
The Final Word on Depleted Uranium

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Earlier this year, a furor swept through Europe over fears that NATO's use of depleted uranium (DU) ammunition in Bosnia and Kosovo put soldiers and civilians at risk of cancers and other health problems. The U.S. Department of Defense, whose planes shot the disputed ammunition, aggressively dismissed concerns about the health effects of exposure to depleted uranium, while some groups opposed to the use of DU munitions strongly condemned the Pentagon and NATO for using "genocidal" weapons. Many European governments were caught in the middle, on the one hand pressured by the United States to downplay the problem but on the other hand squeezed by public opinion to investigate the issue.

The United Nations entered the fray as a voice of reason, but by taking a sensible approach to the problem, it satisfied neither the Pentagon nor anti-DU activists. After a lengthy investigation, the United Nations Environment Programme's (UNEP) "Balkans Task Force" determined that localized contamination at impact sites poses little immediate health risk to local populations, upsetting anti-DU activists. However, the task force recommended marking and cleaning up sites where depleted uranium had been shot, actions the Pentagon does not support out of fear of the precedent it will set.

The controversy has died down since the Balkans Task Force released its report in March 2001, but depleted uranium is likely to remain a volatile issue in the years to come. There are no signs that the leading proponent of depleted uranium, the U.S. Department of Defense, will restrict its use of DU ammunition, nor are there any indications that anti-DU groups will back down from their position that DU munitions are weapons of mass destruction whose use constitutes a war crime. The proliferation of depleted uranium ammunition makes its future use likely, but increased interest in DU will also bring its use under considerable scrutiny.

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Depleted uranium is neither the harmless metal the Pentagon paints it to be nor the weapon of mass destruction decried by activists. Plainly and simply, depleted uranium is a toxic waste that has the potential to cause adverse health and environmental effects; therefore its release in large quantities near populated areas requires remedial action. The United Nations has taken a judicious approach to the depleted uranium issue, but few others are following along.

THE BASICS

Depleted uranium is the waste product of two processes related to the nuclear fuel cycle. When natural uranium is processed to separate highly radioactive isotopes for use in reactors and weapons, the leftover waste is called 'depleted' uranium. This depleted uranium is as chemically toxic as natural uranium, but 40 percent less radioactive. In addition, when spent nuclear fuel from power plants is recycled to extract fissionable isotopes, the resulting waste is added to the depleted uranium stockpiles. In the United States, fifty years of uranium processing and recycling has produced approximately 700,000 metric tons (1.6 billion pounds) of depleted uranium.

In the 1950s, U.S. government agencies investigated commercial uses for the growing stockpiles of depleted uranium. Several potential products were identified, such as radiation shielding for medicine and industry, petroleum exploration drills, and counterweights in aircraft. Depleted uranium's extreme density and ability to burn also attracted the attention of military weapons designers, who recognized its potential use in armor-piercing ammunition. In the 1980s, depleted uranium was also developed for use in tank armor.

The production of depleted uranium ammunition began in earnest in the 1970s. DU ammunition looks remarkably like the arrows used in the wars of the past: a pointed shaft of solid metal stabilized by tail fins. Upon impact, the metal penetrator rod does not explode; its density and the energy of the impact enable it to punch and burn its way through a target, such as a tank. However, the energy of the impact causes roughly 20 percent of a DU penetrator to vaporize into an extremely fine dust, resulting in contamination of the impact site.¹ The impact of one DU tank round against an armored target creates roughly one kilogram (2 pounds) of depleted uranium dust, most of which is confined to the target vehicle and its immediate surrounding area out to 50 meters.

