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Subject: [DU-WATCH] DEPLETED URANIUM: USES AND HAZARDS, Doug Rokke, Ph.D.

Depleted Uranium: Uses and Hazards

by Doug Rokke, Ph.D.

(This paper is an updated version of the paper presented in the British House of Commons; London, England; on December 16, 1999)

WARNING: This paper contains information that may be disturbing because it reflects the harsh reality of environmental and health consequences of war.

Recent Events

The emerging adverse health effects and deaths in NATO-KFOR and residents of the Balkans is an issue of great concern. Depleted uranium (uranium 238) has been implicated. Today, 10 years after warriors were exposed during combat in Iraq, Saudi Arabia, and Kuwait; civilians have been exposed in Vieques, Puerto Rico, Iraq, Okinawa, Oak Ridge, Tennessee, Pudacah, Kentucky, and other sites; we are seeing adverse health effects amongst this entire group. We also need to consider that the releases of numerous other hazardous materials occurred during the Gulf War and recent bombing in the Balkans which are probably contributing to the health effects that are being observed. Consequently, a thorough investigation and more important complete medical care which has been denied for so many years must be provided with immediate environmental remediation of all uranium 238 (DU) completed. Dr. Pekka Havisto of the United Nations in a published interview has recommended that all areas and equipment with uranium contamination be isolated and that it be cleaned. Although, Depleted Uranium training programs were completed -- approved by U.S., Germany, Canada, Great Britain, and Australia military officials -- and ready for distribution and implementation by January 1996, the commanding General for Italian forces in Kosovo verified on January 12, 2001 that the United States Department of Defense did not

give them this training program and that they had not provided Italian soldiers with DU training as required for U.S. military personnel. The commanding General for Italian forces also verified that the U.S. DOD had not provided them with either a copy of the U.S. Army guidelines that specify proper handling and clean up of depleted uranium (uranium 238) contamination. United States and NATO officials continue to state specifically that there are no known adverse health effects in those of us in the U.S. Department of Veterans Affairs Depleted Uranium Medical project. That is a lie as proven by our own medical records based on diagnosis of medical problems completed by our personal primary care physicians.

What Is DU?

Depleted uranium is a metal made from uranium hexaflouride which is the by-product of the uranium enrichment process. Depleted uranium is actually the uranium 238 isotope. Natural uranium contains 99.2% by weight U-238 while DU contains 99.8% by weight U-238. Recent documents released by the U.S. Department of Energy provide evidence to suggest that a small proportion of other toxic heavy metals such as plutonium also may be present.

U-238 emits alpha particles at 4.2 Mev and 4.15 Mev that cause significant internal ionization with consequent cellular damage. In addition daughter products emit beta particles and gamma rays that may cause further radiological damage. While DU may not be an external hazard it is an internal hazard and with consequent inhalation, ingestion, and wound contamination poses significant and unacceptable risks. Although, DU is 60% less radioactive than natural uranium because U-234 and U-235 which emit gamma rays and beta particles have been removed Depleted uranium or uranium 238 is still very dangerous as an internal hazard because the alpha particle emissions are not reduced but proportionally increased. Also spent penetrators or parts of penetrators emit at 300 mrem/ hour and thus cannot be touched or picked up without protection.

What Are the Physical Properties?

Depleted uranium or U-238 has an atomic mass of 238. Its half-life is 4.468 billion years. It’s natural occurrence is 2.1 parts per million. Uranium is silver white, lustrous, malleable, ductile, and pyrophoric. This makes DU an ideal metal for use as kinetic energy penetrators, counterweights, and shielding or armor. High density and pyrophoric (catches fire) nature are the two most significant physical properties that guided its selection for use as a kinetic energy penetrator.

Where Does DU Come From?

Uranium hexaflouride is the non-fissionable residue or by-product of the uranium enrichment process during which fissionable Uranium 235 and Uranium 234 are separated from natural uranium. Depleted uranium is refined from Uranium Hexaflouride (UF6). The United States Department of Energy has so much UF6 stored at various sites that any use that increases disposal of this waste product is welcome. Consequently economic recovery may supersede health and environmental concerns.

