactive and toxic contamination would be a clear demonstration that DU warheads are weapons of indiscriminate effect. (see New Scientist report in Part 1).

Dr Moonie's denials suggest that the Government and MoD are already assessing the risk of international legal action against governments using DU weapons. This is likely to follow if widespread use of large DU guided weapons is proved in Afghanistan and in areas of Iraq and the Balkans.

#### **h) Obsolete basis for assessing health risks?**

Dr Moonie's re-assures Sir Paul about the potential health hazards of DU-based ammunition "minimal as they are". But he acknowledges "the two potential hazards arising from the use of DU: a low level radiation hazard, and a chemical toxicity hazard, similar to that posed by other heavy metals such as lead." Like lead the most hazardous toxic form of Uranium is its oxide dust.

Dr Moonie's comments imply doubts about the safety of DU: "So far there is no scientific or medical evidence linking DU with the ill health of Gulf veterans or with ill health in Balkan peacekeepers, although we continue to remain open minded."

He says that "many independent reports have been produced that consider the battlefield effects of using DU munitions. None have found a connection between DU exposure and leukaemia or other illnesses, and none have found widespread DU contamination sufficient to impact the health of the general population or deployed personnel". Dan Fahey's report [Don't Look, Don't Find](#) explains why.

Several of these reports are not actual medical studies but literature searches. Very little systematic medical research has been done on Gulf veterans. See Professor Malcolm Hooper's analysis of the UK Royal Society report at: <http://cadu.members.gn.apc.org/malchooprs.htm> ). The only extensive observations of DU effects on civilians are by doctors in Iraq. Dr Moonie, a Community Health Physician, seems unaware of their grave concerns. An Inquiry into the effects of DU weapons in Iraq was voted down by the United Nations, opposed by the US Government with UK Government support.

Most medical studies have been impaired by long delays before medical assessments of personnel at risk or with DU-related illnesses. Studies of KFOR troops were conducted 18 months after the Balkans War. As at October 2001 the MoD had not started to assess DU levels for UK troops assigned to the Balkans. UK studies of health effects on troops at land-to-sea DU training grounds are not relevant to hazards for humans in DU target locations.

The UNEP study was severely limited in several ways: it was delayed for over a year by the US Government refusing to disclose DU target locations. They only sampled 11 of 112 reported DU target sites. The sites had been visited (and cleaned?) by up to 10 military survey teams before UNEP was allowed access to them (refer US DoD Information Paper, October 2001, [TAB C](#) , page 99). UNEP did not sample target vehicles, or bomb or cruise missile target locations. The final

report was edited to remove references to "DU hot spots" identified in the survey data. See Dr Chris Busby's review at <http://www.llrc.org/du/subtopic/unept.htm>

Most official studies of DU exposure and medical effects had severe limitations even before suspicions of DU use in large warheads. DU exposure assumptions in all previous studies may be invalidated if DU has been used in large hard target guided weapons, in locations that have not been tested.

## Conclusions

Dr Moonie's reply is a useful indication of the UK Government's level of awareness about suspected DU in hard target guided weapons. It gives no convincing evidence to deny the suspected use of DU weapons in Afghanistan. Its errors of fact and reliance on reports that have multiple flaws only increase suspicion that DU is used in these weapons and has been used in Afghanistan.

The errors of fact are so blatant that they suggest deception, not incompetence. Either the MoD has deceived Dr Moonie or Dr Moonie was trying to deceive Sir Paul. Overall they suggest a four level justification of DU use in Afghanistan: 1) direct denial, 2) if DU has been used then only very small quantities are involved, 3) if DU has been used it is legal and 4) DU only represents minimal health hazards anyway.

These conclusions have **potentially serious implications for UK and other nations' troops and civilian personnel** already in Afghanistan or soon to be posted there for peacekeeping and aid operations.

It remains to be seen whether the UK Government and MoD are taking any operational precautions on behalf of UK personnel in Afghanistan, or whether they have briefed troops and aid organisations to do so. On 5<sup>th</sup> November 2001 UK Minister of Defence Geoff Hoon promised Parliament that such warnings would be given if necessary (see page 60).

UK forces should have conducted their own NBC assessments in Afghanistan over the last 2 months so the **UK Government should know by now if DU weapons have been used in Afghanistan**. Like the US Government, they may have **gravely underestimated the likely health and environmental effects of using large DU warhead weapons** on the scale actually deployed in Afghanistan.

If DU has been widely used in Afghanistan this has serious legal, political and humanitarian implications. These include decisions about troop deployment and the repatriation of refugees. The mystery metal in hard target weapons has been kept secret for 5-10 years. But now it is being questioned denial is only a short-term option. If the MoD and Government have recognised serious DU contamination in Afghanistan they are probably trying to build a case to justify their previous denials.

## Government acknowledgement

Apart from Dr Moonie's reply two recent decisions give some hope that the UK Government is beginning to acknowledge these problems:

1. The delay in sending follow-up forces to Afghanistan - giving time for airborne DU dust to settle and for winter conditions to consolidate it for a few months.
2. It may be significant that the Government have announced they will withdraw UK forces after 3 months i.e. as climatic conditions - thaw and wind - increase the risk of redistributing widespread DU oxide contamination. These are calculated risks.

The welfare of the Afghan population and other nationals is not Dr Moonie's concern. These aspects of suspected DU use in Afghanistan need to be pursued by other Government departments particularly the Foreign Office and Ministry for International Development - if they can get reliable information from the Ministry of Defence.

#### **Need for international co-operation on DU in Afghanistan**

International co-operation is needed to assess potential effects of DU weapons in Afghanistan and neighbouring states. The most optimistic scenario is that DU has not been used at all, or only in local AC-130 strikes. This can only be established if the US Government discloses the materials used in all guided weapons warheads, which use DU, how much is involved per weapon, how many have been used in Afghanistan and where. Such disclosure is not expected.

#### **Key issues for international co-operation include:**

- a) It is important to ensure that the UNEP PCAU (Post Conflict Assessment Unit) is allowed to operate quickly, with maximum international support and rigorous safeguards to ensure no political interference in the publication of their results.
- b) Other countries involved in staffing the Afghan peacekeeping force need to check whether their governments have been briefed on the risks of suspected DU contamination. Are they aware? If so what procedures have been adopted for briefing personnel (e.g. exempting pregnant women) and for DU health and environmental monitoring? If these subjects have been discussed why have they not been reported in the media?
- c) If DU contamination has been found what precautions are being taken to protect the civilian population and returning refugees? It is suspected that DU studies in Kosovo were delayed so that refugees could be repatriated at the first opportunity, regardless of the health hazards they might face. The health and welfare of refugees returning to potentially contaminated environments in Afghanistan may create a major ethical dilemma for the international community and aid organisations.

I understand that Dr Moonie is by profession a community health physician and that his current responsibilities include Depleted Uranium and Veterans affairs. In theory he should be the best informed and most rigorous advocate of the health and safety of past and present UK military personnel. He should be well aware of epidemiological methods and toxicological hazards. He should be someone that UK military personnel and Members of Parliament can trust implicitly for his professional judgement.

Sadly Dr Moonie's reply to my questions only increase my suspicions about the potential use of DU in undisclosed weapon systems, including those used extensively in Afghanistan. Whoever advised him about DU or hard target weapons or drafted his reply cannot be trusted by MPs, troops, veterans or the public. This must be a matter of serious concern to MPs, Gulf and Balkans War veterans exposed to DU, and to UK troops deployed in Afghanistan. If he has been deceived by Ministry of Defence advisers this will be a concern for Dr Moonie and the Government. Perhaps it should also be a matter of concern for the British Medical Association.

Dai Williams  
24 December 2001.

#### 4. Recent extracts from Hansard (1) - Sept 11 - Nov 11, 2001

**Internet search for recent questions and answers regarding Government statements and policy on military use of depleted uranium on November 11<sup>th</sup>.**

Hansard is the official transcript of UK Government proceedings. Source: **Online Hansard**. Use this link for references to DU, missile systems etc:

<http://www.parliament.the-stationery-office.co.uk/cgi-bin/empower?DB=ukparl>

---

#### Hansard spoken questions and answers in the House of Commons re DU since September 11th, 2001

##### 4 Oct 2001

**Mr. Robert N. Wareing** (Liverpool, West Derby): I speak from the left and this is my first opportunity to express publicly in the House my heartfelt sympathy with the American people, among whom I have personal friends, for the barbaric attack that took place on 11 September. It was probably the worst act of terrorism in world history and it deserves a very firm response from us all.

I am pleased that the Prime Minister and President Bush have embarked on attempts to develop diplomatic contacts with many different countries to combat terrorism. Economic and financial actions have been taken, and I happen to believe that we cannot exclude military action. However, I would support military action only on the condition that it is very carefully targeted. I do not want to return to the House in two or three weeks time and find that we are debating whether it was right for the international community, in taking military action, to have used **depleted uranium** or cluster bombs, as were so disgracefully used against the people of Yugoslavia.

---

##### 1 Nov 2001

**Mr. Elfyn Llwyd** (Meirionnydd Nant Conwy): The right hon. Gentleman mentioned armour-piercing ordnance. Can he tell us whether **depleted uranium** is now being used?

**Mr. Hoon**: It is not being used at present. As I said a moment ago, I shall return to the question of cluster bombs.

---

#### Hansard written questions and answers re DU since September 11<sup>th</sup> 2001

##### 24 Oct 2001

##### Afghanistan

**Mr. Chaytor**: To ask the Secretary of State for Defence if he will make a statement on the possible uses of **depleted uranium** in respect of British Forces' engagements in the conflict in Afghanistan. [8238]

**Mr. Hoon** [*holding answer 22 October 2001*]: No British forces currently engaged in operations around Afghanistan are armed with **depleted uranium** ammunition. However, we do not rule out the use of **depleted uranium** ammunition in Afghanistan, should its penetrative capability be judged necessary in the future.

---

**2 Nov 2001**

### Depleted Uranium

**Mr. Laws:** To ask the Secretary of State for Defence what use of **depleted uranium** has been authorised by his Department for use in the production of military equipment or materials of any kind within the United Kingdom; and if he will make a statement. [10630]

**Dr. Moonie:** The Ministry of Defence employs **depleted uranium** (DU) in three principal ways. It is used in ammunition for the weapons systems for the Challenger II tank and the Royal Navy's Phalanx close in weapon system. A DU-based round was also developed for use in the Challenger 1 tank for use in the Gulf conflict. C-130J/K Hercules and Tristar aircraft and some Wessex helicopters use DU as either a counterweight or as ballast. DU is used to shield radiological sources (such as nuclear reactors) and in nuclear medicine. In addition, small amounts of DU are used for defence research purposes, and some nuclear weapons also contain **uranium** in this form. *[Note: no reference to hard-target guided weapons systems].*

**5 Nov 2001**

### Afghanistan

**Pete Wishart:** To ask the Secretary of State for Defence what safeguards will be put in place to protect (a) UK and other military personnel and (b) civilians from hazardous residues from **depleted uranium** in the current conflict in Afghanistan. [12184]

**Mr. Hoon:** **Depleted uranium**-based ammunition has not been used in current operations in Afghanistan. We are not aware of any plans for it to be used in future.

In the event that **depleted uranium** ammunition were to be used in Afghanistan and that UK service personnel might come into contact with it, appropriate guidelines would be issued to ensure that the already low risks to health were minimised.

A great deal of information on **depleted uranium** has already been put into the public domain. Should the need arise, we would discuss with coalition partners and civil agencies what information needs to be made available to the Afghan civilian population. Regrettably, the activities of the Taliban authorities in restricting the flow of information into Afghanistan could make this unnecessarily difficult for UN and other agencies to achieve.

**7 Nov 2001**

### Afghanistan

**Valerie Davey:** To ask the Secretary of State for Defence if **depleted uranium** has been used by (a) US and (b) British forces in Afghanistan. [12694]

**Dr. Moonie:** I refer my hon. Friend to the answer given by my right hon. Friend the Secretary of State on 5 November 2001, *Official Report*, columns 27-28W, to the hon. Member for North Tayside (Pete Wishart).

## 5. Analysis of DU questions and answers in the UK Parliament

Message to other DU researchers on 13 Nov 2001.

This message analyses specific Hansard references to depleted uranium or missile systems since 1999. Other references to DU re the Balkans War and UNEP report are available in Hansard but not included here.

---

To date (13 Nov 01) I have had no reply from the UK Government to questions about suspected use of DU in guided weapons systems and in the Afghan War. However DU has been discussed quite frequently in Parliament earlier this year.

### 1. UK Government information about DU

I have searched the **Hansard** archives (at <http://www.parliament.uk/>) to check on Depleted Uranium (DU) and related references as they affect the UK Government, UK forces and weapons development and manufacture.

The results are interesting. At least 17 MPs have raised questions about DU in the last 3 years. Most detail is available in written questions and answers. They include DU safety precautions, awareness of Dirty DU issues and leads to UK weapons systems past present or future that are likely to include DU.

### 2. Examples of DU questions to Government in 2001

Hansard answers highlight how tightly framed questions to Government about DU must be to get a serious answer e.g.

**Question:** "How many DU shells were fired in Wales in each of the last 10 years?" - Hansard, 7 March 2001

**Answer:** "No depleted uranium rounds have been fired in Wales in the last 10 years".

It might have been better phrased as "How many weapons or warheads containing DU have been fired or tested in Wales in the last 10 years?" (e.g. the BROACH warhead).

and on 7 March 2001:

**Question** "How many weapons dropped by the RAF on Iraqi installations since the UK began patrolling the no-fly zone have had depleted uranium tips...?"

**Answer** "None of the weapons dropped by the RAF on Iraqi installations since the UK began patrolling the no-fly zone have had depleted uranium tips."

The question could have been: "How many weapons containing depleted uranium hard target penetrators have been used by British and US forces in their patrols of Iraq no-fly zones?"

"Tips" is not a technical term. In common use it just means the bit at the front which may be a discardable windshield, or outer casing using tungsten or other alloys. For example in the Maverick AGM-65G the "tip" is its guidance system. According to FAS the "heavyweight warhead" is contained in the centre section see <http://www.fas.org/man/dod-101/sys/smart/agm-65.htm>

/ continued ...

### 3. New questions to the UK Government

A range of much more specific questions are needed as follows:

-re weapons systems

1. What dense metals are used in the hard-target penetrators of the following guided weapons systems: GBU-24, GBU-32 (upgraded), GBU-37, AGM-86D, AGM-65G, AGM-154C, M220-TOW, Storm Shadow and Tactical Tomahawk Penetrator Version?
2. What dense metals are, or have been, used in the development, testing and operational use of BAE-RO BROACH MWS warhead systems? Where have they been tested in the UK and overseas?
3. How many of each of the munitions in (1) are in use, under development or on order for UK forces?
4. Do the dense metals in (1) and (2) include Depleted Uranium or alloys including DU and if so how much? If not then what dense metal do they use to achieve their increased kinetic energy effects?

And re the Afghan War

5. What and how many armour-piercing munitions containing DU penetrators have been used in the Afghanistan conflict to date?
6. How many of these weapons have been used in Afghanistan since 7th October 2001 including prototype versions of new systems under development for the UK and US Governments?
7. What is the total tonnage of DU munitions used to date in the Afghanistan war?
8. How many locations in Afghanistan have been attacked with hard-target guided weapons and where are they?
9. What warnings and precautions about DU hazards have been given to UK and other Allied forces troops (operating in Afghanistan)?
10. What warnings and precautions about DU hazards have been given to UK and international aid or media organisations (operating in Afghanistan)?
11. What environmental monitoring and DU clean-up operations are in place or planned in Afghanistan?
12. What warnings, precautions and specialist medical resources have been given to local civilians, communities, political and military organisations likely to be exposed to DU contamination in Afghanistan?

Hansard is an important UK source. These points may be useful for DU researchers and MP's Research Assistants.

*/continued ...*



#### 4. Contamination levels in DU supplied to the UK since 1990

I was specially interested the following question and answer about Dirty DU on 7 Feb 2001. Can DU researchers in the USA check DU contamination figures quoted for Starmet supplies to UK weapons manufacturers. Are these consistent with US Data? Did these figures apply at the time of the Gulf War?

**Question:** To ask the Secretary of State for Defence how much (a) plutonium and (b) other highly radioactive particles was contained in the **depleted uranium** shells fired by Britain during the Gulf War. [147379]

**Answer: Mr. Spellar:** Information obtained from **Starmet Corporation**, the firm who supply Royal Ordnance with the DU they use to make ammunition, tells us that each gram of DU contains:

	<i>Hansard entry: Grammes</i>	<i>Equivalents in a 1 ton warhead* &gt;&gt;</i>	<i>Kilograms per ton*</i>
Uranium-238	0.997 9		997.900
Uranium-235	0.001 99		1.990
Uranium-234	0.000 01		0.010
Uranium-236	0.000 003		0.003
Technecium-99	0.000 000 71		0.000 7
Neptunium-237	0.000 000 22		0.000 22
Plutonium-239/240	0.000 000 001 2		0.000 0012
Americium-243	0.000 000 001		0.000 001
Americium-241	0.000 000 000 017		0.000 000 17
Plutonium-238	0.000 000 000 005 2		0.000 000 052

Any significant increase in the quantity of highly radioactive particles would be detected by our routine radiation monitoring. DU used in the manufacture of the CHARM 1 round, used at the time of the Gulf conflict, came from the same source. " (end of Hansard quote)

Is this data accurate?

Dai Williams, UK

##### \* DW comments re Dirty DU data presentation and reliability

The Starmet data quoted for Hansard shows contamination per gram of DU. In large warheads it is more relevant to consider kg per ton e.g. "0.001 99" of **U235** per gram of DU (0.2%) adds up to **4 kilograms in a 2000 kg warhead e.g. if DU is used in the GBU-28 Bunker Buster**.

There is a wide variation in contamination levels between different samples (production batches) of DU. In a reply to these questions Dr Sharma quoted a sample with 0.003% of **U236**, 10 times more than the 0.0003% declared by Starmet in the Hansard quote above - 60 grams not 6 in a 2000 kg warhead. Also U236 produces 195x more Alpha counts per gram than U238. So radiation output is more relevant than weight.

**There needs to be an international database of isotopic mixes (i.e. contamination) in civilian and military grade DU from all known production plants and all available production dates. This would be a reference source for fingerprinting DU.**

End of section & notes

## 6. Latest extracts from Hansard - 12<sup>th</sup> Nov to 31<sup>st</sup> January 2002.

These include several questions from MP's seeking clarification on issues raised in the previous section, pages 61-63, that were circulated on the Internet.

12 Nov 2001

### Depleted Uranium

**Llew Smith:** To ask the Secretary of State for Defence, pursuant to his answer of 29 October 2001, *Official Report*, column 519W, which categories of nuclear weapons contain **depleted uranium**; and what the purpose is of including **depleted uranium** in these weapons. [14271]

**Dr. Moonie:** The UK Trident warheads for our nuclear deterrent contain **depleted uranium**. The purpose of this material is ultimately associated with the functioning of the warhead and the details are classified. For this reason I am withholding this information under Exemption 1 of the Code of Practice on Access to Government Information.

---

23 Nov 2001

### Depleted Uranium

**Dr. Jack Cunningham:** To ask the Secretary of State for Defence what (a) guns and (b) gun barrels used for the test firing of **depleted uranium** shells at Eskmeals have been removed to another range not licensed for the testing of **depleted uranium**; who authorised such transfers; whether this complied with health and safety regulations; and if he will make a statement. [16885]

**Dr. Moonie:** I believe my right hon. Friend may be referring to two Challenger 2 tank gun barrels used for test firing **depleted uranium** (DU) ammunition at the Kirkcudbright training area, but stored at the QinetiQ Eskmeals range. These were transferred on 6 November to the firing range at Shoeburyness, for test firing of non-DU ammunition, to support a Challenger 2 tank safety trial to determine acceptable limits of gun barrel erosion. The transfer was carried out by QinetiQ. A risk assessment by the radiation protection adviser showed that the levels of DU in the two barrels were so low and the DU so inaccessible that the material is not a radioactive substance within the meaning of the Ionising Radiation Regulations. These are the regulations that protect workers and members of the public who maybe exposed to ionising radiation and radioactive material from work activities.

---

26 Nov 2001

### Public Bodies

**Mr. Andrew Turner:** To ask the Secretary of State for Defence (1) if he will list those public bodies to which his Department appoints members and which are not listed in Public Bodies 2000; [17579]

(2) if he will list those public bodies which are the responsibility of his Department and which are not listed in Public Bodies 2000. [17580]

**Dr. Moonie:** Public Bodies 2000 sets out information on Non Departmental Public Bodies (NDPBs), certain public corporations (including nationalised industries) and NHS bodies. There are four types of NDPB: executive NDPBs; advisory NDPBs; tribunal NDPBs; and boards of visitors to penal establishments. The next edition will be published around the end of the year. Information about task forces, annual reports and ad hoc advisory groups is set out in an annual report published by the Cabinet Office. Copies of Public Bodies 2000 are in the Library of the House and may be accessed via Cabinet Office's website: <http://www.official-documents.co.uk/document/caboff/pb00/pb00.htm>. Copies of the annual report on task forces and similar bodies have also been placed in the Library of the House and the report is being made available on Cabinet Office's website.

The Ministry of Defence currently sponsors 33 Non Departmental Public Bodies (seven executive NDPBs and 26 advisory NDPBs): <list cut>

The MOD currently sponsors the following reviews/ task forces:

**Depleted Uranium Oversight Board**

Independent Panel on Vaccines Interaction Research  
Services Families' Task Force.

**27 Nov 2001**

**Depleted Uranium**

**Chris Ruane:** To ask the Secretary of State for Defence how many depleted uranium shells have been used in the Afghan conflict.

**Mr. Ingram:** None.

**3 Dec 2001**

**Depleted Uranium**

**Chris Ruane:** To ask the Secretary of State for Defence how many (a) armour piercing and (b) hard target penetrator warheads containing depleted uranium have been tested in Wales in each of the last 10 years.

**Mr. Ingram [holding answer 27 November 2001]:** No depleted uranium rounds have been tested in Wales in each of the last 10 years.

**4 Dec 2001**

**Depleted Uranium**

**Dr. Jack Cunningham:** To ask the Secretary of State for Defence (1) for what reason test firing using depleted uranium contaminated gun barrels from Eskmeals was carried out at Shoeburyness; who authorised the transfer of the gun barrels; and if he will make a statement;

(2) pursuant to his answer of 23 November 2001, *Official Report*, column 514W, on depleted uranium, how many rounds were fired in the tests; and how many were recovered;

(3) pursuant to his answer of 23 November 2001, *Official Report*, column 514W, on depleted uranium, what environmental impact assessment was carried out, and by whom, before depleted uranium contaminated gun barrels from Eskmeals were used in test firing at Shoeburyness;

(4) pursuant to his answer of 23 November 2001, *Official Report*, column 514W, on **depleted uranium**, who was the radiation protection adviser; for which organisation he or she worked; whether the Defence Radiology Protection Service was (a) consulted and (b) involved; and if he will make a statement.

**Dr. Moonie** [*holding answer 30 November 2001*]: Test firing using **depleted uranium** (DU) contaminated gun barrels is required as part of the effectiveness and safety trials to determine the effect of firing a variety of rounds through worn barrels. The Challenger II tank worn barrel trial is planned to commence in January 2002. The trial involves firing a range of non-DU based ammunition natures such as high explosive and training rounds. The trial will involve the use of barrels that have not fired DU rounds as well as those that have. More recently, between 20 to 29 November, one gun barrel stored at QinetiQ Eskmeals, that had fired DU in the past, was used in a CHARM 3 Training Round (a non-DU round) trial at the Shoeburyness ranges. Test firing is being carried out at Shoeburyness because it meets the minimum firing distance required and provides a round recovery facility and a suitable cost-effective solution. There is no reason on health and safety grounds why the work cannot be carried out at this site.

No specific authorisation to transfer barrels allocated to support these trials is needed. Each barrel that has fired DU in the past has a record annotated accordingly and is accompanied with appropriate precautionary advice.

In the November trial, 71 rounds were fired and none were recovered. The worn barrel trial in January is planned to use 184 rounds and it is planned to recover some rounds to ascertain any effects on the round's stability and performance. Recovered rounds fired will be monitored for DU.

No environmental impact assessment was undertaken immediately before the CHARM3 training round trial and none is planned for the worn barrel trial. However, a risk assessment for the routine use of DU contaminated barrels was carried out by the Department's Radiation Protection Adviser, the then DERA Radiation Protection Services, in May 2000. Although this assessment concludes that no DU will be released from the barrel, environmental monitoring was conducted at the start, during and after the firings on 20 November. This involved a base line survey taking soil and grass samples and monitoring around the gun, passive air sampling, and a swab sample of the inside of the barrel when firing was complete. The monitoring will also be conducted in support of the worn barrel trial.

The barrels used at Shoeburyness were monitored before transfer. The monitoring in this case showed that the barrels contained less than 10 kilobecquerels of DU and thus confirmed that the material presented very little risk. This conclusion is based on the generic risk assessment conducted in May 2000, which is applicable to all barrels containing less than 10 kilobecquerels of DU.

---

#### 4 Dec 2001

##### **Depleted Uranium**

**Mr. Russell Brown:** To ask the Secretary of State for Health if he will list the United Kingdom academic research groups with experience in reviewing the risks associated with **depleted uranium**. [16282]

**Ms Blears** [*holding answer 24 November 2001*]: The Department knows of four academic groups which have been active in reviewing the risks from **depleted uranium**, the Royal Society **Depleted Uranium** Working Group, the British Geological Survey, the University of Bristol Department of Earth Sciences and the Southampton Oceanic Centre.

---

5 Dec 2001

### Depleted Uranium

**Mr. Peter Duncan:** To ask the Secretary of State for Defence how many armour piercing and hard target penetrating warheads containing **depleted uranium** have been tested in (a) Scotland and (b) Dumfries and Galloway in each of the last 10 years. [18233]

**Dr. Moonie** [*holding answer 26 November 2001*]: The number of **depleted uranium** projectiles fired in Scotland in each of the last 10 years is listed. These tests have all taken place at the Kirkcudbright training area in Dumfries and Galloway.

Year	Number
1991	666
1992	781
1993	682
1994	455*
1995	280
1996	147
1997	749
1998	134
1999	111
2000	272
2001	<sup>(26)</sup> 109

<sup>(26)</sup> To date \*corrected figure, Hansard 8 Jan 2002

**Mr. Laws:** To ask the Secretary of State for Defence if he will list the (a) items of equipment, (b) munitions and (c) all other property of his Department (i) which contain **depleted uranium** and (ii) in which **depleted uranium** has been used in each of the past 10 years; and if he will make a statement.

**Dr. Moonie:** I refer the hon. Member to the answer I gave on 29 October 2001, *Official Report*, column 519W, and the answer on 12 November 2001, *Official Report*, column 523W, to my hon. Friend the Member for Blaenau Gwent (Llew Smith) which indicate the uses to which **depleted uranium** is put by the Ministry of Defence (MOD) in munitions and in other ways which mirror the widespread use of this material in the United Kingdom. No central record exists of where DU is or has been used or held over the past 10 years--in view of the nature of its use in MOD, the information requested could be provided only at disproportionate cost. However, I can say that DU in munitions will at various times have been found in ammunition depots at Kineton, Longtown and Dean Hill, on ships fitted with Phalanx weapons systems, at the ranges at Eskmeals and Kirkcudbright, and at locations involved in nuclear weapons programmes. DU used for other purposes has been present in a number of the aircraft listed in the earlier answer that are the property of MOD, at RAF Stafford, at the research establishment at Fort Halstead, at sites involved in the naval propulsion programme, and at the Royal hospital, Haslar.