Soldiers who survive an attack by DU ammunition may have wounds containing DU metal and dust, and they will likely have inhaled large amounts of depleted uranium dust. People who subsequently come in contact with contaminated equipment may also inhale or ingest DU dust, or find and collect fragments of depleted uranium metal. A 1995 article in the U.S. Army magazine *Armor* offers practical advice on minimizing exposure to depleted uranium: "If

you find radioactive DU contamination on a vehicle, move the vehicle to a site away from water sources, food storage, or eating areas, and occupied bivouac sites...Of course, always keep personnel away from contaminated equipment or terrain unless required to complete the mission."²

Depleted uranium poses an external radiation hazard if the metal is collected and kept close to the body for an extended period of time, but it is most dangerous if it enters the body through inhalation or wounds. Once in the bloodstream, most depleted uranium is excreted from the body, but significant amounts deposit in the kidney and bone, and to a lesser degree in other tissues including the muscle, lung, brain, lymph nodes, and testes.³

Scientists at the U.S. Armed Forces Radiobiology Research Institute studied rats implanted with depleted uranium metal and identified four health effects of concern: cancer, immune system damage, central nervous system problems, and damage to the male and female reproductive systems.⁴ A separate U.S. Army-funded study by the Lovelace Respiratory Research Institute in New Mexico found that depleted uranium fragments caused cancer when implanted in the muscles of rats. The implications of these findings for humans remain unclear, though further studies are planned. In 1999, the U.S. Department of Veterans Affairs (VA) found one lymphoma and one bone tumor among 51 Gulf War veterans exposed to DU, but the small size of the VA study limits the significance of its findings.

The United States Department of Defense is responsible for the development of depleted uranium ammunition and its first ever use in warfare, but several countries including Russia, Pakistan, France, and the United Kingdom also manufacture DU munitions. To date only the United States and United Kingdom are known to have used depleted uranium ammunition in combat.

BIRTH OF AN ISSUE

Depleted uranium ammunition was used in combat for the first time during the 1991 Gulf War, and subsequently during NATO actions in Bosnia, Kosovo, Serbia, and Montenegro. Each time U.S. forces shot DU rounds, the U.S. Department of Defense neglected to warn ground troops and civilians about DU contamination. The Pentagon justifies its inaction by denying depleted uranium poses any serious health or environmental risk, but these denials have failed to discourage external interest in the issue.

Just prior to the Gulf War, the U.S. Army Armament, Munitions, and Chemical Command released a comprehensive report comparing the use of depleted uranium with tungsten alloy in armor-piercing ammunition. The report noted that DU munitions have greater penetration ability than tungsten alloy ammunition, but it warned that "aerosol DU exposures to soldiers on the battlefield could be significant with potential radiological and toxicological effects,"

including "cancer when exposures are internal." Even before depleted uranium ammunition had ever been fired in a conflict, the Army report predicted: "Following combat, the condition of the battlefield, and the health risks to natives and combat veterans may become issues in the acceptability of the continued use of DU [ammunition] for military applications."⁵

During the Gulf War, American aircraft and tanks fired nearly one million large and small caliber DU rounds against Iraqi forces, releasing approximately 300 metric tons of depleted uranium. British tanks also shot approximately 100 DU tank rounds (400 kg/DU) during the ground war. Guided missiles and high explosive weapons actually destroyed a far greater number of tanks and personnel carriers than did DU rounds, but depleted uranium ammunition nonetheless proved effective in its first battlefield test.

In the days and weeks after the war, tens of thousands of front line and rear echelon troops moved through contaminated battlefield areas of Iraq and Kuwait. A tank crewman who served with the 2nd Armored Division describes a typical scene:

We had 52 tanks on line. We engaged Iraqi tanks, personnel carriers, trucks, bunkers—anything in our path. After everything was over we went back through the areas we had shot up and climbed all over the vehicles we had destroyed. We wanted to see the damage our tanks had done, and we were looking for souvenirs. I knew we were shooting DU rounds, but we were never told to stay away from the vehicles that were hit by DU rounds. We were dipping [chewing tobacco], smoking, and eating without having washed our hands. Right after the war we saw lots of guys from other units climbing on the vehicles that we had shot with DU rounds.⁶

Inexplicably, Gulf War commanders failed to warn soldiers in the field to avoid contact with contaminated equipment.