How Is DU Used By The Military?

DU is used to manufacture kinetic energy penetrators. Each kinetic penetrator consists of almost entirely uranium 238. The United States munitions industry produces the following DU munitions with the corresponding mass of uranium 238:

- 7.62 mm with unspecified mass
- 50 cal. With unspecified mass
- 20 mm with a mass of approximately 180 grams.
- 25 mm with a mass of approximately 200 grams.
- 30 mm with a mass of approximately 280 grams.
- 105 mm with a mass of approximately 3500 grams.
- 120 mm with a mass of approximately 4500 grams.
- Submunitions such as the PDM and ADAM whose structural body contain a small proportion of DU.

Many other countries now produce or have acquired DU munitions. DU is also used as armor, ballast or counter weights, radiation shielding, and as proposed by the U.S. Department of Energy as a component of road and structural materials. All of these current or proposed uses are designed to reduce the huge U.S. Department of Energy stockpiles left over from the uranium enrichment process.

It is important to realize that DU penetrators are solid uranium 238. During an impact approximately 40% of the penetrator forms DU oxides which are left on the terrain, within or on impacted equipment, or within impacted structures. The remainder of the penetrator (60%) retains its initial shape. Thus we are left with a solid piece of uranium lying someplace which can be picked up by children or adults. DU ignites upon impact. The resulting shower of burning DU causes secondary explosions, fires, injury, and death. DU fragments or oxides in the form of radioactive heavy metal contamination are also present. Simply: Who would want thousands of solid uranium penetrators or pencils of masses between 180 and 4500 grams lying in your backyard? Who would want any uranium contamination of any type lying in your backyard?

How Is DU Used By Industry And DOE?

The U.S. Department of Energy possesses about 728,000 metric tonnes of DU. Consequently, DOE has been investigating and advocating additional uses for DU to reduce its stockpiles. DU is stored at Pudacah, Kentucky; Oak Ridge, Tennessee; and Portsmouth, Ohio. DOE has proposed various uses for DU most of which support the nuclear industry. However, DOE has also proposed using DU to reinforce concrete and other building materials. DU is also used as aircraft ballast, as shielding, and in oil well drilling equipment. The potential of recycled DU contaminated metals reaching the consumer market in various products is also a concern.

Where And When Has DU Been Used?

Photographic evidence of destroyed equipment suggests that DU was first used during the 1973 Arab-Israeli war. Various written reports cite information that may have been obtained as a consequence of that use. Physicians using medical laboratory tests have verified an internalized exposure to DU in the individual who inspected that destroyed equipment. The

Persian Gulf war was the first major use of DU in combat. Pilots flying aircraft fired approximately 850,950 rounds and another 9,640 rounds were fired by gunners in tanks for a total weight of 631,055 pounds or over 315 tons. Recent conversations with the individual who managed all DU rounds suggest that this figure may be to low and that the actual quantity should be 25% greater. Although warnings were issued to refrain from DU use the U.S. Marines fired DU munitions on three separate occasions during 1995 and 1996 while conducting operations in Okinawa and then did not tell the Japanese Government for some time. During 1995 the U.S. military also fired approximately 10000 rounds of DU munitions during battle in Serbia. Recently U.S. forces fired over 31000 rounds of 30 mm DU munitions during 100 missions into Kosovo or inner Serbia. DU munitions have been fired on ranges in Indiana, Nevada, New Mexico, Florida, Maryland, and this past year on Vieques in Puerto Rico. The incident in Puerto Rico involved the deliberate use of DU in preparation for combat in Kosovo. Although DU use is prohibited except during combat, the Navy fired at least 258 rounds in Vieques. Navy personnel have reported that the Navy has been firing DU into Vieques for years but this was the first time they were caught. Vieques is currently a national and international issue with confirmed environmental contamination and documented adverse health effects similar to those already observed.

What Did We Find Immediately After
ODS Friendly Fire And Combat Incidents?