6 Dec 2001

### Weapons

**Mr. Laws:** To ask the Secretary of State for Defence what dense metals are used in the hard-target penetrators of the (a) GBU-24, (b) GBU-32 (upgraded), (c) GBU-37, (d) AGM-86D, (e) AGM-65G, (f) AGM-154C and (g) M220-TOW weapons systems. [20340]

**Mr. Ingram:** Only two of the weapons listed--a variant of the GBU-24 and a variant of the AGM-65--are in service with UK armed forces. Neither use depleted uranium or any other "dense metal" in their warheads.

**Mr. Laws:** To ask the Secretary of State for Defence what dense metals (a) are and (b) have been used in the (i) development, (ii) testing and (iii) operational use of the BAE/RO BROACH MWS warhead systems. [20333]

**Mr. Ingram:** The only dense metal contained in the BROACH MWS is a tungsten-based alloy. No other dense metal is or has been used in its development or testing. The BROACH MWS is not forecast to enter service before August 2002.

10 Dec 2001

### Depleted Uranium

**Mr. Laws:** To ask the Secretary of State for Defence what warnings about depleted uranium hazards have been given to (a) UK and other allied forces troops, (b) UK and international aid and media organisations and (c) civilian communities and military organisations likely to be exposed to depleted uranium contamination in Afghanistan. [20341]

**Mr. Ingram** [*holding answer 6 December 2001*]: We are not aware that DU has been used in the current conflict by the Coalition, nor are we aware of any plans for it to be used. We have no information about the use of DU in previous conflicts in Afghanistan.

In the event that it is used in future, suitable guidance will be available to UK deployed forces. It will be for other nations to take similar actions with their own forces as they see necessary. The Coalition will also liaise with the Afghan authorities and human relief agencies in the event that there is a need to issue guidance to the Afghan population.

12 Dec 2001 debate

**Dr. Jenny Tonge (Richmond Park):** Will the hon. Gentleman give way?

**Mr. Viggers:** Yes. I look forward with great enthusiasm to discovering whether the hon. Lady has recanted from her previous position on urging a delay in bombing during Ramadan.

*<exchanges between Jenny Tong and Mr Viggers cut >*

**Jeremy Corbyn:** Will the hon. Gentleman pause for a moment in his triumphalism and consider the consequences of the bombing of Afghanistan? Depleted uranium bombs, cluster bombs and daisy-cutters have been used and there have been civilian and military casualties. In addition, atrocities have been committed by all sides during the taking of prisoners and particular towns. Does the hon. Gentleman honestly think that Afghanistan is now in that much a better position than it was a couple of months ago? [No further references to DU in this debate]



13 Dec 2001

**Depleted Uranium**

**Mr. Laws:** To ask the Secretary of State for Defence how many (a) UK military personnel and (b) UK defence industry employees have been (i) confirmed as suffering from and (ii) suspected of suffering from **depleted uranium** poisoning, in each year from 1980 to 2001-02; and if he will make a statement. [22317]

**Dr. Moonie:** Although a number of people may suspect that they are suffering from ill health as a result of exposure to **depleted uranium**, including personnel in the Gulf and Balkans campaign, I am unaware of any individual who has been confirmed as suffering from ill health arising from exposure to DU over the period 1980 to 2001-02.

**Mr. Laws:** To ask the Secretary of State for Defence what assessment his Department has made of the health risks associated with material containing **depleted uranium** in the last 10 years; if he will publish the results; and if he will make a statement. [22315]

**Dr. Moonie:** I refer the hon. Member to the answer given on 25 January 2001, *Official Report*, column 653W, by my right hon. Friend the Secretary of State for Defence, to my hon. Friend the Member for Gedling (Vernon Coaker), in which the Ministry of Defence published a paper that explained the MOD's position on the risks posed by **depleted uranium** (DU). This paper included reference to the MOD's earlier paper published on 19 March 1999, entitled: "Testing for the Presence of **Depleted Uranium** in UK Veterans of the Gulf Conflict: the Current Position". Copies of both papers are available in the Library of the House and on the MOD's website at [www.gulfwar.mod.uk](http://www.gulfwar.mod.uk).

I also refer the hon. Member to my letter of 24 March (reference: D/US of S/LM 0291L/01/I) to my hon. Friend the Member for Stroud (Mr. Drew), which includes the review paper: "**Depleted Uranium**--Safety Guidance to UK Armed Forces and MOD Civilians"; and my letter of 17 April (reference: D/US of S/LM PQ 0346L/01/M), to my hon. Friend the Member for Stoke-on-Trent, North (Ms Walley), which discusses and lists risk assessments associated with DU. I also refer the hon. Member to my letter of 7 June 2001 (reference: D/US of S/LM PQ 0679L/01/Y) to my hon. Friend the Member for Blaenau Gwent (Llew Smith), which lists reports on **depleted uranium** commissioned by the MOD from DERA and contains some additional relevant material. All three letters are available in the Library of the House.

**Mr. Laws:** To ask the Secretary of State for Defence what investigations his Department has made in the last 10 years into whether (a) UK military personnel and (b) employees within the defence industries of the United Kingdom, have suffered from (i) **depleted uranium** poisoning and (ii) other medical conditions caused by exposure to **depleted uranium**; and if he will make a statement. [22316]

**Dr. Moonie:** The Ministry of Defence is funding a programme designed to establish whether a scientifically rigorous test can be developed to determine historical exposures to **depleted uranium** (DU). Given such a test is developed, epidemiological studies will be undertaken to establish whether there is any correlation between ill-health and exposure to DU. As part of the MOD's Gulf Veterans' Medical Assessment Programme, which has so far seen over 3,000 service personnel and a small number of defence industry employees who served in the Gulf, a very small number of tests for total **uranium** have been carried out in cases where physicians believed that such tests would assist in treatment of their patients. All these tests showed that the signs and symptoms displayed by these patients were not due to any form of **uranium** exposure. In the early 1990s, a small number of UK troops concerned they had inhaled DU dust while conducting work in the Gulf conflict had their lungs monitored--no detectable DU contamination was found.

There are established systems within the United Kingdom for monitoring the health and safety of those who are exposed to **depleted uranium** as part of their work activities.



These systems are, and always have been, employed throughout the MOD and involve monitoring of personnel and the working environment. Some individuals also receive annual health reviews. These measures ensure that exposures to **depleted uranium** are as low as reasonably practicable and do not exceed statutory limits. Therefore there is no reason for investigations of the type mentioned for these employees.

Other than those mentioned above, the health of those employed within defence industries is a matter for the employers concerned and for the Health and Safety Executive.

**19 December 2001**

### **Depleted Uranium**

**Mr. Laws:** To ask the Secretary of State for Trade and Industry what assessment she has made of the (a) volume and (b) value of **depleted uranium** and products containing **depleted uranium**, imported into the United Kingdom in each year since 1985; and if she will make a statement. [22312]

**Nigel Griffiths** [*holding answer 13 December 2001*]: Data on imports of **depleted uranium** and **depleted uranium** products since 1985 are not readily available and could be obtained only at disproportionate cost.

**Mr. Laws:** To ask the Secretary of State for Trade and Industry what regulations there are to control the importation of (a) **depleted uranium**, (b) munitions containing **depleted uranium** and (c) other products containing **depleted uranium**; and if she will make a statement. [22313]

**Nigel Griffiths** [*holding answer 13 December 2001*]: I refer the hon. Member to the answer I gave on 30 October 2001, *Official Report*, column 587.

**19 December 2001**

### **Hansard debate**

**Jeremy Corbyn (Islington, North):** Last Sunday, I went to the Edith Cavell statue, just outside the church of St. Martin-in-the-Fields and just north of Trafalgar square. I joined a couple of hundred other people. For an hour, we took turns to read out the names of people--there were 1,100 in total--who have died in the past year in the conflict in Israel and Palestine.

< comments re Palestine peace process >

I hope that after the bombing campaign in Afghanistan, there will be peace, some self-determination and genuine support for the clean-up operation in the wake of the use of **depleted uranium**, cluster bombs, daisy-cutters and all the other horrific accoutrements of modern warfare. I hope that there will be an examination of human rights abuses by the Taliban and the Northern Alliance, especially the killing of so many prisoners at Mazar-e-Sharif in the early part of the allied campaign against the Taliban.

**8 January 2002**

### **Depleted Uranium**

**Mr. Laws:** To ask the Secretary of State for Health what research his Department has conducted in the last 10 years into illnesses caused by exposure to **depleted uranium**; what assessment has been made of the risks to health from exposure to **depleted uranium** used in munitions and military equipment; and if he will make a statement.

**Ms Blears** [*holding answer 13 December 2001*]: The Department is advised on matters of radiation risk by the National Radiological Protection Board (NRPB). NRPB has not carried out any research specifically into illnesses caused by exposure to **depleted uranium**. However, NRPB has carried out research that is relevant to the assessment

of the risks to health from such exposures. In particular NRPB has carried out extensive research into the distribution of **uranium** between body organs, its retention and excretion, following inhalation of a wide range of **uranium** compounds. It has also developed computer models that enable the concentration of **uranium** in the various organs and resulting radiation doses to be calculated. Depleted **uranium** is mildly radioactive, and NRPB's research programme on the effects of ionising radiation in general is therefore relevant to assessment of the radiological risks from exposure to depleted **uranium**.

NRPB staff have also contributed to studies of the risks to health from exposure to depleted **uranium** carried out by working groups set up by the European Commission, the Royal Society, and the World Health Organisation. Reports from each have been published during 2001.

The Department also knows of four academic groups which have been active in reviewing the risks from depleted **uranium**; they are the Royal Society Depleted **Uranium** Working Group, the British Geological Survey, the University of Bristol Department of Earth Sciences and the Southampton Oceanic Centre.

**15 January**

### **Tungsten Armour Piercing Round**

**Mr. Swayne:** To ask the Secretary of State for Defence (1) what effect the decision to purchase a tungsten armour piercing round will have on existing use of depleted **uranium** rounds; and if he will make a statement; [27495] (2) what factors contributed to his decision to procure a tungsten armour piercing round; and if he will make a statement. [27494]

**Dr. Moonie:** The Ministry of Defence already has tungsten armour piercing rounds which are used by Challenger 2 tanks. The further purchase of tungsten ammunition has been proposed for the test and calibration firing of Challenger 2 tanks. Such a buy would have no effect on the use of depleted **uranium** rounds, since the rounds are used in different roles. The Charm 3 round, which incorporates a depleted **uranium** penetrator, is a war fighting round, while the tungsten rounds are used in the calibration of the Challenger 2 weapons system.

**21 January**

### **Depleted Uranium**

**Llew Smith:** To ask the Secretary of State for Trade and Industry what quantity of depleted **uranium** is in use in civil non-nuclear applications in the United Kingdom; to what uses the DU is put; what disposal facilities exist for waste DU metal and its undiluted compounds; and in what quantities and where unused DU is stored. [28501]

**Nigel Griffiths:** A report on depleted **uranium** has recently been published by the Environment Agency: "Depleted **Uranium**: A Study of its Uses within the UK and Disposal Issues" (Reference R&D Technical Report

P3-088/TR), copies of which are available from the Environment Agency. This report provides details on the quantities, uses and storage of depleted **uranium** in civil non-nuclear applications in the United Kingdom, and describes, among other areas, the safeguards arrangements for the depleted **uranium**. Issues relating to the disposal of radioactive materials, including waste depleted **uranium** metal and its undiluted compounds, are a matter for the Environment Agency. [search up to 31 January]

### **Following the DU debate in the UK Parliament**

**Online Hansard** provides a valuable way to keep up to date with questions and answers about depleted uranium and any other issues in the UK Parliament. Use this search link:

<http://www.parliament.the-stationery-office.co.uk/cgi-bin/empower?DB=ukparl>

Most of the above reports come from written answers.

Crown copyright acknowledged.

## Part 3

### Military use of depleted uranium: Known and suspected DU weapon systems

1. DU and the evolution of hard target weapons	73
2. Properties, advantages and hazards of DU for military use	74
3. New weapons technology - known and suspected DU applications	76
4. DU armour-piercing ammunition and missiles	81
5. Smart or guided bombs	84
6. Hard target cruise missiles	86
<i>Figure 1 - Hard Target Guided Weapons in 2001 with dense metal warheads</i>	89
7. Other suspected weapons systems - cluster bombs and SSB's	91

#### 1. DU and the evolution of hard target weapons

Depleted uranium has been developed for use in armour-piercing ammunition since the 1970's, for sea-to-air cannon and in nuclear bombs. Its first reported combat use by US and UK forces was in anti-tank munitions during the Gulf War in 1991. The use of DU in other conventional weapons systems e.g. in bombs and missiles has rarely been questioned until now, despite comments on **Jane's website** that **"some guided weapons used depleted uranium to increase the penetration effect"** and that DU has been used **"as liners for shaped charge warheads"**. This possibility has either been omitted or denied by the US DoD (except for testing simulated nuclear warheads) and by the UK Government (e.g. 2 Nov & 6 Dec 2001, see Part 2). But the following information strongly suggests that DU is used in several hard target weapons systems.

There is no doubt that a whole new range of hard target warheads are based on some very heavy, **mystery metal** that has been a closely guarded military secret since the 1980's. USAF procurement plans in 1997 give vital clues to recent hard target weapons development based on **"dense metal" ballast or penetrators** (see **Tip of the Iceberg** in Part 1). In view of the serious health and environmental hazards associated with DU it is important that past, present and planned hard target weapons are fully and independently investigated for any use of DU. This analysis is a start.

Why should DU be suspected in other weapons systems, especially those with hard target capability? To understand this it is necessary to appreciate the very unusual **physical properties of Uranium 238**, see **Section 2**.

It is also necessary to appreciate **strategic threats** e.g. suspected production of chemical, biological and possibly nuclear weapons in Iraq, Serbia and other countries in the 1990's. Such installations, together with strategic command centres, are likely to be in heavily protected underground facilities. These issues were identified in the US **Hard or Deeply Buried Target Defeat Capability (HDBTDC) programme**. See the FAS website at: <http://www.fas.org/man/dod-101/sys/smart/hdbtdc.htm>

A key issue is to understand what **new weapons technologies** have been developed in the last 15 years to defeat these hard or deeply buried targets without resorting to nuclear weapons. Anti-tank munitions are an important tactical requirement. But the capability to destroy chemical, biological or command centre targets is a strategic defence issue in the HDBTDC programme. High priority has been put on warhead development to contain these strategic threats. Several **new weapons concepts** have evolved in response to these requirements. These are described in **Section 3**.

Full DU risk assessment requires knowledge of potential sources of contamination (potential hazards) and correlation with epidemiological analysis of exposed populations (see Part 4). The current benchmark for political debate and published health research concerning DU is based on **known DU weapon systems** i.e. armour plating and armour-piercing anti-tank munitions. These are described in **Section 4**.

But when strategic requirements for a new generation of hard target guided weapons are combined with the physical properties offered by depleted uranium, we have the basis for radically different systems. These requirements provide the basis for identifying **specific warheads** likely to contain DU and **the guided weapons systems** designed to deliver use them. These are listed in three groups:

- **Section 5** covers hard target versions of **smart or guided bombs**.
- **Section 6** covers hard target versions of **cruise missiles** and
- **Section 7** explores suspected DU use in **sub-munitions**, cluster bombs & SSB's.

**In the Afghan war** there has been relatively little need to use known (anti-armour) DU weapons except in AC-130U ground support operations. However there has been widespread use of guided bombs and cruise missiles on hundreds of hard-target locations, probably in larger quantities than any other conflict in the last 20 years.

**Establishing whether or not these new guided weapons contain DU, and if so exactly how much, is essential to evaluating potential levels of DU contamination and hence health hazards in Afghanistan.** The potential quantities of DU contamination per target between A10 strikes in the Balkans and guided weapons targets in Afghanistan can be seen in Figure 1.

## 2. Properties, advantages and hazards of DU for military use

**Depleted Uranium** is a dense metal 1.7 times heavier than lead, produced as the major by-product of processing Uranium ore to extract U235 for the nuclear industry **and** of re-processing spent nuclear reactor rods. It is mainly composed of **Uranium 238** (99+%), with variable levels of other radioactive materials including **U234**, **U235**, **U236** and **Plutonium** depending on the reliability of the extraction process and what other materials have been recycled with it.

**Depleted uranium has five advantages** for military applications:

- **Uranium 238 is a very heavy, dense metal.** When used to upgrade existing weapons systems this means that the same weight of warhead can be half the cross-section area of devices previously made with steel i.e. warheads can be much thinner, **doubling their penetration effect** (see weapons upgrade concepts in **Tip of the Iceberg**). It is 2.1 times heavier than Nickel or Cobalt, 2.4 times heavier than Iron and 4.2 times heavier than Titanium. The density of U238 is approximately 19.0 compared to 19.25 for Tungsten (or 19.3 for Gold). Weapons systems using the high density of Tungsten or DU are known as **kinetic energy weapons**. Physical properties of DU and other metals can be checked at: <http://www.webelements.com/webelements/elements/text/periodic-table/phys.html>
- **Uranium 238 is a very hard metal**, the second hardest common metal to Tungsten (apart from rare metals like Osmium). It is 2 times harder than Titanium and 3 times harder than Iron (levels depend on the type of hardness being tested - Vickers hardness used here). Its hardness is increased in alloy form (e.g. with 0.75% Titanium in anti-tank penetrators). Manufacturing processes e.g. heat treatment and forging, determine DU's strength and fragmentation qualities.

- **Uranium is pyrophoric** i.e. it burns fiercely in air igniting at temperatures over 500 degrees Celsius and burning at some 2000 degrees. This makes it valuable as an **incendiary weapon** e.g. to ignite fuel or munitions in tanks and potentially highly effective against other targets where great heat is an advantage e.g. underground ammunition or fuel stores, aircraft hangers and biological or chemical weapons facilities.
- **Uranium 238 is easier to manufacture** than Tungsten (Wolfram) which is 1.75 times harder and has a much higher melting point (U = 1132 °C, W = 3422 °C).
- It is **cheaper and more available** than Tungsten since the world nuclear industry has over a million tons of waste DU to dispose of.  
[http://www.uxc.com/review/ux\\_prices.shtml](http://www.uxc.com/review/ux_prices.shtml)

The main hazards of DU are health and safety issues:

- Risks of **fire**. DU can ignite at relatively low temperatures (500 C).
- **Heavy metal toxicity**: Uranium is a heavy metal and its oxides are reported to be of similar toxicity to Arsenic oxide, particularly affecting the renal system. This may not appear significant from small inhaled quantities but could be serious in acute exposure to explosion dust and debris with a high load of DU oxides entering nose and throat and swallowed, or prolonged exposure in a contaminated environment.
- Risks of **radioactive contamination** by inhaling DU oxide dust and ingesting it from dust in the mouth, in water or in food. DU burns into a very fine black dust or 'aerosol' with a combination of soluble and insoluble Uranium oxides. Larger particles may coat the immediate target area with what looks like soot. But 60%+ are less than 1.5 microns, widely dispersed by wind and small enough to remain suspended in the atmosphere in smog-like conditions. Airborne oxides may be captured in rain or snow and re-suspended in hot weather. DU contamination was recorded up to 25 miles away from one manufacturing site in the USA.

DU's radiation hazards are its most controversial feature. Pure U238 emits alpha-radiation - high energy but very short range (a few millimetres) plus traces of Beta and Gamma from the Thorium and other "daughter" isotopes released as it decays.

For military purposes this low-level radiation appears to be low risk for external exposures e.g. when handling DU in its metal form (e.g. as shells or armour) provided gloves are worn. But some spent munitions have been reported with higher levels of radiation possibly due to inconsistent processing and higher contamination with U235 and other isotopes. DU quality control and contamination (isotopic mix) is likely to vary significantly by manufacturing date, process and country of origin.

The greatest hazard is when soluble and insoluble Uranium oxides are inhaled into the lungs. Particles migrate into the lymph and blood systems, bones and reproductive organs. Alpha radiation will permanently irradiate adjacent tissue. See research on **health effects of Low Level Radiation** at: <http://www.llrc.org/health/healthpage.htm>

Adverse health effects will depend on **exposure level** - a combination of the **quantity** of DU oxide dust inhaled or ingested, **frequency** and **duration** of exposure. Most DU research to date has assumed low dose exposure for fit troops from small and medium calibre weapons (from 30 to 120 mm) weighing from 275 grams up to 4.5 kilograms per penetrator. However if DU is used in much larger quantities - in warheads weighing 300 kg to 2 tons - then humans within several hundred metres may suffer severe contamination and acute health effects. Civilians living in DU targeted areas are vulnerable to ongoing contamination. These wider effects need new analysis.



### 3. New weapons technology - known and suspected DU applications

#### Armour plating

Due to its hardness DU has been used in modern armoured vehicles for at least a decade. In the CDI Defense Monitor (Vol. 6, 1999) - ***Depleted Uranium - a necessary evil?*** They point out that "in the Gulf War Iraqi tank shells failed to penetrate any DU-reinforced parts of U.S. tanks". See <http://www.cdi.org/dm/1999/oct99dm.pdf>

Further descriptions of the use of DU in defensive armour and in DU 120 mm anti-armour shells, are available in ***Depleted Uranium - the truth & nothing but the truth***, by Mike Sheheane in ***Armor*** magazine. Go to index, Back Issues, July-August 2000 at: <http://knox-www.army.mil/center/ocoa/ArmorMag/index.htm>

#### Projectile penetrators (non-explosive)

The only publicly acknowledged DU munitions are non-explosive, armour-piercing **penetrators**. Nominal sizes range from 20, 25 and 30 mm rounds designed for rapid fire cannons up to 105 and 120 mm penetrator rounds for tanks. See Section 4 for specific ammunition types.

Some DU penetrators are like thin darts. Because they are thinner than the calibre of the gun firing them tank rounds are held by a sabot (or washer) which is discarded as they leave the gun barrel. In 30 mm rounds the 16 mm DU penetrator is held inside an aluminium jacket which is shed on hitting the target. The penetrator contains DU alloyed with 0.75% of titanium. They may be mixed with other shells in rapid fire applications.

On impacting the target the penetrator's high kinetic energy is converted into heat, igniting the point which then burns or melts its way through the target's armour. The penetrator may pass straight through the vehicle, shatter into shrapnel or burn inside it. The larger 120 mm DU penetrators, shells or warheads are likely to create intense heat, igniting munitions and fuel. Anti-armour penetrators do not contain explosive - they ignite spontaneously.

The immediate hazards of these DU munitions are to casualties inside target vehicles who may suffer shrapnel wounds, very severe burns or even be carbonised by the fierce heat of burning DU. The ongoing hazard is radioactive contamination of the target and immediate area by DU oxide dust - a risk for repair and recovery personnel, and for civilians tempted to enter a burned out vehicle destroyed by DU e.g. children.

#### Unitary penetrators in hard target bombs and missiles

A major tactical issue in battlefield situations is defeat of **hard or deeply buried targets** e.g. command bunkers, fuel and ammunition stores, aircraft hangers with reinforced roofs etc. Since the 1980's a variety of heavyweight warheads have been developed in various bomb and missile systems to defeat these "hard targets".

Several different hard target warhead technologies have evolved. Some use focused explosives (see ***shaped charge penetrators*** below). But for very thick targets (e.g. 100 feet of earth or 10-20 feet of concrete) **new design concepts and technology** were required and evolved in the 1990's.

This evolved from the success of prototypes of the 2 ton **GBU-28 Bunker Buster** bomb - artillery gun barrels packed with explosives and fitted with a laser guidance system. This

system has subsequently been developed into the **BLU-113** warhead. It may also have been influenced by Maverick G warhead developments in the late 1980's

The **Advanced Unitary Penetrator** concept was described in the 1997 USAF Concept plan (see Tip of the Iceberg). **"The warhead would either be designed with a dense metal case or dense metal ballast to increase penetration"**. Doubling the effect of older steel bombs or warheads requires a very heavy metal. Only tungsten or depleted uranium or a combination can offer double the density of steel.

Some of these penetrators are also designed with special missions in mind e.g. destruction of suspected underground chemical or biological weapons facilities. This is explained in the **Hard or Deeply Buried Target Defeat Capability programme** (HDBTDC). "Agent neutralization will require key data needed to understand the collateral effects consequences of strikes against chemical and biological weapons-related facilities." A powerful **incendiary** warhead could be effective in neutralising biological and some chemical agents.

See FAS at: <http://www.fas.org/man/dod-101/sys/smart/hdbtdc.htm>

The **structure of unitary penetrators** is explained for several weapons systems on the FAS website e.g. for the 2000 lb **GBU-24 Paveway III** guided bomb.

"The **Advanced Unitary Penetrator** [AUP] hard target penetrator features an elongated narrow diameter case made of a tough nickel-cobalt steel alloy called Air Force 1410. With the official designation of BLU-116, and designated the GBU-24 C/B (USAF) and GBU-24 D/B (Navy), is designed to provide at least twice the penetration capability of existing BLU-109 2000-pound bombs.

Penetration capability is directly proportional to the warhead's sectional density - its weight divided by its cross section. **The AUP maximizes sectional density by reducing the explosive payload and using heavy metals in the warhead case.** Lower explosive payload will diminish dispersion of NBC agents to help reduce collateral effects. The AUP will retain the carriage and flight characteristics of the BLU-109, and it will be compatible with the GBU-24, GBU-27, and GBU-15/AGM-130 series of precision-guided bombs. Thus, the AUP will be capable of delivery from a wider inventory of aircraft, including stealth platforms, than the BLU-113/GBU-28. See FAS: <http://www.fas.org/man/dod-101/sys/smart/gbu-24.htm>

Advanced penetrators use delayed action **Hard Target Smart Fuses** that do not detonate until the weapon has reached a void or gone as deep as it can e.g. cutting through several floors of a building and exploding in the basement. Warheads come in various sizes - 250, 500, 1000, 2000 lbs up to the 4400 lbs BLU-113. These approximate weights include explosive and outer casing. The dense metal ballast or case may represent 50-70% of warhead weight depending on the system involved, plus additional weight of airframe, guidance and propulsion. See FAS reports. For incendiary effects DU alloy fragmentation properties would enable optimum ignition.

### Boosted penetrators

A variation on the unitary penetrator concept is a **boosted penetrator**. The basic concept of a high-density warhead is boosted by a wraparound rocket motor or rear facing explosive charge. These may double the impact speed and kinetic energy of the warhead in addition to the advantage of using thinner, high density penetrators.

A rocket booster is used in the BLU-107 Durandel runway breaking bomb. The composition of the explosive penetrator warhead is not known. The 1997 Concept plan referred to other boosted penetrator systems from 250 - 2000 lb.

## Shaped charge warheads

Shaped charge technology dates back to World War 1. Shaped charges increase power by focusing explosives in one direction e.g. by containing them with a conical liner. In February 2001 Jane's website said that DU was also used as "liners in shaped charge warheads" (see Tip of the Iceberg). This reference is no longer available but was sufficient to extend these investigations to include shaped charge weapons.

A wide variety of guided weapons use "**shaped charge**" technology. These range from Maverick and Hellfire missiles to torpedoes, sub-munitions in cluster bombs and the first stage of BROACH MWS warheads.