At about the same time that thousands of victorious soldiers were climbing on and removing souvenirs from contaminated equipment, several military officers serving far from the battlefield voiced their concerns. A colonel at the U.S. Defense Nuclear Agency noted that as "ground combat units and the civil populations of Saudi Arabia, Kuwait, and Iraq come increasingly into contact with DU ordnance, we must prepare to deal with the potential problems."⁷ Another colonel at Los Alamos National Laboratory wrote to his superiors:

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...I believe we should keep this sensitive issue at mind when After Action Reports are written.⁸

Indeed, there was much greater concern after the Gulf War about the political fallout of using DU weapons than there was for the health of soldiers and civilians who might have been exposed to DU dust and debris.

Shortly after the war, the U.S. Army sent a small team of scientists into Kuwait and Iraq to identify and retrieve American vehicles hit by DU rounds in so-called friendly fire incidents. By May 1991, this team found 11 U.S. tanks and 15 Bradley Fighting Vehicles contaminated with depleted uranium as a result of being shot by other American tanks, or from onboard munitions fires.⁹ The DU survey team gathered the American vehicles in Saudi Arabia, but hundreds of pieces of contaminated Iraqi equipment were left on the battlefields. Six of the American vehicles were buried in Saudi Arabia, and the rest were wrapped in tarps and shipped to a newly built \$4 million decontamination facility in Barnwell, South Carolina. Workers wearing protective suits decontaminated some vehicles, but the more heavily contaminated equipment was cut up and buried in a nearby radioactive waste dump.

The Army's DU team also inspected Iraqi equipment being shipped to the United States for historical or research purposes. Three Iraqi tanks contaminated with DU were rejected for shipment because they "could not be placed on public display without substantial risk to the health and safety of the public or members of the military."¹⁰ The government of Kuwait used western contractors to gather destroyed and contaminated Iraqi equipment at a location in its western desert, but the Iraqi government made no effort to restrict access to or decontaminate destroyed equipment in its southern territory.

Several years after the war, depleted uranium was identified as a possible cause of illnesses affecting thousands of American and British veterans. The Pentagon quickly denied even the possibility of any such connection, and it convinced five consecutive federal committees investigating veterans' illnesses that only a few dozen veterans had been exposed to DU, with no adverse consequences. Through the determined work of Gulf War veterans' advocates, however, the Pentagon was eventually forced to dramatically increase its estimates of the number of veterans exposed to depleted uranium.

In January 1998, the Pentagon's Office of the Special Assistant for Gulf War Illnesses made a long-overdue admission: "Combat troops or those carrying out support functions generally did not know that DU contaminated equipment such as enemy vehicles struck by DU rounds required special handling... The failure to properly disseminate such information to troops at all levels may have resulted in thousands of unnecessary exposures."¹¹ Shortly after this confession, the Department of Defense developed training programs to inform military personnel about the use and hazards of depleted uranium munitions, but the Pentagon nonetheless denies that any Gulf War veterans might have or develop health problems related to their DU exposure.

The Pentagon's schizophrenic pattern of both acknowledging and denying the hazards of depleted uranium ammunition grew more apparent following the war in Kosovo. In 1999, American A-10 aircraft shot approximately 31,000 DU rounds at Yugoslav targets in Kosovo, Serbia, and Montenegro—the equivalent of 9.5 metric tons of depleted uranium. When the war ended, the United Nations' Balkans Task Force asked NATO to identify areas contaminated with depleted uranium so that peacekeepers, civilians, and relief workers might be warned about the potential hazard. Inexplicably, the North Atlantic Treaty Organization refused to comply with the request.

In September 2000, the intervention of U.N. Secretary-General Kofi Annan prompted NATO to release a map identifying the 112 locations where U.S. jets shot depleted uranium. UNEP's Balkans Task Force subsequently visited several sites and found small amounts of contamination and several DU bullets. In January 2001—nineteen months after the war—NATO forces began posting warning signs around contaminated areas.