I was assigned to the DU assessment team as the team health physicist and medic by directive of Headquarters Department of the Army in Washington, D.C. via a message sent to the theater commander during March 1991. What we found can be explained in three words: "OH MY GOD". According to official documents each uranium penetrator could loose up to 70% of it’s mass on impact creating fixed and loose contamination with the remainder passing through the equipment or structure to lie on the terrain. On-site impact investigations suggest that the mass loss is about 40% which forms fixed and loose contamination leaving about 60% of the initial mass of the penetrator in the solid or pencil form. Equipment contamination included uranium oxides, other hazardous materials, unstable unexploded ordnance, and by-products of exploded ordinance. U.S. Army Materiel Command documents sent to us during ODS stated the oxide was 57% insoluble and 43% soluble with at least 50% was respirable. In addition other radioactive materials were detected that could pose a risk through inhalation, ingestion, or wound contamination. In most cases except for penetrator fragments, contamination was inside destroyed equipment or structures, on the destroyed equipment, or within 25 meters of the equipment. After we returned to the United States myself and two others with assistance wrote the Theater Clean up plan which was reportedly passed up through U.S. Department of Defense officials to the U.S. Department of State and consequently to the Emirate of Kuwaiti. Today, it is obvious that none of this information regarding clean up of extensive DU contamination ever was given to the Iraqi’s. Consequently, although we knew there were and still are substantial hazards existing within Iraq they have been ignored by the United States and Great Britain for political and economic reasons.

Iraqi, Albano-Kosovar, and Serbian representatives have asked numerous times for DU contamination management and medical care procedures but they have been continuously rebuffed by U.S officials. Although residents of Vieques, who are U.S. citizens, have also asked for medical care and completion of environmental remediation DOD officials have not

responded. Dr. Bernard Rostker, Assistant Secretary of the Army, recently said that he did not see any reason why the United States should tell anyone where DU was used in Kosovo. Consequently military personnel and civilians have been exposed.

How Did The DU Project Get Started And What Were It's Objectives?

The probable hazards were known before the use of depleted uranium munitions during the Gulf war as official documents substantiate. A United States Defense Nuclear Agency memorandum written by LTC Lyle that was sent to our team in Saudi Arabia stated that

> *As Explosive Ordinance Disposal (EOD), ground combat units, and civil populations of Saudi Arabia, Kuwait, and Iraq come increasingly into contact with DU ordnance, we must prepare to deal with potential problems. Toxic war souvenirs, political furor, and post conflict clean up (host nation agreement) are only some of the issues that must be addressed. Alpha particles (uranium oxide dust) from expended rounds is a health concern but, Beta particles from fragments and intact rounds is a serious health threat, with possible exposure rates of 200 millirads per hour on contact.*

This memorandum, the reports that we prepared immediately after the Gulf War as a part of the depleted uranium assessment project to recover DU destroyed and contaminated U.S. equipment, the previous research, and other expressed concerns led to the publication of a United States Department of Defense directive signed by General Eric Shinseki to quote:

1. *"Provide adequate training for personnel who may come in contact with depleted uranium equipment.*
2. *Complete medical testing of personnel exposed to DU contamination during the Persian Gulf War.*
3. *Develop a plan for DU contaminated equipment recovery during future operations."*

It is thus indisputable that United States Department of Defense officials were and are still aware of the unique and unacceptable hazards associated with using depleted uranium munitions. Consequently, I was recalled to active duty in the U.S. Army and assigned to the U.S. Army Chemical School located at Fort McClellan, Alabama as the DU Project Director and tasked with developing training and management procedures. The project included a literature review; extensive curriculum development project involving representatives from all branches of the U.S. Department of Defense and representatives from England, Canada, Germany, and Australia; and basic research at the Nevada Test Site located northwest of Las Vegas, Nevada, to validate management procedures.