"A shaped charge is a **concave metal hemisphere or cone** (known as a liner) backed by a high explosive, all in a steel or aluminium casing \*. When the high explosive is detonated, the metal liner is compressed and squeezed forward, forming a jet whose tip may travel as fast as 10 kilometres per second. Shaped charges were first developed after World War I to penetrate tanks and other armored equipment. Their most extensive use today is in the oil and gas industry where they open up the rock around drilled wells." See <http://www.llnl.gov/str/Baum.html>

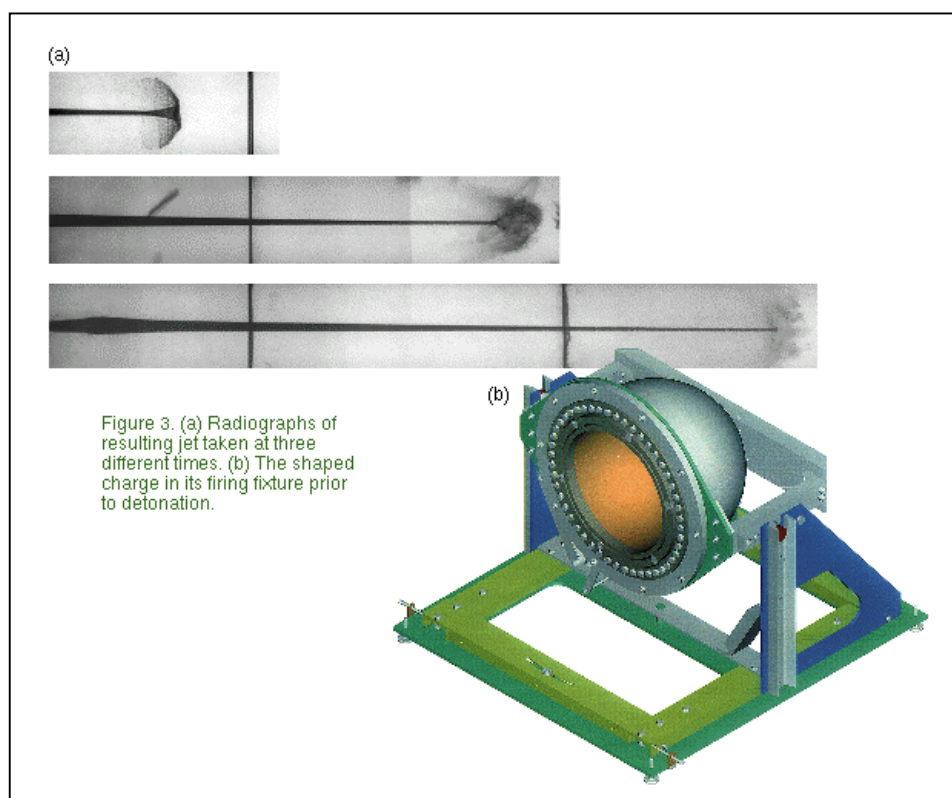


Photo © Baum

\* DU seems a logical metal for the outer casing. Its high density would offer maximum inertia to focus the blast and its strength can be varied according to the alloy mix used e.g. titanium, niobium or molybdenum. The inner (typically cone shaped) shaped charge liner can be made of a variety of metals e.g. Copper, Molybdenum and according to Jane's previous reference Depleted Uranium. These have similar melting points so DU (1132 °C) may be interchangeable with Copper (1085 °C). The very high melting point of Tungsten (3422 °C) seems less suitable for a shaped charge liner. The quantity of DU involved may range from a few kilograms up to 250 kg in larger warheads e.g. as suspected in the first stage of the BROACH warhead.



The WISE website lists a number of DU manufacturing organisations on its website at <http://www.antenna.nl/wise/uranium/dfac.html#AMMFAB> . These include Primex and Alliant. The **Primex** website does not mention its DU products but shows a picture of Copper shaped charge liners at <http://www.primextech.com/warhead.html>



Photo © Primex

The **Manufacturing Sciences Corporation** website (a subsidiary of BNFL) show a range hemispheres, cones and penetrator-sized rods in their **Products from Depleted Uranium** at <http://www.mfgsci.com/metprod.html#du> . Several of these "safe, useful products" look remarkably similar to shaped charge warhead components in the two previous pictures.



Photo © Manufacturing Sciences Corporation

"Since 1985, MSC has converted over 6 million pounds of depleted uranium into more than 70,000 safe, useful products. MSC has performed this work under a radioactive material operating license issued by the State of Tennessee under NRC guidelines. MSC performs its depleted uranium operations in a special controlled area that is continuously monitored and where the air is drawn through high energy filters to remove any airborne dust and particles."

Shaped charge liners are also shown in the diagram of BLU-97/B anti-armour bomblets in the CBU-87B Combined Effects Munition (cluster bomb), see page 91 and FAS illustrations at: <http://www.fas.org/man/dod-101/sys/dumb/cbu-87.htm> and the CBU-97 at <http://www.fas.org/man/dod-101/sys/dumb/cbu-97.htm>.

### Multiple Warhead Systems (MWS or BROACH)

These combine shaped charge and unitary penetrator technologies e.g. in the BROACH warhead developed for the AGM-86D, AGM-154C and Storm Shadow. One or two shaped charges are at the front of the warhead and loosen up the target on initial impact. A unitary penetrator with delayed action fuse follows through the loosened structure and is detonated inside. Developed for 1000 and 2000 lb warheads, possibly more. See **Defeat of High Value Targets** at: <http://www.thomson-thorn.co.uk/activities/mws.htm>

"A multi-warhead system (MWS) achieves its results by combining an initial penetrator charge (warhead) with a secondary follow-through bomb, supported by multi-event hard target fuzing. The outcome is a warhead and fuze combination that provides for the defeat of hardened targets more than twice that achievable for equivalent single penetrating warhead types, at an equivalent weight and velocity. The warhead technology can be scaled and configured for a variety of weapon payload and targets requirements."

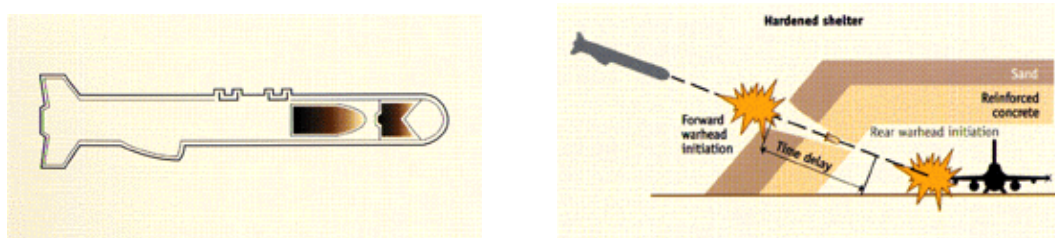


Illustration © 200-2001 Thorn Missile Electronics Limited

Diagrams comparing the unitary penetrator and MWS options for the AGM-86C/D are available at : <http://www.fas.org/man/dod-101/sys/smart/agm-86c.htm> or see section 6 below.

On 6 December 2001 UK Government defence spokesman Mr Ingram denied that DU is used in the BROACH MWS warhead systems, see Hansard quote on page 68 and below.

"The only dense metal contained in the BROACH MWS is a tungsten-based alloy. No other dense metal is or has been used in its development or testing."

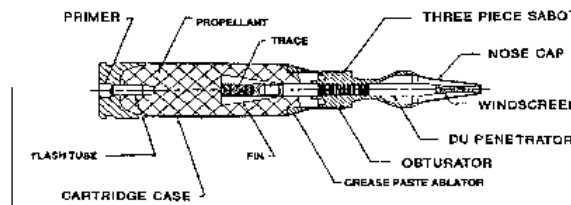
This seems a most improbable reply since Tungsten is likely to have too high a melting point for the shaped charge liner in the first stage. And Tungsten does not offer the potential incendiary effect needed if the second stage warhead is to achieve the US requirement for neutralising chemical and biological warfare targets. The BROACH MWS warhead concept was originally developed to meet US specifications for upgrading the AGM-86D and JSOW AGM-154C, refer data in Tip of the Iceberg on page 15.

#### 4. DU ammunition and armour-piercing weapons

This is the one category of DU weapons that is openly acknowledged by the US and UK governments. These are mostly non-explosive projectile penetrators (see 2.2. above). They provide a reference point for comparing the effects other types DU munitions. Main armour-piercing munitions are:

**20 mm Phalanx** ground-to-air anti-missile shells. Used by several navies including UK and Israel. High density enables low calibre / high velocity. Recent production converted from DU to Tungsten despite price, possibly due to fire risks of stored ammunition. Health and environmental risks low.

**25 mm** ammunition includes the **M791 APDS-T** (Armour Piercing Discarding Sabot with Tracer) shell for the Bradley Fighting Vehicle against light armour. "All rounds are interchangeable with the M242 Bushmaster gun, the KBA B02B automatic cannon, the GE525 (GAU-12/U) Gatling gun, and other NATO-qualified systems." See FAS: <http://www.fas.org/man/dod-101/sys/land/m791.htm> The **M919** 25mm Armor-Piercing, Fin Stabilized, Discarding Sabot with Tracer (**APFSDS-T**) shell has longer range. <http://www.fas.org/man/dod-101/sys/land/m919.htm> .



Picture FAS

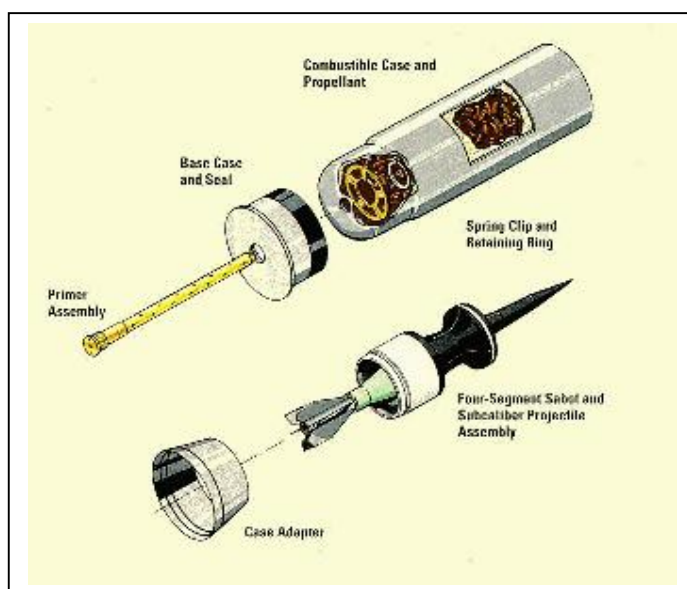
The **AC-130** flying gunship <http://www.fas.org/man/dod-101/sys/ac/ac-130.htm> used extensively for ground support missions in Afghanistan is equipped with the 25 mm **GAU-12** Gatling gun (1,800 rounds per minute) with DU ammunition for use against armoured targets. <http://www.fas.org/man/dod-101/sys/ac/equip/gau-12.htm>

**30 mm PGU-14/B API (Armour Piercing Incendiary)** round "has a lightweight body which contains a sub-calibre high density penetrator of Depleted Uranium (DU). In addition to its penetrating capability DU is a natural pyrophoric material which enhances the incendiary effects. Each DU projectile contains 0.66 pounds (0.3 kg) of extruded DU, alloyed with 0.75 weight percent titanium". Widely used in the Gulf war and 30,000 rounds (9 tons) declared in the Balkans War, mainly from A10 Warthog "Tankbuster" aircraft. These were the DU munitions investigated by UNEP in the Balkans in November 2000. See FAS at <http://www.fas.org/man/dod-101/sys/land/pgu-14.htm> and the "high density" penetrators (DU not mentioned) on the Alliant Techsystems Inc website: <http://www.atk.com/defense/descriptions/products/medium-cal-ammo/gau-8.htm>



Photo © Alliant Techsystems Inc.

**120 mm M829A 2/3** APFSDS-T armour piercing shells for the US Abrams tank. "The 120mm ammunition system equips the M1E1 (Abrams) tank with a 120mm main armament. It consists of a family of kinetic energy (KE) rounds and a family of high explosive anti-tank (HEAT) rounds. The KE rounds use a high length over diameter ratio subcaliber projectile with a depleted uranium (DU) fin-stabilized rod as the penetrator element." Cartridge weight 41 lbs (DU penetrator not specified but perhaps a third of this - 13 lbs / 6 kg). <http://www.fas.org/man/dod-101/sys/land/120.htm>



Picture FAS

"Army test data shows that between 10 and 70 percent of the mass of a DU penetrator oxidises on impact. Thus one 120 mm M829A round would create roughly 1-3 kg (2-7 lb) of depleted uranium dust." (refer Don't Seek, Don't Find, page 20, available at <http://www.miltoxproj.org/DU/IOM-cover.htm>)

Other non-explosive DU penetrator ammunition is known to be manufactured in other countries e.g. the **120 mm CHARM** armour piercing shell for the UK's Challenger tank, and rounds produced by Russia, Israel and China. Different calibre rounds are adapted for a range of other weapons systems e.g. helicopters, small fighting vehicles and field guns (refer FAS and Jane's websites).

**Other armour piercing weapons** include **guided missiles** and some **submunitions** (see section 7). These have much smaller warheads than the hard target guided bombs and cruise missiles described in the next two sections.

But since they all employ heavy metal penetrators or shaped charge warheads it is very likely that some versions rely on Depleted Uranium as a major component in their warheads. DU investigation is needed on at least three missile systems: TOW, Hellfire and Brimstone.

The combined kinetic energy and pyrophoric effects of DU make it a logical option in armour-piercing missiles e.g. the **M220 TOW** fly-by-wire anti-tank missile. "Current versions are capable of penetrating more than 30 inches of armour, or 'any 1990s tank,'. See FAS at <http://www.fas.org/man/dod-101/sys/land/tow.htm>

**TOW** is the most widely distributed anti-tank guided missile in the world with over 500,000 built and in service in the U.S. and 36 other countries."

"(In the Gulf War) the lethality of the TOW missile was proven beyond doubt during the 100-hour ground campaign when one of the antitank munitions fired by US troops went right through the tank it was aimed at and penetrated another tank parked next to it. Another TOW went through a six foot dirt berm and knocked out an Iraqi armored personnel carrier on the other side."

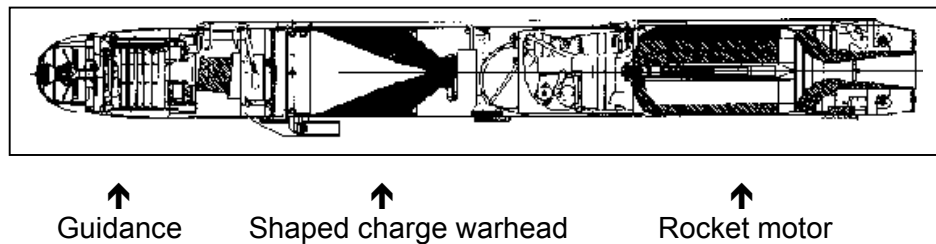
These descriptions are very similar to reports of 120 mm DU tank rounds.

TOW has several warhead options, weight 12 kg, at least one reported to use DU. **"BGM-71C Improved TOW (ITOW)** The Improved TOW (ITOW) was delivered in 1982. This missile has a 5-inch diameter warhead, and includes **an extended probe** for greater standoff and penetration." Is this probe a DU penetrator?

In the late 1980s the **TOW 2A** was developed and in 1991 **TOW 2B (1991)** had a new double (multi-stage?) appears to have no explosive fill in its double warhead.

Other anti-tank missiles e.g. the **AGM-114 Hellfire** and its **Brimstone** variant use **shaped charge warheads**. If DU liners are used in these warheads this would increase their incendiary effects and might explain their names. See FAS at:

<http://www.fas.org/man/dod-101/sys/missile/agm-114.htm>



Picture FAS

No doubt there are several other anti-amour missile systems with similar performance and design options. Though they may deliver relatively small DU loads per target (10+ kilograms) they have been used in significant numbers during and since Operation Desert Storm, potentially adding to DU contamination in target areas

-----=

## 5. 'Smart' or guided bombs (see also Figure 1, page 89)

Smart bombs have been developed by adding fins and guidance units (e.g. JDAM) to "dumb" (free-fall) bombs. Dumb bombs usually have prefixes like BLU e.g. the 2000 lb BLU-109. A smart bomb usually has the pre-fix GBU (Guided Bomb Unit).

The following hard target bombs have been upgraded to use **Advanced Unitary Penetrators** with "dense metal" ballast or casing warheads (see Tip of the Iceberg and 2.3 above). Variants on the AUP concept e.g. the BLU-116 are designed to be fully interchangeable with earlier BLU-109 or 110 bombs. Unless the warhead is specified as well as the guidance kit it is not possible to know which has been used in bombing reports referring generally to GBU-15, 24, 31, 32 etc. Details for each weapon are available via the **FAS Smart weapons index** at <http://www.fas.org/man/dod-101/sys/smart/index.html>

- **GBU-15** GPS guided bomb (2000 lbs) BLU-109 or upgraded with BLU-116 penetrating warhead.
- **GBU-31 JDAM** (2000 lbs) BLU-109 or upgrade.
- **GBU-32 JDAM** (1000 lbs) BLU-110 or upgrade.
- **GBU-24/B Paveway III & 27B Penetrator Weapon**, both with upgraded BLU-109 (2000 lbs) warheads. See FAS website (above) & Raytheon website (below)
- **GBU-28 or GAM-37** (4650 lbs) **Bunker Busters** with upgraded BLU-113 hard target penetrator warhead.

The **JDAM** (Joint Direct Attack Munition) programme "was certified as operationally capable on the B-2 in July 1997. Limited Initial Operational Capability was achieved on the B-52 in December 1998." The bolt on GPS guidance kits cost approximately \$18,000 each. See <http://www.fas.org/man/dod-101/sys/smart/jdam.htm> for JDAM details including the following extracts:

"The Advanced Unitary Penetrator (AUP), a candidate to be integrated with a GBU-31 guidance kit, is a 2000 lb. class penetrator warhead intended as an upgrade/replacement for the BLU-109 warhead in applications requiring increased penetration. The AUP is designed to provide increased penetration capability over the BLU-109 warhead while maintaining the same overall weight, mass properties, dimensions, and physical interfaces associated with the BLU-109 warhead. This concept integrates the AUP warhead with the GBU-31, the JDAM tail kit for 2,000 lb class warheads."

On 12 October 2001 the **Centre for Defence Information** (CDI) Action Update reported that 500 JDAM bombs were used in the first 5 days of the Afghan war. Bombing reports at <http://www.cdi.org/terrorism/actionupdate.cfm>

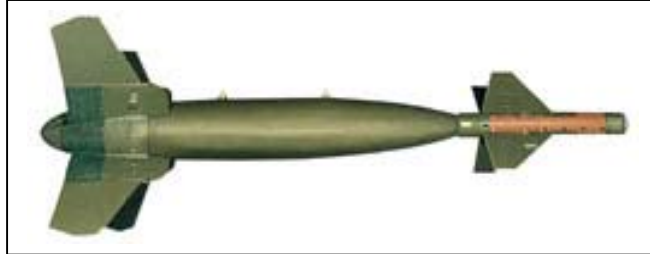
On 5 December a 2000 lb **GBU-31 JDAM** was dropped within 100 metres from US and Afghan alliance troops. Sadly 3 troops were killed. It is hoped for the survivors that this was an old, non-DU version. Otherwise they may have been exposed to intense heat and acute DU oxide dust inhalation.

"Several reporters and photographers complained that they were denied permission to watch or take pictures " not standard Pentagon practice" (Intl Herald Tribune, 6 Dec). If DU was involved they may have suffered severe burns or charring. The survivors may have suffered severe inhaled DU dust contamination putting them at high risk of developing Leukaemia, suffering renal problems or potential defects for future children as suffered by veterans exposed to DU oxide dust in previous operations. Their future



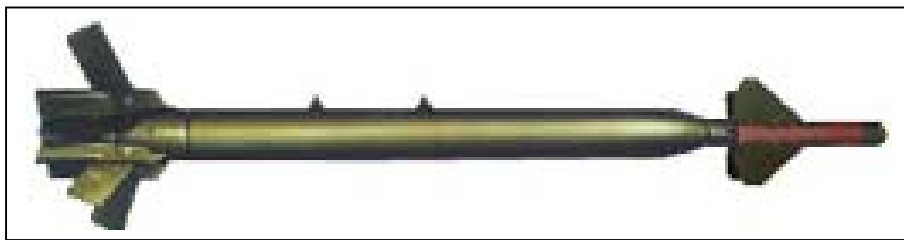
medical condition should be of serious concern to the public and military authorities as potential indicators of the health hazards of high load DU weapons.

For details and pictures of the **GBU-24 Paveway III** (2000 lb), and **GBU-28 or 37** (4400 lb warhead) **Bunker Buster** guided bombs see also the **Raytheon** website at: <http://www.raytheon.com/es/esproducts/dsspvwy/dsspvwy.htm> . .



**GBU-24B**

Pictures © Raytheon



**GBU-28 Bunker Buster**

These are **highly suspected of containing DU as the main ballast in their penetrators** possibly alloyed with small quantities (less than 1%) of other metals like Titanium. They have been used in operation Desert Fox (Dec 98), the Balkans War and Afghanistan. Operations may have involved both old and new versions to run down old stocks and test new ones. See FAS reports via the smart bomb index or direct at <http://www.fas.org/man/dod-101/sys/smart/gbu-28.htm> .

The operation of the **GBU-28 Bunker Buster** is illustrated in a graphic for USA Today at <http://www.usatoday.com/graphics/news/gr/gbuster/frame.htm> .

The GBU-28 weighs 4650 lbs including a 4400 lb warhead with 630 lbs of explosive. "The composition of the rest of the warhead is classified". They cost \$145,600 each. Discounting the cost of guidance unit, fuse and explosives (say \$25,000) then the warhead material would cost about \$32 per lb. Metal traders can calculate whether this is more likely to be tungsten or depleted uranium.

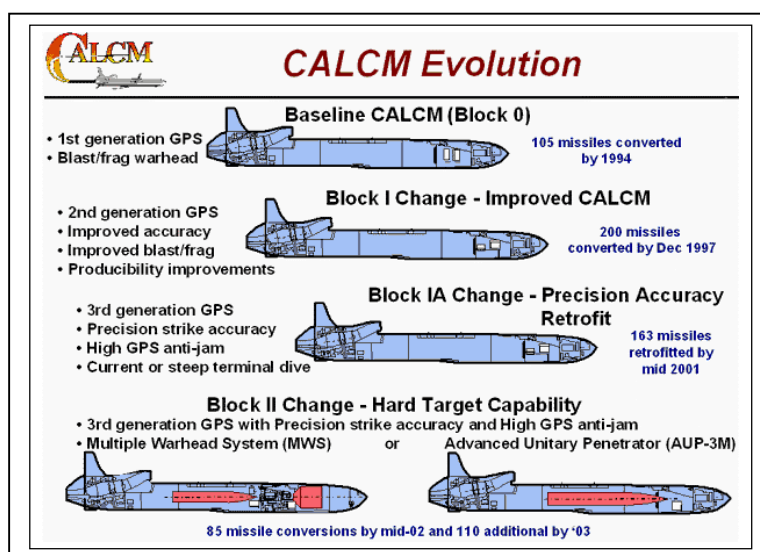
These smart bombs represent a large proportion of the ordnance used in the Afghan War. From CDI reports it is estimated that at least 500 tons of smart bombs and cruise missiles were used in the first month of the war. The extensive bombing of the Tora Bora region would have mainly involved hard target weapons so in total over 1000 tons of them may have been used in the Afghan. If these are mostly DU based munitions they may represent 2-3 times the tonnage of DU declared in the Gulf War in Iraq.

## 6. Hard Target Cruise missiles (see also Figure 1, page 89)

Hard target versions of cruise missiles with new Advanced Unitary Penetrators or Multiple Warhead Systems are highly suspected of containing DU. See the **FAS** index at: <http://www.fas.org/man/dod-101/sys/smart/index.html> Key systems are:

**AGM-86D CALCM (Conventional Air Launched Cruise Missile)** . The CALCM is a long range cruise missile (600+ miles) originally designed for nuclear weapons. Old stocks have been converted to conventional blast or penetrator warheads over the last 3 years. 30-50 86C's were used in the Balkans War. See FAS report for development history and diagrams of warhead options at:

<http://www.fas.org/man/dod-101/sys/smart/agm-86c.htm>



Picture FAS  
© Boeing ?

Uses a Lockheed Martin AUP-3M penetrator (1200 lbs\*) see FAS and Boeing sites. Conversion of 85 from previous nuclear to new hard target warheads. 35 x 86C's were tested in Desert Fox (Dec 98). Others used in the Balkans War. Competition between Lockheed Martin and BAE-RO BROACH warheads from mid-98.

Prototype testing for both warheads suspected during Balkans War. Upgrade contract for 50 AGM-86D confirmed 29 Nov 1999 for delivery by mid-2001. Lockheed option confirmed 2 Dec 99 (see Boeing new releases). **Several different warhead weights are reported.** The AGM-86C Block II upgrade carries a 3,000-lb PBXN-111 Blast Fragmentation Warhead (FAS). The 1998 Boeing BROACH tests refer to a 900 lb warhead (Boeing 11 June 1998).

The FAS description of the AUP-116 2000 lb penetrator notes "a proposal to replace the current CALCM warhead with an AUP warhead provides 2.5 times BLU-109 penetration capability." This would be consistent with plans to standardise warhead options across a variety of guided bomb and missile delivery systems. The Lockheed AUP-3(M) is quoted as 1,200 lb (Boeing 2 Dec 1999). 86D test reported Nov 29, 2001. <http://www.boeing.com/defense-space/missiles/calcm/calcm.htm>

**AGM-130C** A powered version of the GBU-15 guided bomb with a rocket motor for extended range. TV or infrared seeker guidance. The 130C adapts the munition to a 2,000 lb penetrating warhead (BLU-109/B or BLU-116), one of the biggest AGM's. See <http://www.fas.org/man/dod-101/sys/smart/agm-130.htm>

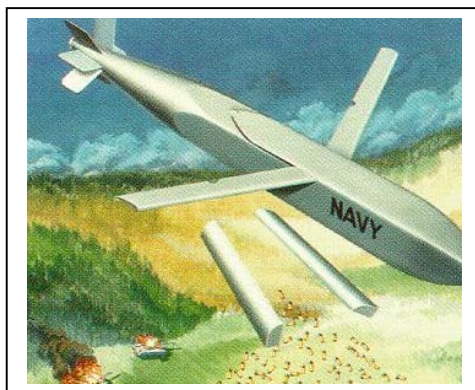


**AGM-142 Raptor (Hav Nap)** One of the earliest and largest hard target cruise missiles, developed by Israel in the 1980's. Its **I-800** penetrator warhead (770-800lbs) was added soon after the Gulf War. The US produced version is designated AGM-142. Used in the Balkans and in the recent Afghan bombing as supplies of US AGM-86D ran low. See FAS at <http://www.fas.org/man/dod-101/sys/smart/agm-142.htm>



AGM-142  
Picture © FAS

**AGM-154C JSOW** see FAS and Raytheon sites. The BAE-RO BROACH warhead was evaluated in 1998 for the hard target version C. It appears that this warhead was chosen for recent production. <http://www.fas.org/man/dod-101/sys/smart/agm-154.htm>



AGM-154C  
Picture © FAS

**BGM-109 Tomahawk** (Unitary & Penetrator Versions). Tomahawk has evolved through several versions including the **conventional land attack missile (TLAM/C)**. It is not clear whether earlier unitary warhead versions of Tomahawk contained DU munitions. This was denied by the US Navy in 1999. However according to FAS "the **Tomahawk Baseline Improvement Program (TBIP)** will also enhance its hard target penetrating capability beyond current weapons systems. These missiles are expected to enter service around 2000."