From all accounts, peacekeepers, civilians, and relief workers in Kosovo were surprised to learn about depleted uranium contamination in their midst. Children had long been playing on destroyed equipment and in contaminated areas. In addition, adults had scavenged destroyed equipment for usable parts and scrap metal. The United Nations and the World Health Organization have not identified any illnesses among local populations directly related to depleted uranium, but they have recommended further health monitoring.

It is difficult to understand the rationale behind the Pentagon's decision to withhold information and warnings about depleted uranium from NATO peacekeepers and civilians. The Pentagon evidently does not want to draw negative attention to one of its weapons, and it also clearly wants to avoid any liability for battlefield clean up and potential health problems among exposed populations. Nonetheless, the Pentagon's sometimes furtive, other times frank, acknowledgment of the inherent risks associated with the use of depleted uranium ammunition helped create and nurture an opposition movement.

GROWING PAINS

Initial opposition to depleted uranium came from a network of community-based environmental groups in the United States working with the Maine-based Military Toxics Project. These groups advocated the clean up of contaminated sites in the United States where depleted uranium ammunition had been manufactured and tested. Soon veterans groups joined forces with these community organizations—a union that drew the Pentagon's attention.¹²

In 1994-1995, the U.S. Army commissioned two intelligence reports on the growing "external interest" in depleted uranium. By 1997, the Pentagon's lead agency for depleted uranium, the Office of the Special Assistant for Gulf War

Illnesses, they also served to fuel suspicion of the Pentagon's DU policies and foster opposition to the use of depleted uranium in munitions. The Pentagon's tactics included threatening libel suits against Gulf War veterans investigating DU, decrying as unpatriotic those who questioned the use of DU munitions, and attributing public concern about DU to an Iraqi propaganda campaign. While these efforts successfully kept the issue off the agenda in Congress, they also served to fuel suspicion of the Pentagon's DU policies and foster opposition to depleted uranium.

Most opposition groups initially promoted a practical, transparent agenda: clean up of contaminated sites, health care for exposed veterans and civilians, safety training for active duty forces, and scientific research on DU health and environmental effects. Many groups also favored an end to the use of depleted uranium ammunition, but most efforts were directed at remedying problems rather than preventing them.

While the issue picked up steam in the United States, groups in Okinawa, Japan seized upon the use of depleted uranium ammunition to further their goal of ridding their island of U.S. military bases. In December 1995 and January 1996, U.S. jets accidentally shot 1,500 depleted uranium rounds (225 kg/DU) at an uninhabited island training range located 100 km west of Okinawa in the East China Sea. Though the release of such a small amount of depleted uranium so far from the mainland posed no risk to the Japanese people, the U.S. Air Force quickly sent a team of scientists to the island to clean up as much depleted uranium as they could find. When a Japanese newspaper uncovered the incident, anti-base groups pointed to the use of DU rounds as evidence of the U.S. military's disregard for the environment. However, the Air Force's unilateral decision to immediately clean up the expended DU rounds was precisely the appropriate action to take.

In the late 1990s, groups working to end sanctions on Iraq picked up the depleted uranium issue to draw attention to the plight of the people in southern Iraq and to attack U.S. policies in the region. Some anti-sanctions groups sensibly advocated for independent investigations of DU in Iraq, but other groups blindly repeated Iraqi propaganda that depleted uranium was causing every cancer and birth defect in Iraq.

The Iraqi government has clearly used the depleted uranium issue to portray itself as a victim of United States aggression. At conferences in Europe organized by anti-DU and anti-sanctions groups, Iraqi doctors routinely show slides of horribly deformed children and men brimming with cancer, all of which they claim is caused by depleted uranium. However, there are no reliable scientific studies linking depleted uranium with these health problems in Iraq. Nonetheless, some anti-sanctions, anti-NATO, and anti-war groups routinely repeat the Iraqi claims and strongly condemn more moderate voices—including leading depleted uranium researchers and sympathetic scientists—of secretly working for the CIA or the Pentagon.