The products of the DU project included three training curricula:

- Tier I: General Audience
- Tier II: Battle Damage and Recovery Operations
- Tier III: Chemical Officer / NCO

Three video tapes:

1. *Depleted Uranium Hazard Awareness*
2. *Contaminated and Damaged Equipment Management*
3. *Operation of the AN/PDR 77 Radiac Set* and
4. The draft DU and LLRM contamination management procedures including a United States Army Regulation: *Management of Equipment Contaminated with Depleted Uranium or Radioactive Commodities* and an United States Army Pamphlet *Handling Procedures for Equipment Contaminated with Depleted Uranium or Radioactive Commodities.*

Although, these products with approval of all participants were all completed and ready for distribution by January 1996, U.S. Army, U.S. Department of Defense, British, German, Canadian, and Australian officials disregarded repeated directives and did not implement or only have implemented portions of the training or management procedures. Unfortunately, only a few U.S. personnel have been trained. The training and management plan have not been given to all individuals and representatives of governments whose populations and environment have affected by DU contamination. These failures have been verified by U.S. General Accounting Office investigators and the report was published during March 2000.

Based On All Previous Research And The DU Project
What Were The Recommendations?

The DU project and review of previous research reinforced the original conclusions and recommendations that we developed while still in Saudi Arabia and which are just plain simple common sense. These recommendations were/are:

1. All depleted uranium contamination must be physically removed and properly disposed of to prevent future exposures.
2. Radiation detection devices that detect and measure alpha particles, beta particles, x-rays, and gamma rays emissions at appropriate levels from 20 dpm up to 100,000 dpm and from .1 mrem/ hour to 75 mrem/ hour must be acquired and distributed to all individuals or organizations responsible for medical care and environmental remediation activities involving depleted uranium / uranium 238 and other low level radioactive isotopes that may be present.
3. Medical screening of all individuals who did or may have inhaled, ingested, or had wound contamination to detect mobile and sequestered internalized uranium contamination must be completed.
4. All individuals who enter, climb on, or work within 25 meters of any DU contaminated equipment or terrain must wear respiratory and skin protection.
5. Uranium 238 contaminated and damaged equipment or materials should not be recycled to manufacture new materials or equipment.

What Has Occurred?

Visual evidence, personal experience, and published reports verify that:

1. Medical care has not been provided to all DU casualties.
2. Environmental remediation has not been completed.
3. DU contaminated and damaged equipment and materials have been recycled to

manufacture new products.
4. DU training and education has only been partially implemented.
5. DU contamination management procedures have not been distributed.

The United States Army Material Command possesses the Nuclear Regulatory Commission license for depleted uranium. A health physicist assigned to the Office of the Surgeon General, U.S. Army Materiel Command told me during a conversation on November 8, 1999 that their office will not release the DU medical treatment protocols nor the DU contamination management and remediation procedures to all those who are affected by depleted uranium contamination. He has restated this decision in writing on behalf of commanding general. This decision ignores United States and international legal requirements.

What Adverse Health Effects Have Been Observed, Recognized, Treated, And Documented?

The answer to this question is difficult. Deliberate denial and delay of medical screening and consequent medical care of not only U.S. friendly fire casualties who inhaled, ingested, and had wound contamination but all others with verified or suspected internalized exposure makes actually knowing what has occurred difficult. Although I, physicians, scientists, and other medical personnel recommended immediate medical care during March, April, and May of 1991 and many times since then the United States Department of Defense, the British Ministry of Defense, and consequently the United States Department of Veterans Affairs are still reluctant to provide thorough medical screening and necessary medical care. Dr. Bernard Rostker wrote to me in a letter dated March 1, 1999 that physicians and health physicists at the completion of the ground war decided that medical screening and care for uranium exposures was not required. Actual documents refute this! Today, individuals are sick and others are dead who were denied medical care even though I requested it in a letter dated May 21, 1997 which was sent to the Office of Surgeon U.S. Army Materiel Command and forwarded to Dr. Rostker by Dr. (LTC) Kelsey.

Verified adverse health effects from personal experience, physicians, and from personal reports from individuals with known DU exposures include:

1. Reactive airway disease
2. Neurological abnormalities
3. Kidney stones and chronic kidney pain
4. Rashes
5. Vision degradation and night vision losses
6. Gum tissue problems
7. Lymphoma
8. Various forms of skin and organ cancer
9. Neuro-psychological disorders
10. Uranium in semen
11. Sexual dysfunction, and
12. birth defects in offspring.