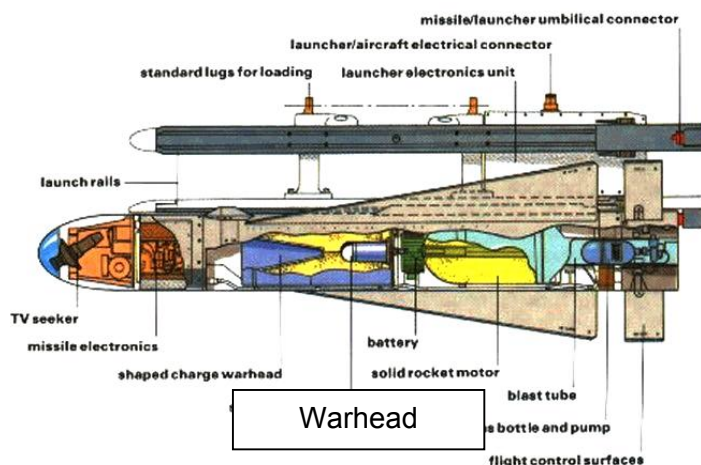
"On 27 May 1999 Raytheon was awarded a \$25,829,379 undefinitized cost-plus-incentive-fee/cost-plus-fixed-fee, ceiling amount contract for the modification of the Tactical Tomahawk missile to the **Tactical Tomahawk Penetrator Variant** configuration as part of the Second Counter-Proliferation Advanced Concept Technology Demonstration. The Tactical Tomahawk missile will be modified to incorporate the government-furnished penetrator warhead and the hard-target smart fuze." Quotes from FAS at <http://www.fas.org/man/dod-101/sys/smart/bgm-109.htm>

Tomahawks can carry a 1000 lb warhead. This could be the AUP-1000 specified in WPNS 114 in 1997 for the GBU-32 upgrade. Or it could be 4 x 250 lbs Small Smart Bombs with high penetration warheads. Prototype and production schedules for Tactical Tomahawk are not known but if an existing warhead is incorporated it seems likely that prototypes at least may have been among the 60 sea launched Tomahawks in the first week of the Afghan war. See also information on the Raytheon website at <http://www.raytheon.com/es/esproducts/esprlist.htm#Missiles>

**AGM-84 SLAM-ER (Expanded Response) Block 1F**, "a major upgrade to the SLAM missile that is currently in production, provides over twice the missile range, target penetration capability, and control range of SLAM. SLAM-ER has a greater range (150+ miles), a titanium warhead for increased penetration etc".. This reference to Titanium is inconsistent with all other reports about the physical properties required for penetrator warheads i.e. 2x the density of steel. It is probably a euphemism for a DU-Titanium alloy with < 1% Titanium. Warhead weight 488 lbs. " About 500 SLAM missiles will be converted to the SLAM-ER configuration between FY 1997 and FY 2001." See FAS <http://www.fas.org/man/dod-101/sys/smart/agm-84.htm> .

**Storm Shadow / SCALP ER**. This is a new European long range cruise missile project (joint BAE-RO and Matra) designed to use a BROACH warhead, strongly suspected of using a DU penetrator in its second stage. In Service Date was planned for late 2001. Similarities in function to the AGM-86D but possibly using the smaller BROACH warhead (500 lbs ?) developed for the AGM-154C in 1998-99. Production progress is not known but on original schedule it may have been used in Afghanistan for combat testing. <http://www.fas.org/man/dod-101/sys/missile/row/casom.htm>

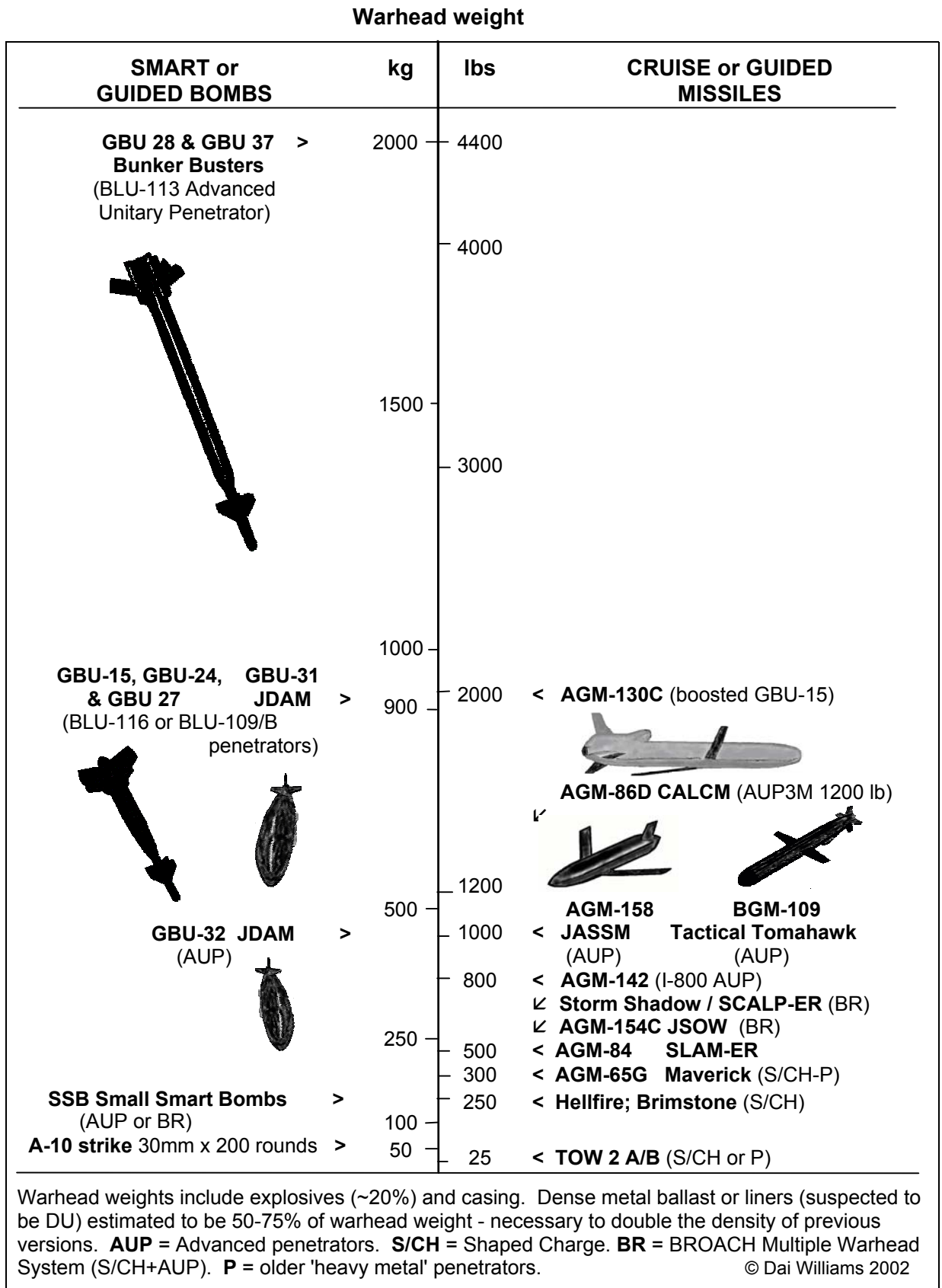
Other cruise missiles suspected of using DU are those described as having "heavyweight" or **shaped charge warheads**, or both. Of these the most important is the **AGM-65G Maverick**. Commissioned in 1989 this radically pre-dates the new generation of advanced penetrator weapons. According to FAS "the **Maverick G** model essentially has the same guidance system as the D, with some software modifications that track larger targets. The G model's major difference is its **heavyweight penetrator warhead** [300 pounds / 135 kg, delayed-fuse penetrator], while Maverick A, B and D models employ the shaped-charge warhead." See FAS at <http://www.fas.org/man/dod-101/sys/smart/agm-65.htm>



Picture © FAS

The AGM-65 Maverick has shaped charge or penetrator warheads depending on version.

**Figure 1: Hard target guided weapons in 2001: smart bombs & cruise missiles with "dense metal" warheads**



**The Maverick** seems too lightweight to have been widely used in the Afghan conflict. Its prime importance in this DU investigation was its **widespread use in the Gulf War** and its **international proliferation**. It has the highest US inventory level in the FAS smart weapons Index (40,000 units) and has been exported to many countries. 5,300 were launched during Operation Desert Storm and it is used by 24 nations according to Raytheon see <http://www.raytheon.com/es/esproducts/dssmav/dssmav.htm>

If one or more versions of the Mavericks in the Gulf War contained DU based warheads this could **significantly alter assessments of DU use in Iraq** - total tonnage, target locations, the geographic spread of DU contamination and hence exposure levels to civilians and veterans. It is reported that some of the UK veterans suffering Gulf War Syndrome had DU exposure ruled out because they had been involved in a Maverick friendly fire incident, not known DU anti-tank munitions. Veterans groups may wish to press for full investigation of all versions of the Maverick system for suspected DU use.

**Hard target cruise missiles** represent the second greatest DU threat in Afghanistan, and possibly the Balkans, after the guided bombs listed above. Their warheads are somewhat lighter because cruise missiles include fuel and propulsion systems, ranging from 300 - 2000 lbs. They are weapons of choice for hard or deep targets in heavily defended combat zones where aircraft may be at risk. They are also up to 3 times more expensive per size of warhead delivered than guided bombs so relatively less missiles than smart bombs may have been used in Afghanistan once air defences had been destroyed. However this conflict was ideally timed for **testing several newly produced or prototype missile systems** e.g. AGM-86D, Tactical Tomahawk, AGM-154C upgraded, SLAM-ER and Storm Shadow.

Suspected use of some of these systems in earlier conflicts in Iraq and the Balkans requires re-assessment of target zones and DU exposure in both regions.

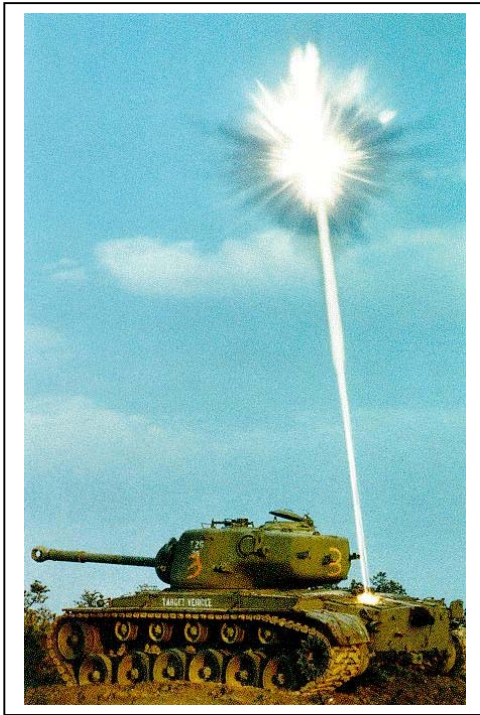


## 7. Other suspected DU weapons systems

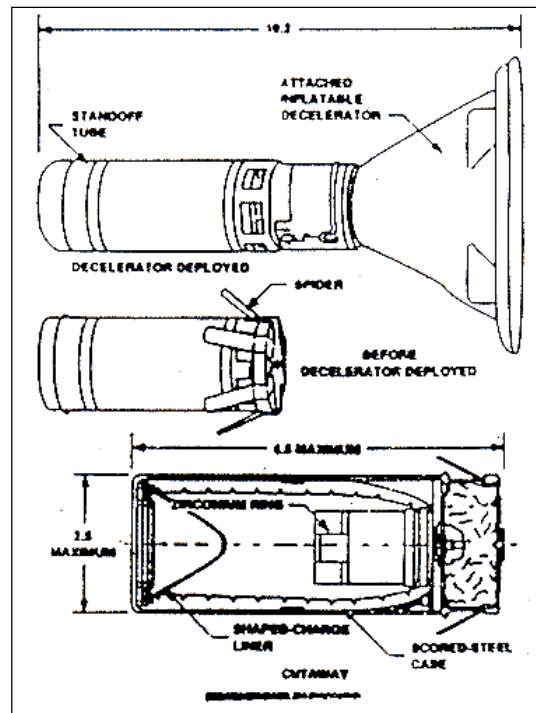
Other suspected applications of DU are in sub-munitions weapons.

**Cluster bombs** with anti-armour sub-munitions may use DU in their shaped charge liners. For example the CBU-97 contains 10 x **BLU-108/B** sub-munitions each with four armour-penetrating projectiles with infrared sensors to detect armoured targets...an **explosively formed penetrator** \* fires at the heat source." see <http://www.fas.org/man/dod-101/sys/dumb/cbu-97.htm> and picture below left.

Pictures © FAS



**BLU-108/B explosive formed penetrator**



**BLU-97B with shaped charge liner**

The CBU-87 Combined Effects Munition contains 200 **BLU-97B** bomblets. This was the most widely used cluster bomb in the Balkans War. Its conical liner is shown in the diagram above (right) and in the full FAS description and illustrations at: <http://www.fas.org/man/dod-101/sys/dumb/cbu-87.htm>

The metal used for the shaped charge liners in both of these systems is not specified in FAS reports. But if DU is used it would add incendiary effects to each weapon. In both cases the combination of high temperatures and explosives would be likely to lead to 100% combustion if DU is used, with significant localised DU contamination hazards.

**UNEP study teams in the Balkans were warned to stay clear of cluster bomb target zones for danger of unexploded munitions.** Ironically if either or both systems contain DU liners they may have yielded as much localised DU oxide contamination as the 30 mm penetrators they found. Since shaped charge liners project molten metal DU liners may burn up to 100% on impacting the target. This could be important in surveying suspected DU targets in Afghanistan i.e. to include DU inspections of vehicles or buildings damaged or burned by cluster bomb attacks. The possibility that wounds may also be DU contaminated is another consideration for medical teams treating cluster bomb victims.

\* Note: A similar molten penetrator design is used in AT (anti-tank) Scatmines. See FAS at <http://www.fas.org/man/dod-101/sys/land/m93.htm>

Another type of sub-munitions suspected of containing DU warheads are the new range of smaller hard target weapons called **Small Smart Bombs (SSB's)** referred to as "**high density loadouts**" in the 1997 Concept Plan (see Tip of the iceberg in Part 1). According to the following FAS descriptions they achieve remarkable penetration for their size:

"As of 07 January 1998 ACC approved a new acquisition strategy for the Small Bomb System (SBS) program. The Small Smart Bomb is a 250 pound weapon that has the same penetration capabilities as a 2000lb BLU-109, but with only 50 pounds of explosive. The submunition, with a smart fuze, has been extensively tested against multi-layered targets. The length to diameter ratio and nose shape are designed to optimize penetration for a 50lb charge.

This weapon is also a potential payload for standoff carrier vehicles such as **Tomahawk, JSOW, JASSM**, Conventional ICBM, etc. The goal of the predecessor Miniaturized Munitions Technology Demonstration (MMTD) effort was to produce a 250-pound class munition effective against a majority of hardened targets previously vulnerable only to 2,000-pound class munitions. Using personnel and experience gained from the GBU-28 "Bunker Buster" program and the Exploitation of Differential Global Positioning System for Guidance Enhancement (EDGE) programs, the MMTD test team completed development testing in 18 months. McDonnell Douglas was awarded a \$6 million contract to assist in the design and development of the MMTD concept. After completing successful warhead (Jan 96) and system (Mar 96) CDRs, the warhead already demonstrated the objective of penetrating 6 feet of reinforced concrete. "

"The **second generation SSB** has an **advanced warhead** which is designed to maximize penetration capability without sacrificing blast/fragmentation potential. This is achieved by use of **liners** to control fragmentation and enhanced energetic explosives such as HMX or CL-20."

See <http://www.fas.org/man/dod-101/sys/smart/mmc.htm> and compare with the 1997 concept WPNS118 at [http://fas.org/man/dod-101/usaf/docs/mast/annex\\_f/part26.htm](http://fas.org/man/dod-101/usaf/docs/mast/annex_f/part26.htm)

It is not known whether SSB's are already in use as Tomahawk or JSOW sub-munitions. The casing is described as "steel". But the above description fits the recurring theme of slim, **high density** warheads common to the advanced unitary penetrators from the same design team as the much bigger GBU-28.

-----

**A systematic investigation is needed of all the suspected DU weapons systems identified in Part 3 of this report, and of any other systems with similar warhead design features. This may be carried out by Parliaments in every country stocking these weapons seeking public disclosure by their military forces and by the weapons manufacturers concerned. Investigations may also need international co-ordination by the United Nations or International Court.**

**At the same time environmental review of all known training and combat target areas for these weapons is needed in case disclosure is not volunteered by the military. Any medical surveys of civilians and troops in regions within at least 10 kilometres of hard target bombs or missiles will also need re-assessment.**

**Part 4**

January 2002

**DU weapons review:  
Human, environmental and political issues in 2002**

<b>1. DU scenarios: What if DU is used in hard target weapons?</b>	<b>93</b>
<b>2. Re-thinking DU: effects of high load DU weapons</b>	<b>99</b>
<b>3. High exposure DU health risks - identification &amp; re-assessment</b>	<b>105</b>
<b>4. Environmental impacts - assessment &amp; radical re-assessment</b>	<b>111</b>
<b>5. Humanitarian aspects of DU risks in Afghanistan</b>	<b>113</b>
<b>6. Political context: deception, DU proliferation and control</b>	<b>115</b>

Parts 1-3 identified suspected proliferation of DU weapons and their potential use in the Afghan War in 2001. Part 4 reviews the immediate implications of these questions for Afghanistan, the need for radical re-assessment of DU use and hazards, and priorities for international action in 2002.

Independent specialists are already investigating several of these issues. But effective action in 2002 will rely on public awareness, international co-operation and rigorous legal and political accountability for the development and use of DU weapons.

The scenarios and issues in Part 4 will require updating as post conflict assessments and aid programmes get underway in Afghanistan and as more facts emerge.

**1. DU scenarios: What if DU is used in hard target weapons?**

This report questions the identity of the high density "mystery metal" used in hard target guided weapon systems. What is it? The answer is currently a military secret. But all available evidence indicates that it is either Depleted Uranium alloy or Tungsten.

If the mystery metal is DU this raises fundamental questions about the potential effects of high load (large warhead) DU weapons. These questions have not been publicly debated by any government, or by medical or environmental scientists outside military research establishments until the DU Conference in Prague on 25 November 2001.

The answers could be vital to the health of civilians and troops in Afghanistan now. If they have to wait several months until physical proof of DU becomes available - in health epidemics, birth defects or samples of DU contamination - thousands of preventable fatalities may occur. But this is the likely outcome if these issues are not put on the international agenda now.

Aid organisations and UN agencies cannot wait for proof about DU hazards before committing resources to post-conflict aid. The US and UK governments know the facts about the weapons used and from their initial NBC survey results. They firmly deny that any DU has been used. Unfortunately they may be relying on obsolete assessments of DU health hazards. On the evidence in Part 2, UK Government statements about hard target weapons cannot be trusted. So how can other governments and aid organisations commit human resources to Afghanistan without risking the health or lives of their personnel?

In business and military planning one method for decision making in conditions of uncertainty is called **scenario planning**. This involves asking "what if" questions before disasters occur - not waiting until they become obvious. Experienced aid organisations probably do this too. Any post-combat environment requires careful and comprehensive risk assessments. This was the objective of the UNEP Balkans Task Force.

DU involves political as well as physical hazards. **There are compelling commercial, military, legal and political reasons for the US, UK and other governments to minimise public interest and concern about Depleted Uranium - both in military and civilian use.** This creates the additional risks that the global proliferation of DU weapons may be far wider than realised and that their risks have been trivialised.

The US, UK and possibly other alliance governments appear to believe propaganda from the nuclear and arms industries, and their sponsored scientists that DU involves minimal health hazards. In doing so they may be putting the lives of their own troops and civilians, as well as the Afghan people, at serious risk. This re-assurance was promoted very effectively with post-Balkans DU assessments published in 2001.

The danger is that this new found confidence in DU safety could deter, delay or subvert rigorous medical and environmental DU risk assessments in Afghanistan (page 127).

**DU scenario planning is important to counter any complacency about potential DU hazards following the Afghan bombing.** This involves considering a range of options - from the most positive hope that DU has not been used to a worst-case scenario. Relevant assessment methods and safety precautions can then be planned for each. The new UNEP PCAU started a desk study of potential environmental hazards in early December prior to field inspections. Should they look for evidence of DU or not?

**DU scenarios can be built around the present areas of uncertainty e.g.:**

#### 1. Capability:

- a) How many **US and alliance weapon systems** use DU components - past, present and under development? Which versions are involved, which warhead technology, and how much by weight in each munition? (This question is not restricted to systems used in Afghanistan.)
- b) Do **Al Qaeda or the Taliban** have DU or any other potential weapons of indiscriminate effect i.e. radioactive, toxic, chemical or biological weapon systems or materials? What is known about them - version, technology, location and weight?

#### 2. Use

- c) **Have any DU or other uranium based weapons been used** by either side since October 7<sup>th</sup> 2001?
- d) **If DU weapons have been used** then which ones, how many, on what targets and exactly when were they used? (Time correlates with wind/dispersal.)

#### 3. Targets and exposure risks

- e) **Population directly exposed** in target area at time of attack: remote location (military personnel only), rural community, or high density urban area.
- f) **Population indirectly exposed** after attack - in target area and downwind.
- g) **Individual dose levels** - low, medium or high. Temporary or ongoing exposure.
- g) **Hazardous target materials** e.g. ammunition stores (with DU?), medical X-ray facilities, other toxic materials (suspected NBC targets).



**Seven DU-exposure risk scenarios** illustrate some combinations of these variables. Other scenarios can be added. Estimated DU tonnage is for the first 3 months.

#### **Low or minimal risk scenario**

- 1) **No DU** has been used by any party in the conflict and no radioactive targets hit.

#### **Localised risk (less than 1 kilometre)**

- 2) **Small quantities of DU** have been used by allied forces in **known DU weapon** systems i.e. the AC-130 gunship. Estimated quantity **less than 10 tons**.
- 3) DU has been used in **some new** (or not previously admitted) **allied weapon** systems. Relatively **small mass of DU per weapon**, or in **very few, non-urban locations**. Estimated quantity **10-50 tons**.

#### **Serious risk to target zones and significant risk to surrounding areas (5-10 km)**

- 4) DU has been used **by Al Qaeda forces** (suggested in US "dirty bomb" report, 5 December). Size of weapons and contamination levels unknown. Tactical reason unknown. OR allied bombs hit weapons store containing DU or other radioactive materials. Estimated quantities **10 - 50 tons, possibly in populated locations**.
- 5) DU has been used in **larger weapons systems but in remote locations** e.g. the Tora Bora region. Estimated quantities **100-500 tons**. Contamination likely to spread to other areas over years through wind & water.

#### **Severe exposure risk in target zone and widespread areas (10-20+ km)**

- 6) DU has been used in several of the **larger weapon systems** identified in this report some of which have been used in **urban locations** like Kabul and Kandahar. Estimated quantities **100-500 tons**. Extensive contamination of populated areas. Contamination likely to spread to wider areas over years through wind and water.

#### **Nightmare scenario (20-50+ km)**

- 7) DU has been used in **most of the hard target weapon systems** identified and in **many locations** including **water catchment areas and supply systems**. Estimated quantity **500-1000 tons or more**. Extensive contamination over large areas. Water supplies and irrigated areas permanently contaminated. Exposure spreads to other regions and across borders in dust storms, rain and snow.

Part 3 explained the type of **US / alliance weapons** that may contain the **mystery dense metal** and approximate amounts per warhead. It can only be Tungsten, Depleted Uranium alloy or a combination of both. If **Al Qaeda "dirty bombs"** have been used, or DU stocks hit by US bombing, these are most likely to involve DU, not enriched uranium. High-level radiation hazards would have been obvious to normal military monitoring and should have reported by now. The environmental impacts and health hazards of DU dirty bombs are likely to be similar to those of hard target DU warheads of similar size. However they would require specialised DU detectors.

Scenarios 1-3 are the most optimistic and feasible to contain. 2 and 3 still present significant hazards to that need urgent assessment and precautions.

Scenarios 4-7 involve serious levels of risk. Unfortunately DU dust requires alpha radiation monitoring and laboratory analysis of dust or water samples. Large quantities could have been used without the public being aware of widespread hazards yet.

**DU contamination may be localised** if hard target weapons explode in **underground targets** without a large surface crater and dust cloud. Some weapons are designed to minimise risks of collateral contamination from chemical or biological weapons targets. However contamination could be very severe within such targets. Full NBC protection would be essential for military or civilian inspection teams including Afghan civilians involved in "clean-up" operations.

**Long term ground water contamination** could be a serious issue for such targets, especially in natural caves or underground water supply aqueducts (or "**kerez**") - refer Fred Pearce's **New Scientist** article reported on page 43. UNEP inspections need to include these targets. Locations should be chosen independently since US forces will know which weapons have been used on each target. Older versions may not contain DU. Newer versions of guided bombs especially **GBU 24** and the **GBU-28** and **GBU-37** Bunker Busters are highly suspected of being DU-based munitions. The New Scientist article suspected they would be used on Kerez targets which supply local communities and irrigation systems. These weapons have the highest contamination potential if they contain DU alloy ballast or casings - potentially from 700 to 1500 kg per weapon - see **Figure 1** on page 89. Comprehensive target and water testing needed

**Immediate DU contamination health effects** e.g. those suspected by Taliban doctors in October (see page 35) could go undiagnosed by non-military personnel as part of multiple injuries associated with heavy conventional bombing. This possibility is illustrated in Professor Herold's study. The reports he analysed recognise many casualties but concentrate on fatalities and obvious blast or fragmentation injuries without questioning potential effects of inhaled or ingested DU dust. Low level radiation is an invisible hazard that may not be recognised for many months until birth defects or cancers become apparent. Even then suspected DU causes may be denied by military and political authorities for years as for Gulf veterans and Iraqis.

**Several fundamental problems could arise if DU is the mystery metal used in large guided weapons warheads, or in fairly large Al Qaeda devices:**

1. **Scale of use per target:** The new hard target warheads - unitary penetrators and multiple warhead systems - could yield up to 100 times more DU oxide contamination per target than an A10 attack with 30mm DU ammunition as monitored by UNEP in Kosovo.
2. **Wider tactical applications than known DU weapons:** Hard target guided weapons are designed for use in a much wider range of combat situations - for any fortified or underground target, not just anti-armour operations.
3. **Higher DU combustion potential in explosive warheads:** The new hard target warheads, penetrators and shaped charges, are all explosive devices. If they contain DU this is likely to yield up to 100% combustion to form DU oxides. Known DU anti-armour ammunition consists of non-explosive penetrators which do not ignite unless they hit a heavily armoured target.
4. **Wider geographic dispersal:** DU oxide contamination from large warheads is likely to be widely dispersed owing to a combination of explosive effects and thermal convection from the intense heat of DU combustion when fragmented or superheated. Larger particles will deposit near and downwind of the target but 60+% of DU oxide converts into fine dust less than 1.5 microns diameter. This may stay suspended in the atmosphere in smog like conditions.