The use of depleted uranium in the Kosovo war attracted the attention of European political parties, anti-nuclear and anti-NATO groups, and environmental organizations. Some groups, such as U.N. agencies and environmental groups, called for identification of contaminated areas, and investigation of possible health and environmental effects. However, other groups, including some anti-NATO and anti-sanctions organizations, pushed the issue to the extreme by comparing depleted uranium to the Chernobyl nuclear disaster or the use of the atomic bomb.

By 2000, the loudest voices on the depleted uranium issue were claiming, erroneously, that the United Nations had declared DU ammunition both illegal and a weapon of mass destruction. Further, the more extreme groups, bolstered by propaganda from the Yugoslav and Iraqi governments, claimed depleted uranium was a genocidal weapon whose use constituted a war crime. The focus of anti-DU efforts shifted away from depleted uranium clean up, investigation, and research, and towards proclaiming the immorality and illegality of DU ammunition. The middle ground was being lost.

While the anti-DU movement was being taken over by extremists, the Pentagon moved forward with a well-planned strategy to downplay the health and environmental effects of depleted uranium. Playing to the weaknesses of the anti-DU forces, the Pentagon created quasi-scientific reports denying that any soldiers or civilians could be sick from DU. In 1999, the RAND Corporation released a report claiming it was unlikely the health of Gulf War veterans had been affected by depleted uranium. However, RAND based its conclusion on "incomplete and misleading" exposure data provided by the Pentagon, and the report's independence is undermined by the fact that one of its primary authors simultaneously worked for the Pentagon's Gulf War illness investigation.¹³ The Pentagon also made frequent use of government scientists who claimed that DU was harmless even to children playing in contaminated tanks.¹⁴

The Institute of Medicine (IOM) conducted the only truly independent U.S. investigation of DU, but this inquiry was severely hampered by a lack of accurate exposure information. After a review of epidemiological studies of uranium industry workers and the limited information on the health of Gulf War veterans exposed to DU, the IOM decided that exposure to very low levels of depleted uranium was unlikely to result in the development of lung cancer or kidney problems. However, the Committee concluded that it lacked sufficient information about the amounts of depleted uranium inhaled by Gulf War veterans to determine if DU exposure might result in increased rates of lymphatic and bone cancers, nervous system disease, or immune system damage.¹⁵

The Pentagon misleadingly touted the RAND and IOM reports as supportive of its position that the use of depleted uranium was unlikely to cause any health problems in exposed soldiers or civilians. At the same time, however, the military's own DU researchers were calling for further research and investigation.

In 1999, Dr. David McClain, the U.S. military's top depleted uranium researcher, told a presidential committee investigating Gulf War illnesses: "Strong evidence exists to support [a] detailed study of potential DU carcinogenicity." Dr. Fletcher Hahn, a scientist at the Lovelace Respiratory Research Institute, called the development of cancer in rats implanted with DU fragments "a warning flag that says we shouldn't ignore this."

The anti-DU forces were unable to muster the resources or the scientists to either effectively promote the findings of the military's own research or expose the flaws in the Pentagon's logic. By the year 2000, the tide was turning in the Pentagon's favor, but events in Europe would soon bring depleted uranium under intense scrutiny.

THE RECENT DEBATE

In September 2000, several Italian papers suggested a link between depleted uranium and the leukemia and cancer deaths of several peacekeepers who had served in Bosnia, where U.S. jets shot 3 tons of DU in 1994-1995. Soon, media in other parts of Europe raised questions about depleted uranium and the health of peacekeepers serving in the Balkans. The nascent anti-DU movement in Europe fanned the flames of the controversy, and by January 2001, concerns about DU hit a fevered pitch.

For the first time, governments across Europe addressed the depleted uranium issue. Germany, Italy, Norway, and the European Parliament called for a moratorium on using the ammunition pending further investigation, but the United Kingdom and the United States aggressively defended its use and denied any connection between DU and cancer or leukemia. Political analysts pontificated about the divisions within NATO exposed by the DU controversy, and NATO itself produced an internal report warning that member nations may not want to participate in future operations in which the U.S. or United Kingdom used DU munitions.