Today, serious adverse health effects have been documented in employees of and residents

living near Puducah, Kentucky, Portsmouth, Ohio; Los Alamos, New Mexico; Oak Ridge, Tennessee; Hanford, Washington. Additionally employees at uranium manufacturing or processing facilities in New York, Tennessee, and the four corners area of southwest Colorado have repeatedly reported adverse health effects similar to those reported by verified Gulf War DU casualties. Iraqi and other humanitarian agency physicians are reporting serious adverse health effects in exposed populations. Today, verifying correlation between uranium exposures and adverse health effects, except in only in a few cases, may not be possible because of deliberate delays in screening. **Health physics guidelines state that testing should be completed within 30 days not 8 years after exposures.** Testing involves the collection of a urine, fecal, and throat samples. Eight years or so after exposures only a small fraction of the sequestered uranium or original dose will be detected. This fraction represents only the mobile or soluble portion that is in the body. Figure 1 shows the relationship between time of sampling and detection of internalized uranium. Two recent autopsies have revealed that sequestering is an observed phenomena and that the mobile fraction may or may not be representative of what is actually present. The current U.S. Army medical department guideline dated April 1999 requires immediate testing as always required by laws and regulations. However, this is still not occurring.

Even when verified medical evidence attributing adverse health effects to DU exposures is available official recognition and documentation has been erratic at best. For example during 1994 and 1995 United States Department of Defense medical personnel at an U.S. Army installation hospital removed, separated, and hid documented diagnoses from affected individuals and other physicians. Some medical records were retrieved, but, probably too late for many individuals. Today, this practice continues and consequently exposed individuals are not receiving adequate and effective medical care. This includes individuals whose medical care has been requested many times. This will continue as long as the United States, British, Canadian and other governments are permitted to ignore the emerging evidence and deny medical care to all individuals who have been or may have been exposed to depleted uranium (uranium 238), other isotopes, and other contaminants created as result of the use of depleted uranium munitions. The criteria describing exposures were specified in a message from Headquarters Department of the Army dated October 14, 1993 (enclosure 2) . Exposures requiring medical screening within 24 hours of exposure and consequent care included :

1. *Being in the midst of smoke from DU fires resulting from the burning of vehicles uploaded with DU munitions or depots in which DU munitions are being stored.*
2. *Working within environments containing DU dust or residues from DU fires.*
3. *Being within a structure or vehicle while it is struck by DU munitions.*

These guidelines should be applicable to all exposed individuals and thus care should be independent of military or civilian status. Today, medical care has not been and is still not being given to all depleted uranium casualties as specified. Although, I am not a physician I have been involved in teaching and providing emergency medicine for over 20 years and thus the following recommendations are based on experience and common sense applications of emergency medicine and simple health physics principles. I also provided emergency medical care for some DU casualties in Iraq and Saudi Arabia during the Gulf War.

Medical care must be planned and completed to identify and then alleviate actual physiological problems rather than placing an emphasis on psychological manifestations and continued testing. Warriors, civilians, employees, non-combatants, and enemy personnel are sick and deserve care for the complex exposures that have resulted in observed physiological effects. Medical care for known uranium exposures should emphasize (concern in parentheses):

1. neurology (heavy metal effects)
2. ophthalmology (radiation and heavy metal effects)
3. urology (heavy metal effects and crystal formation)
4. dermatology (heavy metal effects)
5. cardiology (radiation and heavy metal effects)
6. pulmonary (radiation, particulate, and heavy metal effects)
7. immunology (radiation and heavy metal effects)
8. oncology (radiation and heavy metal effects)
9. gynecology (radiation and heavy metal effects)
10. gastro-intestinal (systematic effects)
11. dental (heavy metal effects)
12. psychology (heavy metal effects)

Many individuals with known exposures still had not received requested care as of March 8, 2000 according to the VA DU project patient manager. As of January 3, 2001 only 63 individuals (including myself) are receiving medical care from physicians assigned to the Baltimore Maryland Department of Veterans Affairs Depleted Uranium program. Today casualties with verified DU health related problems live on antibiotics and steroids to quell problems but treatment or cure has not been tried to restore health. It is impossible to get proper care and treatment.