When DU oxide dust settles into sand, soil or water it cannot be economically removed. Estimated cost for decontaminating the DU testing area at the Jefferson Proving Ground is \$7.8 billion. Heavily contaminated areas could be perpetually unsafe for human habitation, agriculture or water catchment.

**5. DU contamination with higher isotopes:** UNEP analysis of DU penetrators in Kosovo highlighted the issue of "dirty DU" - contamination with exotic isotopes due to recycling nuclear fuel rods during reprocessing. The isotopic mix declared by Starmet for DU supplied to the UK Government contains lower levels of contamination than other reported DU samples. Refining quality control probably varies widely between differing production facilities and at different times. Small percentages may seem insignificant in a 30 mm penetrator. But even the Starmet figures could represent 4 kg of U235 in a 2 ton GBU-28 Bunker Buster bomb. Isotopic contamination could be even more serious if Al Qaeda had obtained DU from unreliable processing sources e.g. possibly from old nuclear facilities in Russia.

**6. New health problems are to be expected from acute DU contamination:** Previous health studies related to Gulf War syndrome investigations have assumed low level exposure to low level radiation hazards e.g. based on the quantities of DU reported in Kosovo. DU is suspected of contributing to long term health hazards but until now military commanders, analysts and politicians have discounted short-term hazards to troops (and presumably civilians) in DU targets zones as "minimal". They didn't have Doha data.

" Even for the relatively small quantities of DU oxide contamination per target known in the Gulf war (0.3 to 3.0 kg ) US Government sponsored studies gave misleading estimates of exposure to soluble DU. The OSAGWI report (1998) indicates that soldiers in the worst case scenario could have inhaled 9 mg of soluble DU. CHPPM's study shows they could potentially inhale up to 25 mg of soluble DU." ([Don't Look, Don't Find](#), pages 20-21)

If DU has been used in bomb and missile warheads in both Afghanistan and the Balkans then these previous exposure assumptions become invalid. There are no published studies of DU contamination levels in the vicinity of DU bomb or missile targets. Since such weapons do not officially exist there are no published studies of the health of troops or civilians with acute DU exposure near bomb or missile targets.

Radiation and toxic exposure levels are likely to be far higher than previously reported except for troops in vehicles hit by large (120 mm) DU penetrators which ignited. Very few of these would have survived the intense heat involved. Serious health effects from acute DU contamination are likely to develop in weeks or months, not years. US and UK forces may already be seeing these effects on special forces troops asked to investigate recently bombed command bunkers etc unless they were wearing full NBC protection.

The DU scenarios suggested for the Afghan bombing, combined with the factors above, raise serious issues for military commanders concerned for the welfare, trust and morale of their troops. The carcinogenic and teratogenic risks to children of troops exposed to moderate or acute DU contamination may have serious implications for future military recruitment.

**These scenarios should ring alarm bells for all politicians and heads of state** who are currently committing troops and civilian aid workers to post-conflict support, or enabling the return of refugees after the recent US bombing in Afghanistan. If 500 - 1000+ tons of DU has been used in Afghanistan, many areas may be unsafe for human habitation.

Such scenarios also raise severe dilemmas for the international community. Afghanistan needs humanitarian aid and military security immediately. But personnel in the international support programme are at potentially serious risk until DU hazards are fully investigated. The immediate task is to find out whether the mystery metal used in hard target guided weapons is Depleted Uranium, and if so exactly how much has been used and where in Afghanistan since October 7th 2001. This information is unlikely to be volunteered by the US or UK governments. It will require pressure from politicians, the media, the UN and possibly the International Court.

Equally urgent is the need to assess potential DU contamination in Afghan locations targeted for bombing, cruise missile and cluster bomb attacks. It is hoped that this will be an immediate objective of the UNEP PCAU team.

However UNEP's analysis is likely to take several weeks before initial environmental samples can be analysed. Full environmental monitoring of all bombing locations and neighbouring areas will take many months and will need to be repeated in the spring and summer as potential airborne dust and water contamination increases. Several waves of sampling will be needed with initial priority on highest potential risk sources e.g. airborne dust and water supplies.

These delays could increase potential DU exposure risks to thousands of people. How can potential DU exposure risks be minimised until more facts are available? Health and safety risk assessments are needed based on all the scenarios proposed. One hope is the possibility that airborne contamination may be less during the winter. This needs to be checked by environmental scientists. It could give 2-3 months for field investigations to be analysed before decisions have to be made about whether to relocate communities in potentially high contamination risk areas.

An immediate concern is for Afghans and international personnel who have been in Afghanistan during the bombing period. This includes refugees now in neighbouring countries near the heaviest bombing zones e.g. northern Pakistan. They may have already had significant DU exposure. Civilians and refugees may need extra medical support in addition to the problems of famine, drought and winter.

These scenarios raise major health and welfare policy issues for all organisations involved in managing the aftermath of the Afghan war - issues that have not even been debated in public yet. The final sections of this report highlight key implications.

## 2. Re-thinking DU: effects of high load DU weapons

Politicians and the public in UK, and probably most other countries appear largely unaware or unconcerned about the use of depleted uranium in military or civilian applications. They are more aware of Gulf War syndrome as a mysterious illness that seems to evade diagnosis. The term "depleted" has been very effective for reducing anxiety and legitimate concerns about "Uranium", well known as a radioactive metal.

Those politicians, reporters, researchers, union representatives and campaigners that are more aware of the uses and potential problems of DU have usually had some direct involvement in its potential hazards. Some have raised questions on behalf of people who are suffering serious health problems, either after military service in the Gulf, after working in civilian or military manufacturing processes involving DU or who live near manufacturing or testing facilities. Others have become concerned about the horrendous health problems in parts of Iraq since the 1991 Gulf War.

Most suspected DU health problems have slow and insidious effects e.g. cancers or birth defects. Except in Iraq or near Uranium mining or intensive weapons testing facilities (e.g. in the USA) these health effects appear to be fairly low occurrence e.g. Leukaemia deaths among Nato troops after the Balkans war. These are not easy to distinguish from effects in the general population owing to a wide range of causes e.g. widespread use of chemicals or fallout from the 2000+ nuclear tests conducted mainly by the USA and Russia in the last 50 years.

The main health problems suspected from DU are due to its "low level" radiation hazards. These have been trivialised in periodic health studies e.g. the US RAND report (1999), the UK Royal Society Report (2001), and a number of Nato troop studies following the Balkans War. These studies are listed in the US Department of Defense report "Depleted Uranium Environmental and Medical Surveillance in the Balkans" (25 October 2001) at [http://www.deploymentlink.osd.mil/du\\_balkans/index.html](http://www.deploymentlink.osd.mil/du_balkans/index.html)

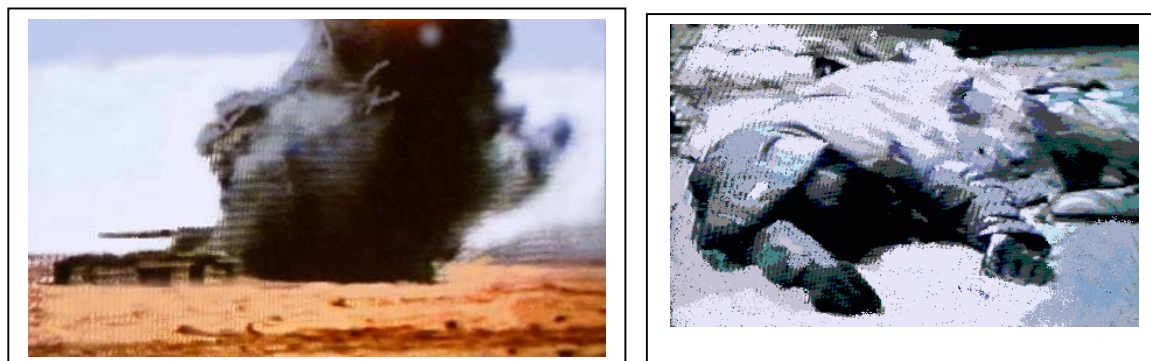
Most of these studies and their associated publicity have assumed that exposure levels to DU oxide are usually low - based on small quantities of airborne dust following use of anti-tank munitions. e.g. the UK **Royal Society** report comment:

"Except in exceptional circumstances any extra risks of developing fatal cancers as a result of radiation from internal exposure to DU arising from battlefield conditions are likely to be so small that they would not be detectable above the general risk of dying from cancer over a personal lifetime". (The Health Hazards of Depleted Uranium Munitions Part 1, May 2001).

Most studies have been conducted so long after initial exposure (several years or not at all) that individuals suffering more severe effects may have already died and been excluded from sampling. This appears to have happened with US and UK studies of Gulf War veterans. I am not aware of any systematic studies of civilian populations exposed to military use of DU by the US, UK or other governments, or by the WHO.

Studies of Gulf war veterans and casualties have been curiously selective. The highest suspected exposure cases - crews injured by shrapnel in vehicles hit by DU penetrators - who appear to have had relatively few health problems are used to indicate that DU munitions are relatively safe. These studies are riddled with flaws explained in **Don't Look, Don't find**, page 3 onwards. They excluded two thirds of the personnel exposed. DU testing and other health assessments were delayed for years.

The smaller penetrators that cause shrapnel without igniting (depending on hardness of armour and angle of impact) would not present anything like the acute inhalation hazards associated with those which did ignite, and less than the larger 120 mm shells. When these ignite they create dense clouds of black DU oxide dust (see picture below left). In the latter case most casualties would also have suffered severe burns (partly carbonised, see below right) and were likely to die of these or multiple injuries.



It is possible that rescue and recovery teams who worked with DU casualties or recovered DU damaged vehicles were at special risk during the Gulf War, and possibly in parts of the Balkans. They may have experienced higher and more prolonged exposure to DU oxide dust from the larger (120 mm) penetrators that ignited, than casualties injured by shrapnel when small penetrators passed through their vehicles, creating some shrapnel but without full ignition. Some of these latter casualties with embedded DU shrapnel have been centre-pieces of the US DoD view that DU is not hazardous even in acute doses. Dan Fahey explains how difficult it was to get accurate exposure statistics for these and thousands of Gulf War veterans.

It now seems possible that other troops and support personnel in the Gulf War may have been exposed to different, and potentially larger, sources of DU contamination from guided weapons not previously suspected e.g. Maverick and TOW missiles.

It follows that the precise circumstances of exposure for these "high risk" DU survivors may need to be questioned more carefully. Were these survivors actually exposed to the same levels of internal DU oxide contamination as others who have since died, or suffered multiple medical problems? How comparable are the biological and radiological hazards of DU as embedded metal shrapnel compared to inhaled and ingested DU oxide dust?

All casualties deserve respect and concern and hope that they have minimum disruption from any kind of contact with DU. But some may have been at higher risk than previously acknowledged by military and medical researchers, depending on exactly the type of exposure they suffered, and how long for.

For example some UK veterans with Gulf War Syndrome symptoms were apparently discounted from DU studies by the UK MoD because they had not been exposed to DU anti-tank penetrators but to other friendly fire weapons i.e. Maverick missiles. The Maverick missile is one of the weapon systems suspected of containing DU listed in Part 3 - either in their shaped charge or penetrator warheads or both. Maverick version G penetrator warheads weigh 135 kg - potentially containing far more DU than the 120 mm anti-tank shells (about 5 kg).



Full evidence in these cases may need a legal enquiry requiring MoD and DoD witnesses to give evidence under oath without the protection of existing secrecy legislation to conceal this information. The design and construction of guided weapon systems are matters of fact and contained in official, though secret, records.

The only obvious reason for concealing the use of DU instead of Tungsten would be to cover up evidence that DU weapons do represent serious health and environmental hazards to troops and civilians. Covering up such hazards if known and proven would constitute deliberate violation of international conventions regarding weapons of indiscriminate effect.

If the UK Government or courts are unwilling to make or permit MoD witnesses to give evidence under oath then these cases should perhaps be referred to the International Court.

-----

The **UNEP Balkans study** had serious limitations. They studied eleven A10 anti-tank target locations in November 2000. According to Nato information these targets had been hit with 8,112 DU rounds. The survey teams found just 7 and a half penetrators.

Penetrators that miss the target may go into the ground or ricochet. They should have found many more than they did. At Gjakove Garrison **"Only one and a half penetrators were found from 300 reportedly fired. Some penetrators had been found and removed from the site during earlier clean-up work"** (UNEP report page 47). The DoD report Tab C "Chronology of environmental sampling in the Balkans". [http://www.deploymentlink.osd.mil/du\\_balkans/du\\_balkans\\_tabc.htm](http://www.deploymentlink.osd.mil/du_balkans/du_balkans_tabc.htm) finally admitted that at least 10 survey teams had visited Balkans sites in the 16 months before UNEP were allowed to do their measurements. Some or all of these sites were sampled before the UNEP visits, and probably cleaned up by the 4 KFOR survey teams plus wind and rain, significantly reducing the validity of UNEP's data and conclusions.

DU metal in weapons offers relatively low level, external radiation hazards before firing. Much higher risks of long lasting internal radiation occurs in target zones if DU oxide dust is inhaled or ingested through air or water contamination. Penetrators that miss their target or do not burn on impact will still oxidise or be slowly dissolved in acidic soil, contaminating soil and water supplies. For A10 shells less than 30% are expected to impact and burn to form breathable dust so UNEP reported minimal contamination scenarios compared to larger penetrators used in Iraq and far less than DU warheads.

**These known DU systems have provided the basis for assuming very low (or nil) DU exposure for most Gulf and Balkans war veterans.** Reports on DU in the Balkans War published in 2001 by UNEP, WHO, the Royal Society and US DoD focused on exposure to A10 targets. For the 11 sites inspected by UNEP they averaged 202 kg of DU rounds of which 30% might have been aerosolised (burned). In practice most ground contamination appeared to be limited to a few centimetres around unburned penetrators. UNEP did not report testing target vehicles in the Balkans.

The rest may have thinly dispersed in the atmosphere so UNEP concluded there was very low risk to troops though possible long-term risks of soil and water contamination for civilians. Reports of several Leukaemia deaths plus the discovery of **dirty DU** (U236 and Plutonium contamination) in the UNEP samples aroused serious political and media concern from Autumn 2000 to March 2001. But the UNEP, WHO and Royal Society reports in March-May re-assured European media and governments that DU is relatively safe. Their conclusions may need review if DU has been used in other and much larger weapons systems several of which were used in other Balkans locations.

The **most serious oxide dust exposure from known DU munitions** arises when 120 mm tank rounds (c 4-5 kg each) ignite. Up to 70% may burn to create up to 3 kg of DU oxide dust. These are known to contaminate the area 50 metres or more around the target subject to wind direction. These rounds were not used in the Balkans War but left far more oxide contamination in the Gulf War. A10 attacks in the Gulf War may also have been far more intense than in the Balkans, and with higher ignition rates from hitting large armoured vehicles. Several Balkans war targets turned out to be wooden decoy tanks. Penetrators would have passed through them without ignition.

-----

**By contrast with known DU weapons the new hard target warheads (advanced penetrators or shaped charges) would create orders of magnitude more contamination if they are DU based.** This would create far more acute DU exposure risk for humans in the immediate vicinity and downwind, and affect far larger areas.

The only comparable exposure data for military personnel would have been **the Doha ammunition dump fire in the Gulf in July 1991**. This involved 660 120 mm DU rounds of which 300 were unaccounted for. 111 were in tanks that caught fire. The rest were in storage containers. These "exploded in fires that were of a sustained intensity that steel howitzers and other equipment had melted, making it likely that many DU rounds had been damaged by oxidation." (OSAGWI, 1998 quoted in [Don't Look, Don't find](#), pages 23-24).

Approximately **1450 kg of DU was lost, presumed burned**, in the Doha fire. This is **equivalent to the suspected DU in one GBU-28 Bunker Buster bomb** (assuming its "dense metal ballast" to be 75% of its 2000 kg warhead). Unfortunately the results of the air monitoring team sent to Doha 6 hours later are "missing" from US military records. And no medical assessments were made of the troops exposed to the fire, smoke, or initial clean-up operation (conducted without any NBC protection).

**Since the possible use of DU in hard target guided weapons has never been admitted there are no known studies of the environmental contamination to be expected.** But if DU warheads have been developed then military research teams should have done contamination studies of their own, including the possibility of very wide dispersal in smoke plumes. **Questions to the US and UK governments should include requests for disclosure of any such studies if they exist.**

**The effects of potential DU warheads in guided weapons or cluster bombs used in the Balkans (Bosnia, Serbia and western Kosovo)** were not seriously questioned, far less evaluated by mainstream political organisations or media channels in Europe. Targets are obvious from the destruction caused. These should be located and studies made of the immediate sites, and the troops and civilians exposed, under EU not US control. Health studies should be thorough, long term (5 years +) programmes

**Unfortunately the Balkans studies published in spring last year led to a serious reduction in public vigilance by mid-2001.** This has given the US and alliance forces a free hand to use hard target weapons in Afghanistan with no suspicion that they may have contained DU. Hence there has been no restraint on their use by either the US Congress or UK Parliament. There was at least some public debate about the use of known DU weapons (A10 shells) during the Balkans war and consequently some precautions for troops and civilians later.



**In Afghanistan much of the bombing has involved hard target guided weapons.** Warheads weigh from 250 - 2000 kilograms in smart bombs, and from 100 to 500+ kilograms in cruise missiles (see Figure 1, page 89). Hundreds if not thousands of tons of these weapons have been used in the Afghan War. **The critical question is whether any of these had DU based warheads? Also how many of each weapon were used and where?** These studies should also include cluster bombs and mines - i.e. any weapon using penetrator or shaped charge technology.

If only 50% of these warheads are DU alloy (99% uranium, 0.75% Titanium, plus 0.25% of U235 and other Uranium and Plutonium isotopes) then **health and environmental analysts must expect a faster and wider range of environmental contamination and adverse health effects.**

**The potential use of large quantities of DU based weapons in Afghanistan needs urgent investigation and evaluation of their potential health and environmental effects.** Ideally the DoD and MoD should be required to publish all their research and field study data on the use of hi-load (100-1000 kg) DU weapons. This should include full disclosure of environmental monitoring carried out by US and UK NBC teams over the last two months.

Some predictions for modelling the potential contamination effects from large hard target weapons should be available from military sources. Some may be available in civilian universities and research centres that research military weapons and strategy. Some are discussed in the DoD Information Paper **The Use of Modelling and Simulation in the Planning of Attacks on Iraqi Chemical and Biological Warfare Targets** at <http://www.gulflink.osd.mil/aircampaign/index.htm> .

These models were questioned by USA Today in August 1997 to establish whether the DoD had considered the potential effects of bombing chemical or biological targets as they might affect contamination for troops. Some modelling was based on previous work to assess the potential effects of nuclear weapons, and the potential effects of Iraqi weapons on coalition troops.

The possibility of contamination risks from DU contained in large target warheads was not an issue in 1991. It may have become an issue for military simulation before the Desert Fox campaign in Iraq in December 1998 as new hard target guided bombs were coming into service. **Such models, although intended to monitor effects of toxic agents from enemy sources, should be very similar to the dispersion effects of potential DU weapons contamination.**

Other non-military organisations may also have **computer models for environmental contamination from explosive or radioactive sources** e.g. for disaster planning in the event of civilian nuclear or chemical incidents. These would have been useful to evaluate the probable DU contamination in the area of the DU fire at the Royal Ordnance factory near Wolverhampton, UK in February 1999.

DU contamination studies also need to question the assumption in military training that because uranium metal is very heavy uranium oxides will deposit close to the target location. Because of the very high temperature of DU combustion much the oxides produced is in the form of very small particles, 60% of less than 1.5 microns. These can travel long distances, increasing the area of air, soil and water contamination.

Nuclear fallout models may be relevant. Past assumptions about the initial dispersal of DU particles in an explosion plume may need to be modified to include the "fly away" effect of very fine particles that remain suspended in the air for long periods. In this respect Depleted Uranium fallout may have similar behaviour to other nuclear weapons fallout with very wide dispersal, though for DU weapons at much lower altitudes.

These **DU dispersion models** may need to be combined with other atmospheric pollution models for fine particles that become re-suspended owing to heat, wind or electrostatic effects, and precipitation effects of rain or snow falling through haze or smog. (refer latest Balkans studies by Dr Chris Busby at <http://www.llrc.org> ).

US and UK military researchers should have prediction methods that can be adapted to the effects of potential large DU hard target warheads. However their previous analysis has probably been focussed on the dispersal of enemy NBC agents. They may not have considered their own weapons as a potential environmental hazard since the military mindset for the last 10 years has been that "DU is safe". Alternatively they may be fully aware of DU's ability to "disappear" into the atmosphere with very few traces unless **rigorous air monitoring** is conducted including rainwater and snow.

Chris Busby's advice for re-investigating air contamination in the Balkans could be highly relevant to UNEP's forthcoming study in Afghanistan. See his recommendations for air and rainwater monitoring in **Response to UNEP**, section 7 at <http://www.llrc.org/du/duframes.htm>

-----

The following Bulgarian News report on 9 January 2002, <http://www.news.bg> gives further cause for concern:

#### **Bulgaria would send 20 servicemen to Afghanistan**

"The special envoy of Ministry of Foreign Affairs Angel Orbetsov would leave for Afghanistan by the end of the month. His mission would be to make contacts with the new government in Kabul and to inspect the state of Bulgarian properties there, the Ministry of Foreign Affairs spokeswoman Elena Poptodorova said for News.bg Agency. She added that sending 20 Bulgarian servicemen within the framework of the peacekeeping mission of UN in Afghanistan was in a process of preparation. **The troops would be composed of specialists in maintenance of decontaminating baths for cleaning the organism of radioactive particles.**

The servicemen are expected to leave by the middle of February. They would be under the command of the British contingent."

01/09/2002 18:30 (This is available in the 9 Jan archive).

**Why should the British-led peacekeeping force require a decontamination team if NBC assessments over two months had not detected any radiation hazards?** Are they involved because of reports about Al Qaeda dirty bombs? It was only on 16 January that US Defense Secretary Donald Rumsfeld reported the first Taliban target with "elevated radiation readings", see page 119. Whose radiation and how much is involved?

These comparisons between past reports of DU use in small, non-explosive penetrators and the likely effects of much larger, explosive DU warheads highlight the need to consider very different models of DU contamination in Afghanistan. They may also apply to re-analysing potential DU bombing in the Balkans and Iraq.

### 3. High exposure DU health risks: Identification & re-assessment

A thorough review of health studies into the effects of high dose DU contamination on humans is urgently needed. DU health monitoring has already been delayed too long in Afghanistan for acute exposure victims. The nearest equivalent for predicting the health risks of DU contamination from large warheads (500 - 1500 kg) or multiple hard target attacks may be studies of fatalities and survivors following large DU fires.

Unfortunately there is no health monitoring data for survivors of the Doha ammunition dump fire in the Gulf (see page 102). The US military report about the A10 crash, with DU ammunition, in the German village of Remscheid in 1988 seems to be unavailable. See <http://wir-remscheid.de/Stellungnahmen/Diverses/14022001.htm>

In the 1992 El Al Boeing 747 crash in Amsterdam the plane had an estimated 450 kg of DU counterweights. In 1999 the Laka Foundation established that there had been DU contamination (from dust samples where the wreckage was stored) including up to 0.66% U235) despite years of official prevarication. See the Laka report at <http://www.antenna.nl/wise/uranium/dhap997.html> Various studies were done including "the report 'Health risks during exposure of uranium' made by radiation expert Leonard A. Hennen from the Dutch Ministry of Defense. The findings of Hennen strongly contradict the findings in the final report of Zuidoost. He said that the people at a possible crash site are running risks. In his report Chapter 5, page 9, he proposes the taking of urine samples and in vivo measurements when there is suspicion of internal contamination of the DU" (from 'Health risks of depleted uranium' page 4 at [http://www.aeronautics.ru/archive/du-watch/us\\_gov\\_about\\_du.htm](http://www.aeronautics.ru/archive/du-watch/us_gov_about_du.htm) ).

In each of these large fires a thorough environmental assessment should have been done for DU contamination, and a full medical and epidemiological study should have been done for the troops and civilians involved. These situations had obvious occupational and public health implications when they occurred.

Each of the incidents listed above involved the amount of DU suspected in just **one** of the suspected warheads used in the Afghan bombing (sizes from 250-1500 kg each). These may have involved equally serious local radiation hazards but potentially affecting far larger geographic areas and communities if DU has been used. For humanitarian, legal and professional reasons it is vitally important to start monitoring troops and civilians in Afghanistan for potential acute and long-term health effects of exposure to severe DU contamination as soon as possible.

The track record of the US and UK governments in health monitoring after known DU exposures for troops and civilians is so poor that their denials of DU use in Afghanistan simply cannot be trusted by employers or aid organisations. This has legal and ethical implications for employers and medical professionals.

Medical aid organisations have many pressing priorities in Afghanistan. But this report recommends that they include medical monitoring to detect early signs of acute DU contamination so that this can be included in diagnosis and treatment. Ideally these should be co-ordinated closely with environmental monitoring by the UNEP PCAU.

If it is proved that people have been exposed to significant DU contamination in Afghanistan it may be important that exposed individuals or communities should be removed from risks of further contamination as soon as possible. This is important for planning and co-ordination between refugee and medical aid organisations.

Most existing DU studies assume low dose exposure or low risk from medium doses (e.g. tank crews). But **much higher DU doses** may occur if victims are enveloped in the smoke / explosion cloud of a bomb or missile attack, assuming they survive the immediate blast, shrapnel or burns.

Medium to high doses are likely downwind of large explosion plumes, or by disturbing contamination in the immediate target zone weeks or months later e.g. entering underground bunkers or caves destroyed by DU-based warheads. Did Nato medical investigators check exposure to guided bomb or cruise missile targets for KFOR troops who have died of early onset leukaemia? Those deaths were mostly among troops from Mediterranean countries that were deployed to western Kosovo. This region received more guided bomb and cruise missile attacks than the US and UK sectors. US and UK special forces troops, and Afghan helpers, sent to investigate US bombing targets may have been at similar risk of severe DU contamination.