The Pentagon initially responded to the DU crisis by dispatching several spokesmen to NATO headquarters. At a January 10, 2001 press conference in Brussels, Dr. Michael Kilpatrick clearly stated the Pentagon's position: "There is no medical evidence in the literature or any scientific studies that have been done, that natural or depleted uranium causes cancers or any kind of leukemia." Kilpatrick backed the Pentagon into a corner by denying the existence of any evidence linking DU to cancer, when in fact the U.S. military's own rat studies showed DU could cause cancer. But the anti-DU movement was too busy criticizing NATO and the United States to take advantage of this blunder.

Dr. Kilpatrick also discussed the U.S. study of Gulf War veterans exposed to depleted uranium. A 1999 examination of 51 veterans exposed to DU in so-called friendly fire incidents revealed that one veteran had Hodgkin's lymphoma,

and another had a bone tumor near the site where he had been wounded by DU fragments.¹⁶ The 51 veterans examined represent only a tiny fraction of the thousands of veterans the Pentagon now acknowledges were potentially exposed to DU contamination on Gulf War battlefields, but these veterans were among several hundred soldiers who probably had the highest exposures.

At the press conference, however, Dr. Kilpatrick told the NATO press corps: "We have seen no cancers or leukemia in this group, which has been followed since 1993."¹⁷ Since the Pentagon was aware of the lymphoma and bone tumor since at least October 1999, Dr. Kilpatrick's statement was nothing short of a bald-faced lie, but neither the press nor anti-DU activists challenged its accuracy. Despite the fact that Pentagon spokesmen made false claims about the findings of the U.S. military's own depleted uranium research on laboratory animals and veterans, Army Colonel Eric Daxon insolently blamed the recent controversy on "a purposeful disinformation campaign" being waged by the Iraqi government.

After several European governments reported that medical testing did not find that any soldiers had been exposed to depleted uranium, the controversy started to die down. Scientists from NATO and the European Commission downplayed any relationship between depleted uranium and the rapid onset of cancers or leukemia. The European Commission reported that up to 95 percent of the DU rounds shot by American jets did not hit any targets, and therefore were likely to be lying intact on or in the ground. The commission recommended: "Specific protection against exposure to depleted uranium should be proposed by a radiation protection advisor with knowledge of the local situation."¹⁸

UNEP's Balkans Task Force issued a final report on its depleted uranium investigation in March 2001. Based on field visits to Kosovo that found only 7.5 DU penetrators and a small amount of contaminated soil, the Balkans Task Force estimated the risk to local populations was low, but it expressed concern about contamination of groundwater and the collection of DU penetrators by civilians, a practice documented in both Iraq and Kosovo. Consequently, the task force recommended that, "The appropriate authorities should undertake the marking of all DU-affected sites, where and when appropriate, until the site is cleared from solid DU and loose contamination at contamination points."¹⁹

NATO started marking sites where DU had been shot in January 2001, but to date there has been no effort to clear solid DU or loose contamination from these areas. The United States military is the logical choice to undertake and finance a clean up effort, since it is responsible for the release of DU and it has experience cleaning up DU contamination on battlefields and training ranges. At Nellis Air Force Range in Nevada, the U.S. Air Force posts radioactive contamination warning signs on target vehicles shot by DU rounds, and it periodically removes solid penetrators from the soil. At Aberdeen Proving Ground in Maryland, the U.S. Army is overseeing the removal of tons of DU fragments and

contaminated soil. While it would not be unprecedented for the Pentagon to undertake a clean-up of depleted uranium, there is little likelihood that this will happen in Kosovo for the simple fact that the Pentagon might then be expected to clean up DU in Serbia, Montenegro, Bosnia, Iraq, Kuwait, and anywhere else it shoots DU in future wars.

THE FINAL WORD

The debate over depleted uranium munitions started after the Gulf War, when depleted uranium became a suspected cause of illnesses among U.S. and British veterans and Iraqi civilians. Throughout the 1990s, the issue became increasingly polarized, with Pentagon and anti-DU activists making progressively more outlandish claims about depleted uranium's safety or harm. While evidence linking depleted uranium to health effects in human populations remains inconclusive, neither the Pentagon nor the more extreme opposition groups have let facts stand in the way of their impassioned claims.