IF YOU DO NOT PROVIDE MEDICAL ASSESSMENT FOR THOSE WITH VERIFIED EXPOSURES AND HEALTH PROBLEMS THEN YOU CAN SAY DU DID NOT CAUSE ANY ADVERSE HEALTH PROBLEMS. SO MUCH FOR MEDICAL SCIENCE WHEN A COVER-UP IS DIRECTED BY POLITICIANS TO LIMIT LIABILITY FOR NON-COMBATANTS, WARRIORS, AND OTHERS.

The cover-up started with the infamous Los Alamos memorandum sent to our team in Saudi Arabia during March 1991. This memo told us to be sure no matter what we did or reported that we should only report information so DU could always be used. A letter sent to General Leslie Groves during 1943 is even more disturbing. In that memorandum dated October 30, 1943, senior scientists assigned to the Manhattan Project suggested that uranium could be used as an air and terrain contaminant. According to the letter sent by the Subcommittee of the S-1 Executive Committee on the "*Use of Radioactive Materials as a Military Weapon*" to General Groves (October 30, 1943) inhalation of uranium would result in "*bronchial irritation coming on in a few hours to a few days*". This is exactly what happened to individuals who inhaled DU dust during Operation Desert Storm.

The subcommittee went on further to state that

Beta emitting products could get into the gastrointestinal tract from polluted water, or food, or

air. From the air, they would get on the mucus of the nose, throat, bronchi, etc. and be swallowed. The effects would be local irritation just as in the bronchi and exposures of the same amount would be required. The stomach, caecum and rectum, where contents remain for longer periods than elsewhere would be most likely affected. It is conceivable that ulcers and perforations of the gut followed by death could be produced, even without an general effects from radiation.

The twisted history of medical care of DU casualties took a unique and unprecedented turn on March 14, 2000 when representatives of the Italian government announced that they would begin providing medical care for Iraqis who had been exposed to depleted uranium as a consequence of deliberate actions by the United States and England and the continued refusal by U.S. and British officials to provide medical treatment protocols. In another twist on March 14 a French investigative journalist reported that

There has been lots of new things: -- there are Belgium sick people from Kosovo . . . same symptoms. -- There are Italian sick soldiers from Bosnia -- Some French soldiers from the Gulf are sick; journalists are working on that.

This provides additional evidence of health related problems that must be addressed as previously cited in a U.S. Department of Defense press release dated July 27, 1999 which stated that 'Some soldiers in the Balkans are coming down with the "Bosnian Crud," a type of upper respiratory infection, according to an article in the July 9, 1999 issue of the "*Talon*," the Operation Joint Forge newspaper for U.S. forces in Bosnia and Herzegovina.' Today, NATO soldiers are reporting medical problems and some have died. Still medical care is denied or delayed for all uranium exposed casualties while United States Department of Defense and British Ministry of Defence officials continue to deny any correlation between uranium exposure and adverse health and environmental effects. They continue to contend that they can spread radioactive waste (depleted uranium) in anyone's backyard without cleaning it up and providing medical care. Their arrogance is astonishing.

What Should Happen Next?

The international community and all citizens of the world must raise a unified voice in opposition to future use of depleted uranium munitions and force those nations that have used depleted uranium munitions to recognize the immoral consequences of their actions and assume responsibility for medical care and thorough environmental remediation. Specifically:

1. Depleted uranium munitions and the use of depleted uranium must be banned.
2. All individuals who were exposed or who may have been exposed to any form of depleted uranium and its various integral contaminants or other contaminants created during combat, research, or training activities must receive a through physical examination and medical care to alleviate or cure the physiological consequences caused by inhalation, ingestion, or uranium wound contamination.
3. All depleted uranium penetrator fragments, depleted uranium contaminated equipment, and depleted uranium oxide contamination must be cleaned up and disposed of at secure sites.