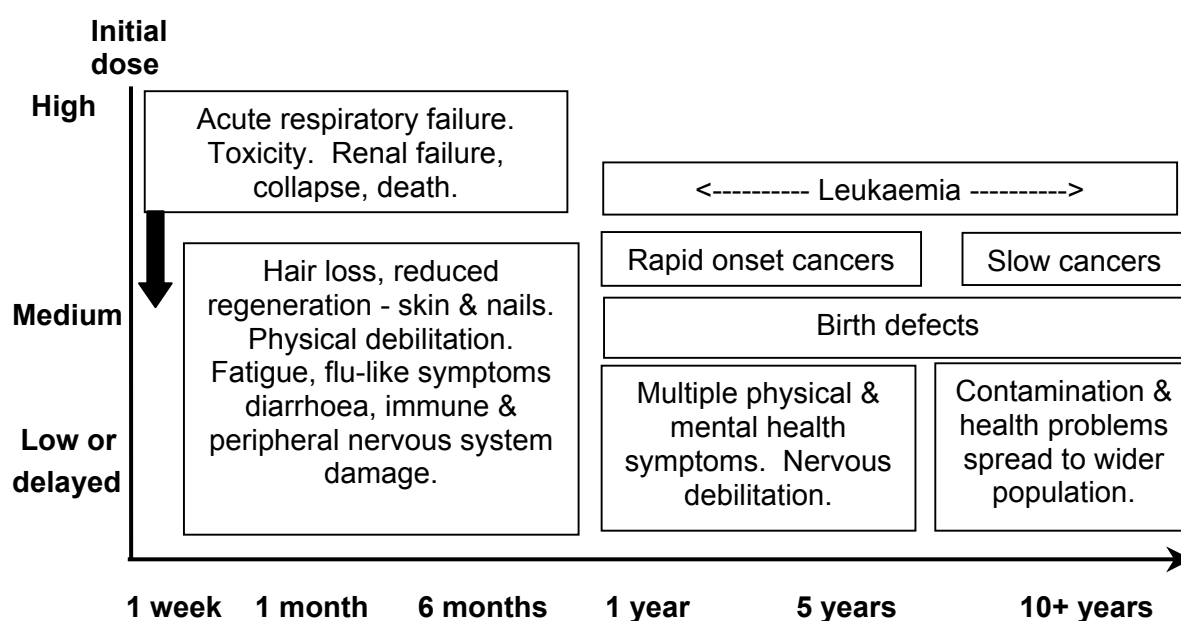
Exposure risks depend on distance from source at the time of the impact, disturbing DU dust in the target areas at any time, or indirect exposure to low dose contamination in air, water or food. This should be a standard epidemiological formula.

What may not be standard in Afghanistan is the size of the potential DU fallout plume downwind of heavy bombing attacks e.g. by 1-2 ton JDAM guided bombs and Bunker Busters (see Part 3). The Tora Bora region received the highest level of hard target bomb and missile attacks. This must be a high priority for environmental assessment and epidemiological monitoring after major urban areas have been checked.

Low but chronic exposure risks may arise from contamination in air, water or food in far larger surrounding areas building up over several years as dust deposited in high ground is washed into water catchment areas.

The **acute symptoms** in **Figure 2** have been reported by Gulf War veterans including medical personnel exposed to DU contaminated targets in Iraq. The slow onset disorders have been reported by Gulf veterans groups and by doctors and health researchers who have worked with civilian populations exposed to DU in Iraq.

**Figure 2: Medical conditions associated with DU oxide exposure**



Better medical descriptions and more sophisticated epidemiological models are described by medical researchers. In 1995 Professor Siegwart Horst-Gunther reported the following medium-term health disorders for civilians exposed to DU contamination in Iraq four years after the Gulf War:

" The results have produced ample evidence to show that contact with DU ammunition has the following consequences, especially for children:

- 1) A considerable increase in infectious diseases caused by severe immuno-deficiencies in a great part of the population.
- 2) Frequent occurrence of massive herpes and zoster afflictions, also in children.
- 3) AIDS-like syndromes.
- 4) A hitherto unknown syndrome caused by renal and hepatic dysfunctions, now so-called 'Morbus Gunther.'
- 5) Leukaemia, aplastic anaemia and malignant neoplasm.
- 6) Congenital deformities caused by genetic defects; also partly diagnosed in animals.

The results of my studies show similarities to a clinical picture described recently by the term 'Gulf War Syndrome' in allied soldiers and their children. The congenital deformities in American and Iraqi children are identical."

[From his paper "The Gulf War Syndrome - a parallel to Chernobyl" 1995

available at: <http://www.wakefieldcam.freemove.co.uk/gulfwarsyndrome.htm>

Professor Gunther's point (1) has grim and immediate implications for the Afghan population facing starvation and cold during the winter. Acute DU exposure casualties are unlikely to survive common diseases with reduced immunity.

Similar serious health effects are described in Dan Fahey's report [Don't Look, Don't find](#), pages 37-45, and the Low Level Radiation Campaign website <http://www.llrc.org> .

Official DU studies to date indicate very little data for high dose incidents that could be used to predict the potential effects of DU in large warhead guided weapons. Military data has always lacked early medical monitoring for DU casualties. Troops injured in the GBU-31 accident on 5 December may be the first DU contaminated casualties to receive full medical assessment and treatment in the USA. Nothing more has been heard about their condition since they were repatriated, or of the four UK SAS troops who were also evacuated for urgent but unspecified medical injuries.

The lack of published studies leaves description and assessments of the early stages of DU radiation and toxic exposure very poorly defined. Military medical personnel must be aware of many cases, including birth defects for the children of Gulf War veterans, concealed owing to DU secrecy policy. This must present responsible military officers and medical professionals with severe ethical dilemmas when silenced by military, political and commercial agencies with a high investment in DU projects.

Acute DU exposure effects may have some similarities to intermediate radiation exposure from more energetic (Beta and Gamma) radiation sources e.g. nuclear weapons and nuclear accidents (Three Mile Island, Chernobyl etc.). But again official studies of civilians have been severely limited, starting from the 6-year delay in monitoring populations in Hiroshima and Nagasaki reported by Rosalie Bertell (<http://www.mothersalert.org/bertell2.html> ) up to studies of Chernobyl in the 1990's. The nuclear military-industrial establishment does not like bad publicity.

Figure 2 suggests **the likely progression from acute to delayed onset medical problems** arising from exposure to DU contamination from medium and large warheads, or fires involving DU. If DU has been used in large quantities in Afghanistan there may be an increased incidence of early onset disorders during the first year after the bombing compared to the Balkans or Iraq. Over longer periods the range of disorders already associated with Gulf War veterans are likely to develop.

There are significant differences between troops and civilians in the duration of their exposure to DU e.g. between troops visiting DU target zones for a short period and civilians who are permanent residents in contaminated areas.

Civilians may have a range of initial exposures from acute to none at all. But if they live in a highly contaminated and dusty environment e.g. in Iraq and potentially in Afghanistan they may be frequently re-exposed to medium or high doses of DU oxide. They may disturb a high risk DU contaminated target zone, or be exposed to on-going and cumulative DU contamination through water, airborne dust or food.

If DU weapons have been used in Afghanistan there are two ways to reduce exposure risks. Either DU contamination must be removed from the environment (e.g. micro-filtration of drinking water). Or individuals and communities at risk must be removed from the contaminated environment.

----

Dan Fahey and other independent DU researchers have looked at longer term health hazards associated with DU in other populations with known or suspected DU exposure. These include Uranium mining communities, nuclear industry process workers and communities in the vicinity of DU weapons manufacturing plants. Many of these show significant increases in slow onset cancers, see reports on the Military Toxics Project website at <http://www.miltoxproj.org>.

Most military studies focus on "healthy soldier" populations. But pregnant women and children in rapid growth phases are likely to be most vulnerable to the mutagenic effects of low level radiation (refer reports by Busby, Fahey and others).

Unfortunately potential DU health hazards in Afghanistan have not been notified to aid organisations, other than my message to the UK Red Cross and Oxfam on 5 November 2001 (see page 37). It is not known whether medical aid organisations like the **International Committee for the Red Cross** <http://www.icrc.org> have had the time to record symptoms of bombing casualties and other seriously ill civilians e.g. from Tora Bora. Have **Médecins Sans Frontières** <http://www.msf.org> doctors seen unexpected causes of death like those reported by Taliban doctors in October (Part 1, page 35)? Watch <http://www.doctorswithoutborders.org/news/afghanistan.shtml>.

It is hoped that this report will alert medical personnel in Afghanistan, and in neighbouring countries working with refugees from the bombing, to be alert for possible medical effects of acute exposure to DU contamination (see Figure 2 page 106).

Occupational health advisers for employers who have sent expatriate personnel to Afghanistan since 7 October are urged to include DU exposure as a potential health hazard. It is also desirable to monitor the health of these personnel for 1-5 years after they return to their home countries. If DU contamination is discovered in Afghanistan this should include uranium testing for expatriates.



Since the first evidence of DU contamination has been reported by the Pentagon the need for these medical precautions and monitoring proposals becomes more obvious.

Occupational health professionals, epidemiologists and other health researchers can do a more rigorous assessment of these potentially new DU health hazards. Ideally these assessments would be co-ordinated by the World Health Organisation - if the UN General Assembly can guarantee their independence.

On March 20, 2000 the Balkans Task Force convened a team of experts in Geneva to discuss post-conflict evaluation in the Balkans. According to Don't Look, Don't Find, page 55, their recommendation number 3 was as follows:

- " 3. A follow up of the BTF Desk Study should be organised with good inter-agency co-operation **and should be conducted in a way as to safeguard independent and reliable results.** Success in the study requires smooth collaboration with military organisations and UN organisations in Kosovo."

This statement of principle is equally relevant to UN post-conflict studies in Afghanistan.

The co-operation and independence needed by UN agencies in the Balkans was plainly undermined by US delays in disclosing DU targets for over a year and deliberate disinformation in providing inaccurate maps. I suspect that far more serious deception occurred in failing to disclose the suspected use of depleted uranium in much larger weapons systems and in entirely different target locations.

This saga brings the reputation of many scientists and some medical professionals into disrepute. It appears that many professionals have been associated with falsification of DU environmental or medical research studies by their methods or omissions. In doing so they may have jeopardised the health, welfare and prompt medical treatment of thousands of loyal troops, civilians and returning refugees over the past 10 years. The Pentagon and other Nato military commanders and spokesmen are plainly involved. Politicians and Governments involved in covering up the hazards and scale of use of DU have either been naïve to the point of incompetence, or complicit in this deception.

These are grave accusations but they are not new. They can be found in most of the references provided in this report. Whether other parliaments, professional organisations or national and international courts will act on them is considered in section 6. But such actions will take years.

**The immediate concern for medical professionals, aid organisations and other employers of expatriate personnel remains the threat of extensive DU contamination in Afghanistan.** However this time these organisations and the world press should be on their guard for similar interference from the US or other governments, or from arms manufacturers and the nuclear industry.

This time, due to the size of weapons suspected of containing DU, UNEP may not need military maps to plan their investigations. Any large hole in the ground (bomb crater or entry point) in Afghanistan will do as a start point for environmental and community health monitoring. And evidence can come from two independent lines of research: either environmental or health monitoring. Ideally both will be done and carefully co-ordinated. However full disclosure of all DU targets - locations, times, weapons, DU quantities and weather conditions - is needed to do a thorough environmental impact assessment of each target area to optimise monitoring and health precautions. Over 50 locations may be involved plus area assessments.

If widespread DU contamination has occurred in Afghanistan this will become obvious to medical and other aid organisations within 12 months, possibly much sooner. It may already have become obvious to Afghan personnel recruited by the US to inspect bombing targets in the search for evidence of bin Laden and Al Qaeda operations. They are now withdrawing co-operation. They are likely to have suffered acute contamination already if DU has been used in hard target bomb and missile warheads

----



#### **4. Environmental impacts of DU: Assessments & radical re-assessment**

From the reported health effects summarised above it is important that thorough environmental monitoring should be co-ordinated with biomedical sampling and epidemiological studies.

Previous studies have assumed relatively low dose sources in the immediate vicinity of armoured vehicles hit by DU penetrators. Small, medium and large warheads that may contain DU (ranging from 10 to 1500 kg of DU) imply progressively larger contamination zones. ALL these warheads have explosive ignition sources likely to shatter DU into small fragments capable of rapid ignition and much higher conversion ratios to DU oxide.

Depending on the design and size of the weapon (from cluster bomb to bunker busters) and on the nature of the target (e.g. surface, near surface or deeply buried) the size of contamination zones may vary a lot. Assumptions that most DU dust particles are heavy and deposited in the immediate target area are not consistent with recent analysis of DU oxide and ceramic aerosol particle sizes (e.g. reported by Pier Denesi, a Director of IAEA, at the Prague DU Conference in November 2001) where 60%+ may be less than 1.5 microns.

Completely new models are required for forecasting contamination areas for high-load DU weapons. These need to include long term suspension and re-suspension of very fine DU oxide particles in "battle haze" and smog conditions. Atmospheric dust levels may remain much higher than normal for months in regions that have experienced extensive bombing. Seasonal factors and local meteorological conditions need to be included in suspected DU bombing environments.

This implies much more extensive monitoring procedures than available to UNEP in the Balkans study. However their multi-disciplinary team had an excellent range of skills to cover different environmental implications - given the right target information and unrestricted access to inspect any area of their choice.

Epidemiologists should be able to develop exposure graphs related to distance from target and medical effects tracked over weeks, months and years from high level DU exposures. Studies by Dr Chris Busby of the Low Level Radiation Campaign and Theodore Liolios in Greece may provide starting points for this different scale of analysis. UNEP teams may also have developed desktop models for large scale DU contamination, and how this may be affected by local geography, weather conditions and wind direction at the time of bombing and changing seasonal conditions in Afghanistan.

----

End of section & notes

## 5. Humanitarian aspects of DU risks in Afghanistan

The UN and other aid organisations are well aware of the practical health and survival problems for civilians in Afghanistan - shortage of food, water, shelter and medical supplies. These may be desperate in many areas so potential DU risks may seem a low priority against more obvious hazards.

BUT if there is widespread DU contamination of buildings or water supplies in bombed areas **DU precautions must be given a very high priority - especially for people most vulnerable to low level radiation effects**. These are pregnant women, young children and sick people whose immune systems may already be weakened by acute DU exposure during the bombing. ANY known additional exposure must be avoided.

Many of the Afghan population are already weakened physically and psychologically by the war and pre-existing humanitarian problems. Any significant radiation exposures in addition to these other problems may **further reduce their resistance to health problems, potentially increasing winter fatalities**. Such fatalities may conveniently "cull" many people already suffering significant radiation or toxic exposure from DU contamination, long before any systematic health investigations can be carried out.

Humanitarian problems include **refugees returning** to communities with shattered infrastructure and potentially DU-contaminated water, air and dusty ground. In December they were returning at 3,000 per week. Ideally they should stay away until DU assessments have been done. This has immediate implications for **UN refugee policy** in Afghanistan and neighbouring countries. Medical monitoring for refugees outside Afghanistan may also be important if they were exposed to significant DU contamination during the bombing.

Medical monitoring for Afghans recruited by the US forces to investigate Al Qaeda target locations - especially caves in the Tora Bora region - may be very important. It may also be too late to prevent high levels of DU contamination.

The US Government should be asked to consider its legal liability to Afghans employed in search missions in potentially DU contaminated target zones if they or their families subsequently develop radiation related diseases. Or have they been provided with full protective equipment as supplied to US forces required to do the same task? (Were US, UK or other special forces troops provided with protective equipment when investigating strategic bombing targets?)

**The current military and political perception of DU being "a minimal risk" to humans has to be challenged.** It has to be kept out of political and humanitarian assessments of DU risks and precautionary action. Potential and recurring DU contamination through water supplies and airborne dust must be considered **a vital public health priority**. Hopefully **these potential hazards may be temporarily reduced by winter weather conditions** (snow, ice).

But if significant DU contamination has occurred **these hazards could be greatly increased in spring** as temperatures rise and wind re-suspends fine DU oxide particles (60% less than 1.5 microns particle size) in dry and dusty conditions to create DU toxic haze, smog or dust storms.

**How can non-scientists relate to the potential health hazards of large scale DU contamination?** For practical purposes **the nearest health risk analogy for DU dust exposure may be blue asbestos dust in similar quantities**. Imagine from half- to 1.5 tons of blue asbestos dust being dropped for each bomb in a village or town in the US, UK or Europe.

- What health precautions would most adults take for their families?
- What precautions would employers be legally liable to take for their staff?
- How much care would be taken in conducting environmental sampling and impact assessments?

If there is ANY evidence of DU contamination in hard target bombing locations then **these precautions should be applied in all Afghan communities that have received guided bomb or cruise missile attacks**. DU monitoring and precautions should also be extended to **cluster bomb target areas** and any vehicle or building hit by aerial strafing from AC-130's or low level fighters with 25mm GAU-12 DU cannon.

These same precautions should be of **immediate concern to international employers** sending civilian staff or troops to Afghanistan in the next 6 months, until rigorous and independent environmental assessments have been completed. After the Balkans War some Swiss agencies exempted pregnant women from serving in the Balkans. Some organisations were also reported to have supplied bottled water to troops and civilian personnel. In view of dust conditions seen in many Afghan news reports breathing masks may be a wise precaution in windy weather or when travelling in vehicles that stir up dust.

If widespread contamination is discovered in some areas the most logical action would be to evacuate the population to avoid further risk.

Environmental monitoring and health precautions may be needed several kilometres from target areas as wind and weather spread suspected DU contamination. One report from the Balkans suggests that rain and snow tend to wash fine suspended DU oxide particles out of the air. While this may improve air quality it is likely to contaminate surface water supplies and soil.

Over longer periods of time airborne DU dust is likely to migrate to wider areas. Local geography and weather conditions may result in new concentrations away from original target locations.

----

## 6. Political context: deception, DU proliferation and control

One problem encountered in these investigations has been mounting evidence of deception or mis-information by commercial, scientific, military and political interests associated with the use of DU in military and civilian applications. This was not always the case. For many years Depleted Uranium was recognised as a hazardous material, subject to handling regulations in the US and UK as a radioactive substance by military, civilian and aviation authorities. Boeing removed DU counterweights from use in new Boeing aircraft in the 1980's.

Although DU regulations still apply in certain situations e.g. military training areas the DU cover-up started during the Gulf War when the value of DU for defeating armoured targets was first tested on a large scale. The US first tested DU tank rounds in combat when they were supplied to Israel for the Yom Kippur war in 1973. Military warnings about potential DU health hazards were circulating within the US military in 1990. For some reason they were not passed on to front-line troops in Operation Desert Storm until after the war had finished. By then over 275,000 US and UK troops had been exposed to DU contaminated environments. This is documented in Dan Fahey's comprehensive DU study **Don't Look, Don't Find** (March 2000) at <http://www.miltoxproj.org/DU/IOM-cover.htm>

Fahey quotes the following memo from Lt Col Ziehm on 1 March 1991 from Los Alamos National Laboratory. It has defined US military policy towards DU ever since:

"It is believed that du penetrators were very effective against Iraqi armor; however, assessments of such will have to be made.

There has been and continues to be a concern regarding the impact of du on the environment. Therefore, if no one makes a case for the effectiveness of du on the battlefield, du rounds may become politically unacceptable and thus, be deleted from the arsenal.

If du penetrators proved their worth during our recent combat activities, then we should assure their future existence (until something better is developed) through Service/DoD proponentcy. If proponentcy is not garnered, it is possible that we stand to lose a valuable combat capability.

I believe we should keep this sensitive issue at mind when after action reports are written."

Fahey described 5 successive US government enquiries into the health risks of DU for Gulf War veterans in the 1990's, each deliberately distorting the evidence of severe DU health effects. The title of the study sums up DU medical and scientific research practices. Long delays in starting even very limited studies of troops exposed to DU safely ensured that many with acute exposures died without autopsy.

Autopsies to seek evidence of DU contamination are still rare. The wife of a Canadian veteran who died of severe DU related illnesses had an autopsy conducted that provided proof that he suffered high DU levels. The evidence was stolen soon after.

Critiques of the methodology of more recent DU reports produced by RAND, WHO, UNEP, the Royal Society etc. are available from several independent DU researchers quoted in this study (see page 56 and on the Low Level Radiation Campaign website at <http://www.llrc.org/du/duframes.htm> ).

Official reports illustrating US Government propaganda about DU to re-assure troops and the public about the low risks of DU weapons can be found by searching for Depleted Uranium on the US Department of Defense **DefenseLINK** website at <http://www.defenselink.mil> .

The US Department of Defence Information Paper "Depleted Uranium Environmental and Medical Surveillance in the Balkans" (25 October 2001) lists recent medical assessments of Nato troops.

" Spurred by the reports of a higher incidence of leukaemia and various health complaints associated with exposure to DU, the Committee of the Chiefs of Military Medical Services in NATO (COMEDS) called a special plenary meeting on January 15 2001 to discuss issues related to DU. The meeting resulted in a report on the initial impression of the health issues as seen by the Surgeons General of the NATO nations' military medical services. Preliminary data provided by the nations at that meeting indicated no causal link between exposure to DU and the health complaints or pathologies, and no link between DU exposure and leukaemia or other cancers in Balkans veterans." Their reports are summarised in Table 1 at: [http://www.deploymentslink.osd.mil/du\\_balkans\\_s04.htm](http://www.deploymentslink.osd.mil/du_balkans_s04.htm)

However enquiries into leukaemia deaths of Italian peacekeeping troops from Bosnia and the Balkans War have been re-opened in recent months. So the **US Embassy in Italy** opened a Depleted Uranium page at <http://www.usembassy.it/policy/topics/du> with links to previous re-assuring DU health studies. The latest analysis of morbidity data for Italian peacekeepers indicates a 12x higher incidence of lymphomas and leukaemia than in the initial medical reports referred to by the DoD Information paper. The original statistics used invalid reference groups (Busby, 2002, <http://www.llrc.org> ).

Overall DU exposure in the Balkans was hopefully much lower than for troops in the Gulf War. But if DU was used in hard target bombs and missiles, especially near the Albanian border, then properly controlled health studies for peacekeepers and civilians in those areas are needed. They may suffer increasing DU-related health problems in the next 5 years. Some of the weapons used were prototypes of guided bombs and cruise missiles used extensively in Afghanistan. It is important that environmental assessments of these potentially heavily contaminated targets should be carried out by independent researchers. At the same time regular medical assessments for troops and civilians deployed in those areas are urgently needed. They may provide important clues to the environmental and health hazards that may exist now in Afghanistan if DU is used in hard target warheads.

----

The characteristics of DU propaganda are analysed in Piotr Bein and Pedja Zoric's paper **Propaganda for Depleted Uranium - a crime against humankind** presented at the DU conference in Prague on 25 November 2001. In essence they are **delay, deny, deceive**. See <http://groups.yahoo.com/group/du-watch/files/DUPraha.doc>

The issue of DU deception spreads far wider than the United States. It has required complicity by the UK and other governments in the UN to prevent the World Health Organisation conducting a thorough DU study in Iraq - even 10 years after the Gulf War. When the UN Balkans Task Force sought to include DU in its post conflict assessments of the Balkans War this was clearly subverted by delay and deception before the UNEP study could start (see also page 101).

The US or Nato severely limited UNEP access to the most relevant sites (armoured targets) and somehow managed to influence the final conclusions of the report to exclude the hot spots of contamination they did find. Robert James Parsons challenged this interference in UNEP and WHO investigations in "**DU - the law of silence**" in *Le Monde Diplomatique* on 1 February 2001, and in his report "**DU Balkans cover-up**" in *the Nation* on 9 April 2001, see:

[http://urbana.indymedia.org/front.php3?article\\_id=3601&group=webcast](http://urbana.indymedia.org/front.php3?article_id=3601&group=webcast)

The links in this report are offered so that readers can check the history of official DU studies and critiques of them by independent DU researchers from original sources.

-----

One advantage of this trail of official deception is that it has to contain mistakes. Denials or omissions give valuable clues to the type of weapons or health hazards that governments, military and the nuclear industry are trying to conceal.

This study of **suspected DU weapons** has found **frequent anomalies between official reports, press releases and government statements** when trying to identify when weapons become available for combat use. Reports of the timing of upgrades to the **AGM-86D CALCM** and **BGM-109 Tactical Tomahawk** and the introduction of the UK/French **Storm Shadow** missile illustrate this. The FAS and manufacturers' websites include authorisation and planned delivery dates. But recent reports from the US and UK governments implied that they were not ready for use in Afghanistan.

For example the hard target **AGM-86D** upgrade for the CALCM was authorised in November 1999 for delivery of 50 units by July 2001 (Boeing news release, December 1999 at <http://www.boeing.com/defense-space/missiles/calcm/calcmnews.htm> ). Yet on 29 November 2001 the latest Boeing release reported what appeared to be the first field test of the AGM-86D in New Mexico (same link).

The latest Boeing report conveniently linked with a Pentagon report published on 4 December 2001 in the *International Herald Tribune*: **US is developing powerful weapons to pierce the deepest sites**. This is available at:

<http://www.iht.com/cgi-bin/generic.cgi?template=articleprint.tmplh&ArticleId=40871>

"Another combat-ready weapon is the AGM-86D, a refurbished deep-penetrating version of the U.S. Air Force's aircraft-launched cruise missile. Last Thursday, the contractor, Boeing, said a missile launched from a B-52 over the White Sands Missile Range, in New Mexico, had successfully struck "a hardened, buried target complex" and detonated inside.

The U.S. Air Force has already received part of an order of 50 of the missiles, on which nuclear warheads had been replaced with a slender, heavy conventional warhead that can drive deep into the earth. A variant of this earth-piercing warhead was used in a small number of bombs dropped in Kosovo in 1999, defense documents say."

Part of this report creates the impression that the AGM-86D was still being developed but it goes on to say that a part order had been delivered. A few days later the Center for Defense information in Washington reported that AGM-86D missiles had been used in Afghanistan.

On 16 December *The Telegraph* reported that the Israeli developed AGM-142 Hav Nap hard target missile was being deployed in Afghanistan because US forces were beginning to run short of air launched cruise missiles (i.e. the AGM-86D CALCM).

See article **Intelligent missile used against bin Laden caves** by Sean Rayment at: <http://www.portal.telegraph.co.uk/news/main.jhtml?xml=%2Fnews%2F2001%2F12%2F16%2Fwtora216.xml>

On 30 December The Telegraph again reported that US forces were running out of "air launched cruise missiles" (CALCM) although the attached photograph was of a Tomahawk missile. Article **US missile shortage delays Iraq strike** by Sean Rayment <http://www.portal.telegraph.co.uk/news/main.jhtml?xml=%2Fnews%2F2001%2F12%2F30%2Fwirq30.xml>

Analysis of earlier Boeing and FAS reports about the AGM-86D (Part 3, page 85) indicated that the new warheads were first tested in summer 1998. Competitive evaluation of the two new hard target warhead options (Lockheed Martin's AUP-3M and BAE-RO's BROACH/MWS) continued from 1998 until the Lockheed version was chosen in November 1999. Boeing's website reported that the AGM-86 was used in Operation Desert Fox in Dec 1998 and in the Balkans War. It seems logical that both prototype warheads were being tested in combat conditions during this period.

Other Boeing reports (except the latest) indicated that delivery plans were on schedule for July 2001. Taken together it seems likely that most of the 50 AGM-86D's were delivered in summer 2001 and used in the Afghan bombing. So why should the Pentagon try to give the impression that this top-of-the-range hard target missile was not available for use in Afghanistan in early December?

----

Similar mis-information seems to apply to the **Tactical Tomahawk Advanced Penetrator** upgrade, approved in 1999 but delivery dates set for 2003. This was intended to use the new "Government supplied" warhead (apparently the 1000 lb version of the BLU-116) also designed for the GBU-32 smart bomb. Warhead development would have been completed well before 2001. **It seems likely that at least prototype versions of the Tactical Tomahawk Penetrator Version were used in sea-to-shore Tomahawk attacks early in the Afghan war.** Over 50 Tomahawks were fired in the first week according to the Centre for Defense Information website. **Tactical Tomahawk is another suspected DU warhead weapon.** Some reports indicate that earlier Tomahawks contained **30 kg of DU** as "ballast" see [http://www.aeronautics.ru/archive/du-watch/us\\_gov\\_about\\_du.htm](http://www.aeronautics.ru/archive/du-watch/us_gov_about_du.htm) "Ballast" sounds benign. But this would be about the weight needed for the casing or liner of earlier shaped charge warheads. The advanced penetrator warhead is estimated to contain **250+ kg of DU** - if DU is the mystery dense metal involved.