The U.S. Department of Defense has successfully defended its use of depleted uranium ammunition by developing a clear strategy and devoting substantial resources to achieve its goals. It has exploited the weaknesses in the anti-depleted uranium movement by creating quasi-scientific reports and influencing investigations to downplay the risks of DU ammunition. While the Pentagon has often misled the public, the press, and the U.S. Congress about DU exposures and the findings of its own research on rats and veterans, it has maintained its credibility on the issue by shifting attention onto the unsubstantiated claims made by the extreme branch of the anti-depleted uranium movement.

The moderate opposition groups have achieved some modest goals: expanded research into DU health and environmental effects, DU training for U.S. military forces, and limited clean up of selected contaminated sites. However, the anti-DU movement as a whole has failed to significantly affect the use or proliferation of depleted uranium ammunition. Opposition groups lack a coherent organizational structure, and they are unable to attract the resources needed to mount a successful campaign to counter the Pentagon's pro-DU propaganda. As more extreme elements take over the anti-DU movement, significant progress on preventing and remedying the problems associated with the use of DU munitions may become increasingly elusive.

Depleted uranium is not the same as fallout from Chernobyl, nor is it something we should carelessly throw into populated areas. The United Nations has emerged as the voice of reason by acknowledging that the release of large quantities of depleted uranium during combat operations results in localized areas of contamination that have the potential to cause adverse health and environmental effects. To minimize or prevent these effects, armed forces using

depleted uranium ammunition should expediently warn soldiers and civilians, and identify and clean up contaminated areas.

Just as advances in technology and tactics gave birth to the development and use of depleted uranium munitions, someday DU ammunition will become obsolete, replaced by newer and more effective killing tools. Many governments, including NATO members Germany, Canada, the Czech Republic, Norway, and the Netherlands have already foresworn the use of depleted uranium munitions. Aside from the United States and the United Kingdom, few democratic governments are willing to accept the health, environmental, and perhaps most significantly, the political problems associated with the use of depleted uranium ammunition. ■