----

The UK/French **Storm Shadow** missile (with the BROACH hard target warhead) was scheduled for delivery by December 2001. On 6 December UK Government defence spokesman Mr Ingram said that "The BROACH MWS is not forecast to enter service before August 2002". (Hansard, see page 69). If true this means that Storm Shadow is 8 months behind schedule, originally planned for December 2001. Also what has happened to the BAE-RO contract to supply BROACH warheads for the **AGM-154C** hard target upgrade, due to be operational in 2001? (see page 87). I suspect that at least prototype versions of Storm Shadow and the AGM-154C have been tested in Afghanistan. These highly inconsistent statements need investigation.



The timing of development and approval of several of the suspected DU guided weapons identified in Part 3 seems to fit in conveniently with opportunities for combat testing in Iraq, the Balkans and Afghanistan. The deployment of US and UK forces to the Gulf / southern Asia region in Summer 2001 was planned up to 2 years ago, possibly in anticipation of the opportunity to launch the Afghan war. So weapons manufacturers had a combat testing target date to work towards. It seems unlikely that they would have wanted to miss this opportunity to test and demonstrate the effectiveness of new weapons to improve future government orders and export opportunities.

----

Ongoing US and UK bombing in **the Iraq no-fly zone** has provided a low profile opportunity to field test prototype and upgraded guided weapons for several years. Refer this quote re the AGM-154A in *The Weaponeer* on 4 February 1999 at [http://www.fas.org/man/dod-101/sys/smart/docs/990204-jsow\\_FA18.htm](http://www.fas.org/man/dod-101/sys/smart/docs/990204-jsow_FA18.htm)

### **JSOW scores first combat success**

By Kathi Ramont, Associate Editor

Three successful Joint Stand-Off Weapon (JSOW) AGM-154A missions were conducted in the Persian Gulf area during the week of Jan. 24 (1999) by an on-station Carrier Air Group. "The revolution in strike warfare has begun," wrote NAWCWD's new commander Capt. Bert Johnston, who is also the program manager for Conventional Strike Weapons, in a message to the JSOW Team. "Three JSOW were launched against targets in Iraq, and reports are that all were successful."

On 7<sup>th</sup> March 2001 the UK Government replied to a question about suspected DU bombing in the Iraqi no-fly zone (see page 60) thus: "None of the weapons dropped by the RAF on Iraqi installations since the UK began patrolling the no-fly zone have depleted uranium tips". This answer was technically correct because the "tips" of most hard target guided weapons contain their guidance systems. Hard target warheads are usually contained in the centre section e.g. in the AGM-65G Maverick (see diagram on page 88) and the AGM-154 JSOW.

**It is essential that investigations of the use of all suspected DU weapon include the periods of prototype testing in all active combat zones (e.g. the Iraq no-fly zone) , and in non-combat training areas like the US training ground in Vieques (Puerto Rico). Targets in all these areas may have been subjected to DU contamination from new hard target warheads.**

-----

Possibly the most serious case of **suspected DU propaganda in the Afghan War** concerns reports of **Al Qaeda's "dirty bombs"**. (See DU scenarios on pages 94-95). This was quoted from US intelligence sources in the International Herald Tribune on 5 December **New evidence is adding to US fears of a Qaida 'Dirty Bomb'**. See <http://www.ihf.com/cgi-bin/generic.cgi?template=articleprint.tmpl&ArticleId=40891>

"U.S. intelligence agencies have recently concluded that Osama bin Laden and his Qaida terrorist network may have made greater strides than previously thought toward obtaining plans or materials to make a crude radiological weapon that would use conventional explosives to spread radioactivity over a wide area, according to U.S. and foreign sources.

A radiological bomb, also known as a "dirty bomb," could be made by taking highly radioactive material, such as spent reactor fuel rods, and wrapping it around readily available conventional high explosives. The device is designed to kill or injure not through its explosive force but by creating a zone of intense radiation that could extend several city blocks. A large, highly radioactive bomb could affect a much larger area."

I sent a message to DU researchers to watch for reports that stocks of DU had been "found" in Al Qaeda weapon stores. This came through at the end of December e.g. Vivienne Walt's report in USA Today **Uranium reportedly found in tunnel complex** See <http://www.usatoday.com/news/attack/2001/12/24/uranium-usat.htm#more>

There were several possible explanations for these reports. First they may be true and Al Qaeda did possess stocks of DU but did not construct or use dirty bombs. Second that they had DU and used dirty bombs in a scorched earth retreat. Third that US bombs have inadvertently hit Al Qaeda stocks of DU resulting in DU contamination. Fourth that these reports were launched as a cover story in the event that the media start to question suspected use of DU weapons in the Afghan bombing, or that UNEP surveys find evidence of DU contamination from US bombs. (DU scenarios, page 95).

The latest news about **suspected Al Qaeda use of DU** was the statement on 16 January by Defense Secretary Donald Rumsfeld. This is covered in the Reuters / Yahoo report **US says more weapons sites found in Afghanistan** .see [http://dailynews.yahoo.com/hx/nm/20020116/ts/attack\\_military\\_dc\\_234.html](http://dailynews.yahoo.com/hx/nm/20020116/ts/attack_military_dc_234.html)

"WASHINGTON (Reuters) - U.S. forces in Afghanistan found more evidence Osama bin Laden's al Qaeda network was seeking chemical, biological and nuclear weapons, and the number of sites to inspect is growing, Defense Secretary Donald Rumsfeld said on Wednesday. ...

The United States does not have evidence that al Qaeda has acquired weapons of mass destruction but the materials indicate they wanted to use such deadly items, he said. ...

The number of suspected chemical, biological and nuclear weapon sites in Afghanistan is growing and U.S. forces are now targeting more than 50, about 10 more than they have already inspected, Rumsfeld said. ...

**One site registered an elevated level of radioactivity but it appeared to be a result of depleted uranium on some warheads and not from any nuclear or radiological weapon of mass destruction,** Rumsfeld said. ...

U.S. forces found some missiles with depleted uranium warheads in the Kandahar area near the end of December, Thomas said. It was not known where al Qaeda obtained those weapons."

From this report it seems unlikely that there is evidence of Al Qaeda actually using dirty bombs or this should have been broadcast and obvious precautions would have been to evacuate a large area. This has not been reported. The first alleged discovery of DU could have been genuine, planted or simply a hoax. The Afghans who reported the discovery would have had no way of confirming that they had found DU except by a name label on a container. It was removed by US troops. It still seems possible that these reports are part of a contingency plan to divert blame for any DU contamination that is discovered following US bombing.

The reference to **an elevated level of radioactivity at one site** is very important and ambiguous. In the context of the report it implies warheads in Al Qaeda weapons. The "missiles" referred to by Thomas may be Milan anti-tank weapons mentioned in a previously unconfirmed Internet report several weeks ago. Or it could be the first acknowledgement that some US warheads contain depleted uranium. The reference seems remarkably low key, perhaps on the assumption that DU is safe whereas they were looking for signs of enriched uranium for nuclear weapons.

**Donald Rumsfeld's statement needs very careful investigation by all countries sending personnel to the Afghan peacekeeping project. It is the first official statement report that radiation hazards associated with DU have been detected in Afghanistan.** This indicates that the **UNEP PCAU** study is justified to include DU surveys in its environmental assessments with the best available alpha radiation detection equipment, despite UK Government denials that DU has been used in Afghanistan.

The Dirty Bomb reports in December were briefly picked up by the international media and sustained **international anxiety** about the risk of terrorist attacks in other countries. Were they being used to justify the ongoing war against terrorism or as the first stage of covering up widespread use of DU?

**The reference to over 50 suspected chemical, biological and nuclear weapon sites in Afghanistan is likely to match the number of sites attacked by US forces with hard-target guided weapons.** This may give the UNEP PCAU an idea of how many potentially DU contaminated locations they need to inspect.

**The location of these targets is essential for provisional estimates of potential DU contamination to towns, villages and water supplies.** As in 1999 the United Nations needs another DU target map from the US Government. Will UN member states tolerate another one-year delay before the Afghan DU map is released?

**The UNEP PCAU needs the Afghan "NBC" target map WITHIN THE NEXT 7 DAYS to plan their surveys. They will also require many times more resources than they were given in Kosovo, and fast.**

If the dirty bomb reports were fabricated by US sources for propaganda purposes this was an incredibly hazardous issue to raise. Though the report referred to use of "spent reactor rods" to create crude bombs it also highlighted the widespread availability of depleted uranium metal in civilian applications as a potential terrorist material. Yet on 19 December the UK Government appeared unconcerned about the trading of DU metal that could be adapted for terrorist bombs: "Data on imports of depleted uranium and depleted uranium products since 1985 are not readily available and could only be obtained at disproportionate cost." (Hansard 19 December 2001, see page 71).

**If governments are concerned about use of dirty bombs by terrorist groups they need to track down and control ALL sources of DU metal.** Environmentally there is little difference between the hazards created by detonating and igniting DU metal in a guided weapon warhead or in a terrorist bomb. Either would be a radioactive "dirty bomb". This raises serious questions about the availability of DU in civilian as well as military applications. The radiation hazards associated with its use in aircraft counterweights have been recognised from airport fire instructions in the 1980's to a Boeing maintenance procedure circular PRO-1861 in July 2001. See <http://groups.yahoo.com/group/du-watch/files/PRO-1861.pdf> There is clearly a conflict of interest between genuine concern to restrict terrorist resources and the nuclear industry's wish to market DU products widely into civilian applications.

Statements from the UK Government (in Part 2) and these statements from US government sources in the last three months suggest **a systematic approach to mislead the public about the suspected use of DU in hard target weapon systems on both sides of the Atlantic.** They have deterred media and hence public concern about potential widespread use of DU in Afghanistan and recent conflicts and reduced public and media vigilance about the hazards of DU in military or civilian use. **At worst Donald Rumsfeld's statement on 16 January may be a prelude to discovery that significant amounts of DU contamination from US weapons will be found in Afghanistan.**

These statements increase my concern for human welfare in Afghanistan. **The danger of this culture of deception concerning Depleted Uranium weapons is that it will be used to subdue political and media debate, and hence to delay, limit, or distort systematic environmental and health assessments for DU in Afghanistan.**

I hope that independent political, scientific and media organisations in every country providing troops or civilian support will realise the importance of supporting the **UNEP PCAU**. Any attempt to interfere with fast, thorough and independent assessment of potential DU risks in Afghanistan should given the widest exposure.

The pressure and support needed for the **UNEP PCAU** to investigate DU hazards rigorously should also be offered to the **World Health Organisation**. The WHO needs to establish fast and thorough **medical monitoring** with immediate effect - not in 6, 12 or 18 months time. Robert James Parsons report **DU Balkans cover-up** questioned the relationship between the **International Atomic Energy Authority** (representing the nuclear industry) and the **WHO's** responsibilities to investigate major health risks if these include suspected radiation hazards. So **any post-conflict health assessment project undertaken by the WHO needs international support and vigilance.**

**Any interference or restriction on WHO investigations of radiation-related health disorders should be a matter for international concern and full debate in the United Nations.** Continuing delays to WHO investigations into DU health effects in Iraq are a matter of grave concern to DU researchers and human rights groups concerned for civilians in Iraq

If there is **evidence of DU weapons being used in Afghanistan**, despite categorical denials by UK Government ministers, then this will have **international political and legal implications**. For example:

- Did the US and UK Governments fully inform European and other governments (e.g. Australia and Turkey) of potential DU weapons use in Afghanistan prior to winning their co-operation to staff up the Afghan clean-up and peacekeeping operation?
- If such briefings did occur were all political parties fully informed e.g. when the Green Party in Germany supported intervention?
- If DU is proved to have been used in hard target guided weapons then where else have they been used - e.g. in Bosnia, Iraq and the Balkans war?
- If so were other Nato countries informed of their use and of locations in the Balkans when KFOR troops were sent in? The highest incidence of Leukaemia cases seems to have been for Italian, Spanish and Portuguese troops assigned to western Kosovo - one of the heaviest bombing locations. US and UK troops were allocated to less heavily bombed regions. Was this taken into account in the health studies done in 2000-2001 by most European countries (except UK)?

If DU has been used in old or new hard target guided weapons at any time since 1990 there may be many further legal and political repercussions. International lawyers have already expressed concern about the potential significance of DU munitions as **weapons of indiscriminate effect**.

The US Government has recently announced **plans and budget commitments to replace and increase its inventory of hard target guided weapons** following the Afghan bombing. They offer tactical military justifications for such weapons in regions suspected of having many underground weapons stores and command centres e.g. in Iraq and North Korea.

But if **DU is used in large hard target warheads these are likely to dissipate low level nuclear waste over large areas and across national boundaries**. For example if they have been extensively used in Afghanistan the DU fallout is bound to spread to northern Pakistan and western China given prevailing wind directions. This has long term implications for pollution of land and water supplies serving very large populations.

-----

There are **alternatives to DU** for hard target warheads e.g. Tungsten for unitary penetrators and other metals in shaped charge warheads. Shaped charge warhead technology and high kinetic energy created by increased missile velocity rather than high density materials appears to offer scope for more powerful weapons without the radiation hazards associated with DU. In effect DU warheads are already obsolete.

These developments, and the widespread proliferation of anti-tank and hard target guided weapons to over 30 countries, indicates an **urgent need for international arms control to ban the current and potential use of DU in weapons** of all kinds from cluster bombs and cruise missiles to very large bunker busters.

The existing inventory of suspect DU weapons identified in Part 3 are worth billions of dollars, though many have been used in the last 3 months. New hard target weapons currently under development by the US, UK, France, Israel and potentially Pakistan, India and China are also involved. DU weapons may have become a low-level nuclear arms race over the last 5 years.

This development has been fuelled by the nuclear industry that sees DU weapons as a profitable way of disposing of nuclear waste. 99% of Uranium waste from the nuclear industry is depleted uranium - U238. But very few members of the public are likely to make that connection without more rigorous media coverage.

The commercial nuclear agenda spreads further. In 2001 sustained scientific and political propaganda has successfully created the public impression that DU is not hazardous - even in military applications. This is closely tied in with clear plans by the nuclear industry to disperse DU products into the public environment. These include dilution of DU in other recycled metals (e.g. as found in Aluminium alloys) and by creating DU oxide aggregates (e.g. DUcrete) for the international construction industry.

New legislation in the US in recent months is seeking to deregulate control of DU products for use in civilian applications. If successful this will enable existing DU stockpiles (500,000+ tons in the US, and other large quantities in Russia and Europe - see WISE at <http://www.antenna.nl/wise/uranium/eddat.html>) to be disposed of and for the businesses concerned to make a profit in the process. Previously DU had to be stored and contained as low level nuclear waste.

The long term environmental implications of DU reinforced concrete are equivalent to the use of Asbestos to reinforce building materials (e.g. interior rendering) in the 1950's. The potential environmental impact of this for future generations can be seen in the dust contamination problems associated with the tragic destruction of the World Trade Centre's Twin Towers.

Depleted Uranium has some valuable uses e.g. in radiation shielding but only under the strictest health, safety and environmental controls. But its use in any context has to take account of the full long term human and environmental cost of using it - in military or civilian applications.

The perils of the unrestricted use of DU in military applications are already obvious in Iraq and beginning to emerge in parts of the Balkans, despite official research and political propaganda which minimises DU hazards. These may also become obvious by August 2002 in Afghanistan, much faster than in the Balkans, if large quantities of DU weapons have been used. Hence the title of this report ***Mystery Metal Nightmare in Afghanistan?***

-----

## Part 5 Conclusions & depleted uranium priorities for 2002

### Framework for analysis of DU weapons and hazards in Afghanistan

This report covers a wide range of technical, research and political issues. Where possible it includes factual evidence and direct sources of research and official statements. However some essential facts are currently military secrets and some official statements and reports about DU weapons and hazards are unreliable. These areas of uncertainty are expressed as questions that may have several answers. These options form the basis for alternative **DU scenarios** for others to test.

In this complex area a **systematic framework** is needed to separate facts from opinions and political processes from technical analysis e.g. risk assessment. This may speed up **the search to identify all DU weapons, their health hazards and implications for people exposed to the effects of bombing in Afghanistan**.

My central concern is the **health and safety of troops and civilians**, and to alert employers and governments to the risks they may face. This calls for **systematic risk assessments** identifying the potential hazards, the people at risk, precautions to minimise exposure, potential health effects, mitigation of risks plus reliable data from health and environmental assessments.

The potential hazards of DU contamination require an understanding of the **military context** e.g. warhead technology, weapons involved and their intended mission.

DU investigations are complicated by the **political context** that has led to secrecy about the mystery dense metal involved in new weapons and compromised research on the health and environmental effects of DU. Political, military and commercial issues have to be recognised. They can help or hinder the immediate task of ensuring human safety in Afghanistan.

### Suggested framework for DU analysis

Refer Table 2 (page 126)

Refer Table 3 (pages 127-8)

Factors	History & past use: 1973-98	Recent events 1999-2001	Immediate priorities	Outlook April 2002 >
<b>Political context</b>	Political agendas, Advocates Sceptics	Recent research & controversies	DU scenarios in Afghanistan. Key players	Political consequences & review
<b>Health, safety &amp; environment</b>	People at risk Health risks Environmental issues	DU use in the Balkans & suspected in Afghanistan	Health precautions Environmental assessments	Summer hazards. Review past DU cases
<b>Military context</b>	Weapon systems DU features Technology Strategic context	Suspected weapons & targets	Full disclosure of DU weapons targets & assessments	Replace DU weapons capability?

Each of these areas - **DU health & safety risks** and their **military** and **political context** can be considered in terms of its **early history** and **recent events** in the Balkans and in Afghanistan as the new weapons became operational. This is summarised in **Table 2**, based on evidence gathered in Parts 1-4. **Table 3** carries these three areas forward to identify **immediate priorities** (February - March 2002) and **consequences from April onwards** if more serious DU scenarios develop with warmer weather.

Table 2: Historical context of DU - Military, Human and Political factors

Factors	1973-1998		1999-2001
<b>Political Agendas</b>	National arms industries/exports-US, UK, FR, IS, RU Nuclear waste marketing - military & civilian. DU military uses vs. Geneva Conventions - secrecy, deny or conceal health risks, reject bans. Gulf veterans compensation & environmental claims. Hide effects. Keep enemies as demons not martyrs		Post-Balkans Leukaemia deaths EU/NATO anxiety Balkans DU cover-up DU Bill in US Congress UK MPs question DU
<b>DU advocates</b>	Military & governments, NATO; arms manufacturers, Nuclear industry (& IAEA?) Government sponsored/dependent research (RAND)		Balkans DU studies: UNEP, WHO, Royal Society, Nato, DoD
<b>DU Sceptics</b>	Radiation & industrial safety agencies e.g. FAA Gulf veterans; victim communities, DU campaigns, independent medical & epidemiological researchers		Military Toxics Project Low Level Radiation C. WISE, LAKA, UK Vets
<b>People at Risk</b>	Enemy troops & civilians; own troops in friendly fire incidents, cleanup & recovery teams; training & plane crash locations; expatriates; refugees		+ troops investigating hard targets; Aid teams & Peacekeepers.
<b>Health Risks</b>	DU metal: External - low; Shrapnel - medium DU oxide aerosols: Internal exposure inhaled or ingested - medium to high due to toxicity & alpha radiation + dirty DU U236, Pu239 leading to renal, immune & nervous systems and carcinogenic effects Risks subject to dose level & brief or ongoing exposure to contamination. Few acute doses monitored. Gulf War Syndrome. Birth defects. Slow onset pathologies e.g. lymphomas, leukaemia		Suspected acute exposure in vicinity of high load DU warheads (up to 1.5 tons each) Indirect exposure through airborne dust, water supply & soil contamination over large areas in Afg.
<b>Environment issues</b>	Localised hazards for known penetrators. But cumulative area hazards from 300+ tons in Iraq	Suspected wider contamination but not assessed (Iraq)	Suspected 100x more DU per target. Heavy bombing in Afghanistan 500-1000 tons of DU?
<b>DU Weapon systems</b>	<b>Known:</b> 25 & 30mm API 120 mm tank rounds	<b>Suspected:</b> AGM-65, TOW 2, AGM-142, JDAM	<b>Suspected:</b> BGM-109 GBU-15,-27,-28,-31,-32 AGM-86D,-130C,-158 +
<b>DU features</b>	High density (18.6) for kinetic energy weapons Very hard alloyed with Titanium, Nb or Mo. Melting point (1132°C) suitable for shaped charges Pyrophoric - burns at high temperature - incendiary.		Less use of anti-tank DU than Gulf. DU use suspected in US guided weapons & by Al Qaeda
<b>Weapons technology using DU or mystery dense metal</b>	DU anti-armour penetrators - 25mm, 30mm, 120mm DU Phalanx sea to air rounds - 25 mm Advanced penetrator warheads (AUP) BROACH multiple warheads (MWS) Shaped charge warheads: A/T & hard target Shaped charge cluster bombs & A/T mines		1999: new & prototype warhead evaluation in Balkans - JDAMs & AUP vs. BROACH. 2001: New systems in tested in Afghanistan.
<b>Strategic context</b>	70's - 80's: Anti-Tank capability 80's-90's: hard & deeply buried targets: e.g. radar, command & control centres (HDBTDC) 90's+ underground NBC & terrorist bases		Command bunkers, suspected NBC targets in Balkans plus caves & tunnels in Afghanistan



**Table 3: DU issues in 2002 - Military, Human and Political factors**

<b>Factors</b>	<b>Immediate issues: January-March 2002</b>	<b>April 2002 &gt;</b>
<b>Political Agendas</b>	Apply & refine <b>DU Scenarios</b> in Afghanistan Precautions & strategic review for international aid, UN peacekeeping & refugee programmes. UNEP/WHO assessments, UNHCR co-ordination Monitor and deter political interference in UN roles. US / UK / EU political response to DU scenarios? Military response to DU scenarios & troop welfare? Political accountability of military & arms industry?	Consequences of DU assessments in Afghanistan, Pakistan, European & other states? Re-open DU history in Iraq, Balkans & more Legal / financial liabilities? DU proliferation control?
<b>DU advocates</b>	Mystery metal disclosure: denial or facts? Scale & location of DU use in recent bombing? The Al Qaeda paradox: whose bombs? - all DU weapons are "dirty". Cover-up or co-operation?	Reviews of past DU use, dirty DU, health research, & environmental impacts. DU a liability, not asset?
<b>DU Sceptics</b>	Update health & environmental models for high load DU weapons. Fast, practical advice for health & environmental assessments in Afghanistan. Fast, practical advice for health & safety precautions and summer re-contamination scenarios.	Re-assess past DU conflict areas. Re-construct case for Veterans & other claims. Increase LLR awareness.
<b>People at Risk</b>	All troops, civilians & expatriates exposed during bombing: a) still in Afghanistan and b) elsewhere. Children and pregnant mothers at highest risk plus new arrivals - refugees, aid, military, commercial.	People in all contaminated areas in summer heat & wind. Risk zones spread. Early onset DU disorders.
<b>Health risks &amp; effects</b>	a) Assess, monitor, isolate immediate risks e.g. water and high contamination target zones. b) Acute exposures: respiratory, nervous & immune system and renal damage (see Figure 2, page 106) Severely reduced immunity to winter conditions including death. DU monitoring & intensive care. Need for rigorous diagnosis & DU autopsies. c) Moderate exposures: Minimise further exposure. Health care includes DU monitoring. d) New arrivals or low exposure: Minimise any DU exposure - water, rigorous dust/food hygiene.	Depend on DU scenarios: Water supplies & irrigation at risk from snow-melt and surface run-off. Airborne dust re-contamination in hot weather and in haze, wind & vehicle movement. Expect contamination to spread during summer. Ongoing health monitoring & support in Afg, Iraq etc..
<b>Environment issues</b>	Rigorous, fast environmental assessments needed. Priorities include all water supplies and known hard target bombing zones in populated areas. UNEP PCAU may require 20x more resources than in Balkans study for Al Qaeda & / or US DU sources. Vigilance for deception & interference. Disclosure of bombing target maps & military NBC assessments.	Extended monitoring required for air, water, sand and soil throughout summer & in trans-border risk areas. Balkans, Iraq re-assessments needed. Data is legal evidence.
<b>DU Weapon systems</b>	UK Govt deny any DU weapons use in Afghanistan. US Govt report Al Qaeda DU & radiation from DU warheads. Rigorous investigation of suspected DU weapons used in Afghanistan and other countries to enable immediate risk assessments. Mystery metal(s) involved must be identified fast. Disclose plume & risk assessments from weapons tests.	Further investigation and historical verification required of all suspected & planned DU weapons. International moratorium on all identified & suspected DU weapons.  / Table 3 continued >>

<b>Table 3 (continued): DU issues in 2002 - Military, Human and Political factors</b>		
<b>Factors</b>	<b>Immediate issues: January-March</b>	<b>April onwards</b>
<b>DU features</b>	Exact Isotopic mix analysis required for all DU contamination to identify sources. Legal evidence.	Historical study required for DU Isotopic database.
<b>Weapons technology</b>	All suspected DU weapons to be identified for health / environmental risk assessments. Models required for environmental dispersion of high load DU warheads and all other suspected DU applications e.g. cluster bombs and mines.	Disclosure and historical analysis of earlier DU weapons. DU substitution e.g. in shaped charge warheads.
<b>Strategic context</b>	Surviving terrorists. Suspected hideouts or weapons stores. Acute and progressive DU health effects on Taliban / Al Qaeda personnel in hard target locations? Environmental hazards of bombing suspected NBC targets including DU? International reaction to DU weapons?	Strategic and legal review of bombing with DU warheads and sub-munitions. Credibility of war on terrorism? Alternatives?

It is hoped that this framework will help managers, medical advisers and others involved in aid planning or health and safety risk assessments who may be unfamiliar with DU weapons and hazards to familiarise themselves quickly with essential factors, and to be prepared for military explanations and political interference.

This report finds that powerful vested interests are involved in the sale and use of DU weapons with strong justifications for their own actions e.g. believing "DU is safe". Secrecy, mis-information and deception appear to be normal in the politics of DU. This may be to deter interference in the multi-billion dollar arms industry, or to avoid equally high stakes for injury compensation or criminal indictment. Aid organisations are familiar with some of this political environment and do the best they can despite it.

The seven **DU Scenarios** provide a framework for further investigations while much key data are kept secret by the US and allied governments and military. A key priority is to persuade these governments to fully disclose the facts about suspected DU weapons and their use in Afghanistan.

Prospects for DU disclosure are another unknown factor. They may need debate in the United Nations Assembly or action by the International Court. Options range from continuing secrecy, through partial but unreliable information to full and verifiable facts.

Until full disclosure is available the UN and other Aid organisations will need independent plans and precautions. **The DU scenarios can be updated and narrowed down** as facts emerge from governments or from independent environmental and medical monitoring.

**The US and UK governments may have been working on their own DU scenarios for weeks - fully aware of the weapons involved.** However they have not previously acknowledged the potentially fatal health hazards of inhaling or ingesting depleted uranium oxides, including dirty DU contamination. They may have seriously underestimated the potential health and environmental effects from using large numbers of high load DU warheads in Afghanistan.

The issues raised in this report have **wider implications** e.g. for re-viewing the use and effects of previously undisclosed DU weapons in other conflict zones including Iraq, the Balkans and Israel and in military testing and training areas around the world. They also have political, legal and commercial implications.

**These wider implications need to be registered now but may distract from the immediate priority to minimise potential DU hazards in Afghanistan, which are likely to worsen in the summer.** They may become major issues later in the year once the situation in Afghanistan has been fully and independently assessed. It would be better to pursue them when more facts are available about DU weapons and contamination in Afghanistan.

On 16 January Donald Rumsfeld's report of elevated radiation in one location due to depleted uranium in missile warheads means that **DU has been used in Afghanistan. The question now is not if DU has been used, but how much, where and by whom.** Scenario 1 is now less likely.

## Interim conclusions and priorities

The human, environmental and political consequences of the war in Afghanistan are moving fast. This report is the input of a concerned citizen without access to full data about the weapons used or their targets. The suspected use of DU in some or many of the weapons identified in Part 3, plus any used by Al Qaeda or Taliban forces is a hypothesis until full and verifiable data are available.

The report contains many deductions or conclusions in each section. The following **Interim Conclusions** highlight concern the most important issues for the current situation in Afghanistan. Several also have wider implications for re-evaluating other DU combat zones and for political and military issues that may follow if DU has been used extensively in Afghanistan. They can be updated when more facts are known.

They are sceptical about the actions and intentions of the US and UK governments and military who have led the war and control post-conflict operations in Afghanistan. But they affect many countries. They highlight the importance impartial operation by UN agencies. They raise issues for national investigation and international vigilance.

## DU Weapons Identification

- 1. Based on developments in warhead technology and properties of DU, I conclude that Depleted Uranium is most likely to be the mystery 'dense metal' involved in a new generation of guided weapons and some sub-munitions.**

These new and upgraded weapons were proposed in the **USAF Mission Plan 1997** quoted in **Part 1**. These were researched and are included in the **known and suspected DU weapons** identified in **Part 3**. They are illustrated in **Figure 1** (page 89). **Table 4** (page 131) lists the weapons and their known or suspected combat use. In **advanced penetrator warheads** the only economic alternative, Tungsten, may be used for the point of impact (the tip) but for physical properties and cost DU is the logical material for the main ballast and, in different alloys, possibly for the casing. Jane's reported that DU is used in liners for **shaped charge warheads**. Its density, moderate melting point and pyrophoric qualities are suitable in explosively formed penetrators. These are used in some hard target and anti-armour missile warheads including BROACH MWS, and in some anti-armour sub-munitions.

2. **Positive identification of suspected DU weapons systems is difficult because the 'dense metal' in penetrator warheads is not identified in any public domain sources found to date.** According to the USA Today illustration of the GBU-28 it is classified i.e. **a military secret**. Despite Jane's quote that DU is used for liners in shaped charge warheads no specific weapons are identified. Unofficially versions of the TOW and Milan anti-tank missiles have been reported to use DU warheads. The metal in shaped charge liners is rarely identified in weapon descriptions. Sometimes copper is used. DU is interchangeable with copper. The photograph of DU products on page 79 look very like the shaped charge casings and liners in the two previous illustrations.
3. **Many of the suspected DU weapons in Table 4 have been used in the Afghan War. It is vital that any use of DU in these weapons should be identified without delay.** These facts are needed to enable full environmental impact assessments to be conducted by the UNEP PCAU, for full health and safety risk assessments to be conducted and for suitable precautions to be taken for expatriates and local citizens. in Afghanistan.
4. **The fastest solution to DU weapon identification and DU risk assessments in Afghanistan is for the US and UK governments or military to give full and verifiable disclosure of all high-density metals used in all the suspected systems including DU and DU alloys.** Recent requests for disclosure of DU weapon systems and of DU use in Afghanistan by UK MP's have been met with repeated denials by UK Government spokesmen except for known anti-armour weapons (see Part 2). Similar requests have been made to the US Government in Bill HR 3155 submitted to the US Congress on 17 October 2001 (link on page 138).
5. **Past government action in the US and UK on many aspects of DU use and health hazards has been characterised by delay, denial or deception.** Parts 2 and 4 of this report indicate continuing denial or deception about DU weapons or their use in Afghanistan. For example:

On 6 December 2001 UK Government Defence spokesmen Mr Ingram stated that " a variant of the **GBU-24** and a variant of the **AGM-65** are in service with UK armed forces. Neither use depleted uranium or any other "dense metal" in their warheads."

Readers can compare this statement with the FAS descriptions of the GBU-24 warhead on page 77 and the AGM-65G warhead on page 88.

He also said that "The only dense metal contained in the BROACH MWS [Multiple Warhead System, see page 80] is a tungsten-based alloy. No other dense metal is or has been used in its development or testing. The BROACH MWS is not forecast to enter service before August 2002". (see page 69)

Regarding the BROACH warhead:

- a) BROACH stage 1 is a large, shaped charge warhead, unlikely to use a tungsten liner because of its high melting point. It may use a tungsten case and DU liner.
- b) BROACH was developed to meet US HDBTDC requirements that are understood to include incendiary capability to neutralise chemical or biological targets. The stage 2 warhead is an explosive, dense metal penetrator, expected to use the same dense metal ballast as other advanced penetrators in US systems with the same capability. DU has incendiary potential. Tungsten does not.
- c) The UK Storm Shadow missile was due for operation in December 2001 so could have been used or tested in Afghanistan. It has a BROACH warhead. Is it 8 months behind schedule? Did it miss combat testing?

Table 4: Combat use of known and suspected DU weapon systems with dense metal penetrator or shaped charge warhead technology

Weapon	Gulf War 1993	Bosnia 1995	Desert Fox 1998	Balkans War 1999	Iraq no-fly zone 1992>	Afghanistan 2001	New 2002 /2003
<b>Guided Bombs</b> (AUP upgraded versions)							
GBU-15	e	P	?	Y	?	Y	
GBU-24	e	P	?	Y	?	Y	
GBU-27	e	P	?	?	?	Y	
GBU-28 B/B	P	P	Y	Y	?	Y	
GBU-31 JDAM	e	e	P	Y	?	Y	
GBU-32 JDAM	e	e	P	Y	?	Y	
GBU-37 B/B			?	Y	?	Y	
SSB					P	P	D
<b>Guided missiles</b>							
TOW 2 A/B A/tank	Y	?					
AGM-65 G Maverick	Y	?	?	?	?	?	
Hellfire II / Brimstone	e	e	e	?	?	?	
AGM-84 SLAM-ER			?	?	?	?	
AGM-86D CALCM			P	P		Y	
AGM-130C				?	?	Y	
AGM-142 Hav Nap		?	?	Y	?	Y	
AGM-154C JSOW					154 A	P	D
AGM-158 JASSM						P	D
BGM-109 Tactical Tomahawk e			e	E		P	D
Storm Shadow / SCALP ER						P	D
<b>Sub-munitions</b>							
BLU-108/B A/Tank cb				?		?	
BLU-97B cluster bomb				Y		Y	
<b>Armor-piercing ammunition</b> (DU confirmed)							
20mm Phalanx sea-to air							
25mm M791						?	
30mm PGU-14/B	Y	Y		Y		?	
120mm-US & Charm-UK	Y	?					
<b>Key:</b> Y = reported use. ? = operational, not reported. P = prototype testing expected. D = due delivery Blank = not operational, not appropriate to combat situation. e = earlier versions not suspected of DU <b>Note:</b> Data on warhead technology, operational status and combat use taken from: Federation of American Scientists; Jane's Defence; Center for Defense Information; Hansard.							

The fundamental errors in Dr Moonie's letter (pages 52-5) and the anomalies in Mr Ingram's statements above suggest that **UK Government statements on hard target weapons cannot be trusted without full, independent and public verification**. Their answers are too short, too vague or contain serious errors of fact. They seem intended to divert the attention of UK Members of Parliament away from the suspected DU use in Afghanistan and previous conflict zones. A version of the AGM-65 injured some UK Gulf War Veterans who are now suffering serious health problems, denied as DU-related by the MoD. Dr Moonie denied knowledge of US warhead materials but also denied use of DU in Afghanistan. If he doesn't know the systems how can he give assurances that troops and civilians currently assigned to Afghanistan are not at risk of severe DU contamination?

**DU disclosure requests to the US and UK governments need to be repeated urgently, preferably in public sessions in Congress and the House of Commons and with full media coverage.** Similar disclosure requests should be made to governments of all countries sending troops or civilians to Afghanistan. Requests should include past as well as present weapons and specific versions. The MPs who asked these questions may wish to pursue their questions again with the facts in this report, possibly in a Select Committee where they can interrogate ministers for fuller answers and question ambiguous replies.

## 6. Other DU weapon identification options

While formal requests for disclosure are blocked by the US and UK governments suspected DU weapons may be investigated by **further analysis of weapons information** from reliable sources, by **target inspection** and by **laboratory analysis of bomb fragments, dust, soil or water** from the target area. This could include inspection of guided bomb and missile targets in the Balkans if access to Afghanistan is difficult. It may include photographs or TV coverage of targets and casualties. These may include signs of intense heat from suspected incendiary effects of large DU warheads. Full DU health precautions should be taken in suspected DU target areas as done by UNEP teams.

Indirect identification may also be done through medical reports of casualties exposed to hard target bomb or missile attacks, subsequent health problems and uranium monitoring. These could include people in Afghanistan and KFOR troops.

7. **If any US or allied weapon systems are proved to contain DU then all weapons using the same warhead technology become highly suspect.**
8. According to US Government reports either **Al Qaeda or Taliban forces or both possessed stocks of DU or weapons with DU warheads** (page 120). The same weapon identification is needed for all potential sources of DU contamination. This is essential to a comprehensive DU risk assessment in Afghanistan, whether such DU materials were used in combat, training or hit by US bombing.

The statement that "U.S. forces found some missiles with depleted uranium warheads" is very important. **This is the first official acknowledgement that any non-nuclear missile in the world contains a DU warhead.** The US Government should be asked what weapon was involved. The UK Government need to know since it invalidates their previous re-assurances to MPs that DU has not been used in Afghanistan.

### **Potential environmental impact of large DU warhead weapons and assessment issues** (and see DU scenarios on page 95)

9. **If none of the suspected weapon systems contains DU**, this will be one less problem for people in Afghanistan and neighbouring countries, and in other countries where these weapons have been used. It will also save a lot of time and resources otherwise needed for investigation. However, **rigorous verification of official re-assurances will be essential** as illustrated by statements from UK Government defence spokesmen in Part 2 and on page 131. This best case scenario is now in doubt due to the US reports of a missile with a DU warhead.

10. **If DU is used in explosive warheads or sub-munitions its toxic and radioactive properties will undoubtedly cause 'widespread, long term and severe damage' to the natural environment, thereby '.. compromising the health and survival of the population'** within the meaning of **Article 55** of the **First Protocol** additional to the **Geneva Conventions** of 1949. Even more so if such weapons have been used in large numbers in Afghanistan.

Weapons containing DU are not "considered illegal" under these terms according to Dr Moonie's letter (page 53). And yet the fine oxide dust produced by burning U238 and contaminated with U234, U235, U236, Plutonium 239, 240 and other transuranic metals disperses widely. Once burned in air DU is a source of radioactive contamination that cannot be removed from the natural environment. The same health precautions, risk assessments, radiation protection and nuclear waste regulations should apply in combat zones as in any other human environment.

11. **If DU has been used in the warheads of the weapons identified in Part 3, there may be a grave and widespread risk of exposure to DU contamination for all civilians and military personnel exposed to bombing locations in Afghanistan.** This should be a matter of immediate concern to all countries supplying troops or civilian personnel to aid and reconstruction in Afghanistan. It has immediate implications for the planning and co-ordination of UN post-conflict operations in Afghanistan including repatriation of refugees.

12. **In the worst case scenario 500-1000 tons of DU may have contaminated populated regions of Afghanistan. If so then the long term health effects are likely to be as grim as those in Iraq, and more widespread.** At worst whole regions may become uninhabitable with major implications for the refugee crisis to be expected once birth defects and other untreatable illnesses become obvious. These hazards should have been clear to US military planners and arms manufacturers unless they shared the popular belief that "DU is safe".

13. **If the UNEP PCAU study is allowed to work quickly, effectively and without political interference they may have a provisional assessment of DU contamination in 2-3 months** - much faster than in the Balkans. This may be vital input to plans for humanitarian aid and repatriation of refugees by other international agencies. Until then DU precautions would be wise.

14. **A serious possibility exists that the US and UK governments, military or commercial organisations may seek to conceal their use of DU weapons in Afghanistan and to delay or interfere in UN environmental assessments as happened in the Balkans studies.** How this can be deterred or controlled is a problem for the world community acting through the UN.



- 15. The source of any DU metal or oxide contamination discovered in Afghanistan can be tracked down.** Like Anthrax, DU has its own "fingerprint" i.e. the isotopic mix for each batch. Rigorous international inspection should be able to track down how many different sources of DU may be involved and which countries they came from. **UNEP isotopic analyses of any DU found will be very important. So will the vigilance of the international media and independent states in the UN.** It is possible that UNEP investigations may be directed towards alleged Al Qaeda DU contamination with DU from Russia or Pakistan instead of inspecting a wide cross section of US bombing targets as well. All DU contamination needs independent scrutiny.

UNEP staff will be aware of this but in the Balkans they were given Nato maps and accompanied by troops 'for their own protection' from unexploded ordnance including cluster bombs. With hindsight perhaps the UNEP teams should have been testing some of this other ordnance and target areas as well because two types include shaped charge cluster bombs, now identified in the list of suspect DU weapons on page 131. Samples of dust and weapons fragments may be legal evidence for the International Court and will need high security.

### **Potential health hazards from large DU warhead weapons: health monitoring and risk assessments**

- 16. The clinical and epidemiological basis for several DU medical studies quoted by the US and UK Governments is deeply flawed** (pages 4 and 99-108). **They have reduced the vigilance of politicians and the media to DU health hazards in 2001. None of these studies addressed the risks of acute and widespread DU contamination from large warheads that may now exist in Afghanistan.**

However these studies are still quoted to justify DU weapons to elected representatives and the public (see Dr Moonie's letter, page 53 and the US Embassy website in Italy). There are very few **acute dose** studies for troops and **no known chronic exposure studies for civilians** living or working in DU contaminated combat locations. Hence they are not valid for predicting health hazards from intense or widespread DU contamination suspected in Afghanistan from many large warheads.

- 17. Recent low level radiation research and epidemiological analysis also indicate significantly higher risks from the alpha radiation of inhaled or ingested DU than previously acknowledged.** Hopefully these problems may be recognised by the newly established DU Oversight Boards in the UK and USA which include military and independent researchers.
- 18. If DU is used in explosive warheads or sub-munitions the resulting toxic and radioactive contamination is a serious health risk to humans, animals and plants.**

DU oxides may be inhaled or ingested in significant quantities from airborne dust, water or food (including animals) produced in contaminated areas. **DU doses may be acute** in target zones **or cumulative** over an extended period in post-combat environments. The **internal alpha radiation exposure** from DU oxides is likely to cause biological mutations resulting in lymphomas, leukaemia, birth defects and other forms of cancer or damage to the nervous or immune systems. **See High exposure DU health risks** in Part 4, section 3 (page 105).

These potential health consequences associated with internal exposure to DU contamination unquestionably involve **unnecessary suffering** by any humanitarian standard. They fall within the meaning of Article 35 of the first Protocol additional to the **Geneva Conventions** of 1949. They are reasons to take DU health precautions and risk assessments very seriously.

19. **Governments, aid organisations, employers, managers, officers, troops and other employees or volunteers involved in the reconstruction of Afghanistan are entitled to demand and support fast, rigorous and independent inspections by UNEP and WHO.** The questions raised in this report must be asked and answered within weeks if the lives of thousands more people are not to be put at risk this year as well as those of native Afghans already at risk. Each organisation may prefer, or be required in law, to do a careful **health and safety risk assessment** for their staff or volunteers assigned to Afghanistan.
20. **The 3-month delay in DU disclosure since my first warnings to the UK Government (see Part 2) has given time for death tolls to rise due to winter conditions and food shortages in Afghanistan.** These problems are likely to dominate the humanitarian agenda there over the next few months. See MSF's report of 18 January: **Food Crisis Worsening in Northern Afghanistan** at: <http://www.doctorswithoutborders.org/pr/2002/01-18-2002.shtml>
21. **A 'natural' humanitarian disaster is likely to deflect media and medical research interest away from significant numbers of acute DU casualties and fatalities.** This potential disaster will also give several months delay before the latency period for more distinctive DU health consequences become evident, e.g. birth defects and early onset lymphomas or leukaemia - see Figure 2, page 106.

If potential DU contamination is not suspected by medical personnel this may affect their diagnosis of some conditions or cause of death. If early medical monitoring is not done it becomes very hard attribute slow onset medical conditions to DU exposure, either for treatment or research purposes. This has been a feature of the "Don't Look, Don't Find" approach to DU health research for Gulf and Balkans War veterans over the past 10 years.

## Political context for the use of DU weapons

22. **If DU has been secretly used in guided weapons in Afghanistan, the Balkans or Iraq, then many countries and citizens need to question how and why it has been concealed.**

The use of DU weapons in the Gulf War has been strongly suspected of having catastrophic effects on the health of many thousands of people - troops and civilians alike. It seems likely that several governments may be well aware of DU contamination hazards but have failed to disclose them to their parliaments or the media for a number of years.

Have other countries been warned about potential DU hazards in Afghanistan during the formation of the UN Peacekeeping force in Afghanistan? Why should Bulgaria be sending a radiation decontamination team to Afghanistan? This raises questions about the democratic accountability of governments who may have developed acquired or used weapons of indiscriminate effect over a decade. If this has happened in the US, UK and other countries then all military technology should be subject to more rigorous public audit and control to ensure it complies with international law.

- 23. The widely held belief in military, government and academic circles that 'DU is safe' and that its military use presents 'minimal' health hazards must be questioned.** This collective rationalisation is one of the features of psychological *group think* in DU politics. See <http://www.cedu.niu.edu/~fulmer/groupthink.htm>

This belief is not consistent with the precautions taken to control DU radiation hazards in manufacturing and military testing facilities or as required by civilian regulations. It may come from military settings where temporary, low dose DU exposure is considered "an acceptable risk" compared to hazards associated with nuclear weapons, reactors or battlefield conditions. The military are concerned with immediate tactical hazards and effectiveness. Long term health consequences and ethical responsibilities for troops and civilians are the responsibility of governments who employ the military, in accordance with international conventions and legal liability.

However, despite official health studies, acute DU doses may incapacitate troops in combat within a few days. This may have occurred to special forces troops inspecting DU targets or caught in the friendly fire bombing accident. If suspected high load DU warheads were involved they may have been exposed to 100x more contaminated locations than any where since the Doha ammunition dump fire in 1991. The only equivalent military exposure may have been for KFOR troops inspecting suspected DU bomb and missile targets in western Kosovo in 1999.

- 24. The myth that 'DU is safe' has become a self-perpetuating belief in government and military circles.**

This belief provides psychological comfort for those responsible for commissioning the manufacture, sale, purchase and use of DU weapons, or justifying them to parliaments. It exonerates them from responsibility for using weapons of indiscriminate effect. It is also very useful for reducing public vigilance in the marketing of civilian DU products.

This myth has been carefully encouraged through compromised research and it may have allowed the US and other governments to justify using more and larger DU weapons. Lt Col Ziehm's memo from Los Alamos on 1 March 1991 (see page 115) has defined US (and UK) military policy towards DU ever since:

" There has been and continues to be a concern regarding the impact of du on the environment. Therefore, if no one makes a case for the effectiveness of du on the battlefield, du rounds may become politically unacceptable and thus, be deleted from the arsenal.

If du penetrators proved their worth during our recent combat activities, then we should assure their future existence (until something better is developed) through Service/DoD proponentcy. If proponentcy is not garnered, it is possible that we stand to lose a valuable combat capability."

For these reasons it is hazardous for scientists and professionals within government, the military or universities that rely on public funding to produce research that could challenge this belief, or that may undermine public confidence in DU. Self-censorship, conformity and negative stereotyping of out-groups are more features of group-think (Irving Janis, Yale, 1977, 83). Dr Gunther in Germany and Dr Sharma in Canada have been severely harassed for their research into adverse DU health effects. Most independent DU researchers are self-funded on very low budgets. By contrast lack of rigorous official DU health research leaves military and political planners dangerously mis-informed.

- 25. High conformity to the mistaken belief that DU presents minimal health hazards to humans may have resulted in strategic errors by the US and UK Governments in the last 4 years.** Group decision making tends to "shift to risk" in group think, ignoring obvious dangers and facts e.g. in the Bay of Pigs affair.

This may have contributed to a decision to develop the new generation of hard target weapons with DU warhead systems. Minimising DU risks may have also contributed to widespread use in Afghanistan without regard to predictable environmental contamination and under-estimating consequent health hazards.

If such errors of judgement have occurred in Afghanistan they may result in major legal actions, deep political embarrassment or criminal prosecution. If a DU health disaster develops in Afghanistan in 2002 then political and military authorities and advisers who believed that DU is safe may find this was a dangerous assumption. Medical professionals involved in DU policy and practice may recognise this first.

- 26.** These conclusions largely focus on the US and UK governments and immediate priorities in Afghanistan. But over 30 countries possess known or suspected DU weapons in their arsenal. These questions should be applied to government policy in all these countries, and to review the use of DU weapons in training or combat in any country since 1973. They also need to be reviewed collectively in the United Nations e.g. by the UN Institute for Disarmament Research.

## Future outlook for DU weapons

- 27.** The total value of suspected DU weapons listed in Table 4, either in stock or on order, around the world must be billions of dollars. Governments will be very reluctant to give them up. However many of the missile systems have modular warheads that can be changed.

**Recent developments in shaped charge warheads and other weapons design suggest that DU penetrators could soon become technically obsolete.** Other metals can be used to achieve similar or greater penetration effects without the human or environmental hazards of DU (see Part 3, page 78). Kinetic energy weapons needed for hard or deeply buried targets increase their effect dramatically with greater speed. Future systems will achieve high penetration with smaller but faster missiles. DU is cheap and readily available as nuclear waste. But it is not essential to effective hard target or anti-armour weapons.

However the costs of attempting to clean up DU contaminated areas, of legal compensation to individual casualties and possibly having to relocate large numbers of refugees may far exceed the cost or benefits of the weapons identified in this report.

If DU has been used in large amounts in Afghanistan a humanitarian disaster of nightmare proportions may be unfolding. Aid programmes can eventually provide food and shelter. They cannot reverse cancers or birth defects. Civilian fatalities of the Afghan bombing already exceed the terrorist murders of September 11<sup>th</sup>. They may become far higher over the next 5-10 years as in Iraq, including expatriates.

The potential political consequences of a DU disaster in Afghanistan for the US and UK governments, and on the credibility of the war on terrorism are serious. They will become worse if there is any further delay in disclosing the actual use of DU weapons, or any attempt to cover this up by fabricating DU evidence against Al Qaeda or the Taliban.

## Further action

The immediate purpose of this report is **to alert UN agencies, governments, aid organisations and other employers to the suspected health and safety risks of DU contamination in Afghanistan** - whether from Al Qaeda devices or US and allied weapons.

A draft of this report was sent to several UN agencies on 23<sup>rd</sup> January. This final version will be circulated to them, the UK Government and media contacts. It will also be offered as a public domain source on the Internet for aid agencies, employers, political representatives and researchers.

Other analysts and researchers have more specialised knowledge of specific subjects in this report e.g. the hazards, diagnosis and treatment of low level radiation exposure, public and occupational health precautions, epidemiology, environmental biology, environmental assessments and weapons technology. Several of these or their organisations are identified by links in the text. They are welcome to question and improve on the data, interpretation and interim conclusions in this report.

Ultimately it may not be public opinion that decides the future of DU weapons or their urgent investigation in Afghanistan. Long term radiation hazards are intangible to most people except those who see or suffer cancers or birth defects in their own lives or work. The best hope for the people of Afghanistan is **that doctors, scientists, writers, editors, politicians and senior military professionals of integrity will decide that Depleted Uranium weapons have become totally unacceptable**, and that as weapons of indiscriminate effect their use is a war crime. This report is for them.

The courage of these key professionals is vital to confront the network of deception that has enabled global DU proliferation to develop unnoticed over the last decade. Their integrity and support is vital to the effectiveness of UNEP, WHO, the United Nations peacekeeping force and aid programmes in Afghanistan.

Their testimonies may be important to empower Bill 3155 put to the US Congress on 17 October, 2001 - the **Depleted Uranium Munitions Suspension and Study Act of 2001\*** - which calls for a moratorium on the development and use of Depleted Uranium weapons in the USA.

Similar DU disclosure and vigilance is needed urgently now in the UK, Europe and other countries to protect troops and civilians involved in the reconstruction of Afghanistan. A similar moratorium is needed internationally through the UN to ensure a global ban on the military and commercial use of depleted uranium. Further action will depend on DU contamination levels in Afghanistan and which DU scenarios develop. The immediate question is no longer if, but how much, DU will be found in the coming weeks and months.

Dai Williams

31 January 2002

---

\* To see the Depleted Uranium Munitions Suspension and Study Act go to <http://thomas.loc.gov> and enter Bill = **HR3155**

## Acknowledgements and use of this report

These reports are mostly based on public domain data currently or recently available on the Internet. It is offered back to the Internet as public domain information. Thanks and copyright acknowledgements are due to the following organisations for background information, extracts and illustrations used in this report. Please follow links in the text to their sites, original sources and full reports.

The Federation of American Scientists  
 Jane's Defence information  
 The Center for Defense Information, Washington  
 The US Department of Defense  
 Alliant Techsystems Inc  
 Boeing  
 Raytheon  
 Primex  
 Manufacturing Sciences Corporation  
 Thorn Missile Electronics  
 The UK Government Stationary Office for the online version of Hansard  
 Military Toxics Project as moderators of the Internet discussion group DU-list  
 Reuters  
 New Scientist  
 The International Herald Tribune  
 The Nation  
 The Guardian  
 The Telegraph  
 Yahoo News

Personal thanks are due to individual DU and media researchers in the USA, UK, Europe, Russia and southern Asia.

### Distribution

This report is written for the UNEP PCAU, WHO, UNHCR, WFP, UNIDIR and other international organisations working for the future of the people in Afghanistan, elected representatives and others with a concern for the use of DU weapons.

Hard copies can be provided on request, with a charge to cover printing and distribution costs. Illustrations in this edition for UN and government information remain copyright of their sources. See Preface for Eos and author's copyright conditions.

For any questions regarding further publication please contact Dai Williams by Email at [eosuk@btinternet.com](mailto:eosuk@btinternet.com).

### Dedication

To the civilians and troops of all countries whose health, lives and families have been, are being, or will be ruined by exposure to depleted uranium weapons.

To those with the courage to confront, expose and ultimately ban the military use of depleted uranium world-wide as weapons of indiscriminate effect, and any unregulated civilian use of this hazardous nuclear waste.

---

*Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has."* Margaret Mead

*We have a testimony to living in that life and power that takes away the occasion of war. How does it lead you towards a way of life that does not rely on, or benefit from violence?*  
 Questions & Counsel, Society of Friends

---