NOTES

- 1 U.S. Army testing found normally 10-35 percent (up to 70 percent) of the round oxidizes into dust upon impact with a hard target. Twenty percent is commonly used to determine the amounts of dust created by an impact. The Office of the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses, "Depleted Uranium in the Gulf (II)" (Washington, DC: 2000), 203.
- 2 Captain Pat Paulsen, "Depleted Uranium Without the Rocket Science," *Armor* (July-August 1995): 34.
- 3 T. C. Pellmar, et al., "Distribution of Uranium in Rats Implanted with Depleted Uranium Pellets," *Toxicological Sciences* 49 (1999): 29-39.
- 4 Dr. David E. McClain, "Project Briefing: Health Effects of Depleted Uranium," U.S. Armed Forces Radiobiology Research Institute (Bethesda, MD: 1999).
- 5 M.E. Danesi, *Kinetic Energy Penetrator Long Term Strategy Study* (Picatinny Arsenal, NJ: U.S. Army Armament, Munitions, and Chemical Command: 1990), Appendix D: Vol. 1, 4-5; Vol. 1, 2-2; Vol. 2, 3-4.
- 6 Dan Fahey, *Don't Look, Don't Find: Gulf War Veterans, the U.S. Government, and Depleted Uranium, 1990-2000* (Lewiston, ME: The Military Toxics Project, March 30, 2000), 15.
- 7 LTC Gregory K. Lyle, U.S. Army, Letter to Director of U.S. Nuclear Agency, "Item of Interest: Depleted Uranium (DU) Ammunition," March 1991.
- 8 LTC M.V. Ziehm, Memo to Studies and Analysis Branch at Los Alamos National Laboratory, "The Effectiveness of Depleted Uranium Penetrators," March 1, 1991.
- 9 Depleted Uranium Recovery Team, Memorandum to Senior Command Representative, U.S. Army Armament, Munitions, and Chemical Command (AMCCOM), "Vehicle Assessment Report Depleted Uranium Contamination," May 14, 1991.
- 10 1LT Douglas L. Rokke, Medical Services Corps, 68B, Nuclear Sciences Officer, Health Physicist DU Assessment Team, "Radiological Survey Report on T72 Iraqi Captured Tank, Located at Dammaam Port Facility," May 1991.
- 11 Office of the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses (OSAGWI), *Annual Report, November 1996 – November 1997* (Washington, D.C.: January 1998), 30.
- 12 The two main veterans groups were the Washington, D.C.-based National Gulf War Resource Center and San Francisco, CA-based Swords to Plowshares Veterans' Rights Organization. Other groups included the Bill Motto Veterans of Foreign Wars Post 5888 (Santa Cruz, CA), the Alexander Hamilton American Legion Post 448 (San Francisco, CA), and Veterans for Peace. The national Veterans of Foreign Wars and American Legion took positions supporting research and health care for veterans exposed to depleted uranium, but they took few actions in pursuit of those goals.
- 13 Presidential Special Oversight Board for Department of Defense Investigations of Gulf War Chemical and Biological Incidents, "Special Oversight Board Analysis (Ver. 2) of OSAGWI's DU Report," (Arlington, VA: February 19, 1999); and Dr. Naomi Harley, et al., *A Review of the Scientific Literature as it Pertains to Gulf War Illnesses*, Volume 7: Depleted Uranium (Washington, D.C.: RAND, National Defense Research Institute, 1999), 120.
- 14 Dr. Naomi Harley, Statement to the Presidential Special Oversight Board for Department of Defense Investigations of Gulf War Chemical and Biological Incidents, (Washington, D.C.: July 19, 1999).
- 15 U.S. Institute of Medicine (IOM), *Gulf War and Health*, "Volume 1, Depleted Uranium, Pyridostigmine Bromide, Sarin, Vaccines" (Washington, D.C.: National Academy Press, 2000), Chapter 4.

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- 16 OSAGWI, "Meeting with Dr. Melissa McDiarmid and her staff on October 15, 1999 to Discuss the Baltimore DU Follow-Up Program and the Extended Follow-Up Program," undated. http://www.gulfink.osd.mil/du_ii/du_ii_refs/n52en651/0089_005_0000001.htm This document confirms that one veteran had lymphoma, but Dr. McDiarmid stated it was a Hodgkin's Lymphoma during a phone conversation with the author on February 12, 2001. Another document on the Pentagon's web site confirms a tank crewman who survived a DU-friendly fire incident was discharged from the Army because he developed cancer approximately six years after the Gulf War. OSAGWI, "Interview of Loader for A-14," Lead Sheet #18932, November 4, 1998. http://www.gulfink.osd.mil/du_ii/du_ii_refs/n52en376/8244_006_0000002.htm The Department of Veterans Affairs and the Office of the Special Assistant to the Secretary of Defense for Gulf War Illnesses, Medical Readiness, and Military Deployments acknowledge the existence of the bone tumor in one veteran. The VA's DU Program states the tumor was benign, but the tumor is not formally documented in a publicly released document. The bone tumor has been reported in the Hiroshima, Japan newspaper *Chugoku Shimbun*, April 4, 2000: http://www.chugoku-np.co.jp/abom/uran/us_e/000404.html.
- 17 Dr. Michael Kilpatrick, Statement at NATO press briefing, Brussels, January 10, 2001. <http://www.nato.int/docu/speech/2001/s010110b.htm>
- 18 European Commission, Directorate General, Environment (EURATOM), "Opinion of the Group of Experts Established According to Article 31 of the Euratom Treaty, Depleted Uranium," (Luxembourg, March 6, 2001), 15.
- 19 United Nations Environment Programme (UNEP), Balkans Task Force, *Depleted Uranium in Kosovo, Post-Conflict Environmental Assessment* (Geneva, March 2001), 27.

